Fall Hazard Recognition, Prevention & Control –

Students' Manual

A Program of the

Health & Safety Department

International Union, UAW

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Fall Hazard Recognition, Prevention & Control

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Course Goal

Course Goal – *The aim of this program is to provide comprehensive on-site training to high-risk workers (i.e. skilled trades and maintenance workers) and management on Fall Hazards: Recognition, Prevention & Control and the prevention of serious fall injuries at their worksites. Participants will develop an understanding of the hazards associated with falls and how to eliminate or control them.*

Section	Content	Objective
1	**Introduction to Fall Hazards**	Participants will be able to: • Identify potential factors that contribute to fall hazards. • Explain the issues (statistics) associated with falls in the workplace., • Describe the intent of a Fall Hazard Identification Program and list the essential elements of an effective program.

2	**Identifying Potential Fall Hazards**	Participants will be able to:
		• Process for identifying potential fall hazards
		• List types of potential hazards to workers during non-routine maintenance work.
		  ○ Trip hazards (extension cords, air hoses, tools, etc…)
		  ○ Proximity to fall hazard during work.
		  ○ Location of work (rafters, tops/sides of equipment, reach, etc…)
		  ○ Slick surfaces (oil, dust, etc…)
		  ○ Lack of proper lighting

3	**Fall Hazard Solutions**	Participants will be able to: • Identify training requirements for exposure to fall hazards • Hierarchy of Health and Safety Controls • Training Requirements for Rescue at Heights • Fixed and Portable Standard Railings • Fall Protection PPE
4	**Identifying Fall Hazard PPE**	Participants will be able to: • Discuss the pros and cons of "restraint devices" and "fall protection" • Describe areas where permanent attachment points would be necessary • Describe the components of fall hazard PPE • Identify the inspection process of all fall PPE
5	**Action Planning and Course Wrap-up**	Participants will be able to: • Provide assistance to help achieve workplace goal of "Preventing" Fall Injuries and Fatalities. • Develop "Action Plan" and strategies for implementing a Fall Hazard Program in their facility.
6	**OSHA**	Rights and Responsibilities under OSHA

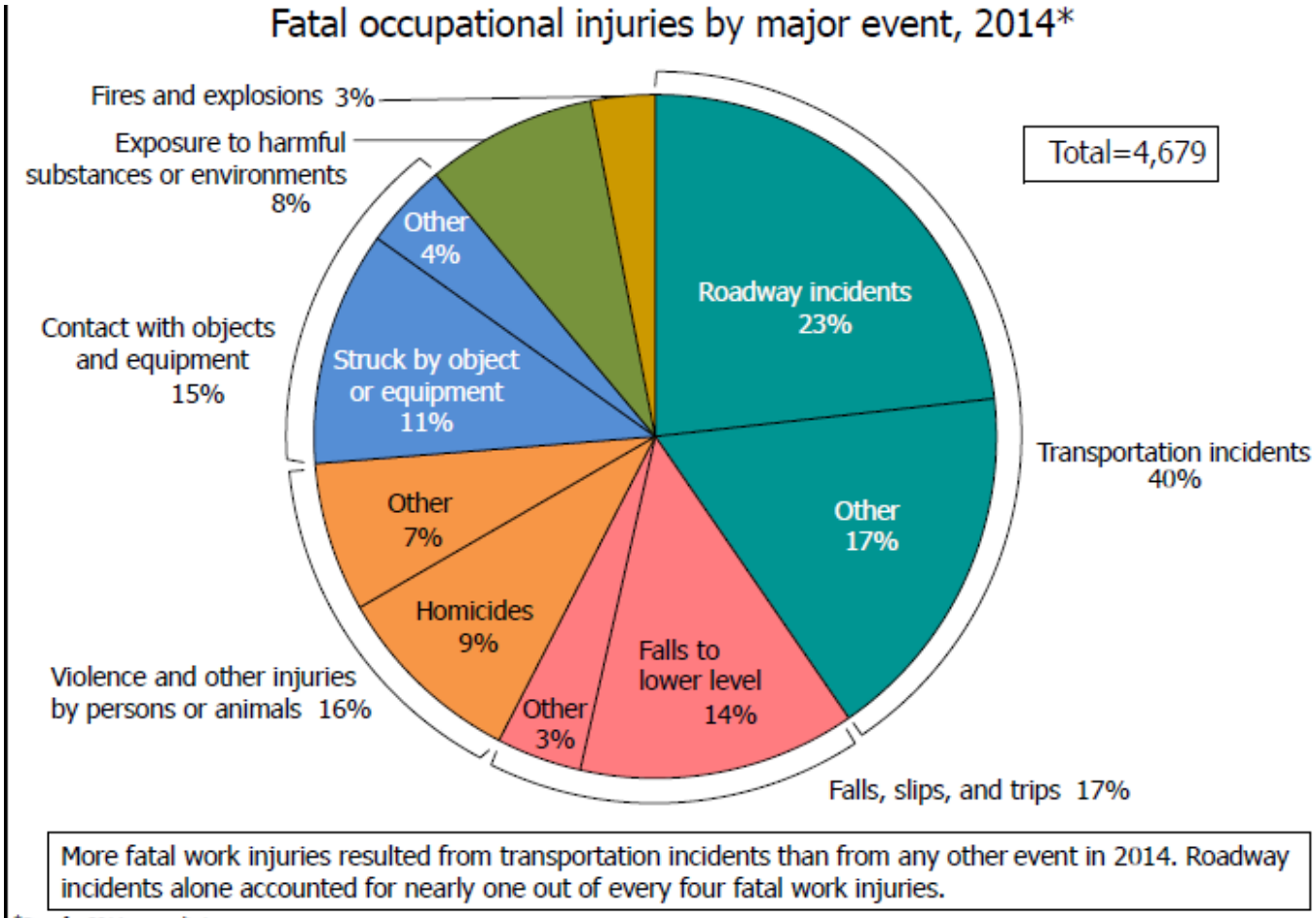
Fall Hazard Recognition, Prevention & Control

(General Industry)

COURSE OBJECTIVES

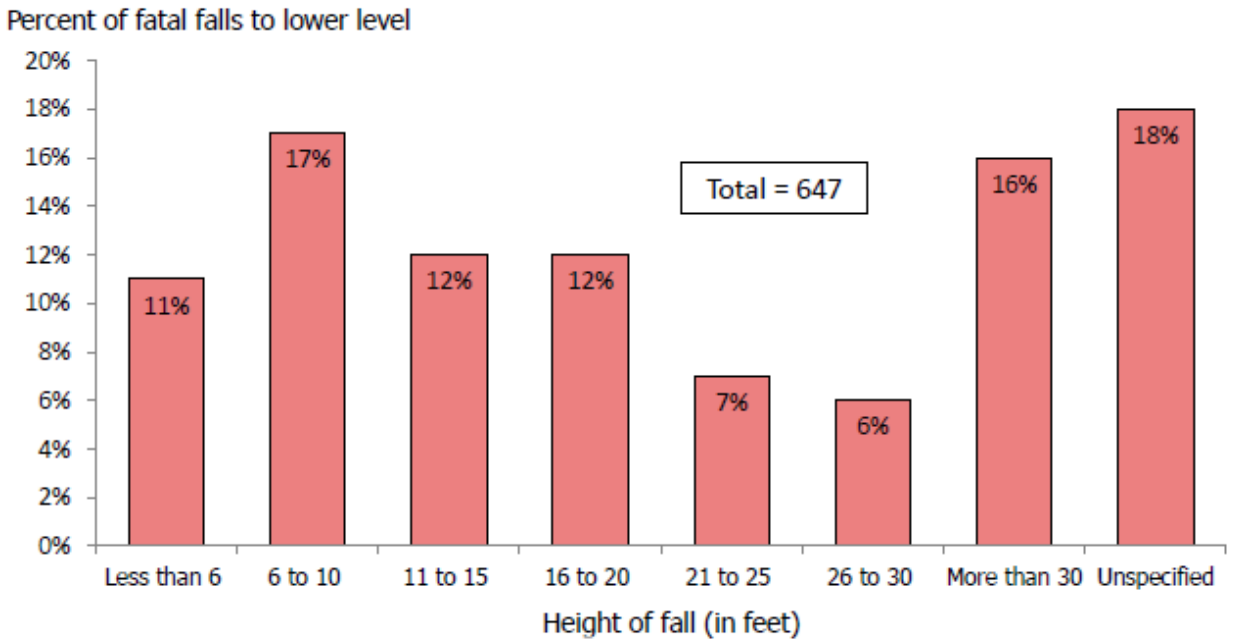
The goal of this course is to provide small employers and employees with information on recognizing potential fall hazards at their work sites and suggest ways to avoid, minimize, control or prevent them. Specifically, this course will:

- Identify factors that contribute to common fall hazards.
- Explain how to analyze work areas for fall hazards.
- Discuss Hierarchy of Health and Safety Controls for fall hazards.
- Describe OSHA regulations and resources addressing fall protection.



*Data for 2014 are preliminary.
Note: Transportation counts presented in this release are expected to rise when updated 2014 data are released in spring 2016 because key source documentation detailing specific transportation-related incidents has not yet been received. Percentages may not add to 100 due to rounding.
Source: U.S. Bureau of Labor Statistics, 2015.

Fatal falls to lower level by height of fall, 2014*



In 2014, the preliminary total for falls to lower level was 647 fatal work injuries, up 9 percent from the final count for 2013. Of the cases where height of fall was known (532 cases), about 2 out of every 3 were falls of 20 feet or less. One in five cases with a known height involved falls from more than 30 feet.

*Data for 2014 are preliminary.
Note: Percentages may not add to 100 due to rounding.
Source: U.S. Bureau of Labor Statistics, 2015.

The US Department of Labor (DOL) lists ***falls*** as ***one of the leading causes of traumatic occupational death***. Any time a worker is at a height of four feet or more, the worker is at risk and needs to be protected.

On your way to work today……..

The radio announcer said that a person at your facility has been injured in a fall from, the radio cuts out before you hear any details.

(Pick someone from your group to record your groups responses and someone from the group to report out your responses.

Where is your first thought about <u>where</u> in must have happened?

- _____
- _____

What were they doing when it happened?

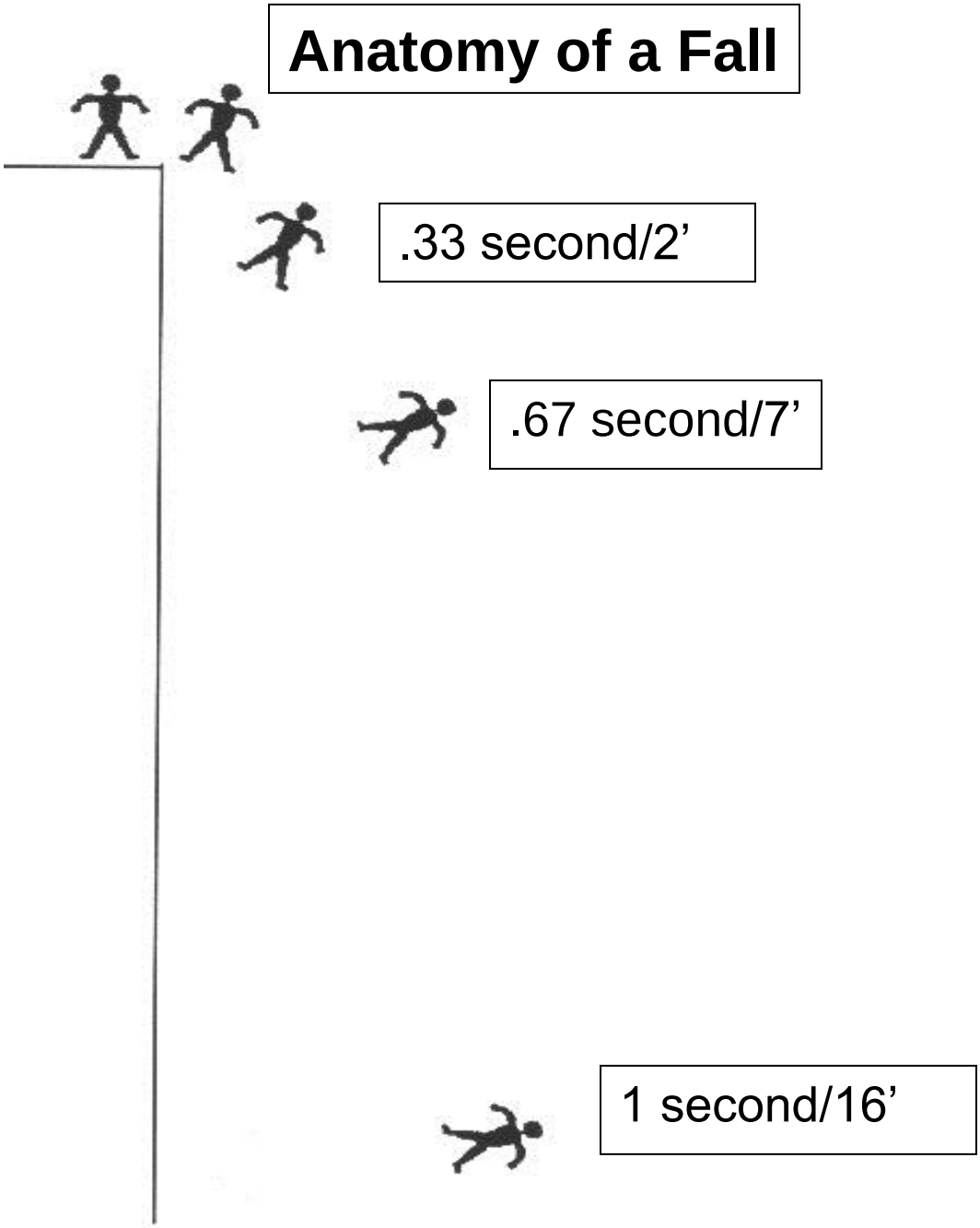
- _____

Other areas (Name of area and location) you think people could fall from:

- _____
- _____
- _____
- _____
- _____

INTRODUCTION

We have all heard the expression - ‘it’s not the fall that’s hurts but the sudden stop at the end’. Think of a fall as *“…a sudden, unanticipated descent in space driven by gravity”.* Although this may not *sound* severe, the consequences are often disabling - or deadly. It takes most people about 1/3 of a second to become aware of a fall. It takes another 1/3 of a second for the body to react. A person can fall up to 7 feet in 2/3 of a second.



