CODE OF PRACTICE FOR FALL PROTECTION/WORK AT HEIGHT

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1. FALL PROTECTION ADMINISTRATIVE STANDARD

1.1. Scope

This policy will apply to all work done by employees and/or contractors on property belonging to the University of Calgary (U of C), inclusive of procedures, equipment and installation of Fall Protection Systems and Equipment.

1.2. Purpose

The U of C is committed to providing a safe work environment for its employees and preventing occupational injuries due to falls. In all areas related to fall protection The University of Calgary shall meet *or exceed* the requirements of the Occupational Health and Safety (OH&S) Code.

Fall Protection (FP) is an integral part of our commitment to a safe work environment. Any time a worker is exposed to a fall hazard there will be a procedure and equipment to reduce and/or eliminate the hazard of working at height.

Fall Protection must be used if a worker is within 2 meters of an edge from which they may fall

a) A vertical distance of 3 meters or more
b) A vertical distance of less than 3 meters where there is an unusual possibility of injury, or
c) Into or onto a hazardous substance or object, or through an opening on a work surface

There is an unusual possibility of injury, if the injury would be worse than falling onto a solid, flat surface

A worker at a permanent work area must be protected from falling by a guardrail if the worker may fall a vertical distance of more than 1.2 meters but less than 3 meters

Fall Protection shall be achieved through a hierarchy of controls that will involve all levels of management, supervisory and field personnel.

1.2.1 Fall Protection and Working Alone

The U of C requires a minimum of 2 people to be present at all times when the use of a travel restraint or fall arrest system is required (Buddy System).

2. RESPONSIBILITIES

2.1. Environment Health & Safety (EH&S)

- review this COP annually in consultation with representatives from Facilities Management.
- Appoint a Program Administrator

2.2 Program Administrator

- review program at least annually, and upon changes to the Alberta Occupational Health and Safety Code
- approve all program content and amendments

2.3. Group Leader/Supervisors

- Be familiar with the contents of this COP
- competent and trained in Fall Protection
- ensure employees and/or contractors under their supervision are trained and competent to complete the task in accordance with this program
- Monitor employee compliance with this program

2.4. Site Person in Charge (PIC)

- conversant with the COP requirements
- competent and trained in Fall Protection Procedures as outlined in the COP
- ensure work at height is performed in accordance with the Fall Protection Plan
- ensure all workers have proof of valid Fall Protection training

2.5. Employees

- must be trained by a competent person
- provide proof of training on demand
- comply with the requirements of this COP
- perform all work at height in accordance with the Fall Protection Plan
- must follow U of C FP COP for all work at height including third party controlled sites e.g. General contractor construction sites, municipal sites, or other sites not on U of C property but work is conducted by U of C employees

2.6. Contractor's/ Visitors

- provide a copy of their Fall Protection Plan along with proof of training for review by EH&S
- where the U of C COP requirements exceed those of the Contractors, the University requirements shall take precedence.

2.7. Prime Contractors

- Must adhere to current OH&S Code Fall Protection requirements
- EH&S shall reserve the right to review the Contractors Code of Practice and/ or tour the worksite

3. TRAINING

All personnel required to use fall protection equipment must be trained in its use by a competent person. **The training referred to must include, at a minimum, the following elements as part of the theory component of the training:**

(a) a review of current Alberta legislation pertaining to fall protection;
(b) an understanding of what a fall protection plan is;
(c) fall protection methods a worker is required to use at a work site;
(d) identification of fall hazards;
(e) assessment and selection of specific anchors that the worker may use;
(f) instructions for the correct use of connecting hardware;
(g) information about the effect of a fall on the human body, including

- (i) maximum arresting force,
- (ii) the purpose of shock and energy absorbers,
- (iii) swing fall,
- (iv) free fall;

(h) pre-use inspection;
(i) emergency response procedures to be used at the work site, if necessary; and
(j) practice in

- (i) inspecting, fitting, adjusting and connecting fall protection systems and components, and
- (ii) emergency response procedures.

In addition to the training described a worker must be made aware of the fall hazards particular to that work site and the steps being taken to eliminate or control those hazards.

Personnel expected to conduct a site rescue will be trained in the procedures and techniques to conduct such a rescue.

4. HAZARD IDENTIFICATION & ASSESSMENT –

While there are several identified tasks where fall protection is normally required, every task undertaken by a worker can have inherent risks associated with it. It is the responsibility of the worker to complete a Hazard Assessment to assess their current task, the risk associated with it and what controls have been put in place to reduce and/or eliminate that risk.

