

24-Hr Fall Protection Competent Person Module 3

Fall Protection Methods

Section 3.1 Hierarchy of Control	3
Section 3.2 Fall Protection Methods	4
3.2.1 Distance Protection/Designated Area (for maintenance work only).....	4
3.2.2 Guardrail System (Passive Control)	5
3.2.3 Fall Restraint System	7
3.2.4 Positioning Device System	7
3.2.5 Personal Fall Arrest System	9

Section 3.1 Hierarchy of Control

In the disciplines of structural engineering and construction, prioritizing the safety of personnel is paramount. This involves ensuring the protection of employees from fall hazards. The implementation of fall protection strategies, such as guardrails, and the utilization of specialized gear, like retractable lifelines, are imperative for employees working at elevated heights. This module will delve into these fall protection methods and equipment in detail.

In order to keep employees safe, fall hazards need to be identified and controlled using the following hierarchy:

- 1) **Eliminate or substitute hazards:** Remove the hazard from work areas or modify the task, process, or controls to eliminate the need for working at heights, thereby reducing exposure to fall hazards.
Examples:
 - i. Construct roof trusses at ground level and subsequently elevate them into place.
 - ii. Lower the location of a meter or valve at high elevations to the worker's level.
- 2) **Enforce passive controls (same-level barrier):** Isolate and separate fall hazards from work areas by creating physical barriers.
Examples:
 - i. Erect guardrails.
 - ii. Install walls, covers, or parapets.
- 3) **Implement administrative controls:** Implement new work practices that reduce the risk of falling or alert workers to avoid approaching a fall hazard.
Examples:
 - i. Use warning systems and warning lines.
 - ii. Install audible alarms and signs.
 - iii. Train workers to recognize specific fall hazards and adopt safe practices.
- 4) **Execute active controls (personal protective systems and equipment):** Utilize personal fall protection systems to protect workers. These systems necessitate the use of a full body harness, connecting means, and a safe anchorage system.

Types of active controls (in order of effectiveness) include:

- i. **Restraint Systems:** Prevent workers from reaching the fall hazard.
- ii. **Positioning Systems:** Allow workers to be supported on an elevated vertical surface, such as a wall, and work with both hands free.
- iii. **Personal Fall Arrest Systems:** Stop a fall in progress.

The methods in this hierarchy are described further in the next section.

Section 3.2 Fall Protection Methods

Fall protection systems criteria and practices are listed in §1926.502. There are several options in fall protection systems. This includes the usage of designated areas, guardrail systems, fall restraint systems, positioning device systems, and Personal Fall Arrest Systems (PFAS). These fall protection methods are outlined next, in order of the hierarchy.

3.2.1 Distance Protection/Designated Area (for maintenance work only)

To protect workers from falls during maintenance work (such as maintenance on rooftop equipment), maintain a distance from unprotected edges. Workers may work in a designated area without the need for additional fall protection if the following requirements are met:

- A distance of at least six feet from the roof edge or 15 feet from other work areas should be maintained.
- Only work of a temporary nature should be performed.
- The working surface should be dry, ice-free, and not slippery.
- The designated area should have a flat surface with a slope of less than ten degrees.
- The designated area should be enclosed by a rope, wire, or chain supported by stanchions meeting the following criteria for strength, height, visibility, and location:
 - Stanchions must be able to withstand a horizontal force of at least 16 pounds without tipping over.
 - Ropes, wires, or chains must have a minimum breaking strength of 200 pounds and should be able to support the loads without breaking.
 - The lowest point of the rope, wire, or chain should be between 34 and 39 inches from the work surface.
 - It should be clearly visible from any unobstructed location, from a distance of 25 feet, and anywhere within the designated area.
 - Stanchions should be as close to the work area as allowed.
 - There should be a clear path to the designated area, formed by two lines attached to stanchions meeting the strength, height, and visibility requirements.
 - No specific arrangements need to be made for rescue.
- Employees must remain within the designated area while work is ongoing.
- The marking must be as close to the work area as possible.
- When using mobile mechanical equipment in the area, additional guidelines for the distance of the marking from the equipment and the roof edge apply.
- For further guidance, refer to 29 CFR 1910.29(d).