2000—March, 2014 UAW "Fall" Fatalities

November 16, 2000 – Michael Spears; 28 years old, Grounds Maintenance Worker, 6 years seniority, **Chrysler Proving Grounds**, Chelsea, Michigan; **LU 1284; Region 1A;** The victim **fell off of the back of a truck** as he was picking up traffic cones from the driving course.

March 7, 2002 – John Aue; 52 years old; Millwright (S/T); 32 years seniority; **Federal Mogul**; Sparta, MI; **LU, Region 1D**. The victim was checking for leaking bags in an unlighted dust collector with an ultraviolet (black) light, when he **fell 30 feet** down an unguarded 60-inch clean air duct.

July 30, 2002 – Samuel R. Heckman: 55 years old, Refrigerator and Air Conditioning Maintenance Journeyman (S/T); 34 years seniority (24 years in classification); **GM Allison Transmission**, Indianapolis, IN; **LU 933, Region 3.** The victim was repairing a fan on the roof when he stumbled backwards and **fell over a parapet wall**, falling 20 feet to his death.

September 2, 2002 – Harold Moyle; 64 years old; Electrician (S/T) 31 years seniority; **General Motors**; Linden, New Jersey; **LU 595, Region 9**. The victim fell 8'4" through a drop ceiling panel down to a steel floor adjacent to a paint spray booth. The victim was assigned to repair lights and apparently was tracking electrical lines. Access to the space was by a fixed ladder. There was no lighting in the space and it does not contain safe working platforms. The ceiling panel **the victim fell** through was not secured to any structural beams.

October 30, 2003 - Douglas A. Mellom; 44 years old; Millwright (S/T); 25 years seniority; **General Motors;** Janesville, Wisconsin; **Local 95, Region 4**. The victim was on the roof of a freight elevator realigning the safety gate. After he had aligned the gate and as he was attempting to enter the access opening to return to ground level, he **fell over the edge** of the elevator roof 18 feet to the floor below.

November 22, 2003 – Jeff West; 44 years old; General Welder (S/T); 13 years seniority; **Ford Motor Company**; Dearborn, Michigan; **Local 600**, **Region 1A**. The **victim fell** approximately twenty (20) feet to a basement area during the installation of a stamping machine. He had received numerous injuries including head injuries and died on December 22, 2003.

July 16, 2005 – Wayne Mueth (died 7/17/05), 42 years old, Millwright (S/T), 21 years seniority, **DaimlerChrysler**, Fenton, Missouri, **LU 110**, **Region 5**. Victim was ejected from a work platform basket elevated on hi-lo forks while pulling conveyor chain, which was attached to the basket. Investigation indicates that a weld securing the restraining chain attaching the basket to the mast failed, causing the basket to **slide on the forks and then fall**.

February 26, 2006 (deceased April 3, 2006) **- Michael A Kruszka; 57** years old; Millwright, 38 years seniority; **DaimlerChrysler** Sterling Stamping Plant, Sterling Heights, Michigan, **LU 1264, Region 1.** The victim suffered a head injury after **falling five feet** from a temporary maintenance platform in a press basement while securing a cushion to a press.

January 16, 2007 – James Bains: 64 years old; Electrician; 6 years seniority; **CC Metal and Alloys;** Calvert City, Kentucky; **LU 523, Region 3**. The victim was found mortally injured near the base of a manlift vertical conveyor used to travel up and down 4 levels of an electric arc furnace. He had apparently **fallen while descending** on the manlift. The victim had been assigned to change light bulbs at the top of the eight story furnace and was working alone at the time of the incident. The victim fell from the 8th floor to 4th floor, a distance of approximately 66 feet.

March 13, 2008 – Hiram Torres: 61 years old; Warehouse Worker; 9 years seniority; **Jose Santiago;** Catano, Puerto Rico; **LU 3401, Region 9A.** The victim was assigned as a helper to deliver food products and materials to a second floor cafeteria at a customer location. His normal job was in the warehouse and he was filling in for the regular worker that day. The driver and victim unloaded material from the delivery truck, placed it on a powered lift platform using a two-wheeled hand truck, closed the lift doors and activated the lift. Both workers walked to the second floor and opened the lift doors to unload materials. The victim stepped onto the lift platform to position himself behind the hand truck and **fell through** an unguarded 28" x 78" opening between the lift platform and the back wall. The second floor area has poor lighting and this was both workers first time delivering to this location.

December 31, 2010 – Claude Brock Jr.: 61 years old; Millwright; 16 years seniority; **Chrysler KCP**; Kokomo, IN; **LU 1166, Region 3**. The victim and another millwright were assigned to trouble shoot and repair an incline scrap conveyor in a die cast area. The conveyor transports scrap castings from a recovery system located in a basement area to a scrap gon on the first floor. They had just finished welding reinforcements to the side chutes on the conveyor when the victim walked around behind to look at the completed work. A security guard onsite for "hot work" purposes followed and observed the victim stepping up onto a barrier rail in front of a small lubrication system located next to the conveyor. The victim lost footing, falling backwards toward the lubrication system and over a guardrail protecting an opening to the basement area. The victim **fell approximately twenty (20') feet** to the basement floor below.

March 10, 2011 (died 3-13-2011) – **Talmadge Sadler: 68** years old; Heavy Truck Driver; 45 years seniority; **Triumph Aerosystems-Vought Aircraft**; Dallas, Texas; **LU 848, Region 5**. The victim and a co-worker were preparing a modified flatbed trailer to transport an airplane wing. The victim's task was to fasten down fixture components and a rolled up tarp prior to driving on the highway. He completed securing the fixture and tarp and was walking toward the mid-point of the flatbed intending to descend by stepping down onto the bumper of a small van. The victim tripped on a contoured part of a rib structure designed to secure the wing in place and **fell approximately six (6') feet to the ground**, landing on his head. The walking path was obstructed by the fixture used to cradle the wing and the rails to hold the tarp and a mobile platform normally used for accessing flatbed trailers was not available at the time of the incident because this trailer was parked in a different location than normal.

What are Fall Hazards?

Fall protection must be provided at four feet in general industry. However, regardless of the fall distance, fall protection must be provided when working over dangerous equipment and machinery. Studies have shown that the use of guardrail systems, fall arrest systems, safety nets, covers, and restraint and positioning device systems can prevent many deaths and injuries from falls.

In this course, we will look at some of the factors that cause fall accidents and fatalities in general industry. We will also look at how to analyze the work area for fall hazards and provide suggestions to prevent fall accidents, injuries and fatalities.
This course is designed to assist in identifying, evaluating, preventing and protecting you from the harmful results of exposure to fall hazards at your work site.

Identifying Fall Hazards

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

- A worker walking on top of an elevator to return to the inside of the elevator falls off unguarded side into the elevator shaft.
- A makeshift scaffold with no rails or fall protection results in a 5 foot fall leaving one dead.
- A worker falls through a 60” open pipe 30’ to his death.

Fall hazards are foreseeable. You can identify them, eliminate exposure to them, eliminate them or control them before they result in injuries or death. Some of the factors that contribute to fall accidents and fatalities include: scaffolds; ladders; roofs; tops of equipment and other elevated work surfaces.

Ladders - BLS data show that each year falls from ladders account for approximately 100 fatalities each year. Factors that contribute to falls from ladders are ladder slip (top or bottom), overreaching, slipping on rung/steps, defective equipment, and improper ladder selection for a given task. One of the most frequently cited OSHA ladder violation includes not securing a portable ladder or having it extend 3 feet above the landing before workers use it to reach an upper level.

Falls from a Floor (One Level to the Next) – falls to a lower level is one of the major causes of fatalities. Factors such as improperly covered/protected floor holes are a common fall hazard. It is very easy to step backwards into them or step into them when carrying something that blocks one’s forward view.

Analyzing Work Areas for Fall Hazards

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Analyzing the work area is another important step in fall hazard prevention.

Analyzing the work area may include: reviewing blueprints before work begins; anticipating upcoming fall hazards as work progresses; reviewing current hazards on the site, and developing a pre-planning checklist.

Review Blueprints Before Work Begins

One of the first steps in analyzing the work area should be the review of the blueprints before work **ever** begins on the site. By addressing fall hazards at this stage, the employer will be better prepared to eliminate the fall hazard or provide fall protection to the employees. The following are suggestions to assist employers in identifying those areas to address.

• At any stage of the job will there be unprotected sides/edges, floors, roof, vertical faces, and open sided floors where a fall hazard exists, if so, here are some options:

- Change sequence to remove hazards or exposures
- Restrict employees from area
- Can guardrails be used?
- Can safety nets be used?
- If guardrails or nets cannot be used, will personal fall arrest or restraining systems, controlled accessed zones, monitoring systems, warning line systems, and positioning device systems be employed?

• Will employees be exposed to floor, or roof opening? If so, will protection be provided?
• Is there the possibility of employees being struck by falling objects, if so, will protection be provided?
• Are scissors or aerial lifts required? And is there a system in place to ensure proper inspection and maintenance of these systems?
• Are operations such as equipment maintenance, roofing, HVAC installation, etc., addressed ahead of time in order to provide fall protection?
• Is there a fall protection policy in place such as:

- Vertical life lines
- Other work methods such as installation from aerial lifts

• Are there structural member adequate to meet the requirements for anchor points with personal fall arrest systems?

Anticipate Upcoming Fall Hazards as Work Progresses

• Additionally, unique fall hazards should be addressed before any exposure.
The safety director or site fall protection competent person never wants to be caught off guard with surprise hazards or exposures. To avoid, what is known as putting out fires, these individuals must always be prepared. One method is to review the job for the fall hazards that will be present in the future. The following should assist in addressing this issue:

1. Review the blueprints for upcoming processes/hazards.
2. Discuss the work process with the maintenance manager, superintendents and workers to identify where new hazards may develop.
3. Ask the foreman for assistance in recognizing what hazards may develop in the future.

Review for Current Hazards on Site

If the job has already progressed beyond the point where review of the blueprints will not be effective, then the site must be reviewed for current hazards. The review for current hazards

will allow the fall protection competent person to address the fall exposures in order to eliminate or minimize the hazard.

Pre-Planning Checklist

An important aspect of fall hazard prevention is planning. An assessment of all fall hazards, even *potential* fall hazards, must be done before appropriate corrective measures are considered. In addition, a fall hazard assessment can also determine training needs and fall rescue methods.

If proper planning isn't done at the onset, time and materials will be wasted and, consequently, unexpected costs will rise. More importantly, fatalities and severe injuries have resulted from simply not making the time or effort to effectively identify and control fall hazards.
The following is a checklist to assist you in your efforts to pre-plan for fall prevention/protection.

It is preferable that this checklist be used before any designing or work begins to be most effective in eliminating falls and related hazards.

1. Begin the process by ***identifying*** those areas where exposure to falls will or already do exist such as:

- Scaffolds
- Ladders
- Roof and roof openings including skylights
- Open sided floors and floor openings
- Structural framing
- Aerial lift platforms
- Tops of equipment
- Permanent and temporary working platform
- Leading edge
- Hoist areas
- Ramps, runways and walkways
- Wall opening
- Stairways
- Working over dangerous equipment
- Potential for falling objects
- Housekeeping concerns

2. Do you have a written fall protection program?

3. If the work has not begun, or is in progress, have you surveyed the site to identify where/what the fall hazards are on the job?

4. Is it possible to provide or install fall prevention/protection measures before there is an exposure? Some possible examples include:

a. Install guardrails before allowing workers on the floor.

b. Install safety nets, stanchions, lifelines to structural steel before members are lifted into place.
c. Don't cut floor opening until prepared to fill with specified object.
d. Attach a self-retracting lanyard or work platform with standard railing to the top of equipment during installation.

5. Is there a competent person on site for fall protection (Required by Construction Standards)?

6. Does the person understand the fall protection standard, trained to select the proper fall protection measures/systems, and understand the differences between the following systems and their use:

- Fall prevention.
- Fall protection.
- Active fall protection.
- Passive fall protection.

7. Will there be a need for a qualified person?

8. Is there an adequate fall protection-training program in place to train employees in the fall protection measures/systems in place on the site?

9. For personal fall arrest systems, are anchor points identified and capable of supporting 5,000 pounds per worker or two times the intended impact load? Additionally, have swing hazards been addressed in the anchor point location?