A Fall Hazard exists when:
(1)(a) a worker will be within 2 meters of an unprotected edge and
(b) may fall 3 meters or more, or

(c) there is an unusual possibility of injury if a worker falls less than 3 meters.

(2) For the purposes of this Code of Practice, there is an unusual possibility of injury if the injury may be worse than an injury from landing on a solid, flat surface.

Once a fall hazard is identified a work procedure shall be developed to ensure that the risk of working at height is minimized, or if at all possible, eliminated. For all tasks where a fall hazard exists, a Fall Protection Plan shall be used to assess the hazard and detail procedures to reduce that hazard.

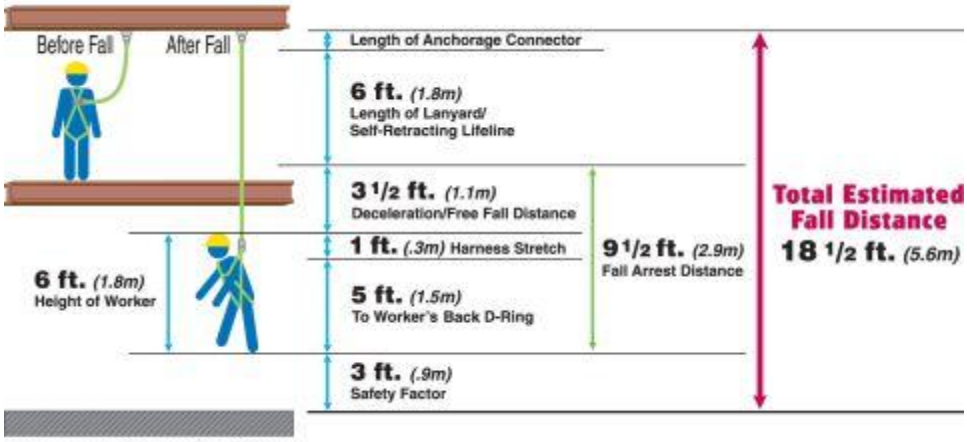
4.1. Fall Protection Plan

Where a worker may fall 3 metres or more and is not protected by guardrails, a Fall Protection Plan must be used to control the fall hazard in compliance with the OH&S Code:

A fall protection plan must specify
(a) the fall hazards at the work site,
(b) the fall protection system to be used at the work site,
(c) the anchors to be used during the work,
(d) that clearance distances below the work area, if applicable, have been confirmed as sufficient to prevent a worker from striking the ground or an object or level below the work area, (see diagram below)
(e) the procedures used to assemble, maintain, inspect, use and disassemble the fall protection system, where applicable, and
(f) the rescue procedures to be used if a worker falls and is suspended by a personal fall arrest system or safety net and needs to be rescued.

The fall protection plan must be available at the work site and reviewed with workers before work with a risk of falling begins.

When conditions affecting FP change, the FP Plan must be updated.



http://www.millerfallprotection.com/smart-solutions/connecting-devices/calculating-fall-clearance-3
(Miller Fall Protection)

The following are examples of activities that may require a Fall Protection Plan during their completion. It should be noted that this is not an exhaustive list.

- Roof Top Repairs and maintenance
- Gutter Cleaning
- Work around Skylights, Pits and Sumps
- Work from a Ladder
- Working from an Elevated Work Platform i.e. Scissor or boom lift
- Erecting and working from Scaffolding
- Work around Pool while empty

4.2 Elevated Work Platforms, Aerial Devices, Man Baskets

Experience in Alberta about ejections has resulted in this subsection of the OH&S Code explicitly requiring that workers use a personal Travel Restraint or Fall Arrest System when working from a boom‐supported work platform, boom supported aerial device, or telescopic forklift truck work platform e.g. zoom boom. As presented in this subsection, two conditions must be met.

1. the worker's personal fall arrest system must be connected to an anchor point. If the work platform manufacturer does not provide an anchor point, then an anchor point certified by a professional engineer to the requirements of the CSA Standard Z259.16‐04, *Design of active fall‐protection systems* must be used. While this could mean having to add an engineered "hard" anchor point to the boom, anchor slings designed for use with booms are also available. If such an anchor sling is used, a professional engineer is still required to specify the limits under which that sling anchor can be safely used without affecting the stability of the machine.

2. The lanyard is to be short enough to prevent the worker from being ejected, yet long enough to allow the worker to perform work.