3.2.2 Guardrail System (Passive Control)

Guardrail systems are essential for protecting workers from fall hazards when it is not feasible to eliminate or replace the hazards. To meet industry standards, a safe guardrail system must include the following features:

- Top rails
 - **Height:** Top rails must be 42 inches \pm three inches above the walking or working level.
 - **Strength:** They should be capable of withstanding at least 200 pounds of force applied within two inches of the top edge in any outward or downward direction.
 - **Deflection:** When the 200-pound force is applied in a downward direction, the top edge must not deflect to a height less than 39 inches above the walking or working level.
 - **Inspection:** Regular checks are necessary to ensure strength and stability.
 - **Design:** They must be designed to prevent punctures, cuts, and entanglement of clothing.
- Midrails
 - **Height:** Midrails must be positioned midway between the top edge of the guardrail system and the walking/working level when there is no wall (or parapet wall) at least 21 inches high.
 - **Strength:** They should support at least 150 pounds of force in any downward or outward direction.
- Toeboards
 - **Industry requirement:** In the general industry, toeboards are always necessary. In the construction industry, toeboards are required if the area below cannot be protected from people entering.
 - **Height:** They must be a minimum of 3.5 inches tall, measured from its top edge to the level of the floor, platform, runway, or ramp.
 - **Material:** Toeboards must be constructed from 1 inch x 4 inches of lumber or equivalent.
 - **Strength:** They must withstand at least 50 pounds of force applied in any downward or outward direction at any point along the toeboard.
 - **Installation:** Toeboards should be securely fastened in place with no more than 1/4-inch clearance above the floor level.
 - **Construction:** They should be constructed of any substantial material, either solid or with openings between adjacent pieces not greater than one inch.
- Parapet walls
 - If an existing parapet wall is to provide effective fall protection, it must be 42 \pm 3 inches tall. If the height of a parapet wall does not meet these requirements, consider installing a guardrail system or using another form of fall protection to ensure safety.
- Posts

- The ends of the top rails and midrails must not overhang the terminal posts, except where such overhang does not create a projection hazard.
 - Posts should not be spaced more than eight feet apart.
 - Install supporting posts at whatever distance is necessary to meet the top rail strength requirement of 200 pounds without failure (29 CFR 1910 Subpart D).
- Additional protection
 - If tools, equipment, or materials are piled higher than the toeboard, paneling or screening must be erected from the walking/working surface or toeboard to the top rail or midrail of the guardrail system to protect employees below.
 - Guardrails receiving heavy stresses must be provided with additional strength using heavier stock, closer spacing of posts, bracing, or other means.

Minimum Construction Materials:

- Wood railings:
 - **Top rails:** They must have at least 2 inches x 4 inches of lumber.
 - **Midrails:** They must have at least 1 inch x 6 inches of lumber.
 - **Posts:** They should be at least 2 inches x 4 inches.
- Structural steel railings:
 - **Top rails and midrails:** They should have at least 2 inches x 2 inches x 3/8 inch angles.
 - **Posts:** They should have at least 2 inches x 2 inches x 3/8 inch angles, spaced not more than eight feet on centers.
- Steel cable (wire rope) railings:
 - **Top rails and midrails:** At least one-quarter (¼) inch steel cable should be flagged every six feet with high visibility material.
 - **Tension:** Ensure cables are tensioned so there is not more than three inches deflection under a 200-pound load.
 - **Support posts:** Locate support posts to ensure proper tension is maintained.
 - **Perimeter safety cables:** Guardrail system criteria must be met.
 - If used for attaching lanyards, they must meet horizontal lifeline (HLL) system requirements.

Guardrail Surface and Material Restrictions:

- Guardrail systems must be smooth surfaced to prevent injury from punctures or lacerations and to prevent snagging of clothing.
- Synthetic or natural fiber ropes should not be used as top rails or midrails.

Commercial Guardrail Systems: Commercial, off-the-shelf, engineered guardrail systems may be used instead of constructing a system.

- The employer must ensure that the system used is approved, completed, installed, and used as designed, meeting the same requirements.

Hoist Areas:

- **Guardrails:** Erect a minimum of six feet of guardrail on each side of the access point through which materials are hoisted.
- **Gates or removable guardrail sections:** They may be used if they meet the standard guardrail height and are secured across the opening when hoisting operations are not taking place.
- **Protection during hoisting:** Use self-closing swing gates, chain, removable guardrail sections, or Personal Fall Arrest System and restraint systems to protect personnel from falling when a segment or side of the railing system is left open during hoisting operations.

3.2.3 Fall Restraint System

A restraint system should prevent workers from reaching fall hazards by restricting their movement within a safe area. It is designed to prevent users from reaching an unprotected edge where a free fall could occur. Below are the requirements for using a restraint system:

- **Anchorage:** Anchors should be capable of supporting a minimum of 3,000 pounds per attached worker for non-certified anchorages, or they should be designed by a QP for twice the maximum foreseeable force for certified anchorages.
- **Lanyards and rope grabs:** They should be attached to a strong part of the structure.
- **Connecting means:** Select and rig the connecting means in a manner that limits the user's travel to prevent exposure to fall hazards.
 - Note that when using lanyards as the connecting means, they may exceed six feet in length. The lanyard length can be adjustable or fixed as per the requirements.
- **Training:** All employees using the restraint system must be properly trained.
- **Usage:** The system is intended to prevent falls, not to arrest them. It should only be used on flat or low-sloped surfaces.
- **Inspection:** The fall protection restraint system should be visually inspected to ensure it's working properly.

