

Chapter 45: [Fall Protection](#)

Fall Protection Requirements

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URL: <https://www-group.slac.stanford.edu/esh/eshmanual/references/fallReqFall.pdf>

1 Purpose

The purpose of these requirements is to prevent unprotected falls through the proper use of fall prevention and arrest systems. It covers working in *unprotected elevated work areas* (defined as any *elevated work surface*, including roofs, not surrounded by a passive fixed barrier such as conforming guardrails or protective parapet), use and design of fall protection systems, and designation of personnel. It applies to workers/authorized persons, competent and qualified persons and qualified engineers, supervisors/line management, the chief safety officer, the Department of Energy (DOE) site manager, and the fall protection program manager.

2 Requirements

2.1 Preferred Controls

The following engineered controls are the preferred means of preventing falls:

- **On roofs.** Engineered guardrails designed in accordance with applicable standards or 42-inch height minimum parapets are required at roof edges when frequent access is required (more than four times per year).
- **On other elevated work surfaces.** Engineered guardrails designed in accordance with applicable standards are required on elevated fixed platforms, mezzanines, catwalks, and balconies when frequent access is required (more than 12 times per year).

For infrequent access to these locations or if guardrails are infeasible, fall protection equipment, such as harnesses, lanyards, and anchorage points, may be used in conjunction with formal authorization as described below.

2.2 Accessing Unprotected Elevated Work Areas

2.2.1 Authorization

Work in *unprotected elevated work areas* requires workers to be *authorized persons*, trained in fall protection (see Section 2.4), and identification of hazards and controls, documented as follows:

1. If conventional fall protection measures (guardrails, fall restraint or arrest equipment, safety nets) are feasible, an *elevated surface work plan* is used.

An elevated surface work plan must be developed by an authorized or competent person and approved by a competent person. Plans for subcontractor construction work must in addition be accepted by a SLAC competent person. The plan will address associated fall hazards and provide a rescue plan as required. (See [Fall Protection: Elevated Surface Work Plan Form](#).)

2. If conventional fall protection is impractical or creates a greater hazard, a control line can be set up and workers can work behind that line in the designated area without fall protection. If a worker needs to work beyond the control line, in the control access zone (CAZ), a *fall protection plan* must be developed.

The fall protection plan must be written by a qualified person and approved in writing by the SLAC chief safety officer and the Department of Energy (DOE) site manager or designee. (See [Fall Protection: Fall Protection Plan Requirements](#) for required elements of such a plan.)

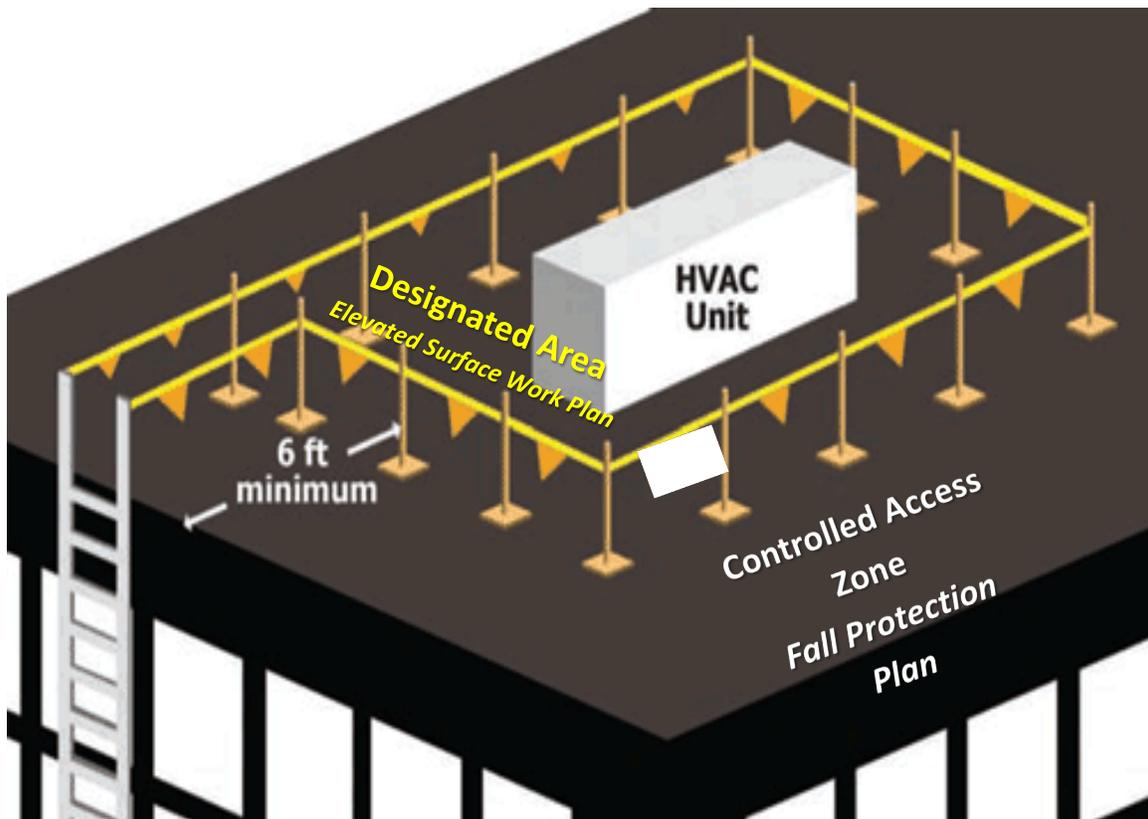
Authorization through an elevated surface work plan or fall protection plan must be noted in the worker's activity and training authorization documents, which must reflect any fall hazard, regardless of how the work is authorized.

