1.0 Walking-Working Surfaces and Fall Protection

It is common to think that falls may only be a concern in industries such as construction, where employees may fall from roofs or scaffolds. However, falls can *and* do occur in any industry. Employees fall downstairs, slip down ramps, fall through openings, and even trip and fall in offices. Tasks at an elevated height or other tasks that place employees at risk for a fall of some kind exist in *any* workplace environment. The task could be as simple as climbing a step ladder to change a light bulb, or as complex as operating an industrial powered platform to wash windows on a high-rise building. Falls are actually among the leading causes of serious work-related injuries. These injuries include not only cuts and bruises, but also broken bones, back injuries, sprains, strains, and even death. In fact, slips, trips, and falls cause more than 15% of all deaths in the workplace, with only motorized vehicle accidents and workplace violence accounting for more workplace deaths. Sadly, more than half of fatal falls come from heights of less than 20 feet.

Employers are responsible to take measures in their workplaces to prevent falls not only from the same level working surface, such as slips and trips, but also falls from heights, like falls from elevated workstations. OSHA regulations actually cover *all* walking-working surfaces, including floors, stairs, roofs, ladders, ramps, scaffolds, elevated walkways, and fall protection systems, otherwise referred to as any “horizontal and vertical” surface.

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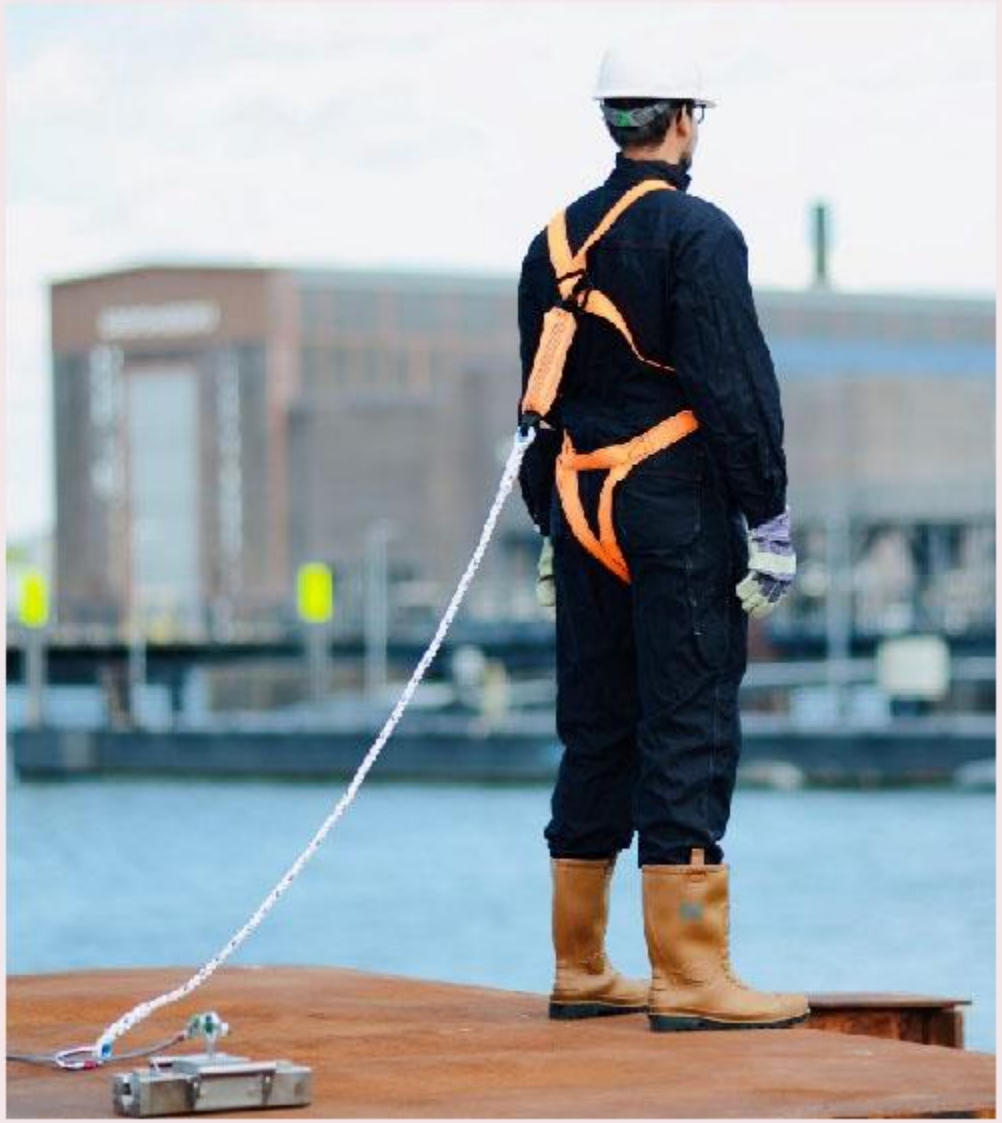
1.1.1 Fall Elements



The optimum approach in reducing the impact on an employee's body in a workplace fall utilizing these elements is to limit the distance of the fall and to utilize personal fall arrest systems appropriate to the work activity. Obviously, if an employee is exposed to fall hazards, it is certainly best to provide support programs that encourage them to maintain a healthy weight, ensuring that their exposure to a dangerous impact is minimized.

With this, it becomes increasingly obvious that in order for any fall protection to be effective, it should be planned and incorporated into the day-to-day activities at a workplace, providing continuous and complete protection without interfering with the work to be performed. Fall protection includes the elimination of fall hazards, the prevention of falls, and the control of falls. Of equal concern is the hazard of falling objects, since working on the lower level of a work area can be just as dangerous as working above the ground if the employees above are not performing their tasks in a safe manner.

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1.2 Significance to an Employer

The Bureau of Labor Statistics estimates that, on average, over 200,000 serious injuries and approximately 800 fatalities occur every year among employees who are directly affected by injuries associated with falls. Serious injuries and fatalities caused by falls in any industry can result in both direct and indirect costs for an employer. Direct costs may include medical bills and workers' compensation costs, while indirect costs include such expenses as loss of productivity with days of restricted activity, retraining, absenteeism due to days away from work, turnover for those that never recover from their injuries, and ongoing employee health and welfare costs. Preventing and controlling fall hazards in the workplace may end up costing an employer only a fraction of these otherwise significant direct and indirect costs. As with most injuries, falls are preventable, and it is an employer's responsibilityto ensure a fall protection plan is in place for every type of possible hazard to ensure the safety and health of workplace employees.

1.3 Standards and Regulations

When you learn that falls are, historically, the leading cause of fatalities in the construction industry, the reason for Fall Protection regulations becomes self-evident. But in addition to the direct effect of a hazard on a worker, the costs associated with workplace injury, including workers' compensation payments, can be among the most devastating to an employer's bottom line. These things come together to emphasize the need to prevent falls before they happen. These specific requirements and tools to reduce the risks that come with working at elevated heights.

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1.3.1 Occupational Health and Safety Administrations (OSHA)

As the OSHA General Duty Clause states, an employer is required to provide their employees with a place of employment that “is free from recognizable hazards that are causing or likely to cause death or serious harm to employees”. The OSHA standards relative to fall protection describe the employer’s duty to provide fall protection, set the criteria and practices for fall protection systems, and require appropriate employee training regarding job hazards and the proper use of personal protective equipment in the promotion of fall protection.

The OSHA standards, Walking-Working Surfaces (29 CFR, 1910 Subpart D) and Personal Fall Protection Systems (29 CFR, 190.140 Subpart I) have been updated to better protect employees in general industry from fall hazards, clarifying the requirements and adding important regulations for training and inspection requirements. Since these updates harmonize general industry requirements with OSHA's existing construction industry standards and many ANSI standards, the updates allow for ease in compliance, particularly for those employers who perform both types of activities. Recognizing that all OSHA standards only offer a minimum level of protection, NASP recommends that an employer consider the adoption of the optimum protection level that best promotes the safety and health of their workplace employees.

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1.3.1 Occupational Health and Safety Administrations (OSHA)

While the standard now affects a wide range of employees engaged in a variety of occupations, from painters to warehouse employees, it does not change construction industry or other related standards relative to falls. Such general industry organizations as building management services, utilities, warehousing, retail, window cleaning, chimney sweeping, and outdoor advertising are covered. The updates are intended to be more straightforward and simpler for employers to follow. For example, the standards:

- Provide compliance flexibility by increasing the fall protection options employers may use.
- Provide greater consistency between OSHA's general industry and construction standards.
- Incorporate advances in technology, industry best practices, and national consensus standards, providing employers with effective and cost-efficient measures to protect their employees.
- Replace outdated specification requirements with performance-based language and criteria, providing greater flexibility.

This course incorporates need-to-know information from the OSHA standard on Walking-Working Surfaces (Course Sections 2 and 3), which includes not only requirements relative to certain surfaces, but also specific information on fall protection devices. Additionally, the course reviews data on Personal Fall Protection Systems (Course Section 4), which is a subcategory under the general industry Personal Protective Equipment standard.

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1.3.2 The American National Standards Institute (ANSI)

OSHA recognizes that organizations such as ANSI which publish national consensus standards play an important role in the development of safety and health standards. OSHA maintains a cooperative working arrangement with ANSI which conducts extensive relating to the promotion of the safety and health of the employee. ANSI has published over 25 consensus standards related to safety requirements for walking-working surfaces and fall protection equipment. Examples of these standards include:

- Safety Requirements for Workplace Walking/Working Surface and their Access, (ANSI/ASSP A1264) which sets forth safety requirements for dangerous areas in which employees or objects fall through floor or wall openings, platforms, runways, ramps, and fixed stairs in all types of conditions.

- Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components, (ANSI/ASSP Z359.1) which establishes requirements for the performance, design, marking, qualification, instruction, training, inspection, use maintenance and removal from service of a variety of protective equipment.

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1.4 Hazard Assessment, Control Measures, and Fall Protection Plan

Whether on a rooftop, an aircraft fuselage, tanker truck, rail car, or above ground storage tank, employees need a safe method to gain access to and from elevated work areas and conduct their work at height. Fall protection in all workplaces requires solutions that are dependable and OSHA compliant.

A critical first step to preventing injury from falls is an analysis of the work at height to identify hazards and how, why, when and where workers are exposed to risk. In this section, we will discuss how hazard assessments, proper control measures, and a thorough Fall Protection Plan are effective solutions for protecting workers.

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1.4.1 Hazard Assessment

Most injuries can be avoided by effective fall prevention or fall protection measures. Gathering statistics can play an important role in the development of a fall protection plan, as this data may provide useful information about the types of workplace falls that have occurred, when they occurred and how they occurred, as well as information about the types and severity of any injuries that are inflicted from falls. By utilizing statistics, an employer may be able to better predict when and where falls may occur so that fall protection efforts may then be focused on those key areas of the workplace.

HAZARD RISK ASSESSMENT MATRIX

Frequency of Occurrence	Hazard Categories			
	1 Catastrophic	2 Critical	3 Serious	4 Minor
(A) Frequent	1A	2A	3A	4A
(B) Probable	1B	2B	3B	4B
(C) Occasional	1C	2C	3C	4C
(D) Remote	1D	2D	3D	4D
(E) Improbable	1E	2E	3E	4E

Unacceptable High Medium Low

Click Box

1.4.1 Hazard Assessment

Analysis of this type of data may reveal surprising information. The following statistics from BLS break down this type of information relative to fall injuries in a variety of situations across industries:

- 28% of the injuries occurred while employees were **climbing up or down** from an elevated position or location
- 17% occurred when **loading and unloading** material
- 13% were involved in **operating, repairing, cleaning, or installing** equipment
- 11% of falls were only **stepping** from one surface to another
- 10% were **moving backwards** while performing a task
- Another 13% were simply **walking!**

1.4.1 Hazard Assessment

The first step in this process is the development of a thorough hazard assessment to identify the hazards that exist or have the potential to exist. A comprehensive assessment of the facility can help to eliminate fall hazards since alternative approaches to performing work activities can be identified. Given that some hazards are not as apparent as others, a complete assessment that evaluates the type of work performed will allow for a recognition of the hazards such that control measures can be taken to reduce the risk of injury. Some suggested questions regarding the conditions and behaviors to consider include:

- How will employees get *to and from* the work area?
- What are the hazards *below* the work area?
- How *high* is the work area?
- Are there *holes or openings* below or around the work area?
- Are there *slip or trip* hazards around the work area?
- How difficult is it to *rescue* someone if they fall?

Consideration should be given to the use of important tools such as Job Hazard Analyses and workplace surveys and inspections. Together, this information can assist the safety manager in collecting data to assess the hazards in their workplaces.

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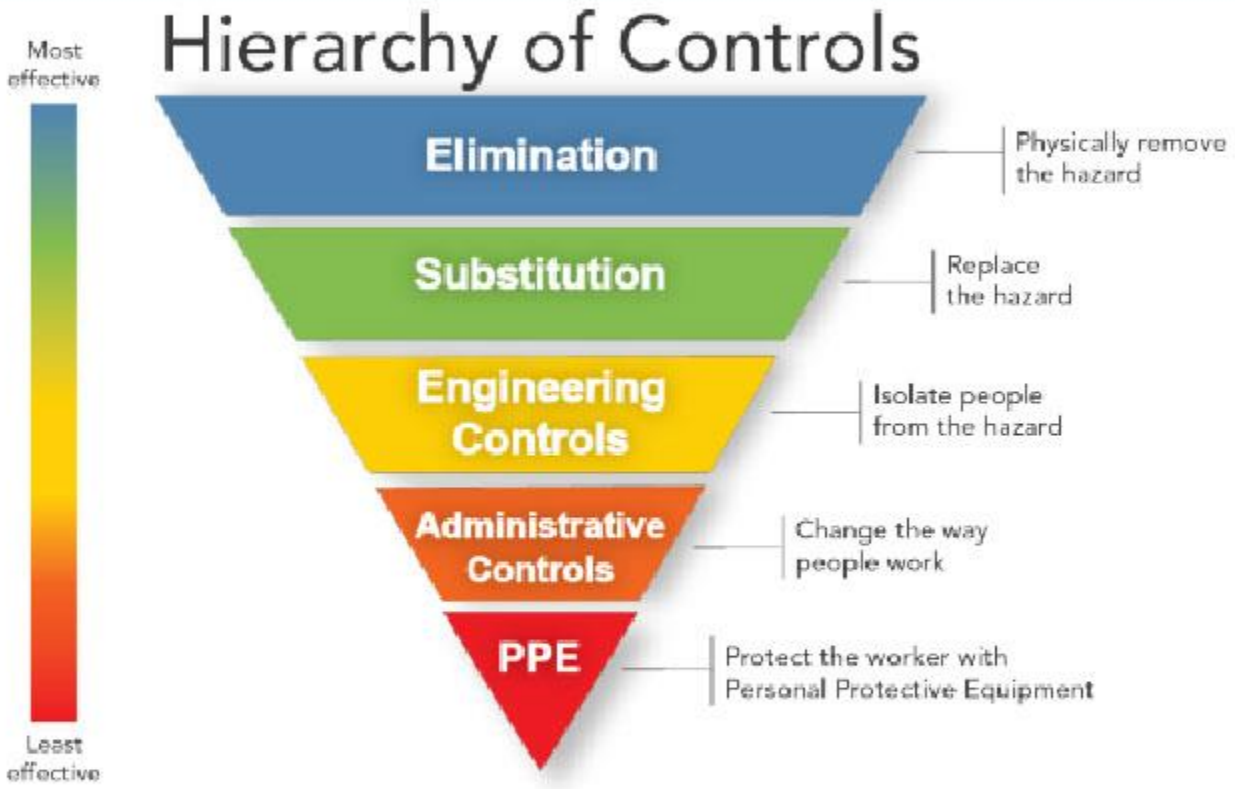
1.4.2 Control Measures



Once the assessment is completed, the next step is to evaluate and implement appropriate control measures that address the hazards. Effective controls protect employees from workplace hazards, help avoid injuries, minimize, or eliminate risks, and assist employers in providing safe and healthful working conditions. The appropriate selection of effective control measures should be according to the established "hierarchy of controls," which emphasizes engineering solutions (including elimination or substitution) to be considered first, followed by administrative controls that include safe work practices, and finally personal protective equipment.