3.2.4 Positioning Device System

A positioning device system is typically intended to hold a person in a particular position, with a given limited range of movement, all while keeping tension on the line. It must be set up so that an employee cannot free fall more than two feet.

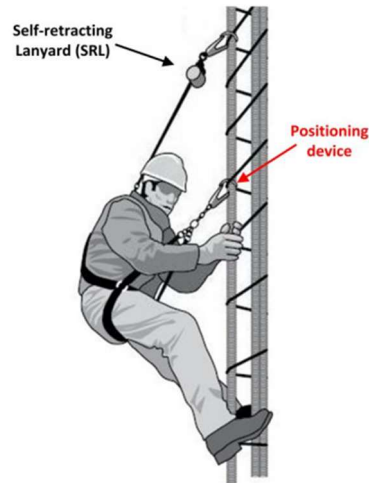
A positioning system utilizes some of the same equipment as a fall restraint system. It includes an anchor point, connectors, and body belt or full-body harness and allows work to be done on

a vertical surface while keeping both hands free. However, when used alone, a positioning system does not function as a fall protection system; therefore, an additional fall protection system, such as a Personal Fall Arrest System, must be used in conjunction. Below are requirements and tips for using a positioning device system.

- **Connector materials:** Connectors should be made from materials like steel and have a finish that resists rust.
- **Connectors:** Connecting assemblies should be able to support at least 5,000 pounds. Proof-test them to make sure they can withstand at least 3,600 pounds without cracking, breaking, or deforming.
- **Snaphook safety:** Only locking snaphooks should be used to prevent accidental disconnection. Snaphooks should not connect directly to webbing, rope, wire rope, other snaphooks, dee-rings with another snaphook attached, HLLs, or incompatibly shaped objects.
- **Anchorage:** The anchors used to attach the positioning devices should support at least 3,000 pounds or at least twice the potential impact load of an employee's fall, whichever is greater.
- **Lanyard:** The positioning device system should use an adjustable locking lanyard.
- **Body belts and harnesses:** These should be used to keep employees safe, not for lifting.
- **Usage:** The system should only be used vertically and should ensure that employees remain secure when working above lower levels.
- **Attachment:** Attachment points should be used in accordance with the manufacturer's instructions.
- **Rescue plan:** The Rescue Plan form should be completed and given to the fire department.
- **Inspections:** The positioning device system should be inspected for wear, damage, or other problems before use. Faulty parts should be removed.

The image below shows an example of a positioning device system used with a self-retracting lanyard (SRL).

Image 1 Positioning Device System

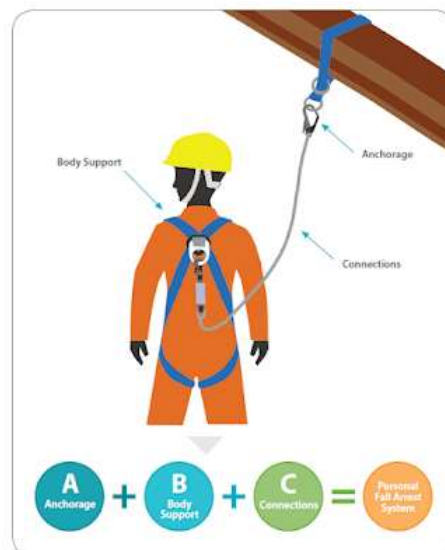


*Source: osha.oregon.gov

3.2.5 Personal Fall Arrest System

When there is a risk of falling that cannot be removed through the methods previously discussed, then a Personal Fall Arrest System (PFAS) should be used to stop falls. This system includes anchorage, body support (such as a full-body harness), and connectors. Refer to the image below for a visual on the components of a PFAS.

Image 2 Personal Fall Arrest System



*Source: firehse.com

The selection of personal fall protection equipment should be based on the type of work being performed, work environment, worker characteristics (e.g., weight, size, shape),

type/position/location of the anchorage, as well as the required length and type of connecting means needed for the work activity.