2.2.2 Control Line

An example of unconventional means would be working in a designated area inside a properly set up control line with an elevated surface work plan. Work beyond the designated area, in the *controlled access zone (CAZ)*, requires a fall protection plan. (See Figure 1.) (The first worker up can set up the control line without using fall protection, "first man up rule". Once the control line is set workers must stay behind the control line.)

The control line must meet the following requirements:

- Be erected not less than six feet nor more than 25 feet from the unprotected or leading edge
- Extend the entire length of the unprotected or leading edge and be approximately parallel to it
- Be connected on each side to a standard railing or wall or securely anchored on each end
- Be flagged or otherwise clearly marked at not more than six-foot intervals
- Be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches from the working level/working area and its highest point is not more than 45 inches



- Control Line Requirements**
- Erected not less than 6' nor more than 25' from leading edge
 - Extend entire length of leading edge
 - Be flagged or otherwise clearly marked at not more than 6' intervals
 - Supported so the lowest point is not less than 39" or more than 45"
 - Have a minimum breaking strength of 200 lbs.

Figure 1 Control Access Zones and Designated Areas

2.2.3 Transit from Ladders

Until barriers or other effective methods of fall protection can be installed, transit to and from ladders at roof edges will be permitted when all of the following conditions exist:

- The roof being accessed is a *low-slope roof*.
- There are no current adverse environmental conditions affecting ability to see or move safely over the roof (such as high wind, extreme heat or sun glare, heavy rain).
- Safe ladder usage

- A fixed ladder is used that has proper grab rails over the roof edge or parapet, conforms to regulations, has been inspected and labeled by a competent person, and is deemed safe for climbing, or
- A portable straight ladder is used that has been set up on a stable base, is properly secured to prevent movement, and extends at least three feet above the roof landing surface.
- Immediately upon reaching the roof, the person immediately walks away from the edge to the location on the roof where the work is to be done.
- To descend, the person approaches the ladder at an angle perpendicular to the roof edge to maximize distance from the edge during access.
- When performing elevated work an elevated surface work plan must be used. If an elevated surface work plan is not feasible then a fall protection plan must be used.

2.2.3.1 Non-conforming Fixed Ladders

Pre-engineered fall arrest equipment (such as an approved ladder climbing system or self-retracting lifeline) must be used on fixed ladders over 20 feet in height that do not have required landing platforms and compliant cages. Such fall arrest equipment must be installed under the supervision of a competent person.

2.3 Fall Protection Equipment

2.3.1 Use of Fall Protection Equipment

When an *elevated work surface* cannot be accessed safely from a ladder or protected work platform or when the installation of guardrails is infeasible, *fall restraint* or *fall arrest systems* may be used. A competent person will make the appropriate equipment selection based on a complete evaluation of the work site, conditions, and nature of work to be done, as documented in an elevated surface work plan.