Work platforms come in square and rectangular shapes. Because of the physical shape of the work platform, the location of the anchor points, and the need for workers to be able to move about the entire platform, it may be *impossible* to both limit the length of the lanyard and still allow a worker to perform work unimpeded. The result may be a compromise.

The personal fall arrest system, which must include a shock absorber can function as a travel restraint system preventing the worker from being ejected. However, if the lanyard is too long to prevent ejection, then the shock absorber will help limit arrest forces on both the worker and the platform's anchor point in the event of an ejection and fall.

4.3**. Fixed ladders and climbable structures**

Applies to fixed ladders and climbable structures constructed and installed after July1, 2009.

A ladder cage is a permanent structure attached to a ladder to provide a barrier between the worker and the surrounding space. It serves to support a worker if the worker needs to rest against a barrier.
A ladder cage is not a means of fall protection.

If a worker is working from or on a fixed ladder or climbable structure at a height of 3 meters or more and is not protected by a guardrail, continuous protection from falling is provided by;

(a) integral fall protection system or
(b) an alternate fall protection system meeting the requirements of the OH&S Code

A fixed ladder on a scaffold is subject to the requirements of OH&S Code 2009 Part 23.

4.4 Portable Ladders

A worker may work from a portable ladder without using a personal fall arrest system in

circumstances where it is not reasonably practicable to do so. The most common example of such a situation is when an anchor of sufficient strength is unavailable or too impracticable to use. ***Subject to the following conditions***:

(1) the work must be a “light duty task”, such as inspection or painting. The work done at each spot where the ladder is set up must be less than approximately 15 minutes in length;

(2) while doing the task, the worker must keep his or her centre of gravity (indicated by the belly button) between the side rails of the ladder; and
(3) the worker must maintain three points of contact whenever the worker extends an arm beyond a side rail

4.5 Ladderway openings

Ladderway floor openings and platforms are normally guarded by a standard guardrail and toe board on all exposed sides, except at the entrance to the opening . A self‑closing double bar safety gate or equally effective means must be provided at the opening to prevent persons from walking directly into the opening and falling.

5. HIEARCHY OF CONTROLS

Subject to a hazard assessment the Fall Protection Hierarchy shall be as follows:

1. **Eliminate the Fall Hazard** if technically and economically feasible
2. **Guardrail - Permanent or Portable** (an area protected by guardrails does not require a Fall Protection Plan)
3. ***A Travel Restraint System** that will not allow a worker to be in a position to fall
4. **Safety Nets**
5. ****A Fall Arrest System**
6. *****Procedure-based fall protection system**.

*A Rope Grab used for Travel Restraint must be of a manual type or be set to manual mode if it is a dual (Automatic or Manual) type.

**If a Fall Arrest System is used particular attention is required to calculate the Total Fall Distance (TFD) and ensure adequate Clearance Distance is available.*

A Procedure Based System may ***only be used if:
(a) it is not reasonably practicable to use one of the fall protection systems described in this Part, and
(b) use of procedures in place of fall protection equipment is restricted to the following situations:
(i) the installation or removal of fall protection equipment;
(ii) roof inspection;
(iii) emergency repairs;
(iv) at-height transfers between equipment and structures if allowed by the manufacturer’s specifications; and
(v) situations in which a worker must work on top of a vehicle or load and the requirements of this COP have been met.

A supervisor must ensure that:
(a) a hazard assessment in accordance with the requirements of Part 2 is completed before work at height begins,
(b) the procedures to be followed while performing the work must be in writing and available to workers before the work begins,
(c) the work is carried out in such a way that minimizes the number of workers exposed to a fall hazard while work is performed,
(d) the work is limited to light duty tasks of limited duration,

(e) the worker performing the work is competent to do it,
(f) when used for inspection, investigation or assessment activities, these activities take place prior to the actual start of work or after work has been completed, and
(g) the procedures do not expose a worker to additional hazards.

Hierarchy of Controls Flowchart

Is the use of an Engineering Control i.e. Guardrail compliant with the OH&S Code practical?

If Not …

Is the use a Travel Restraint System practical?

If Not ….

Is the use a Safety Net meeting the requirements of the OH&S Code practical?

If Not …

Use a Personal Fall Arrest System.