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1.4.2 Control Measures

Hazard Elimination

Eliminating fall hazards altogether is the first and best line of defense against fall injuries. To effectively eliminate a fall hazard, the safety manager must determine employee exposure (when, why, where, and how), which is typically very specific to each workplace. This type of control measure considers the avoidance of working at heights whenever possible and/or the location of the work area and equipment in safe areas where there is no risk of a possible fall. This step will include an evaluation of the actual need to use such items as platforms, lifts, scaffolding, and ladders in the workplace. As an example, an employer might build a safe working platform rather than to have to purchase and maintain fall arrest equipment. By complete elimination of a hazard, an employer can significantly reduce the risk for a fall injury, particularly from heights.

1.4.2 Control Measures

Administrative Controls

Administrative controls are much less effective in the prevention of hazards since they are changes in the way people work and altering behavior patterns is difficult at best. This type of control does not remove the hazard but attempts to limit or prevent the exposure to it. Examples include, fall protection plans, reducing the hazard exposure time by rotating employees in and out of hazardous height conditions, as well as the installation of warning signs and placards reminding employees of proper safety procedures.

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1.4.2 Control Measures

For walking-working surfaces, the hazards can be numerous. Slip hazards are wet, greasy, or slick floor surfaces, slippery shoe soles, weather hazards such as ice or snow, broken floor surfaces, and loose rugs or floor mats. Trip hazards are objects left in walkways, wrinkled, or upturned mats, loose or exposed cords, drawers or cabinets left open, uneven walking surfaces, walking with an obstructed view, and dim or overly bright lighting. One of the most effective administrative controls to address these hazards is good housekeeping practices to prevent slips, trips, and falls on walking-working surfaces.

The controlling of falls at the workplace is the last and least effective form of fall protection. This is because it assumes that a fall has already occurred, and it merely intends to reduce the overall risk of injury from the fall. This form of fall protection should only be considered after it has been determined that the fall hazards cannot be eliminated, or the possibility of the fall prevented. Controlling falls in the workplace involves the use of safety nets and fall arrest equipment, such as harnesses, lanyards, and lifelines.

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1.4.2 Control Measures

Prior to the consideration of personal protective equipment, consideration should be made to the elements discussed earlier regarding the free fall distance and the maximum arresting force, as well as the anchorage point strength and location. For the prevention of injury as a result of falls from heights, the following personal protective equipment should be considered:

- Full Body Harness
- Energy Absorbing Lanyard
- Self-Retracting Lanyard
- Connectors
- Ladder Climbing Devices
- Vertical Lifeline
- Horizontal Lifeline

1.4.2 Control Measures

The goal with falls from heights is to minimize the free fall distance to reduce the arresting force on impact. Approved fall protection equipment has specific design and performance requirements, most established by ANSI. When inspecting personal protective equipment on a regular basis and prior to use, the employer must look for signs of wear or deterioration, cut or frayed edges, broken stitches, distorted snap hooks, loose or damaged parts, and alterations or additions which might affect its efficiency. This type of protective equipment requires additional training for those that are users of the equipment.

For falls resulting from slips or trips, appropriate footwear should be considered. Shoes that fit well, that are comfortable, and that have soles that provide good traction are important in the prevention of injury on walking-working surfaces.

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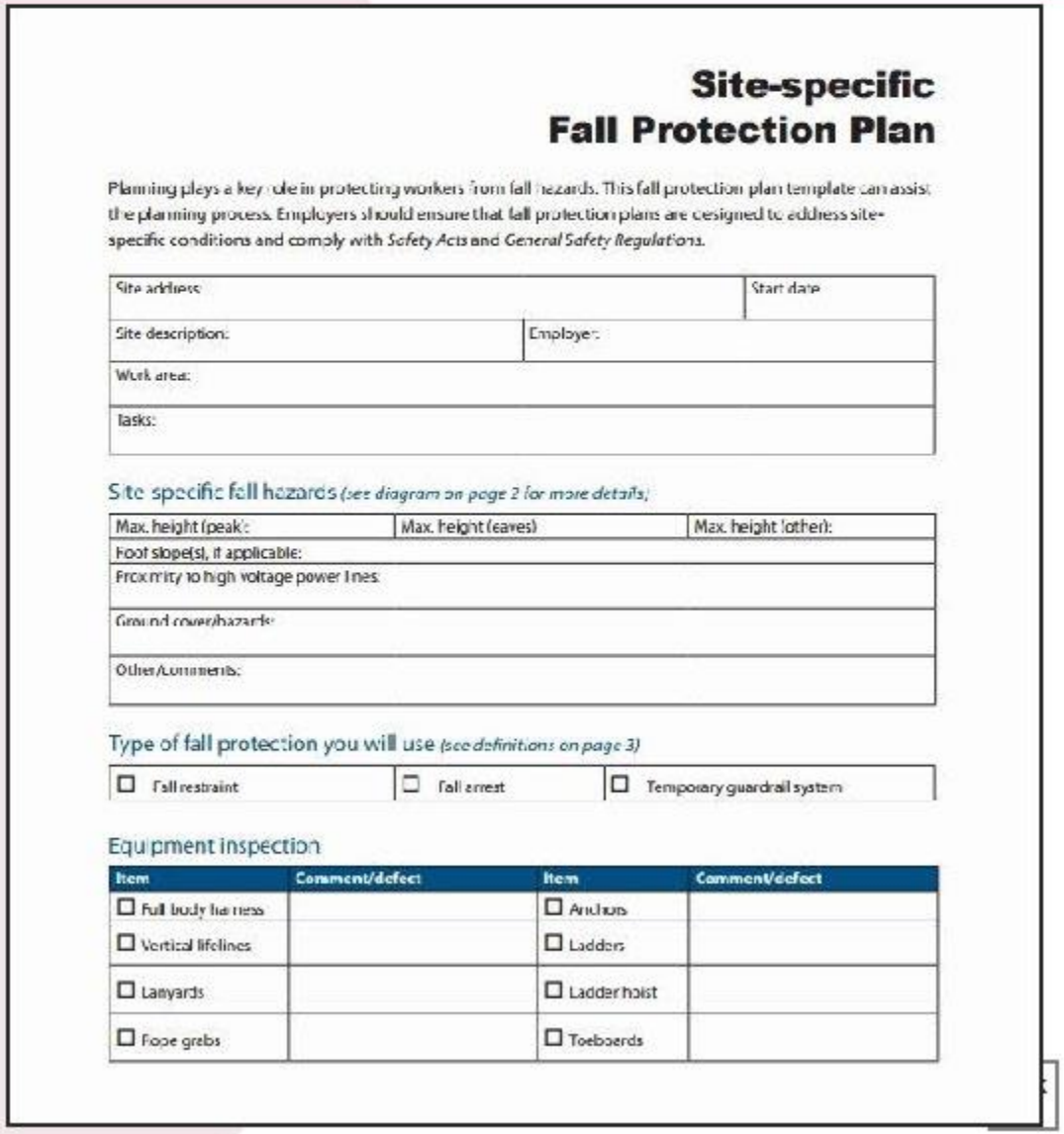
1.4.3 Fall Protection Plan

After performing a workplace assessment and evaluating control measures, a fall protection plan should be developed by the safety manager or other qualified personnel at the location that documents the hazard assessment process and identifies:

- The workplace conditions that require fall protection.
- The activities and procedures to be performed by employees involved in hazardous work.
- Environmental factors and hazards that employees may encounter during work activities at the workplace.
- The control measures taken to address the hazards to include policies and procedures, as well as the selection and use of personal protective equipment.
- The employee training program relative to the prevention of falls and fall protection.



Site-specific
Fall Protection Plan

Planning plays a key role in protecting workers from fall hazards. This fall protection plan template can assist the planning process. Employers should ensure that fall protection plans are designed to address site-specific conditions and comply with *Safety Acts* and *General Safety Regulations*.

Site address:		Start date:
Site description:	Employer:	
Work area:		
Tasks:		

Site specific fall hazards *(see diagram on page 2 for more details)*

Max. height (peak):	Max. height (eaves)	Max. height (other):
Roof slope(s), if applicable:		
Proximity to high voltage power lines:		
Ground cover/hazards:		
Other/Comments:		

Type of fall protection you will use *(see definitions on page 3)*

☐ Fall restraint	☐ Fall arrest	☐ Temporary guardrail system

Equipment inspection

Item	Comment/defect	Item	Comment/defect
☐ Full body harness		☐ Anchors	
☐ Vertical lifelines		☐ Ladders	
☐ Lanyards		☐ Ladder hoist	
☐ Rope grabs		☐ Toeboards	

1.4.3 Fall Protection Plan

As with any safety plan, the fall protection plan should be updated regularly. Given its unique specifications, it is to be developed specifically for the job site where the work is to be performed, and available at the job site for all those participating in the work activities. And while OSHA does not specifically state that the plan must be written, NASP recommends having all of these elements in writing for obvious reasons. Lastly, it is recommended that the plan provides for the investigation of the circumstances of any fall or other serious incident that occurs in the workplace to determine whether the employer needs to consider revisions to the fall protection plan.

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2.0 Walking-Working Surfaces Regulations

The OSHA regulation, Walking-Working Surfaces, is comprehensive, addressing a multitude of fall hazards from heights and walking-working surfaces, given that these risks are one of the leading causes of serious workplace injuries and deaths. The information in this section reviews the general requirements as published in the subpart, as well as very specific requirements relative to such items as ladders, stairways and scaffolds.

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2.1 General Requirements

First thing's first: What exactly is a walking-working surface? OSHA defines it in 29 CFR 1910.21 as "any horizontal or vertical surface on or through which an employee walks, works, or gains access to a work area or workplace location."

Accordingly, the standard offers requirements for ensuring clean, accessible working conditions. Where hazards are unavoidable, OSHA offers requirements for mitigating those risks. The standard covers all general industry walking-working surfaces, including floors, ladders, stairways, runways, dockboards, roofs, scaffolding, and walkways. To protect workers from hazards associated with these surfaces, particularly hazards related to falls from elevations. We will discuss the regulation in more depth in the following sections:

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2.1.1 Surface Conditions

Some of the most frequently-cited violations in this regulation involve housekeeping. As an administrative control measure, it is critical that those who are responsible for housekeeping in the work area understand how they may influence the risk for injury. All workplaces, passageways, storerooms, service rooms and walking-working surfaces are to be kept in a clean, orderly, and sanitary condition.

Floors should be maintained in a dry condition and where wet processes are used, drainage should be maintained with such considerations as grating, mats or raised platforms. Floors should also be kept free from protruding nails, splinters, holes, or loose boards.

Another area often forgotten are aisles and passageways, which should be kept clear and in good repair with no obstruction across or in aisle ways that could create a hazard. Where permanent aisles and passageways exist, they should be marked appropriately. When mobile mechanical equipment is used, aisles should be sufficiently wide, typically, at least a foot of extra clearance. So, if a forklift is three feet wide, the aisle should be at least four feet wide. Improper aisle widths can create an opportunity for injury, damage to equipment and limit egress in emergencies, especially when coupled with poor housekeeping and congestive traffic.

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2.1.2 Loads

It is critical for an employer to ensure that each walking-working surface is capable of supporting the maximum intended load for that surface. This load capacity element is crucial during the planning phase of a work area, particularly when working with heights such as scaffolding and platforms. In addition to walking-working surfaces, all storage areas must be load rated as well.

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2.1.3 Access and Egress

Not only is an employer to provide a safe means of access and egress to and from walking- working surfaces, but also to ensure that each employee utilizes these safe means in their performance of the job duties. OSHA requires a minimum width of 28” of clearance between any given point in a workplace and the exit. A pathway that is clear of obstructions that could impede exit in an emergency situation. It is common for an employee who may be in a hurry to take a shortcut, creating the potential for an exposure to a fall.

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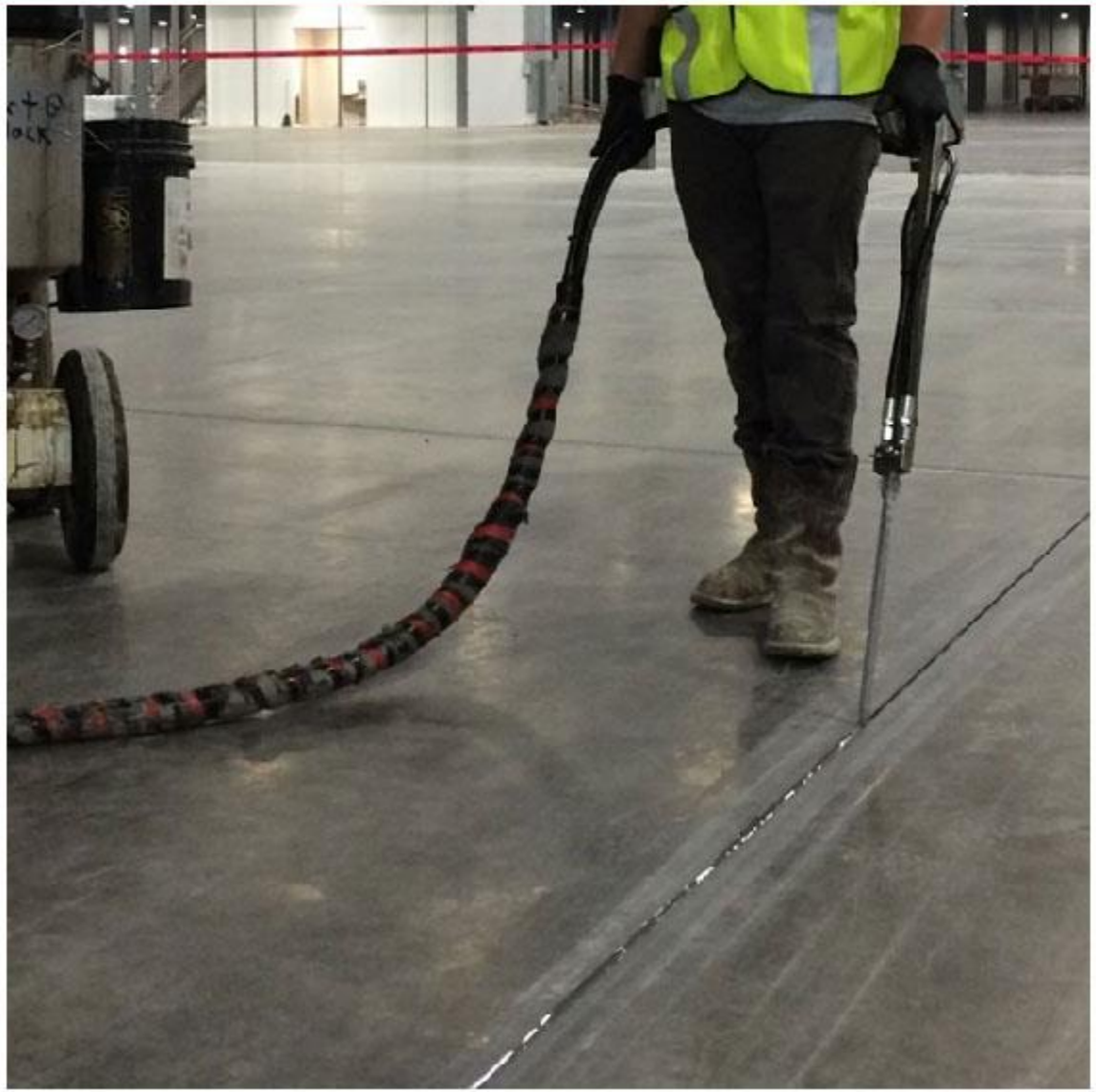
2.1.4 Inspection, Maintenance, and Repair



All walking-working surfaces are to be inspected regularly and as needed. Surfaces are also to be maintained in a safe condition. When a hazardous condition on a surface is corrected or repaired, it must be done so prior to employee use of the surface. If the correction or repair cannot be made immediately, the hazard must be guarded to prevent employees from using the surface until the hazard is addressed. Whenever any correction or repair involves the structural integrity of the surface, a qualified person is to perform or supervise the correction or repair.