10. Has an enforcement policy been established, and if so, is it communicated universally, accepted and enforced?

11. Have fallen worker rescue methods and procedures been addressed?

12. Are employees trained to work at heights safely?

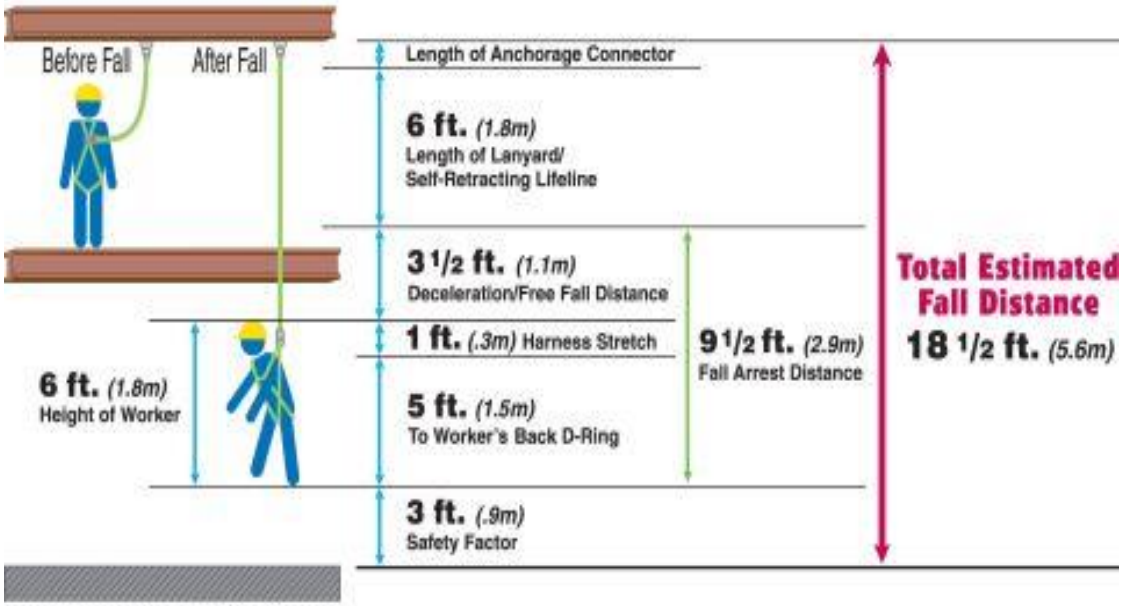
13. Have other work methods been proposed or implemented such as:

a. Working from aerial or scissor lifts.
b. Assembling structures on the ground and lifting them into place, minimizing exposure.
c. Installing safety nets under work level or self-retracting lanyards, vertical and horizontal lifelines materials to be hoisted aloft before the pieces leave the ground and workers are exposed.
d. Installing clamp-on guardrails around roof edge instead of using a warning line system.

14. Have free fall considerations been addressed including:

a. Total free fall clearances are adequate for system in use.
b. Employees will not strike lower objects in the event of a fall.

c. Employees will not be exposed to forces greater than 1,800 foot lbs. in a full body harness



Fall Hazard Prevention

The hierarchy of fall hazard control includes: **elimination** of fall hazards, **prevention** (Engineering Controls) of falls, and **control** (Training and PPE) of falls.

MOST EFFECTIVE	1. Elimination or Substitution	• **change process to be able to perform task at ground level** •
↓	2. Engineering Controls	• **Install platforms and guard railing** • **Utilize boom or scissor lifts** • **Install tie offs where work from heights are necessary.**
↓	3. Warnings	• **signs** •
↓	4. Training & Procedures	• **Safe job procedures** • **Safety equipment & inspections** • **Rescue at Heights**
LEAST EFFECTIVE	5. Personal Protective Equipment	• **safety harnesses and lanyards** • **Portable Guard Rails** •

Elimination of fall hazards is the first and best line of defense against falls from heights. This requires a careful assessment of the workplace and the work process itself. The idea is to combine safety and health into the work process, and not simply try to add safety as an afterthought to an inherently unsafe work procedure.

The **prevention** of fall hazards is the second line of defense when fall hazards cannot be entirely eliminated. This involves making changes to the workplace to preclude the need to rely on the employee's behavior, and personal protective equipment to prevent falls. Examples include use of stairs, guardrails, and barriers to prevent the employee from direct and unprotected exposure to the fall hazard. These techniques prevent the fall before the onset.

Control of falls is the last line of defense. It should be considered only after determining that the fall hazard cannot be eliminated or prevented. Fall controls include fall protection such as safety nets or harnesses, and fall arrests. These controls reduce the risk of injury resulting from a fall.

Activity: Following the Hierarchy of H&S Controls list these in the order:

1. _____.
2. _____.
3. _____.
4. _____.

An Eight Step Approach to Fall Protection

Step 1 Determine walking/working surfaces are structurally safe

Step 2 Conduct a fall hazard assessment

Step 3 Eliminate the need for fall protection, if possible

Step 4 Select the appropriate type of fall protection system

Step 5 Develop rescue/retrieval procedures

Step 6 Develop an equipment inspection, maintenance and storage program

Step 7 Provide fall protection training

Step 8 Monitor the fall protection program

Step "1" Determine if walking/working surfaces are structurally sound

Does the walking/working surface have the strength and structural integrity to safely support all employees and their equipment?

Employees should not be permitted to work on building roofs and other walking/working surfaces until the employer has determined that the surfaces are structurally sound.

Fall hazards are present everywhere simply because any walking or working surface can provide them. In addition, many skilled trades workers work at various levels of elevation, increasing the severity of injury.

Step "2" Conduct a Fall Hazard Assessment

Knowing what can immediately contribute to a fall can help in assessing the risk. Working near unguarded edges, lacking safe access, or walking on a slippery or uneven surface are some common examples. A fall hazard assessment greatly helps identify and evaluate these physical fall hazards.

• Determine which specific jobs, activities or areas expose employees to fall hazards
• Determine the type of work performed
• Determine if employees will be exposed to any of the following:
    - Unprotected sides and edges
    - Leading edges
    - Floor holes
    - Wall openings and hoisting areas
    - Slippery surfaces
    - Ramps, runways and other walkways
    - Portable ladders and stairways
    - Working above dangerous equipment
    - Obstructions (materials)
    - Working overhead and related work
    - Roof work
    - Aerial lifts
    - Scaffolds
• Determine the frequency the work is being performed
• Determine if workers require horizontal and/or vertical movement
• Determine the number of workers exposed to a fall hazard (Skilled trades and/or operators)

• Determine the type of walking/working surface
• Determine the distance to floor level
• Determine if the edge of the building or the working surface is protected by a guardrail system or parapet wall. If yes, is it adequate?
• Determine if employees could be exposed to other types of health and/or safety hazards. Can it affect selection or use of fall protection systems?

The person conducting the assessment should have some education and/or relevant experience in order to recognize and evaluate all fall hazards.

Furthermore, this person should also have practical knowledge and understanding of fall protection requirements and other related fall protection methods.

A competent person is someone who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are hazardous or dangerous to employees, **and** has authorization to take prompt corrective measures to eliminate them.

Various sources of information can be used when conducting the hazard assessment including:
• Survey employees exposed to the fall hazards
• Survey affected supervisors & managers
• Review previous inspections
• OSHA 300 & 301 records
• Injury and incident reports
• Safety committee minutes

Remember - involving employees and supervisors in the hazard assessment is essential. They can provide valuable information about where and when fall protection is necessary and ideas to possibly eliminate or better prevent fall hazards. Obtaining their input will also encourage employees and supervisors to take ownership.

If the hazard assessment indicates the need for fall protection, the next step is to determine if the fall hazard(s) can be eliminated through engineering controls and/or alternative work methods.

• Redesign the process or job task
• Work at lower heights
• Use equipment that prevents fall hazards, boom lift, scissor lift and platforms that provide built-in fall protection
• Use tool extensions and work from ground level
• Lower equipment and tools to ground level
• Use appropriate aerial lifts

Step "3" Eliminate the Need for Fall Protection if Possible

• Design buildings and other walking/working surfaces to eliminate/reduce exposure

Planning Comes First!

Eliminate
– Work from ground
– Walls/enclosures
– Covers
Prevent
– Railings
– Aerial lifts
– Fences/barricades
– Parapets
Arrest
– Personal fall arrest systems
– Personal fall restraint systems
– Nets
– Positioning devices
– Roof brackets/slide guards
Control
– Safety monitors
– Warning lines
– Positioning devices
– Roof brackets/slide guards

Prevention vs. Protection
A textbook definition of fall protection could read: "A method to prevent a person from falling or by reducing the distance of a fall to limit physical damage." Most would agree the first part of the above definition addresses fall prevention and is the more preferred strategy.

However, reality shows us prevention methods are not always available and in many situations fall protection is our only option. If the fall hazards cannot be eliminated, the next approach is to select the appropriate fall protection system.

Of course, no single fall protection system provides adequate fall protection for all job activities. As the type of system will vary from job to job, we must always assess each job and activity to determine the proper type of fall protection.

Consider the following factors when selecting fall protection systems:
• The distance to lower levels
• The types of activities requiring fall protection and the specific requirements of each activity
• The specific types of equipment and components needed with each fall protection
• How much vertical and horizontal movement employees will need to perform each activity
• Environmental conditions (i.e. wind, rain, extreme heat/cold) in which fall protection equipment will be used

• The potential difficulty of using fall protection systems to perform normal and/or non-routine job activities
• The need for anchorage points of suitable design and strength
• The presence of chemical, electrical, and welding hazards
• How employees will recover or be rescued from fallen positions
• The presence of sharp or rough surfaces and edges

Step "4" Select the Appropriate Type of Fall Protection System

Fall Protection Systems and Methods

A fall protection system refers to equipment designed to control fall hazards. All fall-protection systems either **prevent** a fall from occurring or safely **arrest** a fall.
Typical fall protection systems include the following:

• Personal fall-arrest systems
• Guardrail systems
• Safety-net systems
• Fall restraint system
• Positioning-device systems
• Warning-line systems
• Safety-monitoring systems
• Controlled-access zones

Personal fall-arrest systems – consists of an anchor, connectors, and a full body harness that work together to stop one from falling and to minimize the arrest force. Other system components may include a lanyard, a deceleration device, and a lifeline. However, the personal fall-arrest system is effective only if you know how all of the components work together to arrest the fall.
Guardrail systems are vertical barriers consisting of top rails, midrails, and intermediate vertical members. Guardrail systems can also be combined with toe-boards, which are barriers that prevent materials and equipment from dropping to lower levels.
Safety net systems consist of mesh nets, panels, and connecting components.
They are typically used as protection for those who work 25 feet or more above lower levels.
Fall-restraint system consists of an anchor, connectors, and a body harness or a body belt. Unlike the personal fall-arrest system (designed to stop a fall), the fall-restraint systems prevent a fall. The fall-restraint system's anchor must support at least 3,000 pounds. Otherwise, it must be designed, installed, and used under the supervision of a qualified person.
Position-device system enables the worker to work with both hands free on a surface such as a wall or other vertical structure. They are typically used as protection for concrete form work and placing rebar. The difference between a positioning-device system and a personal fall-arrest system is that the positioning device system supports the worker on an elevated surface and limits a fall to two feet.
Warning-line systems consist of ropes, wires or chains, and supporting stanchions that form a barrier to warn those who approach an unprotected roof side or edge. The lines mark off an area which one can do roofing work without using guardrails or safety nets.
Safety-monitoring system is a set of procedures assigned to a competent person for monitoring or warning workers who may be unaware of fall hazards.

Safety-monitoring systems are appropriate for roofing operations on low-slope roofs less than 50 feet wide. A safety monitoring system used in conjunction with a controlled access zone and a fall-protection plan is also appropriate in situations where conventional fall protection is not feasible.

Controlled-access zones is a work area designated and clearly marked in which certain types of work may take place without the use of conventional fall protection systems – guardrail, personal arrest or safety net – to protect the employees working in the zone.

Step "5" Develop Rescue/Retrieval Procedures

When using a personal fall arrest system, employers **must provide for prompt rescue** in case of a fall **or assure that employees are able to rescue themselves**.

Rescue comes down to planning and preparing. Some important points to consider:

- Train your rescuers in rescue techniques and practice rescue attempts
- Ensure available equipment is readily available
- Arrange and communicate with other personnel on site
- Arrange and communicate with outside services, if available
- Designate someone to summon them upon arrival
- Plan a route and establish lines of communication
- Avoid **"Orthostatic Intolerance" – (See Page 53)**

  - **Signs & symptoms of orthostatic intolerance:**

• Faintness	Nausea
• Breathlessness	Dizziness
• Sweating	Unusually Low Heart Rate
• Paleness	Unusually Low Blood Pressure
• "Graying" or Loss of Vision	Increased Heart Rate

"Step 6" Develop an equipment inspection, maintenance and storage program

First and foremost, when it comes to equipment **inspection and maintenance** - follow manufacturer's recommendations!

All fall protection equipment, including harnesses, lanyards, and other connectors **must be visually inspected before each use.**

Inspect for:

- Cuts, tears, rips, snags, punctures, abrasions, mold, or stretching
- Alterations or additions which might effect the system's efficiency
- Damage caused by acids, corrosives
- Distorted hooks or faulty hook springs
- Cracked, broken, or deformed D-Ring, carabiners, grommets, and snaphooks
- Loose, damaged or non-functioning mountings and parts

• Wearing or any internal deterioration in the ropes
• Color fading possibly indicating UV exposure

Periodic inspections by a competent person for wear, damage, or corrosion should be a part of your safety inspection program.
Defective equipment must be immediately taken out of service and tagged/marked as unusable, or destroyed.

Best Practice – destroy when subjected to any significant damage or loading.
Basic care of the equipment will prolong the durable life and will contribute toward the performance of its vital safety function. Proper storage and maintenance after use are as important as the pre-use inspections.

Clean the equipment of dirt, corrosives, or other contaminants. Storage areas should be clean, dry, and free from exposure to fumes or corrosive elements.
Synthetic materials should always be away from strong sunlight and extreme temperatures which could degrade the materials (color fading may indicate UV exposure).

"Step 7" Provide fall protection training

Each employee who may be exposed to fall hazards **must be trained** on how to recognize fall hazards and the procedures they need to follow to minimize these hazards.
The construction standard requires the person providing the training be a "competent person" qualified in the following:
• Nature of fall hazards in work area
• Correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems
• Use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems
• The limitations on the use of mechanical equipment during the performance of work
• Correct procedures for the handling and storage of equipment and materials and the erection of overhead protection
• Employees role in fall protection plans

Bottom line: The trainer must be knowledgeable of fall protection systems and his/her ability to train employees on how to recognize fall hazards and how to properly use, inspect and maintain fall protection equipment.