When using a PFAS, ensure the following specifications:

- **Standards:** All personal fall protection systems must adhere to ANSI/ASSP Z359 standards, with newly purchased equipment meeting the latest ANSI/ASSP standards. Further requirements for fall protection equipment, including PFAS, are published in EM 385-1-1 and 29 CFR 1910 and 1926. Refer to USACE's [Appendix A](#) (2012) for a Fall Protection Comparison Between OSHA Standards and EM 385-1-1.
 - Equipment manufactured to ANSI/ASSP Z359.1 prior to 2007 is not authorized on USACE project sites.
- **Connector materials:** Connectors should be made from materials like steel and have a finish that resists rust.
- **Dee-rings and snaphooks:** Dee-rings and snaphooks should be able to support at least 5,000 pounds. Proof-test them to withstand at least 3,600 pounds without cracking, breaking, or deforming.
 - **Snaphook safety:** Only locking snaphooks should be used to prevent accidental disconnection. Snaphooks should not connect directly to webbing, rope, wire rope, other snaphooks, dee-rings with another snaphook attached, HLLs, or incompatibly shaped objects.
- **Anchorage:** Anchorages should be able to support at least 5,000 pounds or be certified by a QP and maintain a safety factor of at least two.
 - Those used for attaching the PFAS must be independent of any anchorage used to support or suspend platforms.
 - Electric conduits, utility pipes, ductwork, or unstable points should not be utilized as anchorages for personal fall protection systems.
 - It is forbidden to attach more than one connecting means (i.e., worker) to an anchorage connector unless it is specifically designed and designated for such use by a QP or the manufacturer.
- **Horizontal lifelines:** HLLs and anchors should be designed under the supervision of a Qualified Person (QP), maintaining a safety factor of at least two.
 - All HLL anchorages must be designed by a registered professional engineer who is trained and qualified in designing HLL systems.
 - The CP may supervise the assembly, disassembly, use, and inspection of HLL systems if approved by and under the direction of the QP.
- **Vertical lifelines:**
 - Vertical lifelines with a breaking strength of at least 5,000 pounds should be utilized.
 - Each employee should be attached to a separate lifeline.
- **Single anchor lifelines:**
 - Single anchor lifelines must be strong, with a minimum tensile strength of 5,000 pounds.
 - Single anchor lifelines should only be connected to single overhead anchorages.

- Each worker must have their own lifeline system.
 - Single anchor lifelines can be used horizontally, vertically, and on slopes.
- **Ropes and straps:** Ropes and straps should be made from synthetic fibers.
- **Self-retracting lifelines and lanyards:** Self-retracting lifelines and lanyards designed to limit free fall to two feet or less should support at least 3,000 pounds, and those not designed to limit free fall to two feet should support at least 5,000 pounds.
 - Lanyards should be energy-absorbing.
 - They may be single lanyards or double-leg lanyards (“Y” lanyards).
 - The maximum length must never exceed 6 feet.
 - The free fall distance must be a maximum of 6 feet (when the anchor point is above the dorsal dee-ring) or a maximum of 12 feet (when the anchor point is below the dorsal dee-ring).
- **Fall arresters:** Fall arresters (rope grabs) for single anchor lifelines or ladder climbing devices must have a minimum ultimate strength of 3,600 pounds. Automatic fall arresters should be used.
- **Full-body harness:** Usage of a body belt as part of a PFAS is prohibited— a body belt is only acceptable in a positioning device system. The use of a full-body harness is required for PFAS.
 - The full-body harness must permanently incorporate a dorsal attachment element (dee-ring) positioned at the wearer’s upper back between the shoulder blades. This dorsal dee-ring may be used for travel restraint and rescue.
 - It may contain various items, but it must include the following elements:
 - A load-bearing sub-pelvic strap
 - A waist belt, back strap, or another means to control the separation of the shoulder straps on the back
 - It must be equipped with suspension trauma preventers (e.g., stirrups, relief steps) to provide short-term relief from the effects of suspension trauma.
 - Each harness must have at least one fall-arrest indicator and at least one lanyard parking attachment element with a disengagement load of not more than 120 pounds.
- **Attachment:** PFAS components should not be attached to guardrail systems or hoists.
- **Training:** All users should be trained thoroughly.
- **Usage:** PFAS components should be used only for employee protection, not for hoisting materials.
- **Certification:** PFAS are certified for users weighing 130 to 310 pounds, including their weight, equipment, and tools.
 - Do not exceed the weight limit of 310 pounds unless the manufacturer approves it in writing.
 - If a worker weighs less than 130 pounds, use a specially designed harness and energy-absorbing lanyard.
- **Rescue plan:** The Rescue Plan form should be completed and given to the fire department before starting the activity.

- **Inspections:** The positioning device system should be inspected for wear, damage, or other problems before use. Defective parts should be removed from service.
- **Annual inspection:** A CP should inspect the system annually.

In addition, a PFAS should meet the following performance requirements:

- **Arresting force:** The maximum arresting force on an employee should be limited to 900 pounds when used with a body belt (attached at the center of the wearer's back) and 1,800 pounds when used with a body harness (attached at the center of the wearer's back near shoulder level or above the head).
- **Free fall:** Employees should be prevented from free falling more than six feet or hitting any lower level below—stop workers within 3.5 feet.
- **Impact energy:** PFAS devices should be capable of withstanding twice the potential impact energy of a six-foot free fall (or other permitted free fall distance).

By following these requirements, employers can ensure the safety of workers when using a PFAS.