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2.2 Ladders

A *ladder* is a device with rungs, steps, or cleats used to gain access to a different elevation. Injuries from falls associated with ladders are very common. For this reason, there are numerous requirements related to ladders for which an employer must be familiar. The ladder requirements in the standard do not apply to ladders used in emergency operations such as firefighting and rescue or ladders that are an integral part of or designed into a machine or piece of equipment.

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2.2 Ladders

General requirements for all ladders include the following:

- Ladder rungs, steps, and cleats are to be parallel, level, and uniformly spaced when the ladder is in position for use
- Steps on stepstools are spaced not less than 8 inches apart and not more than 12 inches apart, as measured at the centerlines
- Ladder rungs, steps, and cleats have a minimum clear width of 11.5 inches on **portable** ladders and 16 inches for **fixed** ladders, except that:
  - The minimum clear width does not apply to ladders with narrow rungs that are not designed to be stepped on, such as those located on the tapered end of a ladder
  - Rungs and steps of manhole entry ladders that are supported by the manhole opening must have a minimum clear width of 9 inches
  - Stepstools have a minimum clear width of 10.5 inches

Click Box

2.2 Ladders

- Wooden ladders are not coated with any material that may obscure structural defects
- Metal ladders are made with corrosion-resistant material or protected against corrosion
- Ladder surfaces are free of puncture and laceration hazards
- Ladder rungs and steps in elevator shafts and telecommunications towers must meet specific requirements, given their awkward positioning for the task at hand

Ladders are to be used only for the purposes for which they were designed and, in general, must be capable of supporting their maximum intended load. They should be inspected before initial use in each work shift, and more frequently as necessary, to identify any visible defects that could cause employee injury. Any ladder with structural or other defects is to be immediately tagged, "Dangerous: Do Not Use" or with similar language and removed from service until repaired or replaced.

When an employee utilizes a ladder, it is important that they face the ladder when climbing up or down it and use at least one hand to grasp the ladder. At no time should an employee carry an object or load that could cause them to lose their balance and fall while climbing up or down the ladder.

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2.2.1 Portable Ladders

A *portable ladder* is a ladder that can readily be moved or carried, and usually consists of side rails joined at intervals by steps, rungs, or cleats. They can be self-supporting or lean against a supporting structure. Specific requirements of a portable ladder include:

- Each stepladder or combination ladder used in a stepladder mode is to be equipped with a metal spreader or locking device that securely holds the front and back sections in an open position while the ladder is in use.
- Ladders are not to be loaded beyond the maximum intended load, defined as the total load of the employee and all tools, equipment, and materials being carried.
- Ladders are used only on stable and level surfaces unless they are secured or stabilized to prevent accidental displacement.
- The cap and/or top step of a stepladder are not to be used as steps.
- The top of a non-self-supporting ladder is placed so that both side rails are supported unless the ladder is equipped with a single support attachment.
- Rungs and steps of portable metal ladders are corrugated, knurled, dimpled, coated with skid-resistant material, or otherwise treated to minimize the possibility of slipping.

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2.2.1 Portable Ladders

- When a portable ladder is positioned against a wall or other surface, the ladder feet should be placed a distance from the wall equal to one fourth of the working length of the ladder, between the foot and top support. This is referred to as a 4:1 ratio; one foot away from the wall or structure for every four feet of length of the ladder.

- Portable ladders used to gain access to an upper landing surface should have side rails that extend at least three (3) feet above the upper landing surface.

Click Box

2.2.1 Portable Ladders

Portable ladders used on slippery surfaces are to be secured and stabilized and are not to be moved, shifted, or extended while an employee is working on them. Ladders placed in locations such as passageways, doorways, or driveways where they can be displaced by other activities or traffic are to be secured to prevent accidental displacement, and they are also to be guarded by a temporary barricade, such as a row of traffic cones or caution tape, to keep the activities or traffic away from the ladder. Ladders and ladder sections are not to be tied or fastened together to provide added length unless they are specifically designed to do so. Lastly, portable ladders are not to be placed on boxes, barrels, or other unstable bases to obtain additional height, given that this common practice creates significant risk for injury to the employee utilizing the ladder.

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2.2.2 Fixed Ladders

A *fixed ladder* is a ladder with rails or individual rungs that is permanently attached to a structure, building, or equipment. Fixed ladders include individual-rung ladders, but not ship stairs, step bolts, or manhole steps.

Specific requirements for fixed ladders include:

- Fixed ladders are to be capable of supporting their maximum intended load.
- The minimum perpendicular distance from the centerline of the steps or rungs, or grab bars, or both, to the nearest permanent object in back of the ladder is 7 inches except for elevator pit ladders, which have a minimum perpendicular distance of 4.5 inches.
- Grab bars should extend 42 inches above the access level or landing platforms served by the ladder, but do not protrude on the climbing side beyond the rungs of the ladder that they serve. The minimum size of grab bars is to be the same size as the rungs of the ladder.

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2.2.2 Fixed Ladders

- The side rails of through or sidestep ladders is to extend 42 inches above the top of the access level or landing platform served by the ladder. For parapet ladders, the access level should be either the roof, if the parapet is cut to permit passage through the parapet, or the top of the parapet, if the parapet is continuous.
- For through ladders, the steps or rungs are omitted from the extensions, and the side rails are flared to provide not less than 24 inches and not more than 30 inches of clearance. When a ladder safety system is provided, the maximum clearance between side rails of the extension must not exceed 36 inches.
- For side-step ladders, the side rails, rungs, and steps must be continuous in the extension.
- When a fixed ladder terminates at a hatch, the hatch cover should open with sufficient clearance to provide easy access to or from the ladder. Also, the cover should open at least 70 degrees from horizontal if the hatch is counterbalanced.
- Fixed ladders having a pitch greater than 90 degrees from the horizontal are not to be used in any circumstance.

2.2.2 Fixed Ladders

- The step-across distance from the centerline of the rungs or steps is:
  - For through ladders, not less than 7 inches and not more than 12 inches to the nearest edge of the structure, building, or equipment accessed from the ladders.
  - For side-step ladders, not less than 15 inches and not more than 20 inches to the access points of the platform edge.

- Fixed ladders that do not have cages or wells must have a clear width of at least 15 inches on each side of the ladder centerline to the nearest permanent object and a minimum perpendicular distance of 30 inches from the centerline of the steps or rungs to the nearest object on the climbing side.

It is important to note that the standard establishes an employer's duty to provide fall protection for employees on fixed ladders and specifies the criteria for fall protection systems for fixed ladders. These topics are reviewed in the Section 3 of the topic.

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2.2.3 Mobile Ladder Stands and Mobile Ladder Stand Platforms

A *mobile ladder* stand is a mobile, fixed-height, self-supporting ladder that usually consists of wheels or casters on a rigid base and steps leading to a top step. A mobile ladder stand also may have handrails and is designed for use by *one* employee at a time. The associated *platform* is a mobile, fixed-height, self-supporting unit having one or more standing platforms that are provided with means of access or egress.

General requirement considerations include:

- Mobile ladder stands and platforms have a step width of at least 16 inches.
- The steps and platforms of mobile ladder stands and platforms are to be slip resistant. The surface is to be either an integral part of the design and construction, or provided as a secondary process or operation, such as a coating or durable slip-resistant tapes.
- Mobile ladder stands and platforms are to be capable of supporting at least four times their maximum intended load, while wheels or casters under load are capable of supporting their proportional share of four times the maximum intended load, plus their proportional share of the unit's weight.

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2.2.3 Mobile Ladder Stands and Mobile Ladder Stand Platforms

- Mobile ladder stands and platforms with a top step height of 4 feet or above are to have handrails with a vertical height of 29.5 to 37 inches, measured from the front edge of a step. Removable gates or non-rigid members, such as chains, may be used instead of handrails in special-use applications.

- The maximum work-surface height of mobile ladder stands and platforms is not to exceed four times the shortest base dimension, without additional support.

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2.2.3 Mobile Ladder Stands and Mobile Ladder Stand Platforms

Key to the use of a mobile ladder stand that has wheels or casters is that they are equipped with a system to impede horizontal movement when an employee is on the stand or platform in order to minimize the risk of injury.

Several design requirements specific to mobile ladder stands and platforms include:

Ladder Stands

- Steps are uniformly spaced and arranged, with a rise of not more than 10 inches and a depth of not less than 7 inches. The slope of the step stringer to which the steps are attached must not be more than 60 degrees, measured from the horizontal.
- Mobile ladder stands with a top step height above 10 feet have the top step protected on three sides by a handrail with a vertical height of at least 36 inches and top steps that are 20 inches or more, front to back, have a midrail and toeboard. The standing area of mobile ladder stands is within the base frame.

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2.2.3 Mobile Ladder Stands and Mobile Ladder Stand Platforms

Platforms

- Steps of mobile ladder stand platforms meet the same requirements as ladder stands. When an employer demonstrates that the requirement is not feasible, steeper slopes or vertical rung ladders may be used, provided the units are stabilized to prevent overturning.

- Mobile ladder stand platforms with a platform height of 4 to 10 feet have, in the platform area, handrails with a vertical height of at least 36 inches along with midrails.

- All ladder stand platforms with a platform height above 10 feet have guardrails and toeboards on the exposed sides and ends of the platform.

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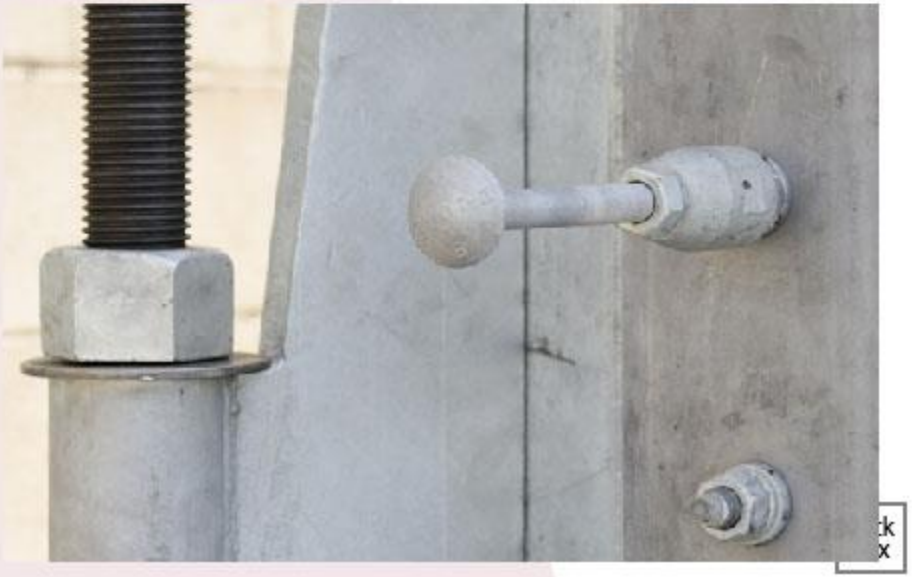
2.3 Step Bolts

A step bolt is a bolt or rung attached at intervals along a structural member used for foot placement and as a handhold when climbing or standing. With the use of step bolts, requirements include:

- Each step bolt is designed, constructed, and maintained to prevent the employee's foot from slipping off the end of the step bolt.
- Step bolts are uniformly spaced at a vertical distance of not less than 12 inches and not more than 18 inches apart, measured center to center. The spacing from the entry and exit surface to the first step bolt may differ from the spacing between the other step bolts.
- Each step bolt has a minimum clear width of 4.5 inches.



2.3 Step Bolts

- The minimum perpendicular distance between the centerline of each step bolt to the nearest permanent object in back of the step bolt is 7 inches.
- Each step bolt installed before January 17, 2017 is capable of supporting its maximum intended load, while each step bolt installed on or after January 17, 2017 is capable of supporting at least four times its maximum intended load.
- Each step bolt installed on or after January 17, 2017 in an environment where corrosion may occur is to be constructed of, or coated with, material that protects against corrosion.

Step bolts are to be inspected at the start of the work shift and maintained accordingly. Any step bolt that is bent more than 15 degrees from the perpendicular in any direction is to be removed and replaced with a step bolt that meets these requirements before an employee uses it.

2.4 Manhole Steps

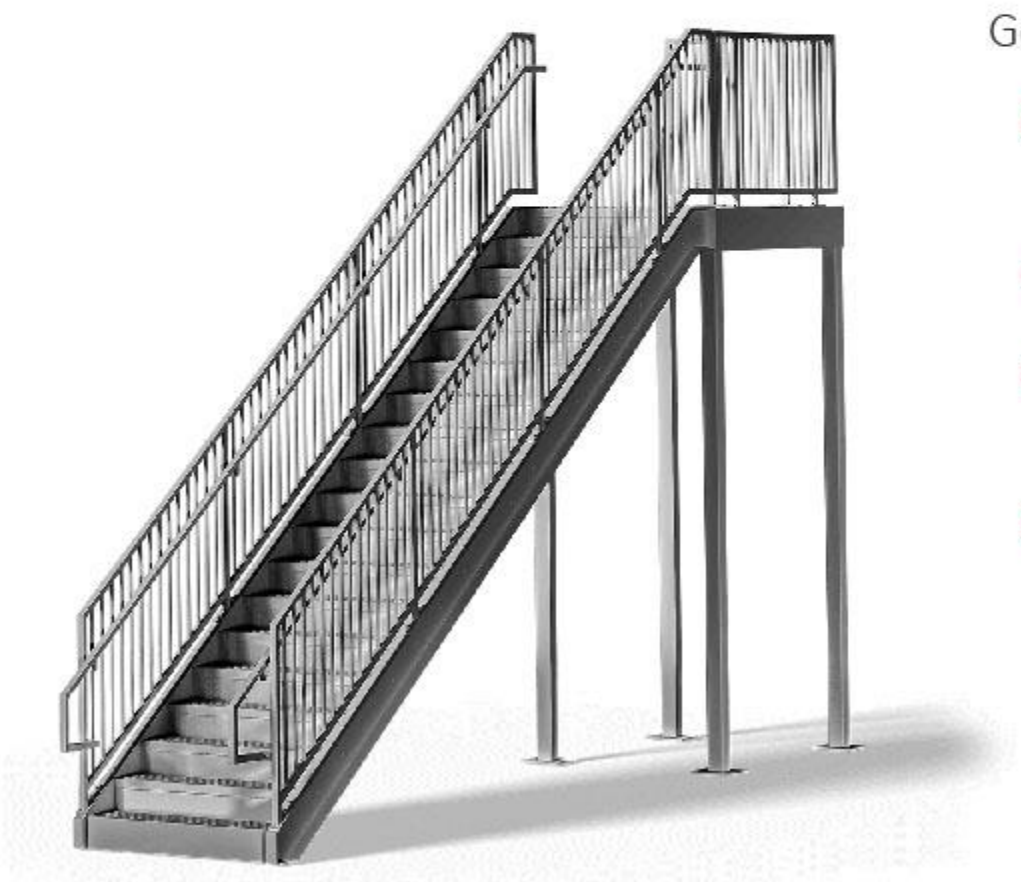
Manhole steps are steps that are individually attached to, or set into, the wall of a manhole structure. An employer must ensure that each manhole step is capable of supporting its maximum intended load and is inspected at the start of the work shift and maintained accordingly. After January 17, 2017, an employer must ensure that each manhole step installed:

- Has a minimum clear step width of 10 inches.
- Is uniformly spaced at a vertical distance not more than 16 inches, measured center to center between steps. The spacing from the entry and exit surface to the first manhole step may differ from the spacing between the other steps.
- Has a minimum perpendicular distance between the centerline of the manhole step to the nearest permanent object in back of the step of at least 4.5 inches.
- Is constructed of, or coated with, material that protects against corrosion if the manhole step is located in an environment where corrosion may occur.