Training must be provided whenever:
• Employees are assigned to work where fall hazards exist
• Responsibilities change or new methods are used
• There is a new fall hazard
• The fall protection program is inadequate
• Additional training is necessary
• Employees have not acquired or retained adequate understanding

Length and format of the training program should consider both classroom instruction and hands-on training on the proper use of the fall protection equipment.

Employers must prepare a written certification that identifies the employee. It must contain:
• Name of the employee(s)
• Dates (s)
• Signature of the trainer or employer

"Step 8" Monitor the Fall Protection Program

Continuously monitor the effectiveness of the program to ensure that the required elements are being followed by supervisors and employees at the jobsite.
The following are suggested ways to monitor a fall protection program:
• Conduct periodic inspections to ensure that employees are properly using fall protection
• Take immediate corrective action including the use of disciplinary action
• Conduct a formal audit of the entire fall protection program at least annually
– Document and communicate the results of the audit to everyone
– Compare the results with previous audits
• Conduct a formal audit of the entire fall protection program at least annually
• Conduct periodic inspections of equipment storage areas
• Require employees to notify their supervisor if they have any problems with the use and/or maintenance of their equipment
• Require employee to notify their supervisor if they are involved in any fall incident/accident
– Promptly and thoroughly investigate and document
• Hold managers/supervisors accountable for their crew.

Reward your efforts - Promote your fall protection plan!

Managers, supervisors, and other staff personnel need to actively promote the proper use of fall protection equipment and encourage employee involvement and support of the program.
The following are suggested ways to promote a fall protection program
• Provide positive feedback to employees who use fall protection properly
• Display posters and distribute information sheets to employees that reinforces the importance of fall protection
• Conduct safety meetings with employees about fall protection
• Respond in a timely matter to suggestions for improving the program and/or equipment
• Encourage union representatives and safety committee members to actively support the program
• Collect and distribute "success stories" about injuries prevented by the use of fall protection
• Formally recognize employees, supervisors, and all involved!

Review

We have covered a lot of material in this section. Let's review some of the concept of the eight step approach to fall protection by having participants do the case studies on fall prevention.

Activity: discuss and analyze these case studies using the guidelines in the eight step approach. Have available various types of fall protection equipment to help in the analysis and discussion.

Participants may want to try on and discuss the features of this equipment.

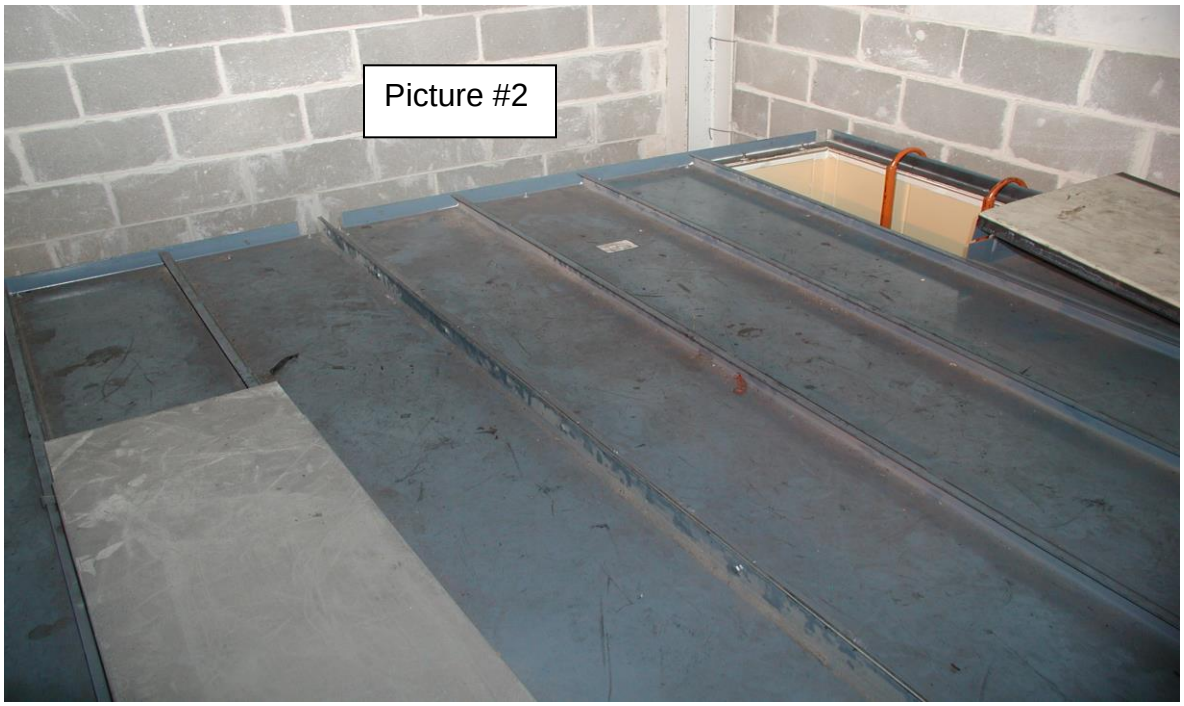
Safety Pays
Falls Cost

PLAN. PROVIDE. TRAIN.

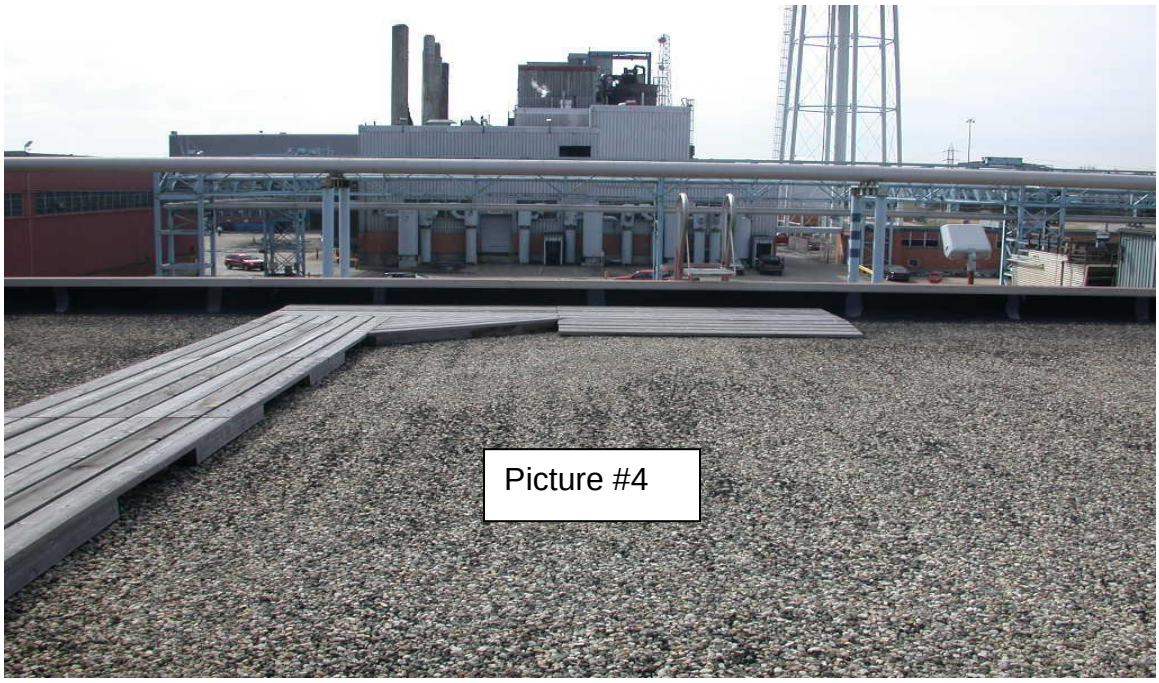
Three simple steps to preventing falls.

Fall Hazard Identification Exercise

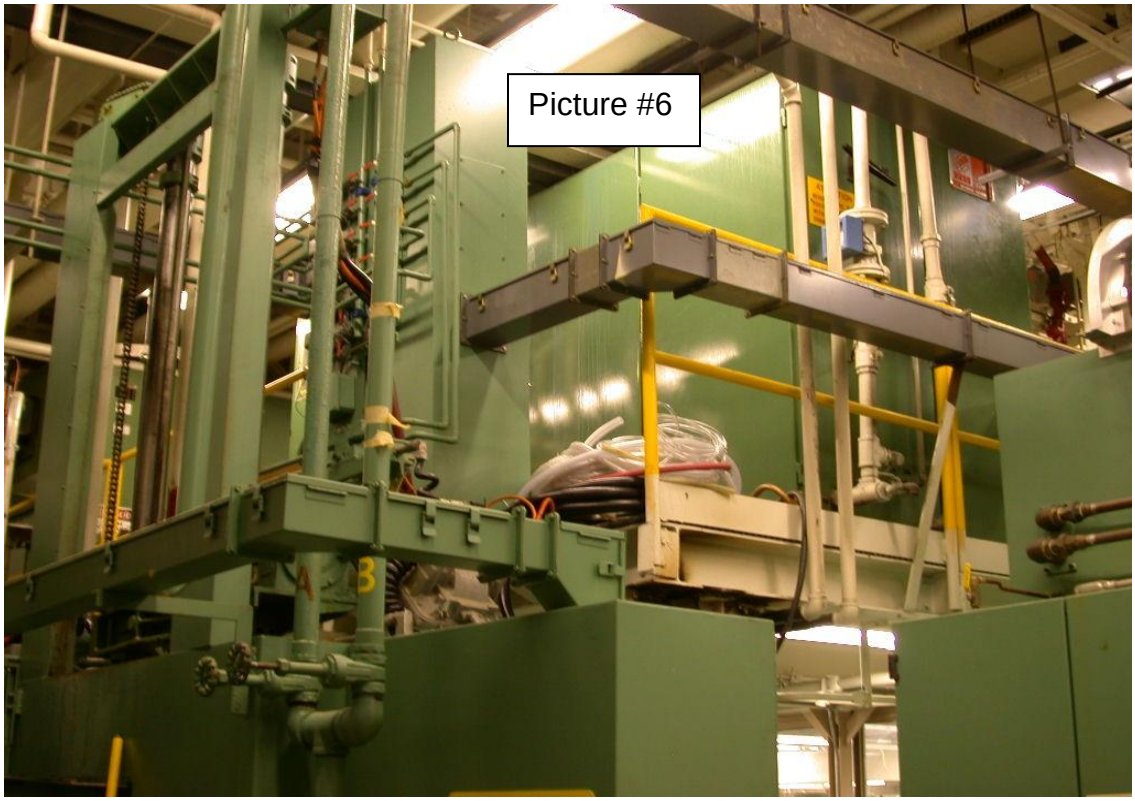
Activity #1: Circle the fall hazard(s) in each of the following 8 picture. How many fall potentials did you circle? _____.

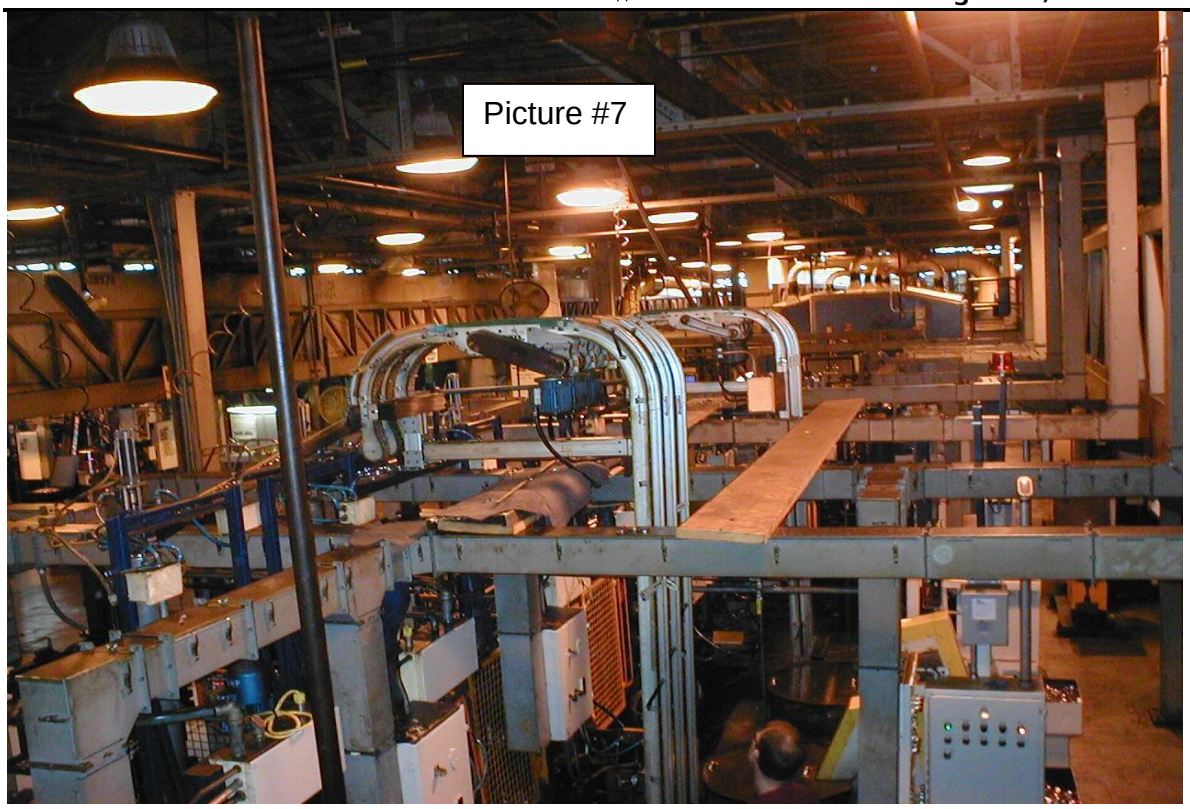


Picture #3


Picture #4

Picture #5


Picture #6


Picture #7

Picture #8
CTLCHP
titan

Activity #2:

Using the Hierarchy of Controls, how would you address each of the fall hazards in the pictures?