If the use of a PFAS is still not practical, an alternative method i.e. Procedure based system meeting the requirements of the OH&S Code Part 9 must be used

5.1 Fall Protection on Vehicles and Loads

If a worker may have to climb onto a vehicle or its load at any location and FP is not reasonably practical:
(a) take steps to eliminate or reduce the need to climb onto the vehicle or its load, and
(b) ensure that the anchor requirements of this Code are met.

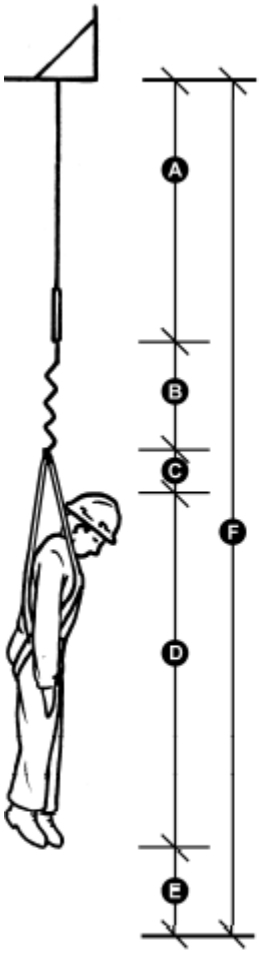
A worker must not climb onto a load if the load is not secured against movement.

5.2 Clearance, Maximum Arresting Force and Swing

A personal fall arrest system must be arranged so that:

1. a worker cannot hit the ground, an object which poses an unusual possibility of injury, or a level below the work area.
2. A personal Fall Arrest System incorporates a full body harness and shock absorber (shock absorber does not apply to installed fixed ladder systems unless specified by the manufacturer)
3. a personal fall arrest system without a shock absorber limits a worker's free fall distance to 1.2 meters.
4. limits the maximum arresting force on a worker to 6 kilonewtons, unless the worker is using an E6 type shock absorber in accordance with the manufacturer's specifications, in which case the maximum arresting force must not exceed 8 kilonewtons.
5. vertical distance of a fall is limited by
    (a) selecting the shortest length lanyard that will still permit unimpeded performance of the worker's duties, and
    (b) securing the lanyard to an anchor no lower than the worker's shoulder height.
6. if the shoulder height anchor required is not available, a worker must secure the lanyard to an anchor that is located as high as is reasonably practicable.
7. **i**f it is not reasonably practicable to attach to an anchor above the level of a worker's feet, the worker must ensure that the clearance and maximum arresting force requirements are met.

Clearance distance



Assumptions:
The worker is 1.8 m (6 ft.) tall using a 1.8 m (6 ft.) long lanyard. The combined weight of the worker, clothing, and tool belt is at least 100 kg (200 lbs).

A Length of lanyard – 1.8 m (6 ft.)

B 1.1 m (3.5 ft) due to shock absorber elongating — 1.75 m (5.75 ft) for European shock absorber

C Harness stretch plus D-ring sliding – 0.3 m (1 ft.) for regular harness and 0.75 m (2.5 ft) for stretch harness

D Height of worker – 1.8 m (6 ft)

E Safety factor – clearance below feet of 0.6 m (2 ft)

F A+B+C+D+E
Overall minimum clearance is 5.3 m (17.3 ft) to 5.75 m (18.9 ft) beneath the anchor

6. ANCHORS

6.1 Anchor strength — permanent

Anchors installed after July 1, 2009 must have a minimum breaking strength per attached worker of 16 kilonewtons or two times the maximum arresting force in any direction in which the load may be applied.

Anchors installed prior to July1, 2009 must have a minimum breaking Strength of 22.2 kN. If the structure to which the anchor is attached is not capable of withstanding 22.2 kN, an anchor designed and installed capable of withstanding twice the maximum arrest force may be used.

An anchor rated at two times the maximum arresting force must be designed, installed and used in accordance with
(a) the manufacturer's specifications, or
(b) specifications certified by a professional engineer

This section does not apply to anchors of Horizontal Lifelines, which may be subjected to much higher forces.

6.2. Flexible and rigid horizontal lifeline systems

A flexible horizontal lifeline system manufactured on or after July1, 2009 meets the requirements of
(a) CSA Standard Z259.13-04, *Flexible Horizontal Lifeline Systems*, or
(b) the applicable requirements of CSA Standard Z259.16-04, *Design of Active Fall-Protection Systems*.
A rigid horizontal fall protection system must be designed, installed and used in accordance with
(a) the manufacturer's specifications, or
(b) specifications certified by a professional engineer.