Manhole steps must be designed, constructed, and maintained to prevent the employee's foot from slipping or sliding off the end. The steps are to have a corrugated, knurled, dimpled, or other surface that minimizes the possibility of an employee slipping.

2.5 Stairways

Stairways are risers and treads that connect one level with another and includes any landings and platforms in between those levels. This section covers all stairways (including standard, spiral, ship, and alternating tread-type stairs), except for stairs serving floating roof tanks, stairs on scaffolds, stairs designed into machines or equipment, and stairs on self-propelled motorized equipment.



General requirements include:

- Vertical clearance above any stair tread to any overhead obstruction is to be at least 7 feet as measured from the leading edge of the tread.
- Stairs have uniform riser heights and tread depths between landings.
- Stairway landings and platforms are at least the width of the stair and at least 30 inches in depth, as measured in the direction of travel.
- When a door or a gate opens directly on a stairway, a platform is provided, and the swing of the door or gate does not reduce the platform's effective usable depth to less than 20 inches for platforms installed before January 17, 2017 and less than 22 inches for platforms installed on or after January 17, 2017.

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2.5 Stairways

Standard stairs, as described below, are used to provide access from one walking-working surface to another when operations necessitate regular and routine travel between levels, including access to operating platforms for equipment. Winding stairways are used on tanks and similar round structures when the diameter of the tank or structure is at least 5 feet. Spiral, ship, or alternating tread-type stairs are only to be used when the employer can demonstrate that it is not feasible to provide standard stairs. When the use of spiral, ship, or alternating tread-type stairs is allowed, they are to be installed, used, and maintained in accordance with manufacturer's instructions.

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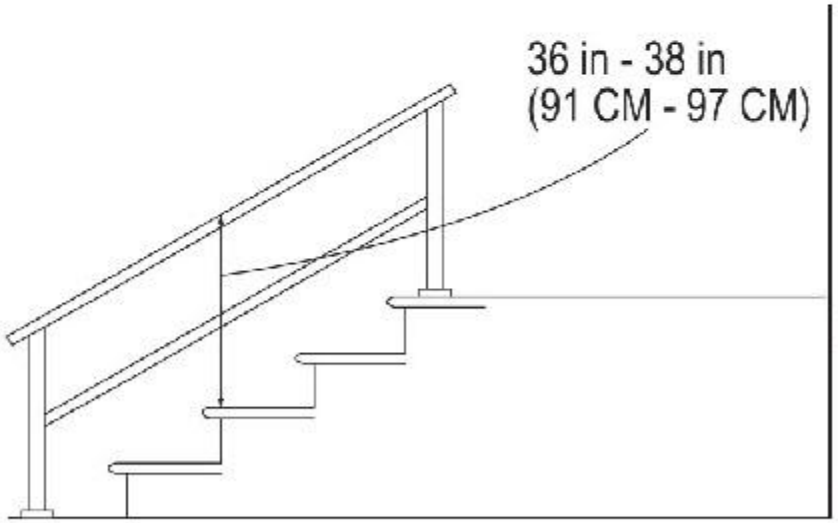
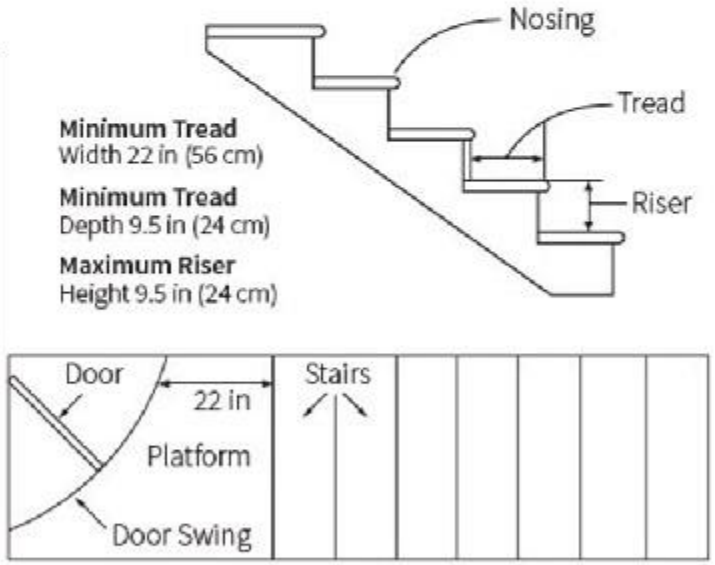
2.5.1 Standard Stairs

In addition to the general requirements stated on the previous slides, standard stairs requirements include:

- Installation at angles between 30 to 50 degrees from the horizontal
- Maximum riser height of 9.5 inches, a minimum tread depth of 9.5 inches and a minimum width of 22 inches between vertical barriers





Exceptions to the above height and depth are for those standard stairs that were installed prior to January 17, 2017. Those stairs will meet compliance if they meet the dimension requirements specified in Table D-1 that appears in the standard OR they use a combination that achieves the angle requirements listed above.

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2.5.2 Spiral Stairs, Ship Stairs, and Alternating Tread-type Stairs

Angle	Type
≤ 30º	Ramps
30º – 50º	Standard Stairs
50º – 70º	Ship Stairs
50º – 70º	Alternating Tread-Type Stairs
60º – 90º	Ladders

With each of these special types of stairs, the standard depicts varying angle degrees that are required, given the space in which they may be confined. Also depicted are the various depth, width and riser dimensions that are required for each. For further details about these specific types of stairs, refer to the standard.

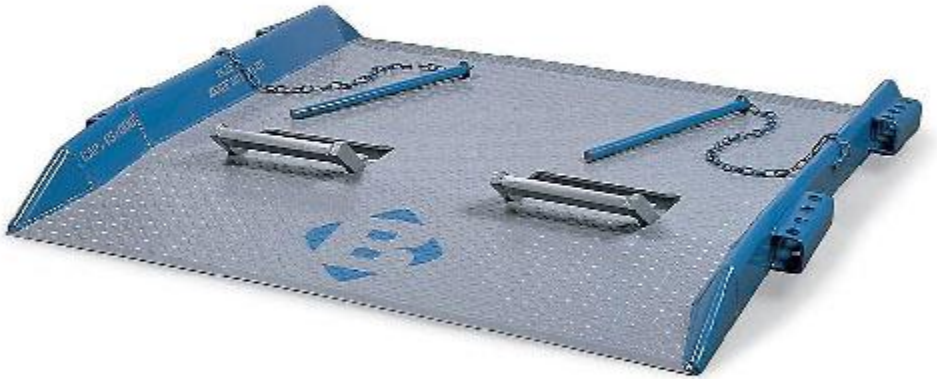
Click Box

2.6 Dockboards

A dockboard is a portable or fixed device that spans a gap or compensates for a difference in elevation between a loading platform and a transport vehicle. Dockboards include, but are not limited to, bridge plates, dock plates, and dock levelers. An employer must ensure that dockboards are capable of supporting the maximum intended load. Dockboards put into initial service after January 17, 2017 are to be designed, constructed, and maintained to prevent transfer vehicles (e.g., forklifts or pallet jacks) from running off the dockboard edge unless an employer can demonstrate that there is no potential hazard of this occurring.

Other requirements of an employer include:

- Portable dockboards are to be secured by anchoring them in place or using equipment or devices that prevent the dockboard from moving out of a safe position. An exception to this would be if sufficient contact is made between the dockboard and the surface to prevent the dockboard from moving out of a safe position.
- Measures, such as wheel chocks or sand shoes, are used to prevent the transport vehicle such as a truck or trailer on which a dockboard is placed, from moving while employees are on the dockboard.
- Portable dockboards are equipped with handholds or other means to permit the safe handling of dockboards.



2.7 Scaffolds and Rope Descent Systems

In a Bureau of Labor and Statistics (BLS) study, 72% of workers injured in scaffold accidents attributed the accident either to the planking or support giving way, or to the employee slipping or being struck by a falling object. Scaffolds are integral to the construction industry with approximately 65% of the workforce involved in work from scaffolds. When used properly, scaffolds can save significant time and money.

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2.7.1 Scaffolds

A scaffold is any temporary elevated or suspended platform and its supporting structure used to support employees, equipment, materials, and other items. There are two basic types of scaffolds:

1. Supported scaffolds, which consist of one or more platforms supported by rigid, load-bearing members, such as poles, legs, frames, or outriggers

2. Suspended scaffolds, which are one or more platforms suspended by ropes or other non-rigid, overhead support

2.7.1 Scaffolds

Other types of equipment, such as scissor lifts and aerial lifts, are often regarded as additional types of supported scaffolds.

Scaffolds used in general industry must meet the construction industry requirements in the standard, Scaffolds (29 CFR part 1926, subpart L). This construction standard depicts requirements associated with the capacity, its construction, basic criteria that is to be followed for supported and suspended scaffolds, access to the scaffold, the use of scaffolds, fall protection, and falling object protection. Given its length and specificity, the following is a synopsis of the major requirements applicable to general industry. For specific details regarding the requirements, the standard should be referenced.

- The footing or anchorage for scaffolds must be sound, rigid and capable of carrying the maximum intended load without settling or displacement. Unstable objects, such as barrels, boxes, loose brick, or concrete blocks are not to be used to support scaffolds or planks.

- Scaffolds and their components must be capable of supporting at least four times the maximum intended load.

2.7.1 Scaffolds

- Scaffolds are to be maintained in a safe condition and shall not be altered or moved horizontally while they are in use. Damaged or weakened scaffolds must be immediately repaired and not be used until repairs have been completed.
- A safe means is to be provided to gain access to the working platform level through the use of a ladder or ramp.
- Overhead protection should be provided for personnel on a scaffold exposed to overhead hazards.
- Guardrails, midrails, and toeboards are to be installed on all open sides and ends of platforms more than 10 feet above the ground or floor. Wire mesh should be installed between the toeboard and the guardrail along the entire opening, where employees are required to work or pass under the scaffolds.

Given the potential hazards, employees are not to work on scaffolds during storms or high winds or when covered with ice or snow.

2.7.2 Rope Descent Systems

A *rope descent system (RDS)* is a suspension system that allows an employee to descend in a controlled manner and, as needed, stop at any point during the descent to perform work. An RDS usually consists of a roof anchorage, support rope, descent device, carabiners or shackles, and chair (seatboard).

2.7.2 Rope Descent Systems

Anchorages

An anchorage is a secure point of attachment for equipment such as lifelines, lanyards, deceleration devices, and rope descent systems. Before any rope descent system is used, the building owner should inform the employer in writing that the building owner has identified, tested, certified, and maintained each anchorage such that it is capable of supporting at least 5,000 pounds, in any direction, for each employee attached. The information must be based on an annual inspection by a qualified person, with certification of each anchorage by this qualified person, at least every 10 years (typically, a Professional Engineer).

The employer should also ensure that no employee uses any anchorage before the employer has obtained this written information from the building owner that each anchorage meets the requirements of this standard. It is also important that the employer retain this information for the duration of any work associated with an anchorage.

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2.7.2 Rope Descent Systems

Use of Rope Descent Systems

Given the dangerous hazards and risks associated with descent from elevated heights, requirements for the use of a rope descent system include:

- No RDS is to be used for heights greater than 300 feet above grade unless the employer demonstrates that it is not feasible to access such heights by any other means or that those means pose a greater hazard than using a RDS.
- The RDS is to be used in accordance with instructions, warnings, and design limitations set by the manufacturer or under the direction of a qualified person.
- The RDS is to be inspected at the start of each shift, ensuring that damaged or defective equipment is removed from service immediately.
- The RDS has the proper rigging, including anchorages and tiebacks, with particular emphasis on providing tiebacks when counterweights, cornice hooks, or similar non-permanent anchorages are used.

2.7.2 Rope Descent Systems

- All components of each RDS, except seat boards, are to be capable of sustaining a minimum rated load of 5,000 pounds. Seat boards should be capable of supporting a live load of 300 pounds.
- Stabilization is to be provided at the specific work location when descents are greater than 130 feet.
- The ropes should be effectively padded or otherwise protected, where they can contact edges of the building, anchorage, obstructions, or other surfaces, to prevent them from being cut or weakened. They should also be protected from exposure to open flames, hot work, corrosive chemicals, and other destructive conditions.

An employer is to ensure that each employee who uses an RDS receives training and secures the appropriate tools to prevent them from falling. Each employee is to use a separate, independent personal fall arrest system. Rope descent systems are not to be used when hazardous weather conditions, such as storms or gusty or excessive wind, are present. Equipment, such as tools, squeegees, or buckets, are to be secured by a tool lanyard or similar method to prevent it from falling below. Lastly, an employer is to provide prompt rescue of each employee in the event of a fall.

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3.0 Fall Protection and Falling Object Protection

Fall protection is defined as any means used to protect workers from falls during work in areas where fall hazards exist. Fall protection is essentially a system that protects an employee, who could lose their balance at a given height, from falling to a lower level resulting in injury. Fall protection involves the elimination of fall hazards, the prevention of falls, and the control of falls. An effective fall protection plan should provide continuous and complete protection without interfering with the work activities to be performed.

Under this standard, an employer is required to provide protection for each employee exposed to fall and falling object hazards. The standard requires an employer to protect their employees from fall hazards along unprotected sides or edges that are at least 4 feet above a lower level. It also sets requirements for fall protection in specific situations, such as hoist areas, runways, areas above dangerous equipment, wall openings, repair pits, stairways, scaffolds, and other platforms.

3.1 General Duty

Employees in general industry perform work on scaffolds, climb up and down ladders, walk on stairs, work in areas where there may be holes in the floor or work on elevated floors which have unprotected sides and edges. These workers often need fall protection, and training in how to use it. The key to protecting employees in these situations is to use the right type of fall protection systems or equipment.

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3.1.1 Unprotected Sides and Edges

It is an employer's duty to ensure that each employee on a walking-working surface with an unprotected side or edge that is 4 feet or more above a lower level is protected from falling by one or more of the following:

- A guardrail system
- A safety net system
- Personal fall protection systems, such as personal fall arrest, travel restraint, or positioning systems

Specific provisions are depicted in the standard for work on residential roofs and loading docks when an employer can demonstrate that it is not feasible or creates a greater hazard to use guardrail, safety net, or personal fall protection systems. Also included in the standard are general provisions for the outdoor advertising industry which are not specifically reviewed in this course.