MOST EFFECTIVE	6. Elimination or Substitution	• **change process to be able to perform task at ground level**
↓	7. Engineering Controls	• **Install platforms and guard railing** • **Utilize boom or scissor lifts** • **Install tie offs where work from heights are necessary.**
↓	8. Warnings	• **signs**
↓	9. Training & Procedures	• **Safe job procedures** • **Safety equipment & inspections** • **Rescue at Heights**
LEAST EFFECTIVE	10. Personal Protective Equipment	• **safety harnesses and lanyards** • **Portable Guard Rails**

Picture #:

1.

2.

3.

4.

5.

6.

7.

8.

Possible Solutions:

Standard Railing

PPE

Horizontal Life line

Fixed Anchor Points

Portable Railing

DUTY TO HAVE FALL PROTECTION

Employers are required to assess the workplace to determine if the walking/working surfaces on which employees are to work have the strength and structural integrity to safely support workers. Employees are not permitted to work on those surfaces until it has been determined that the surfaces have the requisite strength and structural integrity to support the workers. Once employers have determined that the surface is safe for employees to work on, the employer must select one of the options listed for the work operation if a fall hazard is present. For example, if an employee is exposed to falling 4 feet or more from an unprotected side or edge, the employer must select a guardrail system, safety net system, or personal fall arrest system to protect the worker. Similar requirements are prescribed for other fall hazards as follows.

Controlled Access Zones

Controlled access zones are used to keep out workers other than those authorized to enter work areas from which guardrails have been removed. Controlled access zones, when created to limit entrance to areas where leading edge work and other operations are taking place, must be defined by a control line or by any other means that restrict access. Control lines shall

consist of ropes, wires, tapes or equivalent materials, and supporting stanchions, and each must be:

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

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

Hoist Areas

Each employee in a hoist area shall be protected from falling 4 feet or more by guardrail systems or personal fall arrest systems. If guardrail systems (or chain gate or guardrail) or portions thereof must be removed to facilitate hoisting operations, as during the landing of materials, and a worker must lean through the access opening or out over the edge of the access opening to receive or guide equipment and materials, that employee must be protected by a personal fall arrest system.

Holes

Personal fall arrest systems, covers, or guardrail systems shall be erected around holes (including skylights) that are more than 4 feet above lower levels.

Ramps, Runways, and Other Walkways

Each employee using ramps, runways, and other walkways shall be protected from falling 4 feet or more by guardrail systems.

Roofing

Low-slope Roofs

Each employee engaged in roofing activities on low-slope roofs with unprotected sides and edges 4 feet or more above lower levels shall be protected from falling by guardrail systems, safety net systems, personal fall arrest systems or a combination of a warning line system and guardrail system, warning line system and safety net system, warning line system and personal fall arrest system, or warning line system and safety monitoring system.

Steep Roofs

Each employee with unprotected sides and edges 4 feet or more above lower levels shall be protected by guardrail systems with toeboards, safety net systems, or personal fall arrest systems.

Wall Openings

Each employee working on, at, above, or near wall openings where the outside bottom edge of the wall opening is 4 feet or more above lower levels and the inside bottom edge of the wall

opening is less than 39 inches above the walking/working surface must be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system.

Personal Fall Arrest Systems

These consist of an anchorage, connectors, and a body belt or body harness and may include a deceleration device, lifeline, or suitable combinations. If a personal fall arrest system is used for fall protection, it must do the following:

- Limit maximum arresting force on an employee to 900 pounds when used with a body belt;
- Limit maximum arresting force on an employee to 1,800 pounds when used with a body harness;
- Be rigged so that an employee can neither free fall more than 6 feet nor contact any lower level;
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet; and
- Have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet or the free fall distance permitted by the system, whichever is less.

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

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

Unless the snaphook is a locking type and designed for the following connections, they shall not be engaged

(a) directly to webbing, rope or wire rope;
(b) to each other;
(c) to a dee-ring to which another snaphook or other connecter is attached;
(d) to a horizontal lifeline; or
(e) to any object incompatible in shape or dimension relative to the snaphook, thereby causing the connected object to depress the snaphook keeper and release unintentionally.

OSHA considers a hook to be compatible when the diameter of the dee-ring to which the snaphook is attached is greater than the inside length of the snaphook when measured from the bottom (hinged end) of the snaphook keeper to the inside curve of the top of the snaphook. Thus, no matter how the dee-ring is positioned or moved (rolls) with the snaphook attached, the dee-ring cannot touch the outside of the keeper, thus depressing it open. **As of January 1, 1998, the use of nonlocking snaphooks is prohibited.**

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

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

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

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

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

Anchorages shall be designed, installed, and used under the supervision of a qualified person, as part of a complete personal fall arrest system that maintains a safety factor of at least two, i.e., capable of supporting at least twice the weight expected to be imposed upon it.

Anchorages used to attach personal fall arrest systems shall be independent of any anchorage being used to support or suspend platforms and must be capable of supporting at least 5,000 pounds per person attached.

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

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

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

- Is competent in the recognition of fall hazards;
- Is capable of warning workers of fall hazard dangers and in detecting unsafe work practices;
- Is operating on the same walking/working surfaces of the workers and can see them;
- Is close enough to work operations to communicate orally with workers and has no other duties to distract from the monitoring function.

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

- Flagged at not more than 6-foot intervals with high-visibility material;
- Rigged and supported so that the lowest point (including sag) is no less than 34 inches from the walking/working surface and its highest point is no more than 39 inches from the walking/working surface.
- Stanchions, after being rigged with warning lines, shall be capable of resisting, without tipping over, a force of at least 16 pounds applied horizontally against the stanchion, 30

inches above the walking/working surface, perpendicular to the warning line and in the direction of the floor, roof, or platform edge;

- The rope, wire, or chain shall have a minimum tensile strength of 500 pounds and after being attached to the stanchions, must support without breaking, the load applied to the stanchions as prescribed above.
- Shall be attached to each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in the adjacent section before the stanchion tips over.

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

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

PROTECTION FROM FALLING OBJECTS
When guardrail systems are used to prevent materials from falling from one level to another, any openings must be small enough to prevent passage of potential falling objects. No materials or equipment except masonry and mortar shall be stored within 4 feet of working edges. Excess mortar, broken or scattered masonry units, and all other materials and debris shall be kept clear of the working area by removal at regular intervals.
During roofing work, materials and equipment shall not be stored within 6 feet of a roof edge unless guardrails are erected at the edge, and materials piled, grouped, or stacked near a roof edge must be stable and self-supporting.

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

Toeboards
When toeboards are used as protection from falling objects, they must be erected along the edges of the overhead walking/working surface for a distance sufficient to protect persons working below. Toeboards shall be capable of withstanding a force of at least 50 pounds applied in any downward or outward direction at any point along the toeboard. Toeboards shall be a minimum of 4 inches tall from their top edge to the level of the walking/working surface, have no more than 0.25 inches clearance above the walking/working surface, and be solid or have openings no larger than l inch in size.
Where tools, equipment, or materials are piled higher than the top edge of a toeboard, panelling or screening must be erected from the walking/working surface or toeboard to the

top of a guardrail system's top rail or midrail, for a distance sufficient to protect employees below.

TRAINING

Employers must provide a training program that teaches employees who might be exposed to fall hazards how to recognize such hazards and how to minimize them. Employees must be trained in the following areas:

(a) the nature of fall hazards in the work area;
(b) the correct procedures for erecting, maintaining, disassembling, and inspecting fall protection systems;
(c) the use and operation of controlled access zones and guardrail, personal fall arrest, safety net, warning line, and safety monitoring systems;
(d) the role of each employee in the safety monitoring system when the system is in use;
(e) the limitations on the use of mechanical equipment during the performance of roofing work on low-sloped roofs;
(f) the correct procedures for equipment and materials handling and storage and the erection of overhead protection; and,
(g) employees' role in fall protection plans.

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

FALL PROTECTION CATEGORIES

All fall protection products fit into four functional categories: fall arrest; positioning; suspension; and retrieval.

Fall Arrest

A fall arrest system is required if any risk exists that a worker may fall from an elevated position, as a general rule, the fall arrest system should be used anytime a working height of six feet or more is reached. Working height is the distance from the walking/working surface to a grade or lower level. A fall arrest system will only come into service should a fall occur. A full-body harness with a shock-absorbing lanyard or a retractable lifeline is the only product recommended. A full-body harness distributes the forces throughout the body, and the shock-absorbing lanyard decreases the total fall arresting forces.

Positioning

This system holds the worker in place while keeping his/her hands free to work.
Whenever the worker leans back, the system is activated. However, the personal positioning system is not specifically designed for fall arrest purposes.

Suspension

This equipment lowers and supports the worker while allowing a hands-free work environment, and is widely used in window washing and painting industries. This suspension system components are not designed to arrest a free fall, a backup fall arrest system should be used in conjunction with the suspension system.

Retrieval
Preplanning for retrieval in the event of a fall should be taken into consideration when developing a proactive fall management program.

Fall Protection Systems

Listed below are different types of fall safety equipment and their recommended usage.

- **Class 1 Body belts** (single or double D-ring) are designed to restrain a person in a hazardous work position and to reduce the possibility of falls. They should not be used when fall potential exists; positioning only.
- **Class 2 Chest harnesses** are used when there are only limited fall hazards (no vertical free fall hazard), or for retrieving persons such as removal of persons from a tank or a bin.
- **Class 3 Full body harnesses** are designed to arrest the most severe free falls.
- **Class 4 Suspension belts** are independent work supports used to suspend a worker, such as boatswain's chairs or raising or lowering harnesses.
-

Rope Lanyard offers some elastic properties for all arrest; used for restraint purpose.
Web Lanyard ideal for restraint purposes where fall hazards are less than 2 feet.
Cable Positioning Lanyards designed for corrosive or excess heat environments and must be used in conjunction with shock absorbing devices.
Shock Absorbers When used, the fall arresting force will be greatly reduced if a fall occurs.
Rope Grabs A deceleration device which travels on a lifeline, used to safely ascend or descend ladders or sloped surfaces and automatically, by friction, engages the lifeline and locks so as to arrest the fall of an employee.

Retractable Lifeline Systems
Gives fall protection and mobility to the user when working at height or in areas where there is a danger of falling.

Safety Nets Can be used to lesson the fall exposure when working where temporary floors and scaffolds are not used and the fall distance exceeds 25 feet.

Rail Systems When climbing a ladder, rail systems can be used on any fixed ladder as well as curved surfaces as a reliable method of fall prevention.

Effective January 1, 1998, body belts are not acceptable as part of a personal fall arrest system. (Note: the use of a body belt in a positioning device system is acceptable.). An employee who uses a body belt as a personal fall arrest system is exposed to hazards such as falling out of the belt, serious internal injuries, and technical asphyxiation through prolonged suspension.

Inspection and Maintenance

To maintain their service life and high performance, all belts and harnesses should be inspected frequently. Visual inspection before each use should become routine, and also a routine inspection by a competent person. If any of the conditions listed below are found the equipment should be replaced before being used.

Harness Inspection

1. **Belts and Rings:** For harness inspections begin at one end, hold the body side of the belt toward you, grasping the belt with your hands six to eight inches apart.
Bend the belt in an inverted "U." Watch for frayed edges, broken fibers, pulled stitches, cuts or chemical damage. Check D-rings and D-ring metal wear pads for distortion, cracks, breaks, and rough or sharp edges. The D-ring bar should be at a 90 degree angle with the long axis of the belt and should pivot freely.

Attachments of buckles and D-rings should be given special attention. Note any unusual wear, frayed or cut fibers, or distortion of the buckles. Rivets should be tight and unremovable with fingers. Body side rivet base and outside rivets should be flat against the material. Bent rivets will fail under stress.

Inspect frayed or broken strands. Broken webbing strands generally appear as tufts on the webbing surface. Any broken, cut or burnt stitches will be readily seen.

2. **Tongue Buckle:** Buckle tongues should be free of distortion in shape and motion. They should overlap the buckle frame and move freely back and forth in their socket. Rollers should turn freely on the frame. Check for distortion or sharp edges.

3. **Friction Buckle:** Inspect the buckle for distortion. The outer bar or center bars must be straight. Pay special attention to corners and attachment points of the center bar.

Lanyard Inspection

When inspecting lanyards, begin at one end and work to the opposite end.
Slowly rotate the lanyard so that the entire circumference is checked. Spliced ends require particular attention. Hardware should be examined under procedures detailed below.

Hardware

Snaps: Inspect closely for hook and eye distortion, cracks, corrosion, or pitted surfaces. The keeper or latch should seat into the nose without binding and should not be distorted or obstructed. The keeper spring should exert sufficient force to firmly close the keeper. Keeper rocks must provide the keeper from opening when the keeper closes.

Thimbles: The thimble (protective plastic sleeve) must be firmly seated in the eye of the splice, and the splice should have no loose or cut strands. The edges of the thimble should be free of sharp edges, distortion, or cracks.

Lanyards

Steel Lanyards: While rotating a steel lanyard, watch for cuts, frayed areas, or unusual wear patterns on the wire. The use of steel lanyards for fall protection without a shock-absorbing device is not recommended.

Web Lanyard: While bending webbing over a piece of pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Due to the limited elasticity of the web lanyard, fall protection without the use of a shock absorber is not recommended.

Rope Lanyard: Rotation of the rope lanyard while inspecting from end to end will bring to light any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period. When a rope lanyard is used for fall protection, a shock-absorbing system should be included.

Shock-Absorbing Packs

The outer portion of the shock-absorbing pack should be examined for burn holes and tears. Stitching on areas where the pack is sewn to the D-ring, belt or lanyard should be examined for loose strands, rips and deterioration.