Workers will use harnesses, self-retracting lifelines, lanyards, I-beam straps, and so on only as permitted by the equipment manufacturer and in accordance with published instructions unless authorized by a designated competent person.

2.3.1.1 Two-person Rule

Workers using fall restraint or fall arrest systems or control lines must work in teams of two or more (*two-person rule*).

2.3.1.2 Overhead Work

If work is being done in a location overhead where others may be working or walking below, access to that lower area must be restricted if any items could be dropped or fall from the higher work level. This can be accomplished through the use of barricade tape, signs, and rigid barriers. Signs and barricades will be removed when work is completed.

Tools and materials being used over an occupied area must be secured (tethered) to the structure or person if they might be dropped to the lower level. Toe boards must be provided on working platforms and scaffolds over six feet in height.

2.3.2 Fall Restraint Systems

Fall restraint systems consisting of the following minimum components may be used to prevent *free fall*:

- Rated and approved anchorage point with a capacity at least four times the intended load or 800 pounds, whichever is greater
- Lanyard (length must be limited to prevent access to edges where fall could occur)
- Connecting hardware (double-locking snaphooks, carabineers, D-rings)
- Full body harness

2.3.3 Fall Arrest Systems

Minimum fall arrest system components are

- Rated anchorage point of at least 5,000 pounds or as part of a complete personal fall arrest system that maintains a safety factor of at least two, and under the supervision of a qualified person
- Lanyard (length must be limited to prevent access to edges where fall could occur)
- Connecting hardware (double-locking snap hooks, carabineers, D-rings)
- Full body harness

When using a fall arrest system, the fall distance calculation must account for the length of lanyard, connecting hardware, deceleration distance, the height of the person wearing the equipment (or the height of the D-ring attached to the back of the harness), one foot of stretch in the harness, the position of the anchorage point, lanyard or rope elongation, and a safety factor.

A competent person must perform the fall distance calculation, or at a minimum verify that it was performed properly if calculated by someone else.

Depending on the above variables, the minimum height required for a fall arrest system to be effective in preventing contact with a lower level may be as much as 18 feet. Fall arrest systems should not be used at heights with less than 18 feet clearance to a lower level unless it can be proven by a competent person that the person will not contact the lower level in a fall. Where vertical clearance is inadequate, another way to gain access to the elevated work location must be found (for example, scissors lift or ladder).

The area below and to the sides of the individual must be free of obstructions that could cause injury during a fall. Fall arrest systems must be rigged so that a person cannot free fall for more than four feet or so that the arresting forces on the body do not exceed 1,800 pounds.

Fall arrest systems should not be used to protect personnel working near vertical drop-offs such as roof edges and hoist areas due to the potential for a swing impact injury, and the difficulty of rescue. Instead, fall restraint systems should be used in these situations.

2.3.3.1 Rescue Plan

When fall arrest systems are in use, a competent person will develop an effective rescue plan specific to the work location and job being performed before work starts. All SLAC fall protection rescue plans will be documented in the elevated surface work plan. A written plan, prepared in advance, facilitates the training of rescue personnel by increasing their familiarity with specific areas difficult to access.

2.3.4 Self-retracting Lifelines

Self-retracting lifelines (SRLs) must be installed directly above the user's head, or at shoulder height directly adjacent to the work area at a minimum. Extreme care must be taken to ensure the person will not be exposed to a swing hazard, strike objects below, or exceed the maximum permissible free fall distance or arresting forces on the body after a fall involving an SRL (such as may be the case if the SRL is mounted below shoulder level). A designated competent person must inspect and approve of all SRL installations before use.

Exceptions to installing an SRL at or above shoulder level near the work zone will be approved by a competent person when no other fall protection option is feasible, and when the installation complies with applicable regulations and manufacturers' requirements addressing free-fall distance, arresting forces on the body, and swing fall hazards.

2.3.5 Anchorage Points

Rated and approved anchorage points will be easily identified on the elevated surface work plan. Only anchorage points that have been approved by a designated SLAC *qualified engineer* or that are known to hold at least 5,000 pounds (such as structural I-beams or properly-installed pre-manufactured points) will be used for fall protection purposes. Anchor points that are repeatedly used must be permanently marked or identified and inspected twice annually by a competent person.