Click Box

3.1.2 Hoist Areas

An employer has a duty to ensure that each employee in a hoist area is protected from falling 4 feet or more to a lower level by:

- A guardrail system
- A personal fall arrest system, or
- A travel restraint system

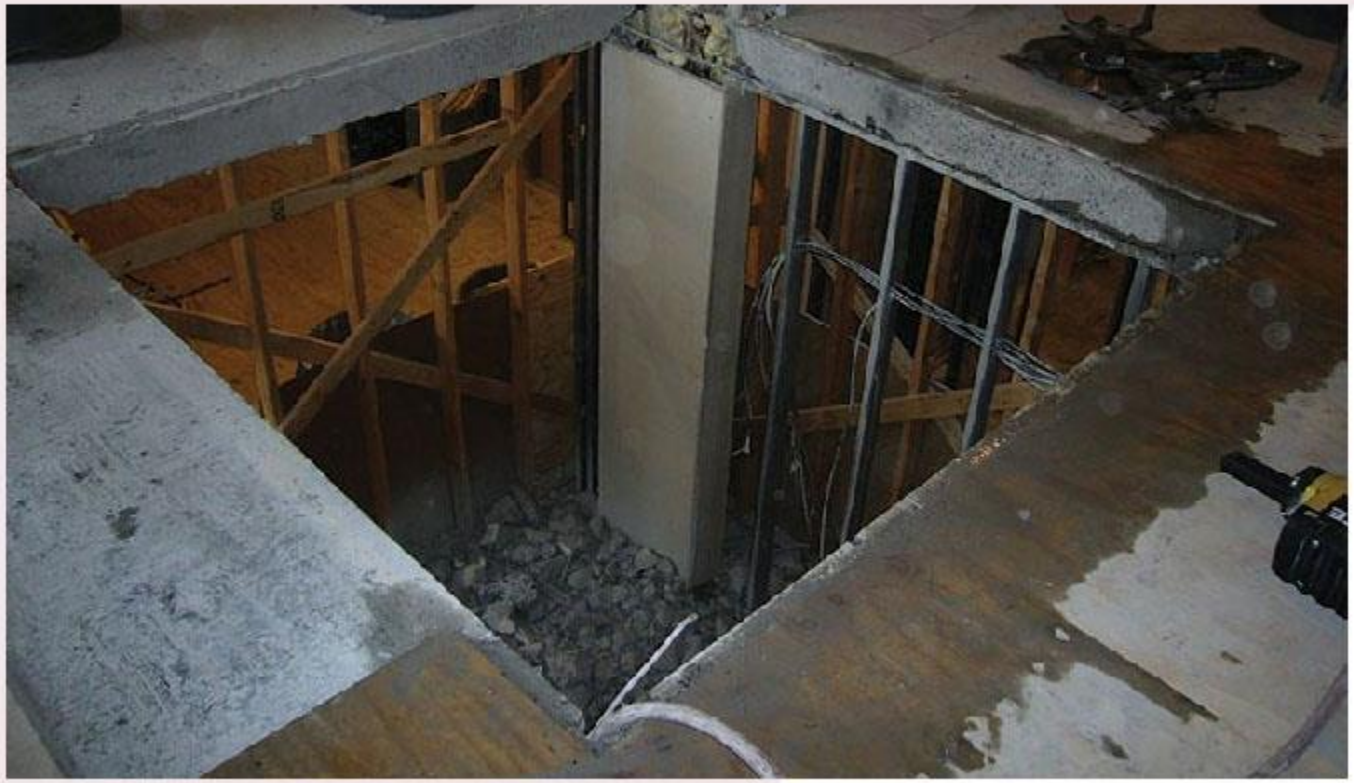
When any portion of a guardrail system, gate, or chains is removed, and an employee must lean through or over the edge of the access opening to facilitate hoisting, the employee is to be protected from falling by a personal fall arrest system. If approved grab handles are installed at hoist areas, the requirement is met.

3.1.3 Holes

An employer must ensure that each employee is protected from falling through any hole (including skylights) that is 4 feet or more above a lower level by one or more of the following:

- Covers
- Guardrail systems
- Travel restraint systems, or
- Personal fall arrest systems

Employees are to be protected from tripping into or stepping into or through any hole that is less than 4 feet above a lower level by covers or guardrail systems.



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3.1.3 Holes

It is important that employees be protected from falling into a stairway floor hole by a fixed guardrail system on all exposed sides, except at the stairway entrance. However, for any stairway used less than once per day where traffic across the stairway floor hole prevents the use of a fixed guardrail system, such as holes located in aisle spaces, the employee must be protected from falling into the hole by using an approved hinged floor hole cover and a removable guardrail system on all exposed sides, except at the entrance to the stairway.

Similarly, employees are to be protected from falling into a ladderway floor hole or ladderway platform hole by a guardrail system and toeboards erected on all exposed sides, except at the entrance to the hole, where a self-closing gate or an offset must be used.

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3.1.3 Holes

Lastly, employees are to be protected from falling through a hatchway and chute-floor hole by:

- An approved hinged floor-hole cover and a fixed guardrail system that leaves only one exposed side. When the hole is not in use, the employer must ensure the cover is closed or a removable guardrail system is provided on the exposed sides
- A removable guardrail system and toeboards on not more than two sides of the hole and a fixed guardrail system on all other exposed sides. The employer must ensure the removable guardrail system is kept in place when the hole is not in use, or
- A guardrail system or a travel restraint system when a work operation necessitates passing material through a hatchway or chute floor hole

3.1.4 Dockboards

An employer must ensure that each employee on a dockboard is protected from falling 4 feet or more to a lower level by a guardrail system or handrails. A guardrail system or handrails are not required when dockboards are being used solely for material handling operations using motorized equipment and employees engaged in these operations are not exposed to fall hazards greater than 10 feet. As always, employees are to be trained in the safe procedures associated with dockboards.

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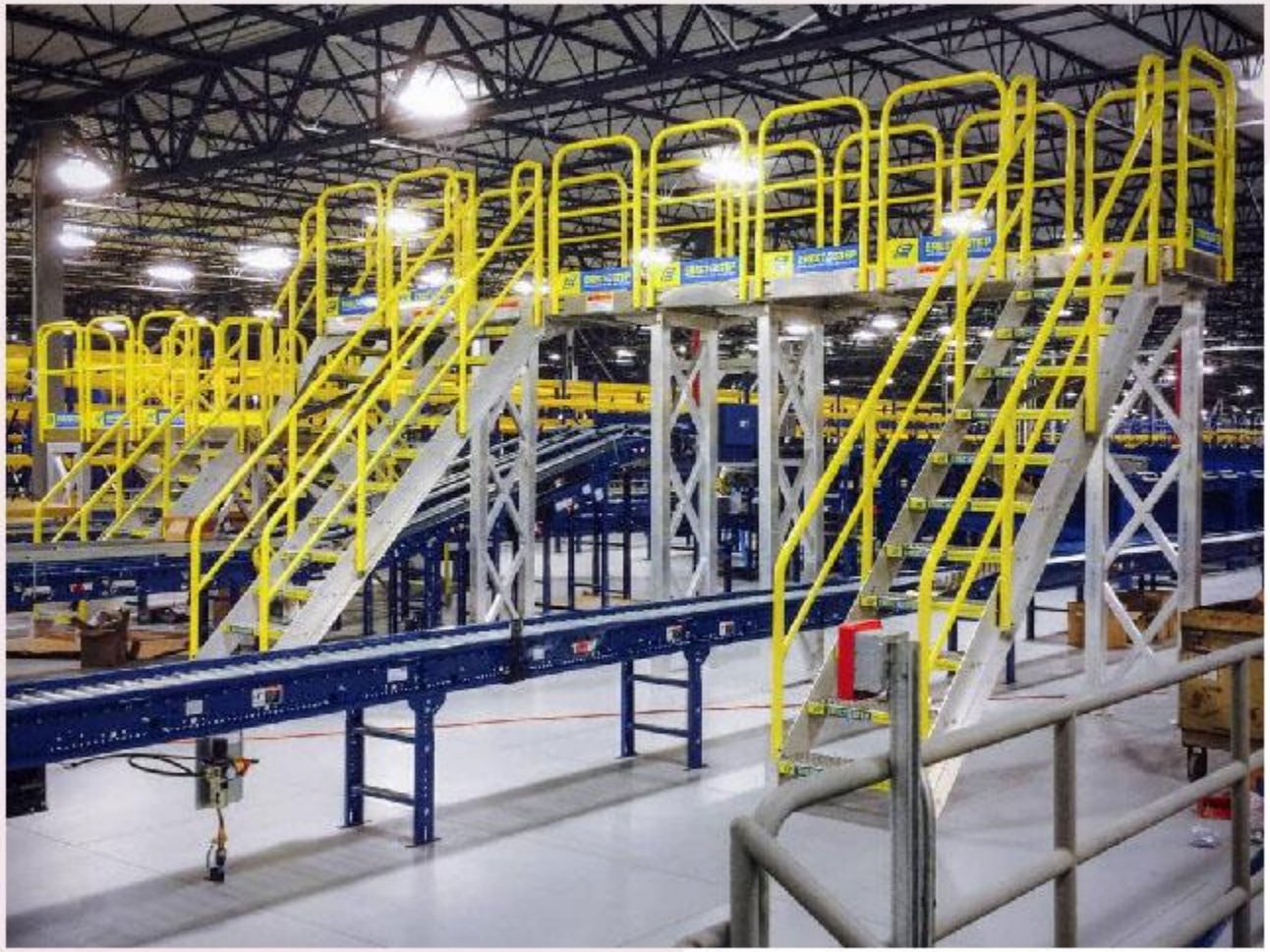
3.1.5 Runways and Similar Walkways

An employer is to ensure each employee on a runway or similar walkway is protected from falling 4 feet or more to a lower level by a guardrail system. When the employer can demonstrate that it is not feasible to have guardrails on both sides of a runway used exclusively for a special purpose, the employer may omit the guardrail on one side of the runway, provided the employer ensures that the runway is at least 18 inches wide and each employee is provided with and uses a personal fall arrest system or travel restraint system.



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3.1.6 Dangerous Equipment

An employer has a duty to ensure that each employee less than 4 feet above dangerous equipment is protected from falling into or onto the dangerous equipment by a guardrail system or a travel restraint system unless the equipment is covered or guarded to eliminate the hazard. Each employee 4 feet or more above dangerous equipment must be protected from falling by either a guardrail system, a safety net system, a travel restraint system, or a personal fall arrest system.

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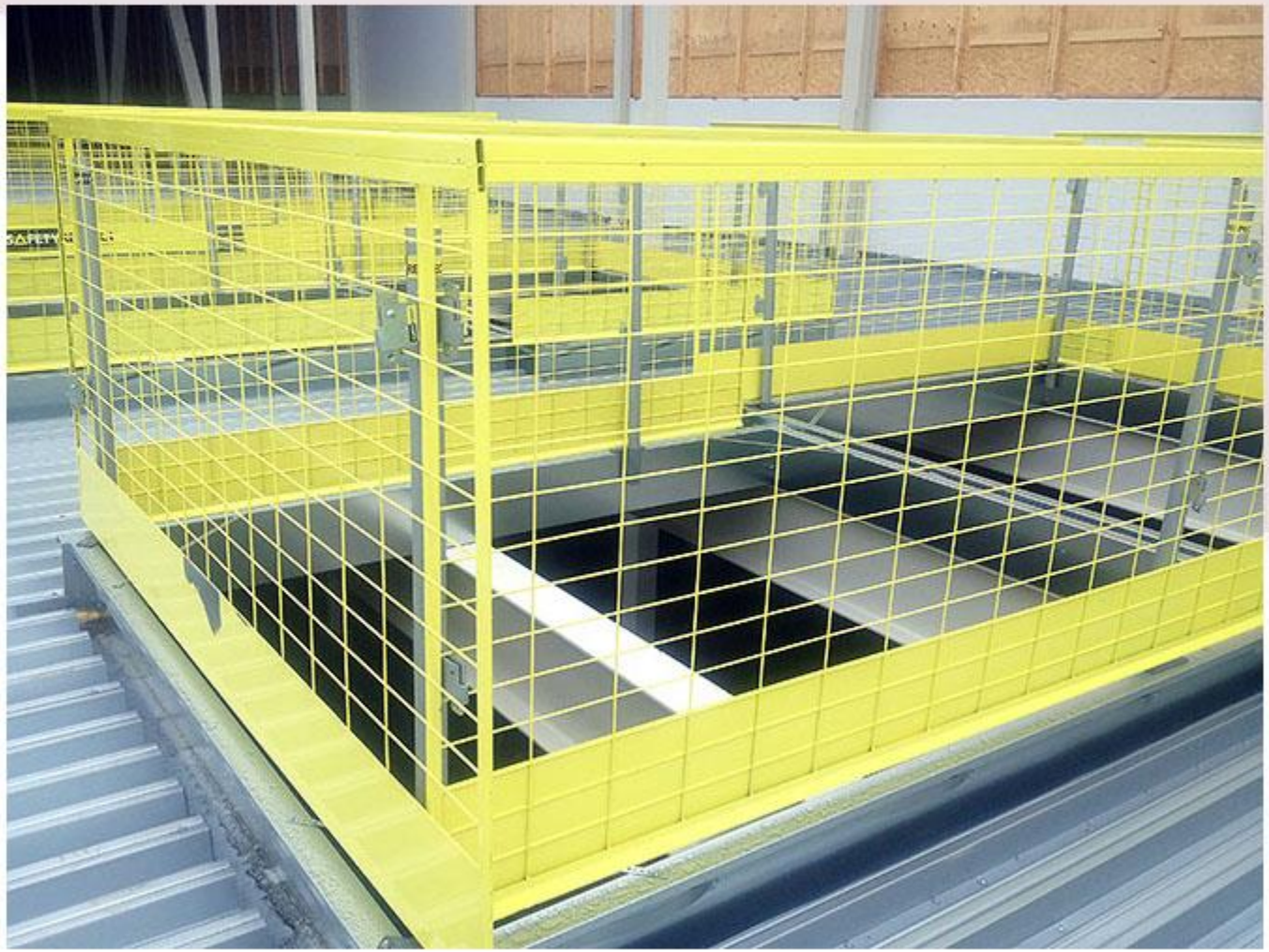
3.1.7 Openings



An employer has a duty to ensure that each employee on walking-working surfaces near an opening, including one with a chute attached, where the inside bottom edge of the opening is less than 39 inches above that surface and the outside bottom edge of the opening is 4 feet or more above a lower level is protected from falling by the use of either a guardrail system, a safety net system, a travel restraint system or a personal fall arrest system.

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3.1.8 Repair, Service, and Assembly Pits

The use of a fall protection system is not required for a repair, service, or assembly pit that is less than 10 feet deep, provided the employer:

- Limits access within 6 feet of the edge of the pit to authorized and trained employees.
- Applies floor markings at least 6 feet from the edge of the pit in colors that contrast with the surrounding area or places a warning line at least 6 feet from the edge of the pit as well as stanchions that are capable of resisting, without tipping over, a force of at least 16 pounds applied horizontally against the stanchion at a height of 30 inches.
- Places a combination of floor markings and warning lines at least 6 feet from the edge of the pit. When two or more pits in a common area are not more than 15 feet apart, the employer may comply by placing contrasting floor markings at least 6 feet from the pit edge around the entire area of the pits.
- Posts readily visible caution signs that state "Caution-Open Pit."

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3.1.9 Fixed Ladders

For fixed ladders that extend more than 24 feet above a lower level, the employer has a duty to ensure that:

- **Existing fixed ladders:** Each fixed ladder installed before November 19, 2018 is equipped with a personal fall arrest system, ladder safety system, cage, or well.
- **Newer fixed ladders:** Each fixed ladder installed on and after November 19, 2018, is equipped with a personal fall arrest system or a ladder safety system.
- **Replacement:** When a fixed ladder, cage, or well is replaced, a personal fall arrest system or ladder safety system is installed in at least that section of the fixed ladder, cage, or well where the replacement is located.

