

Carnegie Mellon University Environmental Health & Safety FIRE LAB WORK	Environmental Health and Safety (EHS) Fall Protection Program
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1. Purpose

The mission of Environmental Health and Safety (EHS) is to support Carnegie Mellon University's (CMU) mission and values by sustaining and enhancing a safe and healthy environment within the CMU community. The purpose of this Fall Protection Program is to protect CMU faculty, staff (herein referred to as "employee") and students from injuries and incidents related to falls and working from heights.

2. Scope

This Fall Protection Program covers the prevention of injuries associated with falls at CMU's workplace. It addresses standards established by the Occupational Safety and Health Administration (OSHA) in 29 CFR 1910.

While this program provides the generic components and parameters for fall protection, it is understood that fall protection must be project-specific, where control measures must be developed and implemented for each identified project and/or job function. In many cases, the fall protection controls are unique to that project and/or job function.

The goals of this program are to:

- Support the [University Policy on Environmental Health and Safety](#) by providing standards specifically designed to cover fall protection;
- Ensure that each employee is trained and made aware of the safety provisions which are to be implemented by this plan prior to the start of each job;
- Ensure fall protection is being used when personnel are working at heights of 4 feet or greater; and
- Define guidelines and inspection schedules for fall protection equipment and systems.

Definitions used in this plan can be found in 29 CFR 1910.21 and in the following section.

3. Definitions

- Anchorage** - A secure point of attachment for equipment such as lifelines, lanyards, deceleration devices and rope descent systems.
- Authorized** - An employee who the employer assigns to perform a specific type of duty or allows in a specific location or area.
- Competent Person** - An employee who can identify existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

- d. **Designated Area** - A distinct portion of a walking-working surface delineated by a warning line in which employees may perform work without additional fall protection.
- e. **Failure** - A load refusal, breakage or separation of component parts. A load refusal is the point at which the ultimate strength of a component or object is exceeded.
- f. **Fall Hazard** - Any condition on a walking-working surface that exposes an employee to a risk of harm from a fall on the same level or to a lower level.
- g. **Fall Protection** - Any equipment, device or system that prevents an employee from falling from an elevation or mitigates the effect of such a fall. This is usually required at a height of 4 feet or greater.
- h. **Fixed Ladder** - 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.
- i. **Guardrail System** - 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. The top rail of a guardrail system must be between 39 and 45 inches high from the level it is on.
- j. **Handrail** - A rail used to provide employees with a handhold for support.
- k. **Hole** - A gap or open space in a floor, roof, horizontal walking-working surface or similar surface that is at least 2 inches (5 cm) in its least dimension.
- l. **Low-Slope Roof** - A roof that has a slope less than or equal to a ratio of 4 in 12 (vertical to horizontal).
- m. **Lower Level** - A surface or area to which an employee could fall. Such surfaces or areas include, but are not limited to, ground levels, floors, roofs, ramps, runways, excavations, pits, tanks, materials, water, equipment and similar surfaces and structures, or portions thereof.
- n. **Maximum Intended Load** - The total load (weight and force) of all employees, equipment, vehicles, tools, materials, and other loads the employer reasonably anticipates being applied to a walking-working surface at any one time.
- o. **Midrail** - Installed at a height midway between the top edge of the guardrail system and the walking-working surface.
- p. **Mobile Ladder Stand Platform** - A mobile, fixed-height, self-supporting unit having one or more standing platforms that are provided with means of access or egress.
- q. **Opening** - A gap or open space in a wall, partition, vertical walking-working surface or similar surface that is at least 30 inches (76 cm) high and at least 18 inches (46 cm) wide, through which an employee can fall to a lower level.
- r. **Passive Fall Protection System** - A fall protection system that does not require the use of Personal Protective Equipment or active participation from the worker. Typical passive solutions include guardrails, stair rails, hole and opening covers, skylight guards or netting systems.
- s. **Personal Fall Arrest System (PFAS)** - A system used to arrest an employee in a fall from a walking-working surface. It consists of a body harness, anchorage and connector. The

means of connection may include a lanyard, deceleration device, lifeline, or a suitable combination of these.

- t. **Personal Fall Protection System** - A system (including all components) an employer uses to provide protection from falling or to safely arrest an employee's fall if one occurs. Examples of Personal Fall Protection Systems include PFAS, positioning systems and travel restraint systems.
- u. **Platform** - A walking-working surface that is elevated above the surrounding area.
- v. **Portable Ladder** - A ladder that can readily be moved or carried, and usually consists of side rails joined at intervals by steps, rungs or cleats.
- w. **Positioning System (work-positioning system)** - 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, and work with both hands free. Positioning systems also are called "positioning system devices" and "work-positioning equipment."
- x. **Qualified** A person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience has successfully demonstrated the ability to solve or resolve problems relating to the subject matter, the work or the project.
- y. **Ramp** - An inclined walking-working surface used to access another level.
- z. **Safety Monitor** - Competent person who is educated and trained to recognize fall hazards. And will warn the employee when they are unaware of a fall hazard or is acting in an unsafe manner.
- aa. **Scaffold** - Any temporary elevated or suspended platform and its supporting structure, including anchorage points, used to support employees, equipment, materials, and other items. For purposes of this subpart, a scaffold does not include a crane-suspended or derrick-suspended personnel platform or a rope descent system.
- bb. **Tieback** - An attachment between an anchorage (e.g., structural member) and a supporting device (e.g., parapet clamp or cornice hook).
- cc. **Toeboard** - A low protective barrier that is designed to prevent materials, tools, and equipment from falling to a lower level, and protect employees from falling.
- dd. **Travel Restraint System** - A combination of an anchorage, anchorage connector, lanyard (or other means of connection), and body support that an employer uses to eliminate the possibility of an employee going over the edge of a walking-working surface.
- ee. **Unprotected Sides and Edges** - Any side or edge of a walking-working surface (except at entrances and other points of access) where there is no wall, guardrail system or stair rail system to protect an employee from falling to a lower level.
- ff. **Walking-Working Surface** - Any horizontal or vertical surface on or through which an employee walks, works, or gains access to a work area or workplace location.
- gg. **Warning Line** - A barrier erected to warn employees that they are approaching an unprotected side or edge, and which designates an area in which work may take place without the use of other means of fall protection.