Visual Indication of Damage to Webbing and Rope Lanyards

- **Heat**

In excessive heat, nylon becomes brittle and has a shriveled brownish appearance. Fibers will break when flexed and should not be used above 180 degrees Fahrenheit.

- **Chemical**

Change in color usually appears as a brownish smear or smudge. Transverse cracks appear when belt is bent over tight. This causes a loss of elasticity in the belt.

- **Ultraviolet Rays**

Do not store webbing and rope lanyards in direct sunlight, because ultraviolet rays can reduce the strength of some material.

- **Molten Metal or Flame**

Webbing and rope strands may be fused together by molten metal or flame.
Watch for hard, shiny spots or a hard and brittle feel. Webbing will not support combustion, nylon will.

- **Paint and Solvents**

Paint will penetrate and dry, restricting movements of fibers. Drying agents and solvents in some paints will appear as chemical damage.

Cleaning of Equipment

Basic care for fall protection safety equipment will prolong and endure the life of the equipment and contribute toward the performance of its vital safety function.
Proper storage and maintenance after use are as important as cleaning the equipment of dirt, corrosives or contaminants. The storage area should be clean, dry and free of exposure to fumes or corrosive elements.

Nylon and Polyester

Wipe off all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up a thick lather with a vigorous back and forth motion. Then wipe the belt dry with a clean cloth. Hang freely to dry but away from excessive heat.

Drying

Harness, belts and other equipment should be dried thoroughly without exposure to heat, steam or long periods of sunlight.

Personal Fall Arrest Systems

Anchorage

An **anchorage point** is a secure point of attachment for lifelines, lanyards, deceleration devices, or self retracting lanyards.
The anchorage point can be a single attachment to a substantial structure above the surface from which the employee is working, or it can be one to two attachments used to anchor a vertical or horizontal lifeline.

Remember - The anchorage point for fall arrest systems must be capable of supporting **5000 lb.** for each worker or used as part of a complete PFAS which maintains a safety factor of at least two and under the supervision of a qualified person.

A **qualified person** is defined as one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, the work, or the project.

Full Body Harness

The impact of the fall is imposed on the trunk of the body which distributes the maximum arresting force (MAF) to a larger area than the safety belt, reducing the potential for damage to the body.

OSHA allows a maximum of **1800 lbs.** MAF when using a full body harness.
The attachment point (D-Ring) must be located in the center of the wearer's back near shoulder level.

Connector means a device which is used to connect parts of the PFAS and positioning devices together. Connectors include everything between your harness and anchor. Connectors include lanyards, snaphooks, carabiners, D-Rings, lifelines, and deceleration devices.

- **Lanyards** are devices which connect the worker to the anchorage point
- used to connect the two front D-Rings to the anchorage
- point for positioning
- secured at one end to the worker's harness D-Ring and
- the other end to the anchorage point for fall arrest
- Lanyards must be made from synthetic material and have a minimum breaking strength of 5000 lbs.
- Only locking-type *snaphooks* and *carabiners* can be used
- The following connections are prohibited (unless the locking type snaphook is designed for it):
    - engaged directly to webbing, rope, or wire rope
    - engaged to another snaphook
    - engaged to a D-Ring to which another
    - snaphook/carabiner is attached
    - engaged to a horizontal lifeline
    - engaged to any object which is incompatibly shaped or
    - dimensioned such that unintentional disengagement can occur (roll out)

Deceleration device means any mechanism which dissipates a substantial amount of energy imposed on an employee during fall arrest. Deceleration devices include rope grabs, rip-stitch/tearing lanyards, and self-retractable lanyards.

Remember - maximum arresting forces on an employee during a fall arrest must be less than 1800 lbs.

Lifelines are flexible lines which connect to an anchorage point at one end to hang vertically, or at both ends to stretch horizontally.
Vertical lifelines are designed to be used by only one person and with a rope grab.
Horizontal lifelines can be used only as part of a complete PFAS which maintains a safety factor of at least two, **and** when designed, installed, and used under the supervision of a qualified person.

Fall Protection Equipment

Introduction

Before you can begin a fall protection program, you must identify the potential fall hazards in your workplace. Any time a worker is at a height of six feet or more, the worker is at risk and needs to be protected. The two ways of accomplishing this are: **engineering controls** and **fall protection equipment**. Engineering controls can be as simple as moving the work to ground level and eliminating the work height. Or they can mean the addition of platforms, railings and toe boards to provide permanent, secure access to high maintenance areas and devices. The number of engineering controls is extensive, so contact your plant engineering or maintenance department for further assistance. When engineering controls are not feasible or practical, such as construction or maintenance projects, a personal fall protection system is employed to prevent injuries from falls.

Fall Protection Systems

Fall protection systems can consist of devices that arrest a free fall or devices that restrain a worker in position to prevent a fall from occurring. A **fall arrest system** (see Figures A, B and C) is employed when a worker is at risk of falling from an elevated position. A **positioning system** (see Figure D) restrains the elevated worker, preventing him from getting into a hazardous position where a fall could occur, and also allows hands-free work. Both systems have three components: harnesses or belts, connection devices and tie-off points.

Harnesses and Belts

Full-body harnesses wrap around the waist, shoulders and legs (see Figures A, B and C). A D-ring located in the center of the back provides a connecting point for lanyards or other fall arrest connection devices. In the event of a fall, a full-body harness distributes the force of the impact throughout the trunk of the body—not just in the abdominal area. This allows the pelvis and shoulders to help absorb the shock, reducing the impact to the abdominal area.
Maximum force arrest on a full-body harness, which is used for the most severe free fall hazards, is 1800 pounds. Full-body harnesses come with optional side, front and shoulder D-rings. The side and front D-rings are connection points used for work positioning, and the shoulder D-rings are for retrieval from confined spaces.
Three factors determine the arresting force from a fall: lanyard material type, free fall distance and the weight of the worker. The use of a shock-absorbing lanyard or a higher tie-off point will reduce the impact force.

Belts are used in positioning system applications. These belts have two side D-rings, and are used only for restraining a worker in position. This type of belt is not used for any vertical free fall protection *(see Figure D)*.

Connection Devices

Connection devices attach the belt or harness to the final tie-off point. This can be one device, such as a lanyard, or a combination of devices, such as lanyards, lifelines, worklines, rope grabs, tie-off straps and carabiners.

Lanyards are used both to restrain workers in position, and to arrest falls. When using a lanyard as a restraining device, the length is kept as short as possible (see Figure D), as a restraining lanyard should not allow a worker to fall more than two feet. Restraining lanyards are available in a variety of materials, including steel cables, rebar chain assemblies and nylon rope. Fall protection lanyards (see Figures A and C) can be made of steel, nylon rope, or nylon or dacron webbing.

Fall protection lanyards may also have a shock-absorbing feature built in, thus reducing the potential fall arrest force. Remember that maximum arrest force is 900 pounds for belts, or 1800 pounds for full-body harnesses. With a belt, the use of a shock-absorbing lanyard is recommended because it limits the arresting force from a six-foot drop to 830 pounds. If a shock-absorbing lanyard is not used, the tie-off point must be high enough to limit the arrest force to less than the 900-pound limit. The height of this tie-off point will vary, depending on the lanyard material and the weight of the person involved. A lanyard used for a fall is limited to allow a maximum six-foot free fall. For this reason, most lanyards are a maximum of six feet long. However, if a higher tie-off point is used, the lanyard can be longer if the free fall distance does not exceed 6 feet.

Lifelines add versatility to the fall arrest system. When used in conjunction with **rope grabs** (see Figure C), a lifeline allows the worker to move along the length of the line rather than having to disconnect and find a new tie-off point. The rope grab is engineered to arrest a fall instantly. A rope grab and lifeline system is a passive form of protection, allowing the user to move as long as tension is slack on the lifeline. If a fall occurs, the tension on the rope grab triggers the internal mechanism to arrest the fall. **Retractable lifelines** (see Figure B) automatically retract any slack line between the worker and the tie-off point. While this type of line doesn't require a rope grab, it must be kept directly above the worker to eliminate any potential swing hazard if the worker falls.

A **cross-arm strap** (see Figure A) is used at a tie-off point with a large diameter, such as an I-beam, to which a lanyard or lifeline cannot directly attach. Using a cross-arm strap ensures the lanyard or lifeline doesn't become abraded from wrapping around the I-beam. A carabiner (see Figure D) works in the same situations. It is used for tie-off points with a diameter of one to five inches, and then the lanyard is attached to the carabiner.

Tie-Off Points

A **tie-off point** (see Figures A, B, C and D) is where the lanyard or lifeline is attached to a structural support. This support must have a 5000-pound capacity for each worker tying off. Workers must always tie off at or above the D-ring point of the belt or harness. This ensures that the free fall is minimized, and that the lanyard doesn't interfere with personal movement.

Workers must also tie off in a manner that ensures no lower level will be struck during a fall. To do this, add the height of the worker, the lanyard length, and an elongation factor of 3.5 feet. Using this formula, a six-foot tall worker requires a tie-off point at least 15.5 feet above the next lower level.

Other Devices

For confined space applications, a **tripod and winch system** is used as both the tie-off point and connection device. It is used in conjunction with a full-body harness to lower and raise workers into tanks or manholes. Make sure that the tripod system you choose is designed for your application. Never **use a material-handling device for personnel** unless it is specifically designed to do so.

Ladder systems are lifelines attached directly to a ladder. The systems consist of a cable or channel, with a grabbing device attached for a connection point.

Inspection and Maintenance

New OSHA regulations require that all fall arrest equipment be inspected prior to its use. This includes looking for frays or broken strands in lanyards, belts and lifelines, and oxidation or distortion of any metal connection devices. To properly maintain the devices, periodic cleaning is necessary. Clean all surfaces with a mild detergent soap, and always let the equipment air dry away from excess heat. Follow the manufacturer's instructions for cleaning and maintenance.

IMPORTANT NOTE: ANY EQUIPMENT EXPOSED TO A FALL MUST BE TAKEN OUT OF SERVICE AND NOT USED AGAIN FOR FALL PROTECTION.

Sources for More Information

Federal Register, Vol. 59, No. 152, August 9, 1994, pp. 40672–40753.
29 CFR 1910 Subpart F, Powered Platforms, Manlifts, and Vehicle-Mounted Platforms
29 CFR 1910 Subpart D, Walking-Working Surfaces
ANSI A10.14-1991, Standard for Construction and Demolition Operations—Requirements for Safety Belts, Harnesses, Lanyards and Lifelines for Construction and Demolition Use.
ANSI Z359.1-1992, Standard for Personal Arrest Systems, Subsystems and Components.

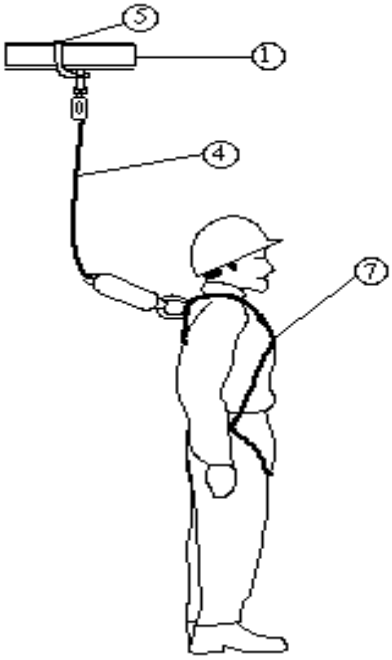


Figure A

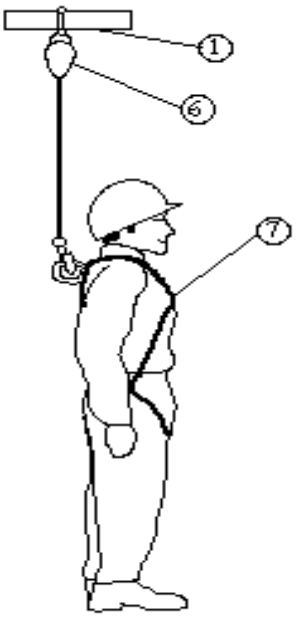


Figure B

1. Tie-off Point
2. Lifeline
3. Rope Grab
4. Shock-Absorbing Lanyard
5. Cross-Arm Strap
6. Retractable Lifeline
7. Full-Body Harness
8. Restraining Belt
9. Restraining Lanyard
10. Carabiner

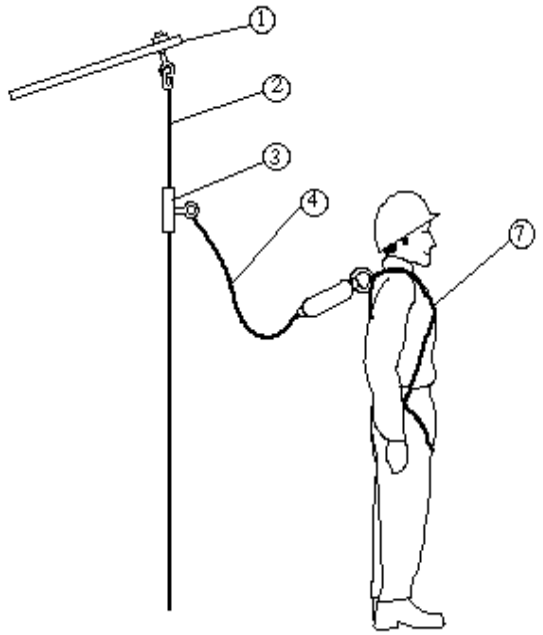


Figure C

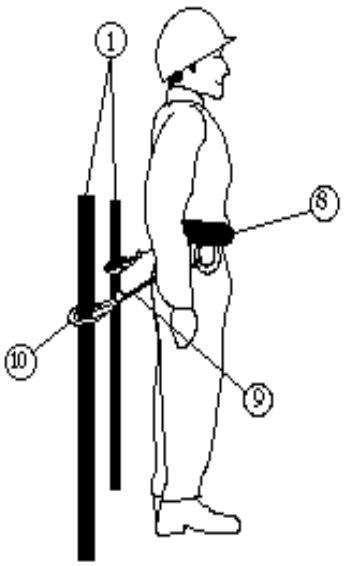


Figure D

1. Tie-off Point
2. Lifeline
3. Rope Grab
4. Shock-Absorbing Lanyard
5. Cross-Arm Strap
6. Retractable Lifeline
7. Full-Body Harness
8. Restraining Belt
9. Restraining Lanyard
10. Carabiner

Personal Fall Arrest Systems - The Fall

We have all heard the expression - ‘it’s not the fall that’s hurts but the sudden stop at the end’. Think of a fall as *“…a sudden, unanticipated descent in space driven by gravity”.* Although this may not *sound* severe, the consequences are often disabling - or deadly. The free fall velocity at impact when falling 12 feet is nearly 20 mph. Put another way, a person will hit the ground in just under one second after falling this distance.