Under no circumstances will workers tie-off to piping, unistrut, racks, bracing, ventilation fan housings, or any other non-approved locations. Permanent, fixed guardrails will not be used as anchorage points unless specifically engineered and marked as approved anchorage points by a SLAC qualified engineer.

2.3.6 Design of Fall Protection Systems

Only SLAC-designated qualified engineers may engineer and design fall protection systems such as anchorage points, horizontal lifeline systems, or safety nets. If commercially available systems are pre-engineered and certified to provide fall protection and comply with regulatory requirements, they may be installed and used under the direction of a competent person and do not require a separate design by a SLAC qualified engineer.

2.3.7 Equipment Inspection, Marking, and Storage

2.3.7.1 Inspections

Before each use, the user will inspect harnesses, lanyards, self-retracting lifelines, and connecting hardware for wear, damage, contamination, and other deterioration according to manufacturer's instructions and checklists. Equipment not meeting inspection criteria will immediately be tagged DANGER – OUT OF SERVICE and will not be used.

Twice annually, a competent person will inspect personal fall protection systems according to manufacturers' instructions and checklists. Such systems may include fixed, installed fall protection systems such as self-retracting reels, anchorages, lifelines, or personal systems such as harnesses, connectors, and lanyards. Ensuring the completion of inspections and required documentation is the responsibility of line management.

Line management must designate a competent person as custodian of inspection records. The competent person will retain documentation of the semi-annual inspection for three years. Documentation will include the name of the inspector, the date equipment was inspected, and the results of the inspection. The documentation will be made available upon request. The equipment itself will also be labeled with proof of inspection.

Any equipment exposed to in-use loading or potential damage will be sent back to the manufacturer for complete inspection, rebuild if necessary, and recertification before being used again.

2.3.7.2 Marking

All fall protection system components will be labeled by the manufacturer according to [ANSI/ASSE Z359.1](#) or [ANSI/ASSE A10.32](#). Only designated competent persons are authorized to mark harnesses and lanyards with other information (such as name or department) to ensure proper ink is used to prevent material deterioration

2.3.7.3 Storage

Fall protection system components will be stored away from direct sunlight and corrosive materials, oils and solvents, moisture, heat, or any other substance that may cause damage. Harnesses, straps, and lanyards will be hung by the D-ring or other connecting means to keep straps in a natural and untangled position when not in use.

2.4 Fall Protection Personnel

Work in *unprotected elevated work areas* requires workers to be *authorized persons*, trained in fall protection. Planning and oversight is provided by a *competent person*. Fall protection plans are prepared by a *qualified person*. Design of systems is provided by a *qualified engineer*. Competent and qualified persons and qualified engineers are designated by fall protection program manager in consultation with line management. (See the [Competent and Qualified Persons and Engineers](#) list.)

3 Forms

The following are forms required by these requirements:

- [Fall Protection: Elevated Surface Work Plan Form](#) (SLAC-I-730-0A21J-047). Form for documenting plan for working on unprotected elevated work platform or area
- [Competent and Qualified Persons and Engineers](#)

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- Completed elevated surface work plans and fall protection plans must be kept with other work authorization documents for the duration of the work
- Competent persons maintain fall protection equipment inspection records, for three years

- The fall protection program manager maintains fall protection designations in the [Competent and Qualified Persons and Engineers](#) list

5 References

[SLAC Environment, Safety, and Health Manual](#) (SLAC-I-720-0A29Z-001)

- [Chapter 45, “Fall Protection”](#)
 - [Fall Protection: Fall Protection Plan Requirements](#) (SLAC-I-730-0A21S-054)

Other SLAC Documents

- None

Other Documents

- American National Standards Institute (ANSI)/American Society of Safety Engineers (ASSE) A10.32, “Personal Fall Protection Used in Construction and Demolition Operations” ([ANSI/ASSE A10.32](#))
- American National Standards Institute (ANSI)/American Society of Safety Engineers (ASSE) Z359.1, “The Fall Protection Code” ([ANSI/ASSE Z359.1](#))