4. Roles and Responsibilities

a. EHS:

- i. Developing the written Fall Protection Program.
- ii. Provide and/or help organize fall protection training that includes fall hazard identification, selecting proper fall protection, proper ways to put on and take off a harness and equipment inspection requirements.
- iii. Maintain fall protection training records electronically through [SciShield](#) to include name of employee and the date training was completed.
- iv. Perform a thorough investigation into any incidents involving falling from heights with or without injury.
- v. Collaborate with FMCS and Campus Design and Facility Development (CDFD) to ensure areas with a fall hazard 4 feet or greater are designed with fall protection or appropriate facility elements to support fall arrest systems.
- vi. Assist FMCS and contractors in creating fall protection plans for work near unguarded edges.
- vii. Assist FMCS in creating a fall arrest rescue plan.
- viii. Conduct fall protection equipment inspections at least once every six months. Conduct one equipment inspection during annual zone shop inspection process.
- ix. Remove any equipment from service that fails an inspection. Notify the owning manager of the equipment's removal, the reason it was removed and the need to purchase replacement equipment.
- x. Assist with pre-planning operations that include fall hazards and fall protection systems when necessary.
- xi. Create an initial inventory list of fall protection equipment and house this information in Campus Optics. Update this list when notified of equipment removed or added to service.
- xii. Assist with fall protection equipment selection and verification.
- xiii. Contact emergency services prior to employees beginning work that involves PFAS.

b. FMCS:

- i. Reference [SciShield](#) for a master list of trained employees within their zone and ensure only trained employees are using PFAS.
- ii. Provide fall protection systems for employees in work areas of 4-feet or greater and where injury from a fall to a lower level is a recognized hazard.
- iii. Ensure that fall protection systems meet OSHA's requirements.
- iv. Organize fall protection training for employees and ensure employees have all required training prior to starting work.
- v. Correct any unsafe acts or conditions immediately.
- vi. Assist with pre-planning operations that include fall hazards and fall protection systems when necessary.
- vii. Ensure newly installed equipment or machinery is designed with fall protection systems in work areas of 4-feet or greater and where injury from a fall to a lower level is a recognized

hazard.

- viii. Report to EHS any time fall protection equipment is removed or added to service.
- ix. Determine a designated location to store fall protection equipment for each zone or department.
- x. Notify EHS as soon as possible when planning operations that involve fall arrest systems.
- xi. Assist EHS in creating a fall arrest rescue plan.
- xii. Report any incident to EHS as soon as possible.
- xiii. Assist EHS in any investigation into any falls from elevation incidents with or without injury.

c. FMCS employees:

- i. Review this fall protection program and follow the guidelines.
- ii. Successfully complete fall protection training.
- iii. Inspect fall protection equipment prior to use.
- iv. Function as a safety monitor when needed.
- v. Stop work and request guidance and direction from their manager when a fall hazard is encountered, where they do not feel safe, do not have adequate training or similar.
- vi. Report any incident as soon as possible to their supervisor or the supervisor on duty.
- vii. Assist EHS in any investigation into any fall from an elevation incident with or without injury.

d. Fall Protection Committee:

- i. Review Fall Protection Program on an annual basis, make updates as needed and appropriately distribute updated document.
- ii. Assist as needed in any investigation into any incidents with or without injury and incorporate process improvements and/or make recommendations to leadership when necessary.

e. CDFD:

- i. Ensure EHS and affected departments are invited to newly built or renovated areas containing fall hazards so that training and planning may take place.

5. General Requirements for Passive Fall Protection Systems

Each employee on a walking-working surface with an unprotected side or edge that is 4 feet (1.2 meters) or more above a lower level will be protected from falling by one or more of the following passive fall protection measures as a preferred method of fall protection. Appendix A contains several specific types of walking-working surface fall hazards, associated risks, and types or recommended fall protection (both Passive Fall Protection and Personal Fall Arrest Systems). If passive fall protection options are not possible, PFAS must be used (see section 6).

Passive Fall Protection Systems Include:

- Guardrail systems
- Designated Areas
- Warning Line Systems
- Controlled Access Zones

Employees are not permitted to access any roofs or other areas that may expose them to falls outdoors in the event of severe weather:

- High Wind (more than 40 miles/h for sustained, 60 miles/h for gusts)
- Lightning (within 10 miles radius)
- Tornado
- Severe Thunderstorm
- Heat (105 °F or greater for more than 3 hours)
- Cold Wind Chill (-20 °F or below)

Exceptions: Fall protection is not always required during inspection, investigation, or assessment activities. 29 CFR 1910.28(a)(2)(ii) states under its fall protection exemption section:

- When employers are inspecting, investigating, or assessing workplace conditions or work to be performed prior to the start of work or after all work has been completed.
- This exemption does not apply when fall protection systems or equipment meeting the requirements of 29 CFR 1910.29 have been installed and are available for workers to use for pre-work and post-work inspections, investigations, or assessments.