A free fall is defined as the act of falling before a personal fall arrest system begins to apply force to arrest the fall. When a fall is experienced using a PFAS, the fall is referred to as a free

fall up until the system starts to arrest the fall to stop the fall. OSHA regulations allow no more than a **six** foot free fall distance.
When the fall does come to a complete stop, the action is referred to as the fall arrest. Tremendous force is imposed on the body during the fall arrest. This force imposed during the arrest is known as the ***arrest force***. Forces imposed in a fall greatly depend on the type of system you are using and the free fall distance.

For example: A 220 lb. worker:

- **Free falling 2 ft. using a wire rope lanyard (without a deceleration device) = approx. 3917 lbs.**
- **Free falling 4 ft. using a nylon rope lanyard (without a deceleration device) = approx. 2140 lbs.**
- **Free falling 6 ft. using a synthetic web lanyard (with a deceleration device) = <900 lbs.**

OSHA sets limits on the Maximum Arrest Force (MAF). The law prohibits the use of a safety belt for fall arrest and allows a maximum of **1800 lbs.** when using a full body harness.

ARREST FORCE = the force imposed when the stop occurs.

Harness Life
Harnesses may be stored / used up to 10 years from date of manufacture. Max usage: 5 years from date harness placed in service. An additional 2 years of use may be added if the unit passes inspection by supplier or their authorized personnel. If the harness is more than ten years old from the date of manufacture or five years old from the date of first use, remove the harness from service and dispose of properly.

The production date is found on the product label or label permanently stitched to the harness. Keep complete records of use of the harness.

If the harness sustains a fall factor greater than 1, remove it from service.

In addition to checking before and after each use, we recommend a complete inspection every 3 months.

Inspection of Webbing
The inspection is required to be done on all accessible parts, especially on edges and spots where the webbing contacts metal components and other equipment.

If any yarn is completely broken (cut or worn through), remove the harness from service and dispose of properly. It is especially important to pay attention to both edges of the webbing where the possibility of damage is greatest.

Local coloring (stains, spots, etc.) wash in lukewarm water. If the stains or spots do not disappear, damage may have been caused by an unknown chemical. Remove the harness from service at once.
Check webbing for a Glossy surface. Glazing suggests the harness has been exposed to a heat source (flame or friction) If glazing exist, remove the harness out of service immediately. High temperatures will permanently damage synthetic fibers

Webbing and Fabric: Cuts, Tears, Abrasion Usage, Damage, Burns/Glazing Chemical Damage Cleaning, Required Dynamic Loading, Other Inspection of Seams
Inspect all thread and stitch patterns in all seams. Check to insure that no threads or stitches are broken, cut, worn, burned, glazed, or unraveled. Check the stitch patterns on both sides of the webbing.

If any thread in a seam is completely broken (cut or worn) and the thread ends are not factory sealed, remove the harness from service.

If the seam is rough and one of the three individual thread components is completely broken, remove the harness from service.

Wash local discoloration (stains, spots, etc.) in lukewarm water. If the stains or spots do not disappear, damage may have been by an unknown chemical, remove the harness from service at once.

Discoloration of thread caused by high temperatures may be in the form of a glossy surface. High temperatures will permanently damage synthetic fibers and require the harness be removed from service.

All the seams in the harness must have the terminations (thread ends) sealed in such a way that a loose end of the thread is not longer than 2mm and the visible ends sealed to prevent the seam from unraveling. If the loose end of the thread is longer than 8mm, it is necessary to remove the harness from service. An 8mm long exposed thread end indicates more than two stitches have unraveled.

A loosened stitch is also a reason to remove a harness from service. A loosened stitch is defined as a loose loop of a stitch that allows the insertion of a 2mm round wire into the loop.

Stitch Patterns/Thread:
Cuts Tears Abraded Loose
Burn/Glazed Missing Stitches Other

Inspection of Metal Components
Check for Deformities from the original shape of the component. If a permanent deformation is visible or the reduction of the original size of the metal component is more than 5% - remove the harness from use.

Check for cracks and burrs on all surfaces. If any cracks are discovered, remove the harness from use.

Check for corrosion and oxidation of metal devices that do not disappear after washing the harness in lukewarm, soapy water. Discoloration may indicate chemical damage. --Remove the harness from service.

Check for proper function of the metal component. Reduction in function is important to be checked especially if two components fit into each other. The function of metal components is reduced if it can be opened unintentionally or if it does not fit the original specification. If a reduction in function is observed, remove harness from service.

Metal components, D-Rings:
Cracked Bent Chemical Corrosion Sharp Edges Other

Metal components, Buckles / Connectors:
Cracked Bent Chemical Corrosion Sharp Edges Poor Function Other

Labels Missing Illegible
Harness Alterations Pass/Fail

If the user is unsure of any condition is found that suggests removal from service, return the harness to the manufacture for inspection.

Maintenance and Storage
Harnesses should be initially rinsed in clean cold water. If soiling remains, it may be washing in lukewarm water (30 degrees C max.) using mild soap (no detergent or bleach) with a pH range of 5.5 to 7. Rinse thoroughly and dry away from heat sources and sunlight. All chemical products, corrosive materials and solvents should be regarded as harmful.

Always carry and store the harness in an appropriate bag. Despite the addition of the UV inhibitors to the fibers in the webbing and thread, store the harness away from direct sunlight, in a well ventilated place away from sources of direct heat and chemical fumes.

Usage temperature range: Between -40C and 80C. Lifetime and Inspection The service life of this product is directly related to the frequency of use, skill of user, storage practices and the usage environment. Without taking wear or mechanical damage into account and compliance with all conditions and inspections stated in the manufacturer's literature, a harness may be placed in service up to 10 years from the date of manufacture.

APPENDIX A

Fall Job Hazard Analysis Checklists

Scaffolding Checklist

1. Is a competent person present during the erection, alteration, movement, and disassembly of the scaffold system?
2. Are all scaffold systems inspected on a regular basis?
3. Are all scaffold systems erected in accordance with manufacturers' recommendations?
4. Is equipment being used for ways it was not intended?
5. Is the scaffold base erected in a firm foundation, or adequate sill/pad?
6. Is the scaffold system, plumb, level, rigid and square?
7. Are all cross/support braces properly installed?
8. Are all scaffolds components compatible with each other?
9. Are all pins, clips and locking mechanisms installed and operating correctly?
10. If required, is the scaffold system secure/tied to the wall or structure at the proper interval? (30' horizontal/24' vertical)
11. Are outriggers installed on freestanding scaffolds, which exceed 4 times their minimum base width vertically (in some states plans it is 3 times the base width), and are they locked into place?
12. Is a safe means of access provided to working level via a ladder, ramp, or stairway?

13. Are guardrails or other forms of fall provided when are exposed to falls in excess of the Subpart “D” standard?
14. Is the working surface properly planked/decked with scaffold grade material?
15. Are the working surface, guardrails, and access/egress maintained in a clean and non-slippery condition to avoid slip hazards?
16. Is the scaffold system overloaded?
17. For suspended scaffolds, are the pulley, motor, anchors and fall protection systems in place and operating correctly?
18. Is rigging correct on the suspended scaffold system?
19. Are the tiebacks sized, installed, anchored and inspected to ensure their effectiveness?
20. Are all inspection requirements recommended by the manufacturer being performed?
21. Are heavy loads placed over bearing portions of the scaffold assembly, and not in the center of the work surface?
22. Are all defective scaffold components tagged and immediately removed from service to be repaired or destroyed?
23. Are employees trained on scaffold use, erection and inspection?

Ladders Checklist

1. Is the correct ladder for the job been used?
2. Are ladders inspected before use?
3. Are metal ladders prohibited near electrical sources?
4. Are stepladders being placed against the wall, in a closed position, which can cause them to slide out underneath a worker?
5. Are extension ladders secured at the top, and bottom if possible?
6. Is the extension ladder installed at the correct angle (the 1 to 4 rule)
7. Do side rails extend 3’ above the working surface?
8. Are ladders being overloaded?
9. Is the extension ladder overloaded?
10. Are materials being hoisted by a line, and not by the individual climbing the ladder?
11. Is the three-point-contact rule being followed? (i.e., both feet and one hand or both hands and one foot)
12. Never allow two ladders to be tied together!
13. Are all damaged ladders immediately tagged and repaired or destroyed?
14. Are ladder feet placed on a firm foundation?
15. Are proper climbing/working procedures being followed?
16. Never allow an individual to “bounce” or walk a stepladder to move it!
17. Are stepladders used in the fully open position only?
18. Are individuals working on the correct side of a stepladder?
19. Are all hinges, spreaders, locks and feet on in serviceable condition?
20. Never allow any ladder to be used in the horizontal position as a scaffold plank or work! Platform
21. Are ladders with broken or missing rungs or split side rails, tagged and taken out of service or destroyed?
22. Are access/egress areas around the top and bottom of the ladder kept clear?
23. Are all ladders inspected regularly?
24. Are filler blocks placed between the cleats of job made ladders?
25. Where simultaneous two-way traffic can be inspected, is there a double cleat ladder installed?

26. Does the design and assembly of the job built ladder meet the requirements of ANSI Standard A14.4?

Roofing (Including Skylights) Checklist

1. Are all skylights/roof openings protected by covers or guardrails? Note: Most glass or plastic covers on skylights will not meet the structural requirements of a cover, check with manufacturer. To be safe, the installation of a proper cover or guardrail is recommended.
2. Is there a warning line in place?
3. Is there a safety monitor in visual/verbal range of employees?
4. Is all mechanical equipment kept inside the warning line?
5. Is the hoist area protected with a guardrail system?
6. Are employees below the hoist area protected from falling objects/material?
7. Are guardrails, safety nets or personal fall arrests systems in use on roofs that exceed a 41/2 pitch?
8. Are employees working on surfaces, which are hazardous because of poor footing due to frost, ice, or mildew?
9. Are employees working in hazardous conditions such as high winds, poor visibility or inclement weather?
10. Is there a safe/secure access to the roof via stairs or a secured ladder?

Falls From A Floor Checklist (One Level to the Next)

1. Are all holes covered with structurally appropriate, marked and secured covers?
2. Are all exposed edges protected with a guardrail system?
3. When guardrails are not installed, are personal fall arrest, safety nets or fall restraining systems in place and being used?
4. Are windows or wall openings, where the lower sill is below 39 inches from the walking/working surface, protected with a guardrail system?
5. Are removable sections of the guardrails for incoming materials replaced and structurally sound after materials are loaded?
6. When guardrails are removed for incoming materials, are alternate fall protection measures being used (i.e., personal fall restraint or safety nets)?
7. Are toe boards installed to protect employees below from falling objects?

APPENDIX B

Fall Protection Case Studies[6]

Case Study 1 - Laborer Killed in Fall Through Roof

A 40-year old laborer/helper died when he fell through an opening in a warehouse roof. He fell approximately 27 feet to the flow below.

The employer was demolishing the roof of the warehouse portion of a commercial building. Work was done at night because the coal tar on the roof would release hazardous gases if disturbed in the heat of the day. The site had adequate halogen lighting. None of the workers on the job were using fall protection.

After the roofing material was removed, 4x8 foot sheets of plywood were exposed. Any damaged sheet needed to be replaced. The helper's job was to follow the workers who were replacing the plywood, and to pick up damaged sheets of plywood they had removed. He disposed of them in a chute.

On this evening, one worker had removed a sheet of damaged plywood, but had run out of nails to attach the replacement plywood. He walked away to get more nails. The opening where the damaged plywood had been was left unguarded.

The crew was not informed that it was temporarily unguarded. The opening was covered by silver-colored insulation inside the roof.

The helper came along, picked up the sheet of damaged plywood, and headed for the chute. He stepped into the opening, ripped through the insulation, and fell.

What should have been done to prevent this accident?

Case Study 2 - Ironworker Dies After Falling Off Beam

A 42-year-old structural ironworker foreman died when he fell off a steel beam in an incomplete warehouse roof. He fell about 38 feet to the floor below. The employer was installing the final structural beam (bar hoist) in the roof of a new cold storage warehouse under construction. After a crane lifted the beam into place, it was not quite straight and the ironworker foreman wanted to use a hammer to straighten it.

The area where the foreman needed to work had been barricaded with wire rope safety lines on all four sides, but he removed these lines to gain access. He was not using fall protection equipment.

The foreman was standing on a portion of roof decking that had already been completed. To get to the beam, he reached his left foot out over an open, undecked area of the roof. He rested his left foot on the nearest joist girder. As he was preparing to strike a blow with the hammer, his foot slipped off the girder.

His hands caught the bar joist, but he couldn't hold on and fell.

What should have been done to prevent this accident?

Case Study 3 – Sheet Metal Worker Dies After Fall from Ladder

A 46-year old sheet metal worker died when he fell off an 8-foot stepladder and struck his head on the edge of a metal floor plate.

The worker was doing sheet metal work on a hospital addition. He and two coworkers were adding a fire damper (a fire safety device) to previously installed metal duct.