3.1.9 Fixed Ladders

On and after November 18, 2036, all fixed ladders are to be equipped with a personal fall arrest system or a ladder safety system. When a one-section fixed ladder is equipped with a personal fall protection or a ladder safety system or a fixed ladder is equipped with a personal fall arrest or ladder safety system on more than one section, the employer is to ensure:

- The personal fall arrest system or ladder safety system provides protection throughout the entire vertical distance of the ladder, including all ladder sections.
- The ladder has rest platforms provided at maximum intervals of 150 feet.
- Ladder sections having a cage or well are offset from adjacent sections and have landing platforms provided at maximum intervals of 50 feet.

The employer may use a cage or well in combination with a personal fall arrest system or ladder safety system provided that the cage or well does not interfere with the operation of the system.

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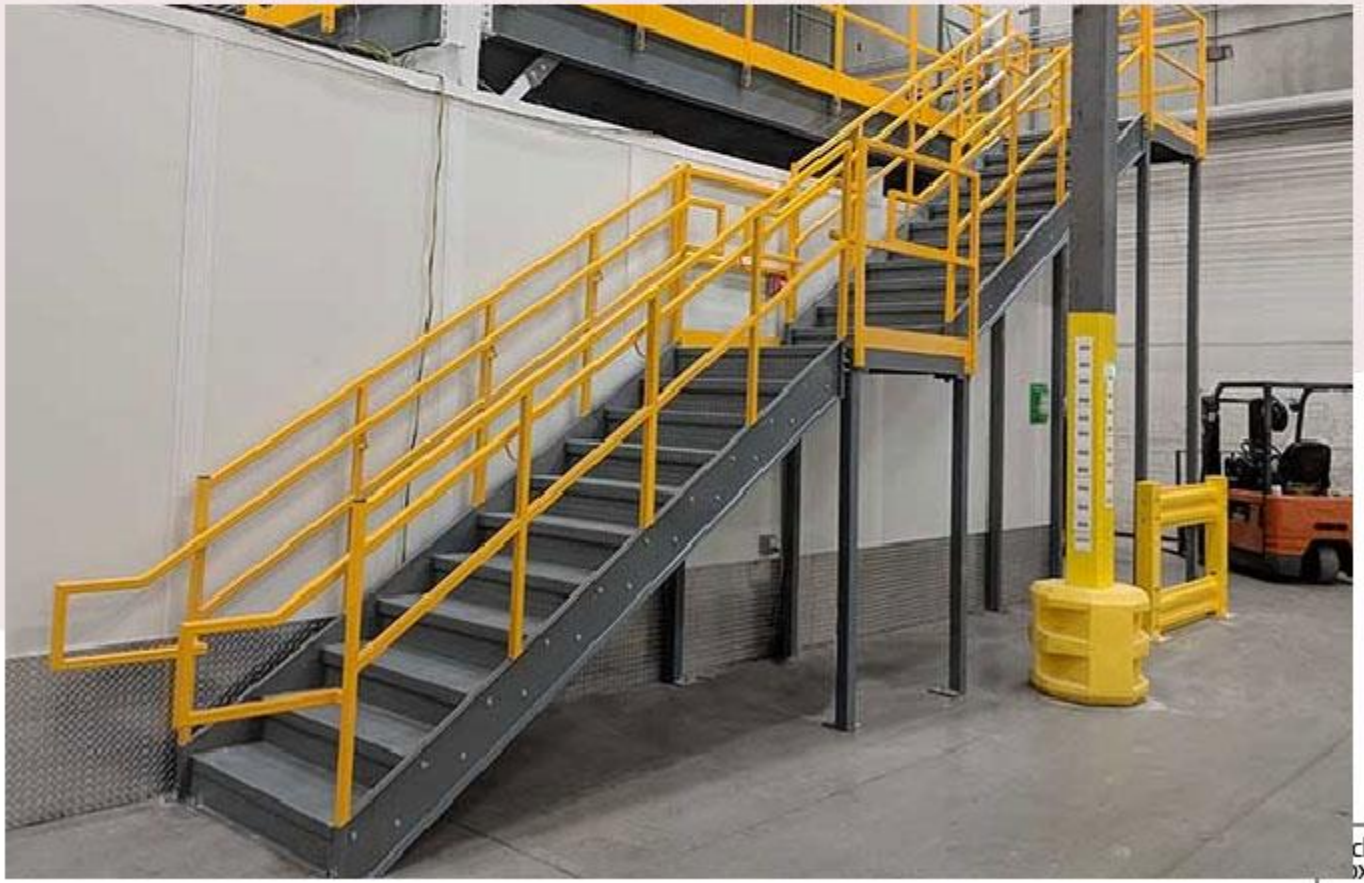
3.1.10 Stairways

The employer has a duty to ensure that each employee exposed to an unprotected side or edge of a stairway landing that is 4 feet or more above a lower level is protected by a guardrail or stair rail system. Each flight of stairs that have at least 3 treads and at least 4 risers should be equipped with stair rail systems and handrails as depicted in Table D-2 of the standard. The table columns in Table D-2 include “stair width”, “enclosed”, “one open side”, “two open sides” and “with earth built up on both sides”. Under each column, a depiction of the requirement for each of the stair width conditions is depicted, from less than 44 inches to greater than 88 inches. It is to be noted that ship stairs and alternating tread type stairs is to be equipped with handrails on both sides.



3.1.11 Scaffolds and Rope Descent Systems

The employer has a duty to ensure that each employee on a scaffold is protected from falling in accordance with this standard, as well as that each employee using a rope descent system 4 feet or more above a lower level is protected from falling by a personal fall arrest system.

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3.1.12 Work on Low Slope Roofs

When work is performed less than 6 feet from the roof edge, the employer has a duty to ensure that each employee is protected from falling by a guardrail system, safety net system, travel restraint system, or personal fall arrest system. When work is performed at least 6 feet but less than 15 feet from the roof edge, the employer is to ensure each employee is protected from falling by using a guardrail system, safety net system, travel restraint system, or personal fall arrest system. When work is performed 15 feet or more from the roof edge, the employer must protect each employee from falling by a guardrail system, safety net system, travel restraint system, or personal fall arrest system or a designated area. The employer is not required to provide any fall protection, provided the work is both infrequent and temporary, but the employer should use a designated area when performing this type of work. Finally, the employer is to provide any fall protection, provided the work is both infrequent and temporary, but the employer should use a designated area when performing this type of work. Finally, the employer is to implement and enforce a work rule prohibiting employees from working within 15 feet of the roof edge without using fall protection.

Other provisions specific to the outdoor advertising industry and slaughtering facility platforms are included in the standard.

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3.1.13 Protection from Falling Objects

When working above ground, it is critical that tools and materials are not inadvertently kicked over the edge where they could fall on an employee below. Additionally, items should not be thrown over the edge, even when it appears that it may be safe to do so.

When an employee may be exposed to falling objects, an employer has a duty to ensure that each employee wears head protection that meets the requirements in the Personal Protective Equipment Standard (29 CFR 1910 subpart I). In addition, the employer should protect employees from falling objects by implementing one or more of the following:

- Erecting toeboards, screens, or guardrail systems to prevent objects from falling to a lower level
- Erecting canopy structures and keeping potential falling objects far enough from an edge, hole, or opening to prevent them from falling to a lower level, or
- Barricading the area into which objects could fall, prohibiting employees from entering the barricaded area, and keeping objects far enough from an edge or opening to prevent them from falling to a lower level

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3.2 Criteria and Practices

To further emphasize the importance of certain requirements for fall protection and protection from falling objects, regulations for specific criteria and practices for various fall protection systems have been published.

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3.2.1 Guardrail Systems

A *guardrail system* is a barrier erected along an unprotected or exposed side, edge, or other area of a walking-working surface to prevent employees from falling to a lower level. Specific requirements related to guardrail systems for fall protection include:

- The top edge height of top rails, or equivalent guardrail system members, are to be 42 inches, plus or minus 3 inches above the walking-working surface.
- Midrails, screens, mesh, intermediate vertical members, solid panels, or equivalent intermediate members are to be installed between the walking-working surface and the top edge of the guardrail system as follows when there is not a wall or parapet that is at least 21 inches high.
- Other equivalent intermediate members (such as additional midrails and architectural panels) are to be installed so that the openings are not more than 19 inches wide.

3.2.1 Guardrail Systems

- Guardrail systems are to be capable of withstanding, without failure, a force of at least 200 pounds applied in a downward or outward direction within 2 inches of the top 40 edge, at any point along the top rail.
- When the 200-pound test load is to be applied in a downward direction, the top rail of the guardrail system must not deflect to a height of less than 39 inches above the walking-working surface.
- Midrails, screens, mesh, intermediate vertical members, solid panels, and other equivalent intermediate members are to be capable of withstanding, without failure, a force of at least 150 pounds applied in any downward or outward direction at any point along the intermediate member.
- Guardrail systems are to be smooth-surfaced to protect employees from injury, such as punctures or lacerations, and to prevent catching or snagging of clothing.
- The ends of top rails and midrails are not to overhang the terminal posts, except where the overhang does not pose a projection hazard for employees.
- Steel banding and plastic banding are not to be used for top rails or midrails.
- Top rails and midrails are to be at least 0.25-inches in diameter or in thickness.

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3.2.1 Guardrail Systems

- When guardrail systems are used at hoist areas, a removable guardrail section, consisting of a top rail and midrail, are placed across the access opening between guardrail sections when employees are not performing hoisting operations. The employer may use chains or gates instead of a removable guardrail section at hoist areas if the employer demonstrates the chains or gates provide a level of safety equivalent to guardrails.
- When guardrail systems are used around holes, they are installed on all unprotected sides or edges of the hole.
- For guardrail systems used around holes through which materials may be passed:
  - When materials are being passed through the hole, not more than two sides of the guardrail system are to be removed.
  - When materials are not being passed through the hole, the hole must be guarded by a guardrail system along all unprotected sides or edges or closed over with a cover.

3.2.1 Guardrail Systems

- When guardrail systems are used around holes that serve as points of access (such as ladderways), the guardrail system opening:
  - Has a self-closing gate that slides or swings away from the hole, and is equipped with a top rail and midrail or equivalent intermediate member that meets the above requirements
  - Is offset to prevent an employee from walking or falling into the hole
- Guardrail systems on ramps and runways are to be installed along each unprotected side or edge.
- Manila or synthetic rope used for top rails or midrails are to be inspected as necessary to ensure that the rope continues to meet the strength requirements previously mentioned.

3.2.2 Safety Net Systems

A *safety net system* is a horizontal or semi-horizontal, cantilever-style barrier that uses a netting system to stop falling employees before they contact a lower level or obstruction. Safety net systems are considered conventional arrest systems and typically consist of mesh nets, including panels, connectors, and other impact absorbing components.

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3.2.2 Safety Net Systems

An employer should ensure each safety net system used in general industry meets the requirements in the construction industry standard, *Fall Protection* (29 CFR Part 1926, Subpart M). Given its length and specificity, the following is a synopsis of the major requirements applicable to general industry. For specific details regarding the requirements, the standard should be referenced.

- Safety nets are to be provided when workplaces are more than 25 feet above the ground or water surface, or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical.
- Safety net systems are to be installed as close as possible below the surface on which persons are working, but in no case more than 30 feet below the working surface.
- The systems are to be installed with sufficient clearance under them to prevent contact with the surface or structures below if subjected to an impact that is equal to that imposed under the required drop test.

3.2.2 Safety Net Systems

- The system is to extend outward from the outermost projection of the work surface as follows:
  - Use nets with an 8-foot minimum extension width for nets positioned at the same level as the work, up to 5 feet below the work surface.
  - Use nets with a 10-foot minimum extension width for nets positioned at 5 to 10 feet below the work surface.
  - Use nets with a 13-foot minimum extension width for nets positioned more than 10 feet below the work surface.

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3.2.2 Safety Net Systems

- Drop testing is required to ensure that safety nets and safety net installations are working properly. Every safety net system is to be drop tested at the job site after initial installation, relocation, repair, and at six-month intervals if they are left in one place. The drop test consists of a 400-pound bag of sand, 30 inches in diameter, dropped to the net from a surface from which an employee could fall.

- Systems are to be inspected weekly for mildew, wear, damage, or deterioration of components such as connection points. Should any materials or tools have fallen into a safety net, they should be removed as soon as possible, at least before the next work shift. Safety nets are also to be inspected after any occurrence which could affect the integrity of the safety net system.
- To work properly, the safety net must have safe openings. Each system is to have mesh openings that do not exceed 36 square inches and no longer than 6 inches on any side.
- A border rope or webbing with a minimum breaking strength of 5,000 pounds is required for all safety nets.
- All connections between safety net panels are required to be as strong as integral net components and are to be spaced no more than 6 inches apart. Forged steel safety hooks or shackles should be used to fasten the net to its supports.

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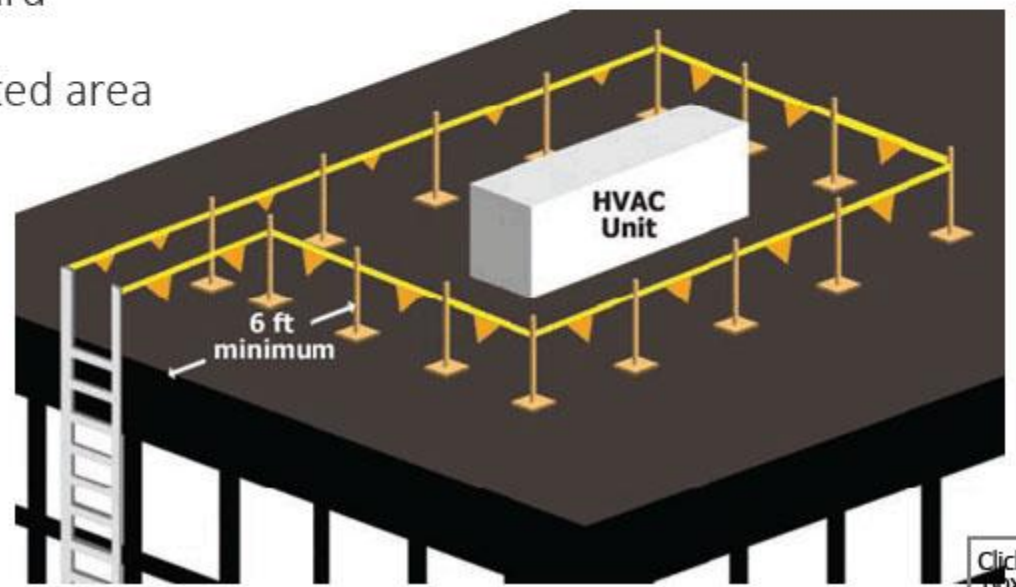
3.2.3 Designated Areas

When the employer uses a designated area, it must ensure that employees remain within the designated area while work operations are underway and that the perimeter of the designated area is delineated with a warning line consisting of a rope, wire, tape, or chain that meets the requirements as stipulated in the standard. The warning line should:

- Have a minimum breaking strength of 200 pounds
- Be installed so its lowest point, including sag, not less than 34 inches and not more than 39 inches above the walking-working surface
- Be supported in such a manner that pulling on one section of the line will not result in slack being taken up in adjacent sections causing the line to fall below the limits specified in the standard
- Be clearly visible from 25 feet away, and anywhere within the designated area
- Be erected as close to the work area as the task permits, not less than 6 feet from the roof edge for work that is both temporary and infrequent, or not less than 15 feet for other work