Additionally, if CMU determines that the use of fall protection systems is not feasible on the working side of a platform used at a loading rack, or loading dock, the work may be completed without a fall protection system, provided:

- Access to the platform is limited to authorized employees; and,
- The authorized employees are trained in accordance with OSHA regulations through EHS.

a. Guardrail Systems

Guardrail systems shall meet OSHA's requirements, as outlined in 29 CFR 1910.29(b), including, but not limited to, the following:

- i. Top rail installed 39-45 inches above the walking/working level.
- ii. Mid-rail (or suitable alternative) located 21 inches above walking/working level.
- iii. Able to withstand a force of at least 200 pounds in any outward or downward direction.
- iv. Smooth-surfaced to protect employees from injury such as puncture, laceration, or catching/snagging of clothing.
- v. Designed so as not to constitute a projection hazard.
- vi. Installed on all unprotected sides or edges when used around holes.
- vii. When guardrail systems are used around holes that serve as points of access (such as ladder ways), 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, or
 - Is offset to prevent an employee from walking or falling into the hole.
- viii. Guardrail systems on ramps and runways are installed along each unprotected side or edge.
- ix. Manila or synthetic rope used for top rails or midrails are inspected as necessary to

ensure that the rope continues to meet the strength requirements in 29 CFR 1910.29(b)(3) & (5).

- x. Ensure guardrail systems are capable of withstanding, without failure, a force of at least 200 pounds (890 N) applied in a downward or outward direction within 2 inches (5 cm) of the top edge, at any point along the top rail.

b. Designated Areas

When CMU uses a designated area, the following requirements must be followed:

- i. The perimeter of the designated area will be delineated with a warning line consisting of a rope, wire, tape or chain that meets the requirements of 29 CFR 1910.29(d)(2) and (3).
Ensure the following:
 - Has a minimum breaking strength of 200 pounds (0.89 kN).
 - Is installed so its lowest point, including sag, is not less than 34 inches (86 cm) and not more than 39 inches (99 cm) above the walking-working surface.
 - Is 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 bullet point above.
 - Is clearly visible from 25 feet (7.6 m) away, and anywhere within the designated area.
 - Is erected as close to the work area as the task permits.
 - Is erected not less than 6 feet (1.8 m) from the roof edge for work that is both temporary and infrequent, or not less than 15 feet (4.6 m) for other work.
- ii. Employees are required to remain within the designated area while work operations are underway.
- iii. When mobile mechanical equipment, such as a powered industrial truck/forklift, is used to perform work that is both temporary and infrequent in a designated area, the warning line will be erected not less than 6 feet (1.8 m) 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 (3 m) from the unprotected side or edge that is perpendicular to the direction in which the mechanical equipment is operated.

c. Warning Line Systems

- i. Erected around all sides of the roof work area.
- ii. Erected not less than 6 feet (1.8 meters) from roof edge when mechanical equipment is not being used.
- iii. Points of access, materials handling areas, storage areas and hoisting areas shall be connected to work area by an access path formed by two warning lines.
- iv. Consist of ropes, wires or chains and supporting stanchions where the sag of the warning line is no less than 34 inches and at no point higher than 39 inches. The rope, wire or chain shall have a minimum tensile strength of 500 pounds.
- v. No employee allowed in area between roof edge and warning line without fall protection or dedicated safety monitor.
- vi. Mechanical equipment on roofs is used or stored only in areas where employees are

protected by a warning line system, guardrail system or personal fall arrest system.

d. Controlled Access Zones

- i. Defined by a control line or other means that restrict access and flagged at 6-foot intervals for visibility.
- ii. Control line to have a minimum breaking strength of 200 pounds.
- iii. All employees in a controlled access zone must comply promptly with fall hazard warnings from the safety monitor.

e. Positioning Systems

- i. An example of a position system includes a full body harness, a short lanyard and anchor point used to prevent a fall when climbing a ladder.
- ii. Rigged such that an employee cannot fall more than 2 feet (.9 meters).
- iii. Secured to an anchorage capable of supporting at least twice the potential impact load of an employee's fall or 3,000 pounds, whichever is greater.
- iv. No more than one employee may be attached to any one anchor point.
- v. Connectors, D-rings and snap-hooks:
 - shall be drop forged, pressed or formed steel, or made of equivalent materials;
 - shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system;
 - shall have a minimum tensile strength of 5,000 pounds;
 - shall be proof tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or taking permanent deformation;
 - shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snap-hook by depression of the snap-hook keeper by the connected member;
 - shall be a locking type of snap-hook designed and used to prevent disengagement of the snap-hook by the contact of the snap-hook keeper by the connected member; and
 - only locking type snap-hooks shall be used.
- vi. Unless the snap-hook is a locking type and designed for the following connections, snap-hooks shall not be engaged:
 - directly to webbing, rope or wire rope;
 - to each other;
 - to a D-ring to which another snap-hook or other connector is attached;
 - to a horizontal lifeline; or
 - to any object which is incompatibly shaped or dimensioned in relation to the snap-hook such that unintentional disengagement could occur by the connected object being able to depress the snap-hook keeper and release itself.
- vii. Positioning device systems shall be inspected by the user prior to each use for wear, damage and other deterioration, and defective components shall be removed from service.
- viii. Body belts, harnesses and components shall be used only for employee protection (as part of a personal fall arrest system or positioning device system) and not to hoist materials.