The job was difficult, and the sheet metal worker had his right foot on the 5th step of the ladder, at a height of 4 feet, 9 inches. His left foot was on the step above.

According to a co-worker, the ladder spun around and tangled his legs in the steps. He fell head first to the concrete floor, striking his head on a metal floor plate.

One co-worker said the sheet metal worker might have extended himself out too far from the ladder, or lost his balance.

What should have been done to prevent this accident?

Case Study 4 – One Killed, Three Injured in Scaffold Accident

A 29-year-old hod carrier died and three co-workers were injured when they fell from the fourth story of a pump house building that was under construction at a reservoir.

The hod carrier and other had been spraying fireproof insulation onto the structural frame of the building. They used a rolling tower scaffold to gain access to the structural steel overhead. Putlogs (types of trusses) had been added to the sides of the rolling tower scaffold, and an extension platform had been built there. This platform was used to reach the outer side of the structural steel.

On this day, a supervisor said a guardrail was needed on the scaffold. The hod carrier joined three co-workers on the scaffold. The hod carrier joined three coworkers on the extension platform to help install the guardrail. Their combined weight caused the scaffold to tip. They were all thrown to the concrete deck 44 feet below.

The scaffold had not been engineered for the extension platform. No counterweights, anchorage, or bracing were used. Neither the hod carrier nor his co-workers were wearing personal fall protection. The scaffold and platform had been constructed using parts from different manufacturers.

APPENDIX C

Glossary

“Anchorage" means a secure point of attachment for lifelines, lanyards or deceleration devices, and which is independent of the means of supporting or suspending the employee.

"Body belt" means a strap with means both for securing it about the waist and for attaching it to a lanyard. Lifeline or deceleration device.

"Body harness" means a design of straps which may be secured about the employee in a manner to distribute the fall arrest forces over at least the thighs, pelvis. waist, chest and shoulders with means for attaching it, to other components of a personal fall arrest system.

"Buckle" means any device for holding the body belt or body harness closed around the employee's body.

"Competent person" means a person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as in their application and use with related equipment.

"Connector" means a device which is used to couple (connect) parts of the system together. It may be an independent component of the system (such as a carabiner), or an integral component of part of the system (such as a buckle or dee-ring sewn into a body belt or body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

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

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

"Deceleration distance" means the additional vertical distance a falling employee travels, excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body belt or body harness attachment point at the moment of activation (at the onset of fall arrest forces) of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.

"Equivalent" means alternative designs materials or methods which the employer can demonstrate will provide an equal or greater degree of safety for employees than the methods, materials or designs specified in the standard.

"Free fall" means the act of falling before the personal fall arrest system begins to apply force to arrest the fall.

"Free fall distance" means the vertical displacement of the fall arrest attachment point on the employee's body belt or body harness between onset of the fall and just before the system begins to apply force to arrest the fall. This distance excludes deceleration distance, lifeline and lanyard elongation but include any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur.

"Lanyard" means a flexible line of rope, wire rope, or strap which is used to secure the body belt or body harness to a deceleration device, lifeline, or anchorage.

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

"Personal fall arrest system" means a system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these.

"Qualified person" means one with a recognized degree or professional certificate and extensive knowledge and experience in the subject field who is capable of design, analysis, evaluation and specifications in the subject work,
project, or product.

"Rope grab" means a deceleration device which travels on a lifeline and automatically frictionally engages the lifeline and locks so as to arrest the fall of an employee. A rope grab usually employs the principle of inertial locking, cam/lever locking, or both.

"Self-retracting lifeline/lanyard" means a deceleration device which contains a drum wound line which may be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of a fall, automatically locks the drum and arrests the fall.

"Snap-hook" means a connector comprised of a hookshaped member with a normally closed keeper, or similar arrangement, which may be opened to permit the hook to receive an object and, when released, automatically closes to retain the object. *Snap-hooks are generally one of two types*:

1. The **locking type** with a self-closing, self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection, or
2. The **non-locking type** with a self-closing keeper which remains closed until pressed open for connection or disconnection.

"Tie-off' means the act of an employee, wearing personal fall protection equipment, connecting directly or indirectly to an anchorage. It also means the condition of an employee being connected to an anchorage.

Appendix D

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
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.

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". While in a sedentary position, blood can accumulate in the veins, which is commonly called "venous pooling," and cause orthostatic intolerance. 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. 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.

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	

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

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. 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.

The amount of time spent in this position, with the legs below the heart, affects the manner in which the worker should be rescued. 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. 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. 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."
- Continuous monitoring of the suspended worker for signs and symptoms of orthostatic intolerance and suspension trauma should be conducted.
- Ensuring that a worker receives standard trauma resuscitation 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.

Developing a One Year Plan

Activity: In your group, decide what steps need to be taken to insure workers are protected from serious injury or death from "Falls" in your facility. (Examples of steps are provided to get you started)

Month # 1	Month # 2	Month # 3	Month # 4	Month # 5	Month # 6
Select "Fall Hazard Committee" (FHC) **++++++++++**	**Report by FHC Committee of all recognized potential fall hazards** **++++++++++**	**Prioritize areas and decide on how to address them** **+++++++++++**			
Month # 7	**Month # 8**	**Month # 9**	**Month # 10**	**Month # 11**	**Month # 12**
					Review Fall Protection Program **++++++++++**

Rights and Responsibilities under OSHA Law

Employers have the responsibility to provide a safe workplace. **Employers MUST provide their workers with a workplace that does not have serious hazards and must follow all OSHA safety and health standards.** Employers must find and correct safety and health problems. OSHA further requires that employers must first try to eliminate or reduce hazards by making feasible changes in working conditions rather than relying on personal protective equipment such as masks, gloves, or earplugs. Switching to safer chemicals, enclosing processes to trap harmful fumes, or using ventilation systems to clean the air are examples of effective ways to eliminate or reduce risks.

Employers MUST also:

• Inform workers about chemical hazards through training, labels, alarms, color-coded systems, chemical information sheets and other methods.

• Provide safety training to workers in a language and vocabulary they can understand.

• Keep accurate records of work-related injuries and illnesses.

• Perform tests in the workplace, such as air sampling, required by some OSHA standards.

• Provide required personal protective equipment at no cost to workers.*

• Provide hearing exams or other medical tests required by OSHA standards.

• Post OSHA citations and injury and illness data where workers can see them.

• Notify OSHA within eight hours of a workplace fatality or when three or more workers are hospitalized (1-800-321-OSHA [6742]).

• Prominently display the official OSHA *Job Safety and Health – It's the Law* poster that describes rights and responsibilities under the OSH Act.

• Not retaliate or discriminate against workers for using their rights under the law, including their right to report a work-related injury or illness.

* Employers must pay for most types of required personal protective equipment.

Workers have the right to:

• Working conditions that do not pose a risk of serious harm.

• File a confidential complaint with OSHA to have their workplace inspected.

• Receive information and training about hazards, methods to prevent harm, and the OSHA standards that apply to their workplace. The training must be done in a language and vocabulary workers can understand.

• Receive copies of records of work-related injuries and illnesses that occur in their workplace.

• Receive copies of the results from tests and monitoring done to find and measure hazards in their workplace.

• Receive copies of their workplace medical records.

• Participate in an OSHA inspection and speak in private with the inspector.

• File a complaint with OSHA if they have been retaliated or discriminated against by their employer as the result of requesting an inspection or using any of their other rights under the OSH Act.

• File a complaint if punished or discriminated against for acting as a "whistleblower" under the 21 additional federal laws for which OSHA has jurisdiction.

OSHA's Whistleblower Program:

Protection from Discrimination

To help ensure that workers are free to participate in safety and health activities, Section 11(c) of the OSH Act prohibits any person from discharging or in any manner retaliating or discriminating against any worker for exercising rights under the Act. These rights include raising safety and health concerns with an employer, reporting a work-related injury or illness, filing a complaint with OSHA, seeking an OSHA inspection, participating in an OSHA inspection and participating or testifying in any proceeding related to an OSHA inspection.

Protection from discrimination means that an employer cannot retaliate by taking "adverse action" against workers, such as:

• Firing or laying off;

• Blacklisting;

• Demoting;

• Denying overtime or promotion;

• Disciplining;

• Denying of benefits;

• Failing to hire or rehire;

• Intimidation;

• Making threats;

• Reassignment affecting prospects for promotion; or

• Reducing pay or hours.

If a worker believes an employer has discriminated against them for exercising their safety and health rights, they should contact their local OSHA office right away. To file a complaint under Section 11(c), contact the nearest OSHA office within 30 days of the discrimination. **No form is needed, but workers must call OSHA within 30 days of the alleged discrimination** (at 1-800-321-OSHA [6742]). For more information, please visit www.whistleblowers.gov.

Filing a Complaint

Hazardous Workplace Complaints

If a workplace has unsafe or unhealthful working conditions, workers may want to file a complaint. Often the best and fastest way to get a hazard corrected is to notify a supervisor or employer. Workers or their representatives may file a complaint online or by phone, mail, email or fax with the nearest OSHA office and request an inspection. A worker may also ask OSHA not to reveal his or her name. To file a complaint, call
1-800-321-OSHA [6742] or contact the nearest
OSHA regional, area, state plan, or consultation office listed at www.osha.gov. The teletypewriter (TTY) number is (877) 889-5627.

Written, signed complaints submitted to OSHA area offices are more likely to result in an on-site OSHA inspection. Most online or unsigned complaints are resolved informally over the phone with the employer. Complaints from workers in states with an OSHA-approved state plan will be forwarded to the appropriate state plan for response. Workers can call 1-800-321-OSHA [6742] to request a complaint form from their local OSHA office or visit www.osha.gov/pls/osha7/eComplaintForm.html to download the form. Completed forms should be faxed or mailed to the local OSHA office (provided at the end of this guide). Include your name, address and telephone number so that OSHA can contact you.

OSHA FactSheet

Preventing Falls

Falls and falling objects can result from unstable working surfaces, ladders that are not safely positioned, and misuse of fall protection. Workers are also subject to falls or to the dangers of falling objects if sides and edges, floor holes, and wall openings are not protected. Any time a worker is at a height of six feet or more (construction industry) or four feet or more (general industry), the worker must be protected.

Fall Protection

Fall protection must be provided for each employee on a walking/working surface with an unprotected side or edge at the height required by the OSHA standard applicable to their work environment. Management is required to:

- Develop, implement and commit to a fall protection program
- Provide training on the fall protection program
- Evaluate the program on a regular basis to insure the program's effectiveness and determine whether it needs to be changed or updated

Employers are required to assess the workplace to determine if the walking/working surfaces on which employees are to work have the strength and structural integrity to safely support workers. Once employers have determined that the surface is safe for employees to work on, the employer must select one of the options listed for the work operation if a fall hazard is present.

- Where protection is required, select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Train workers in the proper selection, use, and maintenance of fall protection systems.

Unprotected Sides, Wall Openings, and Floor Holes

Almost all sites have unprotected sides and edges, wall openings, or floor holes at some point during construction. If these sides and openings are not protected at your site, injuries from falls or falling objects may result, ranging from sprains and concussions to death.

- Use at least one of the following whenever employees are exposed to a fall of 6 feet or more [see comment above] above a lower level:
- Guardrail Systems
- Safety Net Systems
- Fall Arrest Systems
- Cover or guard floor holes as soon as they are created.
- Guard or cover any openings or holes immediately.
- Construct all floor hole covers so they will effectively support two times the weight of employees, equipment, and materials that may be imposed on the cover at any one time.
- In general, it is better to use fall prevention systems, such as guardrails, than fall protection systems, such as safety nets or fall arrest devices.

Ladders

You risk falling if portable ladders are not safely positioned each time they are used. While you are on a ladder, it may move and slip from its supports. You can also lose your balance while getting on or off an unsteady ladder. Falls from ladders can cause injuries ranging from sprains to death.

- Position portable ladders so the side rails extend at least 3 feet above the landing
- Secure side rails at the top to a rigid support and use a grab device when 3 foot extension is not possible.
- Make sure that the weight on the ladder will not cause it to slip off its support.
- Before each use, inspect ladders for cracked, broken, or defective parts.
- Do not apply more weight on the ladder than it is designed to support.
- Use only ladders that comply with OSHA standards.

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

Think Safety!

For more complete information:

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

www.osha.gov

(800) 321-OSHA

UNITED STATES
DEPARTMENT OF LABOR

SAFETY AND HEALTH TOPICS

Fall Protection

OSHA has developed this webpage (***https://www.osha.gov/SLTC/fallprotection/***) to provide workers and employers useful, up-to-date information on fall protection.

Why is fall protection important?

Falls are among the most common causes of serious work related injuries and deaths. Employers must set up the work place to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls.

What can be done to reduce falls?

Employers must set up the work place to prevent employees from falling off of overhead platforms, elevated work stations or into holes in the floor and walls. **OSHA requires that fall protection be provided at elevations of four feet in general industry workplaces**, five feet in shipyards, six feet in the construction industry and eight feet in longshoring operations. In addition, OSHA requires that fall protection be provided when working over dangerous equipment and machinery, **regardless of the fall distance**.

To prevent employees from being injured from falls, employers must:

- Guard every floor hole into which a worker can accidentally walk (using a railing and toe-board or a floor hole cover).
- Provide a guard rail and toe-board around every elevated open sided platform, floor or runway.
- Regardless of height, if a worker can fall into or onto dangerous machines or equipment (such as a vat of acid or a conveyor belt) employers must provide guardrails and toe-boards to prevent workers from falling and getting injured.
- Other means of fall protection that may be required on certain jobs include safety harness and line, safety nets, stair railings and hand rails.

OSHA requires employers to:

- Provide working conditions that are free of known dangers.
- Keep floors in work areas in a clean and, so far as possible, a dry condition.
- Select and provide required personal protective equipment at no cost to workers.
- Train workers about job hazards in a language that they can understand.