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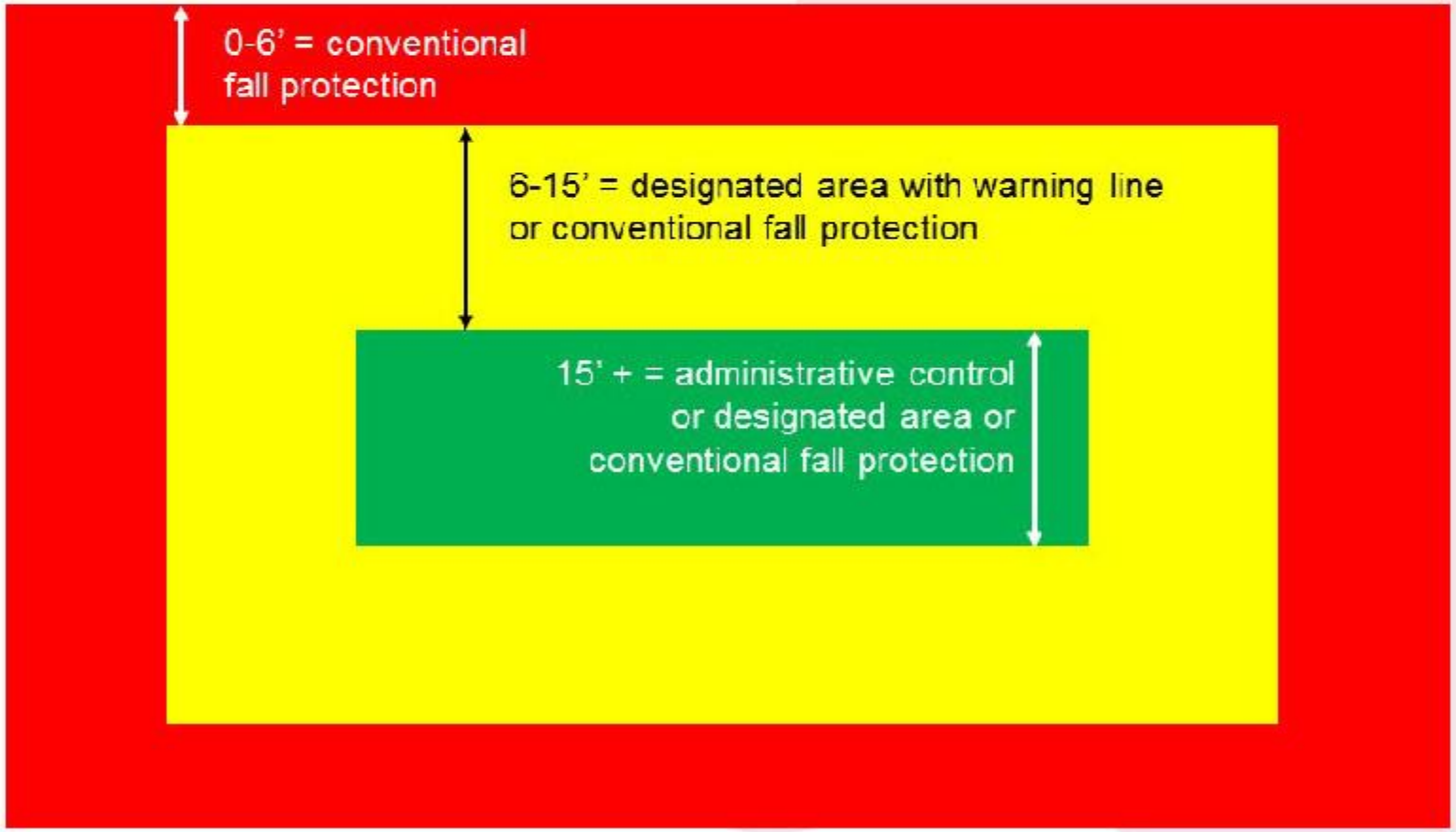
3.2.3 Designated Areas

When mobile mechanical equipment is used to perform work that is both temporary and infrequent in a designated area, the employer must ensure the warning line is erected not less than 6 feet from the unprotected side or edge that is parallel to the direction in which the mechanical equipment is operated, and not less than 10 feet from the unprotected side or edge that is perpendicular to the direction in which the mechanical equipment is operated.



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3.2.4 Covers

Each cover for a hole in a walking-working surface should be capable of supporting, without failure, at least twice the maximum intended load that may be imposed on the cover at any one time. Covers should also be secured to prevent accidental displacement.

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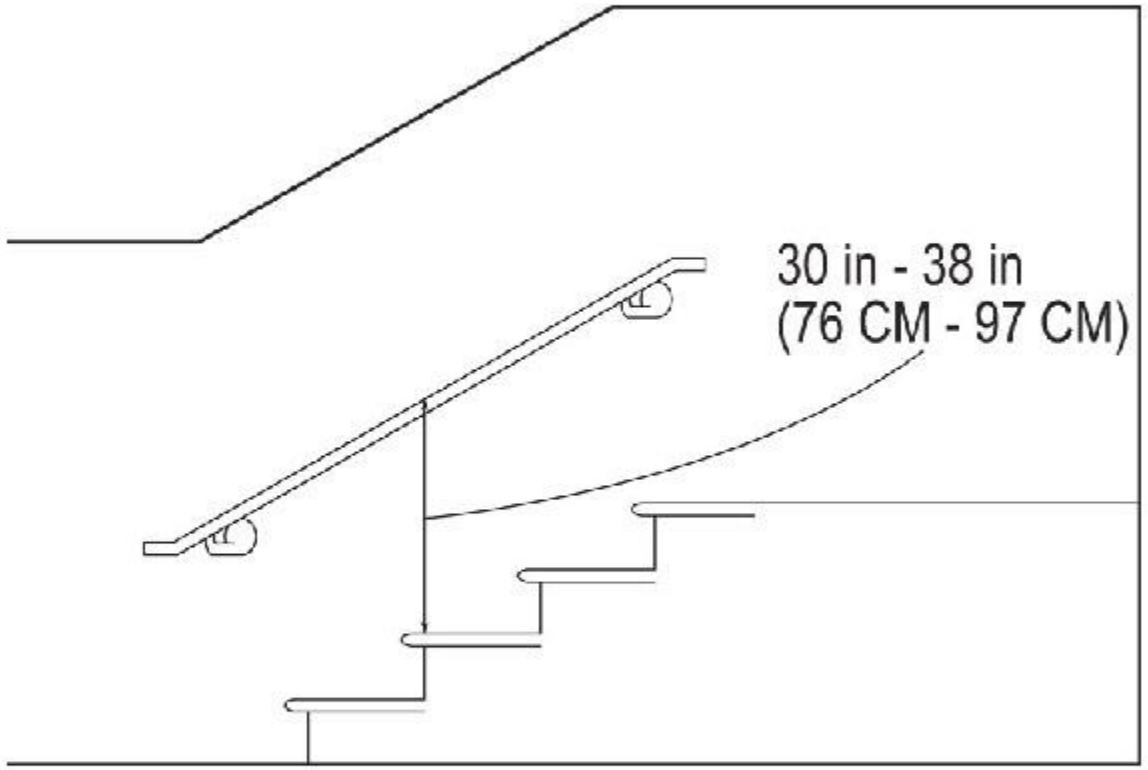
3.2.5 Handrails and Stair Rail Systems

For handrails and stair rails, requirements include:

- **Height criteria:** Handrails are not to be less than 30 inches and not more than 38 inches, as measured from the leading edge of the stair tread to the top surface of the handrail.
  - The top rail of a stair rail system may serve as a handrail only when: The height of the stair rail system is not less than 36 inches and not more than 38 inches as measured at the leading edge of the stair tread to the top surface of the top rail.
  - The top rail of the stair rail system meets the other handrail requirements in this section.



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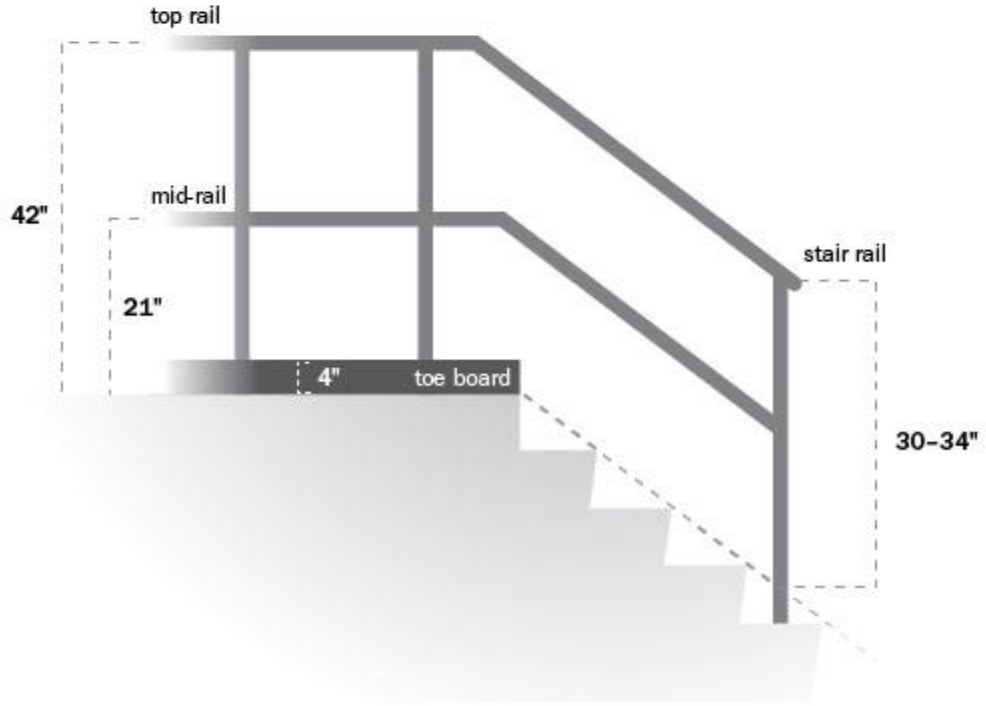
3.2.5 Handrails and Stair Rail Systems

- **Finger clearance:** The minimum clearance between handrails and any other object should be 2.25 inches.
- **Surfaces:** Handrails and stair rail systems should be smooth-surfaced to protect employees from injury and to prevent catching or snagging of clothing.
- **Openings in stair rails:** No opening in a stair rail system is to exceed 19 inches at its least dimension.
- **Handhold:** Handrails should have the shape and dimension necessary so that employees can grasp the handrail firmly.



- **Projection hazards:** The ends of handrails and stair rail systems should not present any projection hazards.
- **Strength criteria:** Handrails and the top rails of stair rail systems are to be capable of withstanding, without failure, a force of at least 200 pounds applied in any downward or outward direction within 2 inches of any point along the top edge of the rail.

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3.2.6 Cage, Wells, and Platforms Used

The employer is to ensure that cages and wells installed on fixed ladders are designed, constructed, and maintained to permit easy access to, and egress from, the ladder that they enclose. Cages and wells are to be continuous throughout the length of the fixed ladder, except for access, egress, and other transfer points. Cages and wells are to be designed, constructed, and maintained to contain employees in the event of a fall, and to direct them to a lower landing. Platforms used with fixed ladders must provide a horizontal surface of at least 24 inches by 30 inches.

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3.2.7 Ladder Safety Systems

A *ladder safety system* is a system attached to a fixed ladder designed to eliminate or reduce the possibility of an employee falling off the ladder. A ladder safety system usually consists of a carrier, safety sleeve, lanyard, connectors, and body harness. Cages and wells are not considered ladder safety systems.

An employer is to ensure that each ladder safety system allows the employee to climb up and down using both hands and does not require that the employee continuously hold, push, or pull any part of the system while climbing. The connection between the carrier or lifeline and the point of attachment to the body harness or belt is not to exceed 9 inches. Mountings for rigid carriers are to be attached at each end of the carrier, with intermediate mountings spaced, as necessary, along the entire length of the carrier so the system has the strength to stop employee falls. Mountings for flexible carriers are to be attached at each end of the carrier, and cable guides for flexible carriers are installed at least 25 feet apart but not more than 40 feet apart along the entire length of the carrier. The design and installation of mountings and cable guides must not reduce the design strength of the ladder. Lastly, the ladder safety systems and their support systems must be capable of withstanding, without failure, a drop test consisting of an 18-inch drop of a 500-pound weight.

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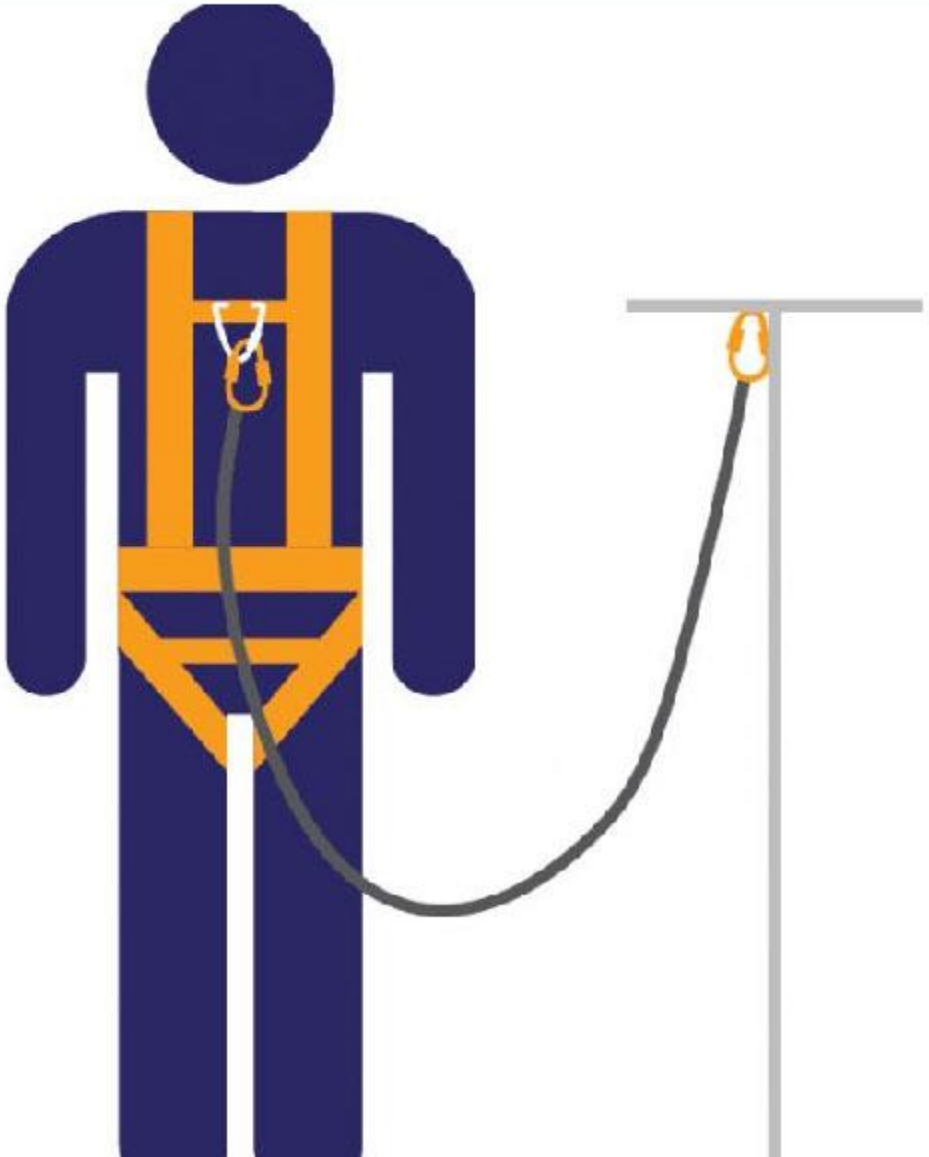
3.2.8 Personal Fall Protection Systems



Body belts, harnesses, and other components used in personal fall arrest systems, work positioning systems, and travel restraint systems must meet the various requirements contained in the standard, Personal Protective Equipment (29 CFR, Part 1910, Subpart I) which are reviewed in Section 4 of this course.