6. Personal Fall Arrest Systems (PFAS)

PFAS are used in general industry if an employee is on a walking-working surface with unprotected sides or edges that is 4 feet (1.2 meters) or more above a lower level. If the fall hazard cannot be controlled with standards rails or covers or if the work cannot be performed with scaffolds, lifts or ladders (i.e., Passive Fall Protection Systems), PFAS shall be used. If none of the fall protection systems, active or personal fall arrest, can be used or it creates a greater hazard, EHS along with the affected department will develop and implement a fall protection plan that meets OSHA standards.

Employees are not permitted to access any roofs or other areas that may expose them to falls outdoors in the event of severe weather:

- High wind (more than 40 miles/h for sustained, 60 miles/h for gusts)
- Lightning (within 10 miles radius)
- Tornado
- Severe thunderstorm
- Heat (105 °F or higher for more than 3 hours)
- Cold wind chill (-20 °F or below)

a. PFAS Components:

It is important to follow all manufacturer's instructions and warnings when it comes to PFAS. Prior to selecting fall protection, ensure each component of fall protection is ANSI Z359 approved and able to be used with the other components of fall protection.

It is best practice to ensure all components of the fall arrest system are of the same manufacturer or ensure that the manufacturer approves use with other manufactures. Information on this may be in the owner's manual or by contacting the manufacturer with any questions. EHS can assist in selection or verification of appropriate fall protection equipment.

- i. Connectors, D-rings, snap-hooks, lanyards, lifelines and anchorage are designed, constructed and installed according to the following:
 - Connectors shall be drop forged, pressed or formed steel or made of equivalent materials;
 - Connectors shall have a corrosion-resistant finish, and all surfaces and edges shall be smooth to prevent damage to interfacing parts of the system;
 - Dee-rings and snap-hooks shall have a minimum tensile strength of 5,000 pounds (22.2 kN);
 - D-rings and snap-hooks shall be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking or taking permanent deformation;
 - Snap-hooks shall be sized to be compatible with the member to which they are connected to prevent unintentional disengagement of the snap-hook by depression of the snap-hook keeper by the connected member or shall be a locking type of snap-hook designed and used to prevent disengagement of the snap-hook by the contact of the snap-hook keeper by the connected member;
 - Only locking type snap-hooks shall be used;

- Unless the snap-hook is a locking type and designed for the following connections, snap-hooks shall not be engaged:
 - directly to webbing, rope or wire rope;
 - to each other;
 - to a D-ring to which another snap-hook or other connector is attached;
 - to a horizontal lifeline; or
 - to any object which is incompatibly shaped or dimensioned in relation to the snap-hook such that unintentional disengagement could occur by the connected object being able to depress the snap-hook keeper and release itself;
 - On suspended scaffolds or similar work platforms with horizontal lifelines which may become vertical lifelines, the devices used to connect to a horizontal lifeline shall be capable of locking in both directions on the lifeline;
 - Horizontal lifelines shall be designed, installed and used under the supervision of a qualified person as part of a complete personal fall arrest system, which maintains a safety factor of at least two;
 - Lanyards and vertical lifelines shall have a minimum breaking strength of 5,000 pounds (22.2 kN);
 - When vertical lifelines are used, each employee shall be attached to a separate lifeline unless during construction of elevator shafts.
 - During the construction of elevator shafts, two employees may be attached to the same lifeline in the hoistway, provided that (1) both employees are working atop a false car that is equipped with guardrails, (2) the strength of the lifeline is 10,000 pounds [5,000 pounds per employee attached] (44.4 kN) and (3) all other horizontal lifeline criteria specified in section 6.a.i for lifelines have been met;
 - Lifelines shall be protected against being cut or abraded;
 - Self-retracting lifelines and lanyards which automatically limit free fall distance to 2 feet (0.61 m) or less shall be capable of sustaining a minimum tensile load of 3,000 pounds (13.3 kN) applied to the device with the lifeline or lanyard in the fully extended position;
 - Self-retracting lifelines and lanyards which do not limit free fall distance to 2 feet (0.61 m) or less, rip stitch lanyards, and tearing and deforming lanyards shall be capable of sustaining a minimum tensile load of 5,000 pounds (22.2 kN) applied to the device with the lifeline or lanyard in the fully extended position;
 - Ropes and straps (webbing) used in lanyards, lifelines and strength components of body belts and body harnesses shall be made from synthetic fibers; and
 - Anchorages used for attachment of personal fall arrest equipment shall be independent of any anchorage being used to support or suspend platforms and capable of supporting at least 5,000 pounds (22.2 kN) per employee

attached, or shall be designed, installed, and used as follows:

- as part of a complete personal fall arrest system which maintains a safety factor of at least two; and
 - under the supervision of a qualified person.
- ii. Limit maximum arresting force on an employee to 1,800 pounds when used with a body harness, rigged such that employees can neither free fall more than 6 feet (1.8 meters) nor contact any lower level.
 - iii. Body belts and related components may be used only for employee positioning and not for fall protection.
 - iv. PFAS and components subject to impact loading shall be removed from service until inspected and approved for use by a Competent Person.
 - v. PFAS components must be inspected prior to each use for wear by the employee intending to use the equipment. Damage and/or deteriorating equipment or equipment with defective components must be removed from service (see Appendix B for the Fall Protection Inspection Checklist to assist in the inspection).
 - vi. PFAS components must not be attached to guardrail systems.
 - vii. Components of a fall arrest system must be used only for employee fall protection or positioning and not to hoist materials.
 - viii. The information found while calculating fall clearance distance should be used to select the type of PFAS and equipment that must be used.

b. PFAS Pre-planning:

- i. EHS should be consulted to assist in the pre-planning of any task involving a fall protection system (when the fall protection system is an existing set of barriers or guardrails, EHS consultation is not required)
- ii. System Pre-planning shall include:
 - Fall clearance calculation;
 - Equipment inspection; and
 - Rescue planning

c. Fall Clearance Calculation:

A few basic measurements and equations can aid in evaluating and selection of a PFAS to determine if it will be sufficient to prevent workers from contacting a lower level.

- i. Total Fall Clearance Distance:

The total fall clearance distance is the minimum vertical distance between the worker and the lower level that is necessary to ensure the worker does not contact a lower level during a fall. The total fall clearance distance is calculated **before** a decision is made to use a PFAS. If the available distance is not greater than the total fall clearance distance, it is inappropriate to use the PFAS and a fall restraint system might be used instead. Total fall clearance distance calculations are calculated by adding the following values together:

- Lanyard length;

- The height at which the lanyard is anchored relative to where the other end attaches to the worker's harness;
- The worker's height;
- Free fall distance, which is the distance the worker falls before the PFAS begins to slow the fall. When using a PFAS, this distance must be 6 feet or less and prevent the worker from contacting a lower level;

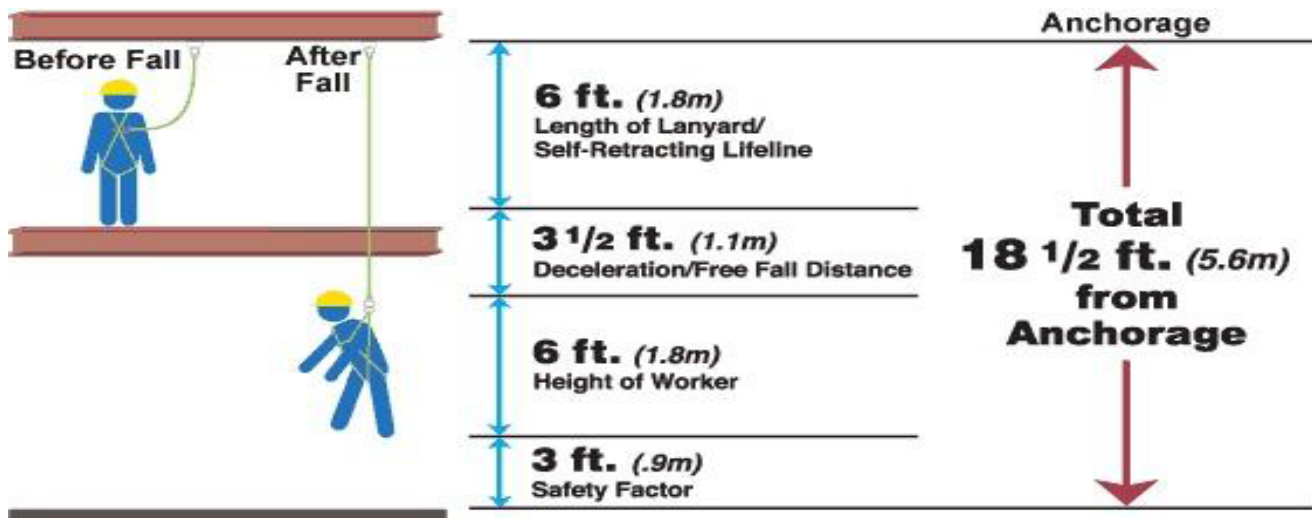
Free fall distance varies depending on the lanyard's length and where the anchor is set relative to the back D-ring on the harness;

- Deceleration distance, which is the distance the lanyard stretches to arrest the fall. Deceleration distance must be no greater than 3.5 feet;
- D-ring shift, which is the distance the D-ring moves and the harness shifts when they support the worker's full weight. As the line tugs upwards, the harness can shift so the D-ring location is higher on the worker than it was before the fall. This shift is often assumed to be one foot, but it can vary, depending on the equipment design and the manufacturer;
- Back D-ring height, which is measured as the distance between the D-ring and the worker's shoe sole while the worker is wearing the harness. This height is often standardized as five feet for six-foot-tall workers (shorter workers may also be protected using this default distance). It is necessary to adjust the back D-ring height for workers exceeding six feet; and
- Safety factor, which is an additional distance added to the total fall clearance distance to ensure there is enough clearance between the worker and the lower level after a fall. It is typically 2 feet.

The equation below shows how to add the various values, and the common assumptions to calculate total fall clearance distance. A fall arrest system will not protect a falling worker if the calculated clearance distance is greater than the actual distance available below the elevated work area (measured as the distance between the point at which a worker would be anchored and any lower surface). Once the calculation has been confirmed, the PFAS equipment will be determined (i.e., type of anchorage and lanyard).

Clearance Distance	=	Free Fall Distance	+	Deceleration Distance (lanyard/lifeline stretch/elongation)	+	D-Ring Shift (harness slip)	+	Back D-Ring Height	+	Safety Factor
<i>Calculate</i>	=	<i>See chart below</i>	+	<i>Assume 3.5 feet*</i>	+	<i>Assume 1 foot*</i>	+	<i>Assume 5 feet*</i>	+	<i>Typically 2 feet</i>

* If actual workplace values or manufacturer specifications are available, or if circumstances dictate the need to use alternative values, use them instead.



d. Equipment Inspections:

- i. FMCS shall purchase any needed passive fall protection and PFAS components;
- ii. Fall protection equipment shall be stored in a designated location in each zone/department determined by the zone manager or department head;
- iii. EHS will create an initial inventory list of fall protection equipment and house this information in Campus Optics. FMCS will help to maintain this list by notifying EHS any time that equipment is removed or added to service. EHS will update this information within Campus Optics;
- iv. Fall protection equipment shall be identified by barcodes generated through Campus Optics and shall be attached to fall protection equipment in a way that protects the barcode from weather and elements while also not covering parts of the fall protection equipment that may be damaged or worn.
 - An example of this is to laminate a barcode tag and attach it to a harness with a zip tie, key ring or other similar fashion. The barcode will be used during the inspection process to access the Campus Optics record for the specific piece of equipment and the inspection results documented;
- v. Personal Fall Protection Systems must be inspected by the employee planning to use the system before initial use and before each work shift when in use for mildew, wear, damage, and other deterioration or defective components must be removed from service (See Appendix B);
- vi. EHS shall act as the competent person and inspect fall protection equipment every six months;
 - One of the two inspections per year shall be conducted during the annual shop inspections.
- vii. Equipment that does not pass the inspection shall be removed from service immediately, taken to the EHS office, and marked "REMOVED FROM SERVICE, DO NOT USE";
- viii. Any time equipment is removed from service by EHS, the manager of the equipment

- shall be notified immediately, the reason for the equipment's removal will be provided and replacement equipment should be obtained; and
- ix. EHS shall update Campus Optics to reflect these changes.

e. Rescue Plan:

- i. A rescue plan is required to be included as part of the fall protection pre-plan. Plan details must include:
- What events would occur if an employee fell and
 - Listing of equipment or resources necessary to rescue employees.
- ii. Managers' planning operations that utilize fall arrest systems must notify EHS as soon as possible during the planning of the operation. EHS shall collaborate in the planning and shall assist in the creation of a rescue plan.
- iii. EHS will contact outside rescue services at least 24 hours before work occurs to notify of the possibility and location of a rescue.
- This rescue service is the Pittsburgh EMS Rescue Team, and they must be notified prior to work by emailing the chief of this unit, currently Anthony Darkowski Anthony.Darkowski@pittsburghpa.gov;
 - Pittsburgh EMS Rescue Team must be used instead of University Police because Pittsburgh EMS Rescue Team have the resources and abilities to rescue a fall victim from heights;
- iv. It is vitally important to know that in the event of an employee fall, all other work is required to be stopped and all personnel must focus on the prompt rescue of the employee. Rescue efforts must begin immediately, and the fall arrest victim must be relieved from suspension force within 15 minutes of the fall; and
- v. Notify emergency services immediately in the event of a fall. If the fall occurs on campus, call 911 and then contact University Police by calling 412-268-2323. If the event occurs off campus, call 911.

7. Training

Each employee who may be exposed to fall hazards, including each employee who uses Personal Fall Protection Systems or who is required to be trained as outlined in 29 CFR 1910 Subpart D, will receive training. This plan enables each employee to recognize fall hazards. Employees will be trained in the procedures to be followed to minimize these hazards.

a. Training Curriculum:

Each employee shall receive training from qualified EHS personnel or a qualified vendor. The topics covered shall include:

- i. Fall Hazards:
- The nature of fall hazards in the work area and how to recognize them.
 - The procedures to be followed to minimize fall hazards.
 - The correct procedures for installing, inspecting, operating, maintaining, and disassembling the Personal Fall Protection Systems.

- The correct use of Personal Fall Protection Systems and equipment, including, but not limited to, proper hook-up, anchoring, and tie-off techniques and methods of equipment inspection and storage, as specified by the manufacturer.
 - Prevention and avoidance of slip/trip/fall hazards.
 - General ladder requirements including inspection, erecting, and securement.
- ii. Equipment Hazards:
- Proper care, inspection, storage and use of fall protection equipment before an employee uses the equipment.
 - Each employee who uses a designated area must be trained in the proper set-up and use of the area.

b. Certification of Training:

- i. FMCS and EHS shall maintain a record of the latest training certification for each employee within [SciShield](#) and that record shall contain:
- The name, and Andrew ID of employees being trained.
 - The date(s) of the training.
 - Identification of person that conducted the training.
- ii. FMCS zone managers or department heads of trained employees are responsible for collecting training documentation from the trainer or trained employee. Copies of this documentation must be emailed to EHS who will then update the affiliated training records in [SciShield](#).
- iii. Retraining
- Documented refresher training will be conducted annually and more frequently if needed. Retraining will be provided and documented under the following circumstances:
- When changes to the workplace result in a change to fall hazards;
 - When there are changes to the types of fall protection systems or equipment to be used; or
 - When an employee requires more training to increase their knowledge and skill to a level necessary to use equipment and perform the job safely.