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3.2.9 Protection from Falling Objects: Criteria and Practices

As stated earlier in this course, this standard also addresses falling objects, and as such, depicts requirements associated with work above a lower level. For the most part, the standard requires the use of toeboards as a protection against falling objects. It is important that toeboards used for this purpose:

- Are erected along the exposed edge of the overhead walking-working surface for a length that is sufficient to protect employees below.
- Have a minimum vertical height of 3.5 inches as measured from the top edge.
- Are solid or do not have any opening that exceeds 1 inch at its greatest dimension.
- Have a minimum height of 2.5 inches when used around vehicle repair, service, or assembly pits. Toeboards may be omitted around vehicle repair, service, or assembly pits when it can be demonstrated that a toeboard would prevent access to a vehicle that is over the pit.
- Are capable of withstanding, without failure, a force of at least 50 pounds applied in any downward or outward direction at any point along the toeboard.

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3.2.10 Grab Handles

Grab handles utilized for the protection against falls are not to be less than 12 inches long. They are to be mounted to provide at least 3 inches of clearance from the framing or opening. Handles must be capable of withstanding a maximum horizontal pull-out force equal to two times the maximum intended load or 200 pounds, whichever is greater.

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4.0 Personal Fall Protection Systems (Subpart I)

Key to the effective use of personal fall protection system is the consideration of the importance of planning. Prior to the use of any personal fall protection systems, the employer should take the appropriate planning steps with the following in mind:

- **Free fall distances.** Since free fall distances should be kept to a minimum, an employer is to be aware that a system's maximum arresting force is evaluated under normal use conditions established by the manufacturer. Compliance to the standard requires that personal fall arrest systems be rigged so an employee cannot free fall in excess of 6 feet, since even a few additional feet of free fall can significantly increase the arresting force on the employee, possibly to the point of causing injury and exceeding the strength of the system.

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4.0 Personal Fall Protection Systems (Subpart I)

- **Elongation and deceleration distances.** During fall arrest, a device may stretch or elongate, whereas activation of a deceleration device will result in a certain stopping distance. These distances must be added to the free fall distance to arrive at the total fall distance before an employee is fully stopped.
- The location of suitable **anchorage points**.
- The **work conditions** in which the work will be performed. The presence of acids, dirt, moisture, oil, grease, or other substances may have potential effects on the system selected.
- The **environment**, including seasonal weather changes. Hot or cold environments may affect fall protection systems effectiveness.
- **Electrical hazards** that may be anticipated since roping comprised of wire may create substantial risk for injury.
- In selecting a location for use of a fall protection system, an employer should consider obstructions in the potential fall path of the employee. Tie-offs that minimize the possibilities of exaggerated swinging should be considered with this type of planning.

This standard establishes requirements for the performance, inspection, use, and maintenance of personal fall protection systems.

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4.1 General Requirements

In general, personal fall protection systems and their components must be:

- Used exclusively for employee fall protection and not for any other purpose, such as hoisting equipment or materials.
- Must be removed from service immediately when subjected to impact loading and not used again until a competent person inspects the system or components and determines that it is not damaged and safe for use for employee personal fall protection.
- Must be inspected before initial use during each work shift for mildew, wear, damage, and other deterioration, and defective components must be removed from service.
- Ropes, belts, lanyards, and harnesses used for personal fall protection must be compatible with all connectors used. It is important to note that not all fall protection systems components are interchangeable.

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4.1 General Requirements

- Ropes, belts, lanyards, lifelines, and harnesses used for personal fall protection must be protected from being cut, abraded, melted, or otherwise damaged.

- Must be worn with the attachment point of the body harness located in the center of the employee's back near shoulder level. The attachment point may be located in the pre-sternal position if the free fall distance is limited to 2 feet or less.

As with any fall protection safety plan, an employer is to provide for prompt rescue of each employee in the event of a fall. The availability of rescue personnel, ladders, or other rescue equipment needs to be evaluated given that there may be situations in which an employee is not able to self-rescue, such as they have become unconscious or seriously injured. In cases where self-rescue is possible, providing devices that allow descent capability is desirable.

4.1.1 Connectors

Connectors should be drop forged, pressed, or formed steel, or made of equivalent materials. Connectors should have a corrosion-resistant finish, and all surfaces and edges are to be smooth to prevent damage to interfacing parts of the system.

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4.1.2 Lifelines and Lanyards

Given the risks associated with the use of horizontal lifeline, they are to be designed, installed, and used under the supervision of a qualified person. The elements of their geometry and sag are critical consideration in their ongoing use. They should be used as a part of a complete personal fall arrest system that maintains a safety factor of at least two. Extreme care should be taken when considering this type of lifeline for multiple tie-offs.

When vertical lifelines are used, each employee must be attached to a separate lifeline. If multiple tie-offs to a single lifeline are used, and one employee falls, the movement of the lifeline during the arrest of the fall may pull other employees' lanyards, causing them to fall as well. In addition, lifeline and lanyards must meet the following requirements:

- Lanyards and vertical lifelines must have a minimum breaking strength of 5,000 pounds.
- Self-retracting lifelines and lanyards that automatically limit free fall distance to 2 feet or less are to have components 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.
- A competent person or qualified person must inspect each knot in a lanyard or vertical lifeline to ensure that it meets the requirements before any employee uses the lanyard or lifeline.
- Lifelines are not to be made of natural fiber rope. Polypropylene rope must contain an ultraviolet (UV) light inhibitor.

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4.1.3 D-Rings, Snap hooks, and Carabiners

An employer should at all times be aware that the strength of a personal fall arrest system is based on its being attached to an anchoring system that can support the system. Therefore, if a means of attachment is used that will reduce the strength of the system, that component should be replaced by a stronger one that will also maintain the appropriate maximum deceleration characteristics.

- D-rings, snap hooks, and carabiners are to be capable of sustaining a minimum tensile (tension resistance) load of 5,000 pounds. They should be proof tested to a minimum tensile load of 3,600 pounds without cracking, breaking, or incurring permanent deformation. The gate strength of snap hooks and carabiners should be proof tested to 3,600 lbs. in all directions.

- Snap hooks and carabiners are to be the automatic locking type that require at least two separate, consecutive movements to open.

4.1.4 Anchorages

The strength of any fall protection equipment is based upon its ability to be connected to a secure attachment point.

- Anchorages used to attach to personal fall protection equipment should be independent of any anchorage used to suspend employees or platforms on which employees work.
- Anchorages used to attach to personal fall protection equipment on mobile work platforms on powered industrial trucks should be attached to an overhead member of the platform, at a point located above and near the center of the platform.
- Anchorages, except window cleaners' belt anchors covered in the standard, are to be:
  - Capable of supporting at least 5,000 pounds for each employee attached
  - Designed, installed, and used, under the supervision of qualified person, as part of a complete personal fall protection system that maintains a safety factor of at least two

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4.1.5 Travel Restraint Lines

As a part of a travel restraint system that eliminates the possibility of an employee going over the edge of a walking-working surface, travel restraint lines should be capable of sustaining a tensile load of at least 5,000 pounds.

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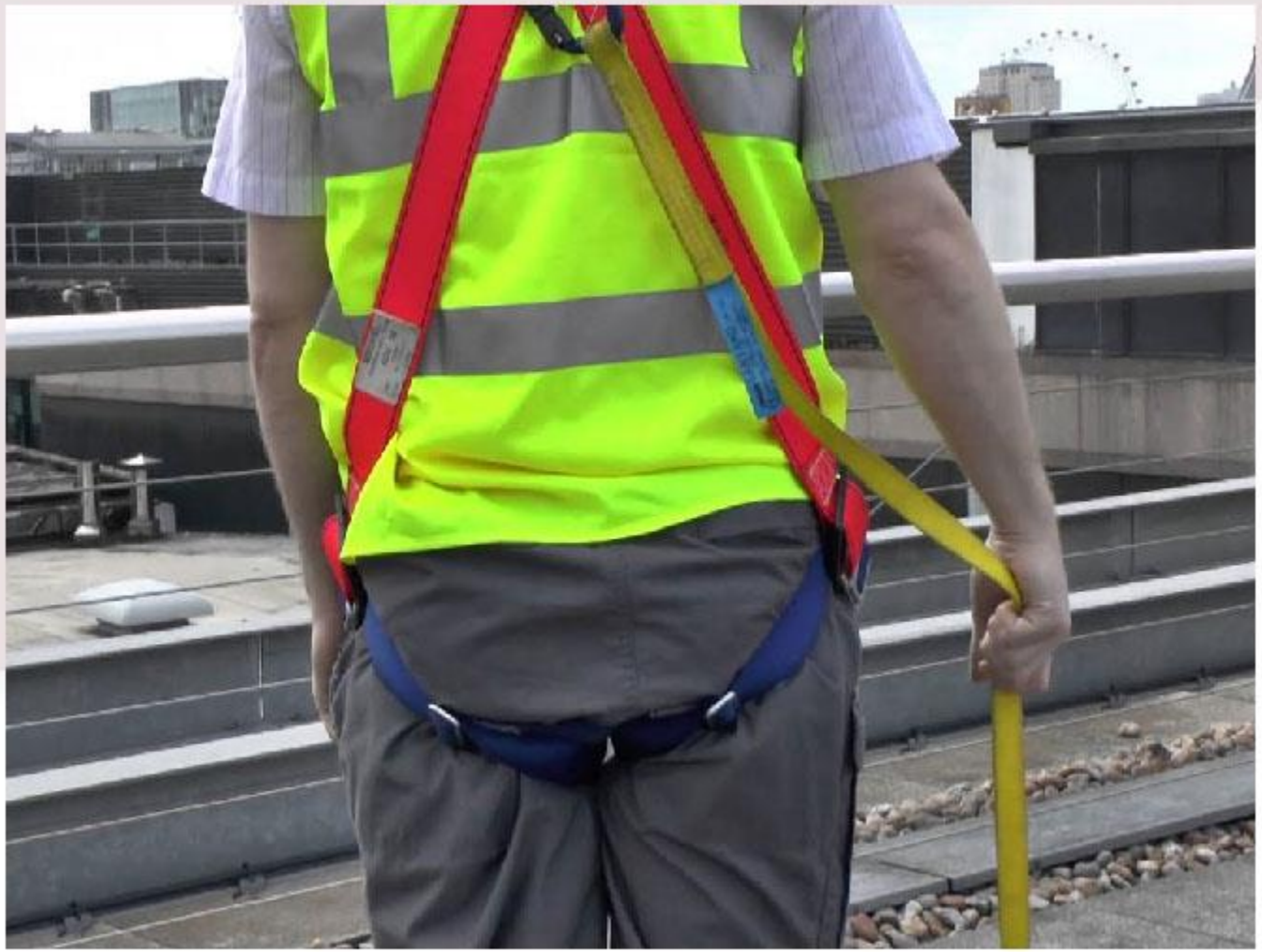
4.2 Personal Fall Arrest Systems (PFAS)

A personal fall arrest system is a system that arrests or stops a fall before an employee contacts a lower level. It consists of a body harness, anchorage, and connector, and may include a lanyard, deceleration device, lifeline, or a suitable combination.



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4.2.1 Performance Criteria

In addition to the general requirements above for personal fall protection, the employer is to ensure that personal fall arrest systems meet the following criteria:

- Limit the maximum arresting force on the employee to 1,800 pounds
- Bring the employee to a complete stop and limit the maximum deceleration distance the employee travels to 3.5 feet.
- Have sufficient strength to withstand twice the potential impact energy of the employee free falling a distance of 6 feet or the free fall distance permitted by the system.
- Sustain the employee within the system/strap configuration without making contact with the employee's neck and chin area.

4.2.1 Performance Criteria

If the personal fall arrest system meets the criteria and protocols in the standard and is being used by an employee having a combined body and tool weight of less than 310 pounds, the system is considered to be in compliance with the provisions of this standards. If the system is used by an employee having a combined body and tool weight of 310 pounds or more and the employer has appropriately modified the criteria and protocols, then the system will be deemed to be in compliance with the requirements.

Appendix D to this subpart contains test methods which are recommended for evaluating the performance of any system. There are some circumstances in which an employer can evaluate a system based on data and calculations derived from the testing of similar systems. Enough information should be available for the employer to demonstrate that its system and the tested system(s) are similar in both function and design.

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4.2.2 Use Criteria

Basic criteria for the use of personal fall arrest systems include:

- If any horizontal lifeline may become a vertical lifeline, the device used to connect to the horizontal lifeline is to be capable of locking in both directions on the lifeline.

- Personal fall arrest systems are to be rigged in such a manner that the employee cannot free fall more than 6 feet or contact a lower level. A free fall may be more than 6 feet provided the employer can demonstrate the manufacturer designed the system to allow a free fall of more than 6 feet and tested the system to ensure a maximum arresting force of 1,800 pounds is not exceeded.

As with the construction industry standards, this standard prohibits the use of body belts as part of a personal fall arrest system.

4.3 Positioning Systems

A *positioning system* is a system of equipment and connectors that, when used with a body harness or body belt, allows an employee to be supported on an elevated vertical surface, such as a wall or windowsill, to perform work with both hands free.

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4.3.1 Performance Requirements

An employer is to ensure that each positioning system meets the following performance requirements:

- All positioning systems, except window cleaners' positioning systems, are capable of withstanding, without failure, a drop test consisting of a 4-foot drop of a 250-pound weight.
- Window cleaners' positioning systems must meet further requirements for which are depicted in the standard.
- Lineman’s body belt and pole strap systems also have further requirements for testing for electrical and flammability tests.

Positioning systems that meet the test methods and procedures in Appendix D of this standard are considered to be in compliance.

4.4 Training

Careless or improper use of fall protection equipment can result in serious injury or death.

Before fall protection equipment is used, employees should be trained in the following:

- The intended function and performance characteristics of each piece of equipment.
- Proper use of the equipment, including methods of donning, adjusting, and interconnecting the equipment.
- Proper inspection and storage of the equipment prior to use.
- The method to estimate and limit the maximum arresting force to a safe and acceptable limit.
- Proper attachment locations and methods of the equipment, including compatibility of the sizes of snaphooks, D-rings, and other connections to reduce the probability of accidental disengagement.

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4.4 Training

- Proper anchoring and tie-off techniques, including:
  - Determination of elongation and deceleration distance.
  - Procedures to follow after a fall to protect the user from injury.
  - Unique conditions specific to a worksite, which may be important in determining the type of system to use.
- Emergency rescue planning and execution to include methods of rescue and rescue personnel availability, the type of equipment available for rescue, the effective means for summoning rescue personnel and the drilling of rescue personnel in rescue and evacuation procedures.

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4.5 Inspection of Fall Protection Equipment

All fall protection wears out and must be inspected before each use by an authorized person. Fall arrest equipment should also be inspected annually by a skilled third party. Many accidents and fatalities have occurred because equipment was not inspected.

Before any fall protection harness is used, its condition needs to be inspected for damage or wear that might keep it from functioning as designed. No item should be used if any damage is discovered that would cause the user to question the item's integrity.

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4.5.2 Lanyard Inspection

When inspecting lanyards, begin at one end and work to the opposite end, slowly rotating the lanyard so that the entire circumference is checked.

Hardware

- **Snaps:** Inspect closely for hook and eye distortions, cracks, corrosion, or pitted surfaces. The keeper (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 locks must prevent the keeper from opening when the keeper closes.

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

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