8. Accident Investigation Reporting and Analysis

All fall-related incidents shall be documented using the [Supervisor's Injury/Illness Report](#). Each incident will be investigated using this form. Any involved employee, employee supervisor, and EHS shall work together to investigate the incident and shall review each form and provide feedback regarding necessary corrective actions. All incidents falling under the parameters of this plan shall be analyzed annually to determine trends and the need for further control measures.

9. Revisions

Date	Documented Changes	Initials
07/15/2024	Initial	EHS/FMCS

Appendix A – Walking-Working Surface Hazards

Each employee on a walking-working surface with an unprotected side or edge that is 4 feet (1.2 meters) or more above a lower level will be protected from falling by passive fall protection measures or by a PFAS. The information below provides additional definitions and specific walking-working surface hazards that can be found in the workplace.

1. Definitions

- a. **Alternating tread-type stair** - A type of stairway consisting of a series of treads that usually are attached to a center support in an alternating manner such that an employee typically does not have both feet on the same level while using the stairway.
- b. **Cage** - An enclosure mounted on the side rails of a fixed ladder or fastened to a structure behind the fixed ladder that is designed to surround the climbing space of the ladder. A cage also is called a “cage guard” or “basket guard.”
- c. **Carrier** - The track of a ladder safety system that consists of a flexible cable or rigid rail attached to the fixed ladder or immediately adjacent to it.
- d. **Dangerous Equipment** - Equipment, such as vats, tanks, electrical equipment, machinery, equipment or machinery with protruding parts, or other similar units, that, because of their function or form, may harm an employee who falls into or onto the equipment.
- e. **Dockboard** - 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.
- f. **Grab Bar** - An individual horizontal or vertical handhold installed to provide access above the height of the ladder.
- g. **Hoist Area** - Any elevated access opening to a walking-working surface through which equipment or materials are loaded or received.
- h. **Ladder Safety System** - A system designed to eliminate or reduce the possibility of falling from a ladder. A ladder safety system usually consists of a carrier, safety sleeve, lanyard, connectors, and body harness. Cages and wells are not ladder safety systems.
- i. **Runway** - An elevated walking-working surface, such as a catwalk, a foot walk along shafting, or an elevated walkway between buildings.
- j. **Stair Rail or Stair Rail System** - A barrier erected along the exposed or open side of stairways to prevent employees from falling to a lower level.
- k. **Step Bolt (pole step)** - A bolt or rung attached at intervals along a structural member used for foot placement and as a handhold when climbing or standing.

2. Holes

Each cover for a hole in a walking-working surface will be engineered so that it can support

without failure, at least twice the maximum intended load that may be imposed on the cover at any one time; and secured to prevent accidental displacement.

CMU will help ensure that each employee is protected from falling, tripping, or stepping through:

- a. Any hole (including skylights) that is 4 feet (1.2 m) or more above a lower level by one or more of the following: covers, guardrail systems, travel restraint systems, or PFAS.
- b. Any hole that is less than 4 feet (1.2 m) above a lower level must be protected by covers or guardrail systems.
- c. 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 (e.g., holes located in aisle spaces), the employer may protect employees from falling into the hole by using a removable guardrail system on all exposed sides and a hinged floor hole cover that meets the following criteria:
 - Covers located in roadways and vehicular aisles shall be capable of supporting, without failure, at least twice the maximum axle load of the largest vehicle expected to cross over the cover;
 - All other covers shall be capable of supporting, without failure, at least twice the weight of employees, equipment, and materials that may be imposed on the cover at any one time;
 - All covers shall be secured when installed to prevent accidental displacement by the wind, equipment, or employees; and
 - All covers shall be color coded, or they shall be marked with the word "HOLE" or "COVER" to provide warning of the hazard.
- d. A ladder way floor hole or ladder way platform hole must be protected by a guardrail system and toe boards erected on all exposed sides, except at the entrance to the hole, where a self-closing gate or an offset must be used.
- e. A hatchway and chute floor hole must be protected by:
 - A hinged floor-hole cover that meets the criteria in 29 CFR 1910.29 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.
 - When guardrail systems are used around holes that serve as points of access (such as ladder ways), the guardrail system opening (1) 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 requirements in section 5.a.; or (2) is offset to prevent an employee from walking or falling into the hole.
 - Guardrail systems on ramps and runways are installed along each unprotected side or edge.
 - 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. Runways, Catwalks and Similar Walkways

- a. Employees on a runway or similar walkway will be protected from falling 4 feet (1.2 m) or more to a lower level by a guardrail system. If after a review and inspection of the area EHS determines it is not feasible to have guardrails on both sides of a runway which is at least 18" wide and used exclusively for a special purpose, the guardrail on one side of the runway may be omitted and each employee will be provided with and uses a personal fall arrest system or travel restraint system.
- b. Using a ladder near a fall protection guardrail or barrier where the employee will be elevated above the minimum of 39 inches from the top of top rail is prohibited without further fall protection in place.
- c. Employees may not make or build their own catwalk. This includes using any materials such as plywood to create walkways. This is especially important in areas such as attics where a surface may exist but does not have the strength to support the body weight of an employee and would cause a fall to a lower level if used as a walking/working surface.

4. Dangerous Equipment

- a. Each employee less than 4 feet (1.2 m) above dangerous equipment will be 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. Examples of this include running machinery that can crush or trap, live electrical parts/wires, drowning possibilities such as cooling towers, etc.
- b. Each employee 4 feet (1.2 m) or more above dangerous equipment must be protected from falling by guardrail systems, safety net systems, travel restraint systems, or PFAS.

5. Openings

- a. Each employee on a walking-working surface near an opening, including one with a chute attached, where the inside bottom edge of the opening is less than 39 inches (99 cm) above that walking-working surface and the outside bottom edge of the opening is 4 feet (1.2 m) or more above a lower level is protected from falling by the use of guardrail systems, safety net systems, travel restraint systems, or PFAS.

6. Working on Sloped Roofs

- a. Working on ANY sloped roof is always prohibited. No employee shall complete work on any sloped roofs at any time.

7. Dockboards

- a. CMU will help ensure that each employee on a dockboard is protected from falling 4 feet (1.2 m) or more to a lower level by a guardrail system or handrails. However, a guardrail system or handrails are not required when:
 - Dockboards are being used solely for materials-handling operations using motorized equipment;
 - Employees engaged in these operations are not exposed to fall hazards greater than 10 feet (3 m); and
 - Those employees have been trained in accordance with 29 CFR 1910.30.
- b. Additionally, all dockboards used will meet the following requirements:
 - Dockboards must be strong enough to support the maximum intended load.
 - For any dockboards put into initial services on or after January 17, 2017, CMU will evaluate if there is a hazard of transfer vehicles running on the dockboard's edge. If such a hazard exists, the dockboards will be designed, constructed, and maintained to prevent transfer vehicles from running off the dockboards edge.
 - Portable dockboards will be secured in position, either by being anchored or equipped with devices which will prevent their slipping.
 - Measures such as wheel chocks or sand shoes will be utilized to prevent the transport vehicle on which a dockboards is placed from moving while employees are on the dockboards.
 - Handholds, or other effective means, will be provided on portable dockboards to permit safe handling.

7. Protection from Falling Objects

- a. When an employee is exposed to falling objects, each employee must wear a hard hat to protect themselves from the potential falling object. In addition, employees will be protected from falling objects by one or more of the following:
 - Erect toe boards, screens, or guardrail systems to prevent objects from falling from higher levels;
 - Toeboards used for falling object protection must:
 - Be 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 (9 cm) as measured from the top edge of the toeboard to the level of the walking-working surface;
 - Not have more than a 0.25-inch (0.5-cm) clearance or opening above the walking-working surface;
 - Be solid or do not have any opening that exceeds 1 inch (3 cm) at its greatest dimension; and

- Have a minimum height of 2.5 inches (6 cm) when used around vehicle repair, service, or assembly pits. Toeboards may be omitted around vehicle repair, service, or assembly pits when the employer can demonstrate that a toeboard would prevent access to a vehicle that is over the pit.
- Be capable of withstanding, without failure, a force of at least 50 pounds (222 N) applied in any downward or outward direction at any point along the toeboard. Erect a canopy structure and keep potential fall objects far enough from edge of the higher level so that those objects would not go over the edge if they were accidentally displaced;
- Install Signage to the area where objects could fall, prohibit employees from entering the barricaded area, and keep objects that may fall far enough away from the edge of a higher level so that those objects would not go over the edge if they were accidentally displaced;
- Where tools, equipment, or materials are piled higher than the top of the toeboard, paneling or screening must be installed from the toeboard to the midrail of the guardrail system and for a length that is sufficient to protect employees below. If the items are piled higher than the midrail, the employer also must install paneling or screening to the top rail and for a length that is sufficient to protect employees below;
- All openings in guardrail systems must be small enough to prevent objects from falling through the opening; and
- Canopies used for falling object protection must be strong enough to prevent collapse and to prevent penetration by falling objects.

Appendix B - Fall Protection Equipment Checklist

Fall protection equipment must be inspected prior to each use and on an annual basis. Use the applicable sections of this form to document the equipment inspection process. Questions, contact EHS safety@andrew.cmu.edu.

Inspector:	Date of Inspection:		
Zone:	Type of Inspection: ☐ Pre-Use ☐ Annual		
Equipment Model/Serial Numbers:			
Harness Inspection	Accepted	Rejected	Comments
Hardware: D-rings, buckles, keepers, and back pads. Inspect for damage, distortion, sharp edges, burrs, cracks and corrosion.			
Webbing: Inspect for cuts, burns, tears, abrasions, frays, excessive soiling and discoloration.			
Stitching: Inspect for pulled or cut stitches.			
Labels: Inspect, making certain all labels are securely held in place and are legible.			
Lanyard Inspection	Accepted	Rejected	Comments
Hardware: Snap hooks, carabiners, adjusters, keepers, thimbles and D-rings. Inspect for damage, distortion, sharp edges, burrs, cracks, corrosion and proper operation.			
Webbing: Inspect for cuts, burns, tears, abrasions, frays, excessive soiling and discoloration.			
Stitching: Inspect for pulled or cut stitches.			
Synthetic Rope: Inspect for pulled or cut yarns, burns, abrasions, knots, excessive soiling and discoloration.			
Energy Absorbing Component: Inspect for elongation, tears and excessive soiling.			
Labels: Inspect, making certain all labels are securely held in place and are legible.			
Snap Hooks/Carabiners	Accepted	Rejected	Comments
Physical Damage: Inspect for cracks, sharp edges, burrs, deformities and locking operations.			
Excessive Corrosion: Inspect for corrosion, which affects the operation and/or the strength.			
Markings: Inspect and make certain marking(s) are legible.			