6.2.1. Installation of horizontal lifeline systems

Before a horizontal lifeline system is used, a professional engineer, a competent person authorized by the professional engineer, the manufacturer, or a competent person authorized by the manufacturer certifies that the system has been properly installed according to the manufacturer's specifications or to specifications certified by a professional engineer.

6.3. Anchor strength — temporary

A temporary anchor used in a *travel restraint system*:
(a) has a minimum breaking strength in any direction in which the load may be applied of at least 3.5 kilonewtons per worker attached,
(b) is installed, used and removed according to the manufacturer's specifications or specifications certified by a professional engineer,
(c) is permanently marked as being for travel restraint only, and
(d) is removed from use on the earliest of
    (i) the date on which the work project is completed, or
    (ii) the time specified by the manufacturer or professional engineer.

A temporary anchor used in a *personal fall arrest system*
(a) has a minimum breaking strength in any direction in which the load may be applied of at least 16 kilonewtons or two times the maximum arresting force per worker attached,
(b) is installed, used and removed according to the manufacturer's specifications or specifications certified by a professional engineer and,
(c) is removed from use on the earliest of
    (i) the date on which the work project for which it is intended is completed, or
    (ii) the time specified by the manufacturer or professional engineer.

6.4 Duty to use anchors

Workers using a personal fall arrest system or a travel restraint system, must ensure:
a) that it is safely secured to an anchor that meets the requirements of this Code.
b) it is visually inspected prior to attaching a fall protection system.
c) a damaged anchor is not used until the anchor is repaired, replaced or re-certified by the manufacturer or a professional engineer.
d) uses an anchor connector appropriate to the work.
e) an anchor connector appropriate to the work is used
f) is not part of an anchor used to support or suspend a platform.

6.5 Wire rope sling as anchor

A wire rope sling used as an anchor must be terminated at both ends with a Flemish eye splice rated to at least 90 percent of the wire rope's minimum breaking strength.

6.6 Water danger

Use an appropriate fall protection system in combination with a life jacket or personal flotation device if the worker may fall into water that exposes the worker to the hazard of drowning, or could drown from falling into the water, from other than a boat.

7. EQUIPMENT

7.1. Selection/Care/Use

Equipment for Fall Protection Systems must be selected and used according to the OH&S Code, relevant CSA, ANSI/ASSE or CEN Standards. As per manufacturers' recommendations and legislated requirements, shall be inspected prior to use by the worker using the equipment and at least annually by a competent person. It is imperative that workers follow the manufacturer's guidelines in the use, care and maintenance of the specific equipment used.

A Personal Fall Arrest System must ensure:

1) a worker cannot hit the ground or an object or level below the work area.
2) limits the maximum arresting force on a worker to 6 kilonewtons unless the worker is using an E6 shock absorber in accordance with the manufacturer's specifications in which case the maximum arresting force must not exceed 8 kilonewtons.
3) limit the vertical distance of a fall by selecting the shortest length lanyard that will still permit unimpeded performance of the worker's duties, and securing the lanyard to an anchorage connector no lower than the worker's shoulder height.
4) that a life safety rope is installed and used in a manner that minimizes the hazards of swinging and limits the swing drop distance to 1.2 meters if a worker falls.
5) If a shoulder height anchorage connector required by subsection (3) (b) is not available, a worker must secure the lanyard to an anchor point that is as high as reasonably practicable.
6) If it is not reasonably practicable to attach to an anchorage connector above the level of a worker's feet, the worker must ensure that the clearance and maximum arresting force requirements of subsections (1) and (2) are met.

Special Hazard Note Self Retracting Lifeline/ Self Retracting Device (SRL/SRD)

SRLs: It is a recognized hazard that a worker can fall and have the SRLs line (cable and/or web) come into contact with a sharp edge. Where this hazard exists the worker increases the potential of injury and/or death due to the SRL not being allowed to function properly. Wherever possible the placement and use of the SRL should take this hazard into consideration and the worker should eliminate the possibility of the SRLs line coming into contact with an unprotected sharp edge. Where the elimination of this hazard is not possible it is industry practice and University of Calgary's policy to use an energy absorber (not an energy absorbing lanyard) attached between the harness dorsal "D" ring and the SRLs snap hook. By adding this energy absorber, it reduces (not eliminates) the potential of the SRL line's failure over the sharp edge.

It is important to understand that where the energy absorber is integral to the harness it must be taken into consideration when attaching other fall protection components. For example when attaching a lanyard to the shock pack, both freefall and increased required clearances must be taken into consideration by

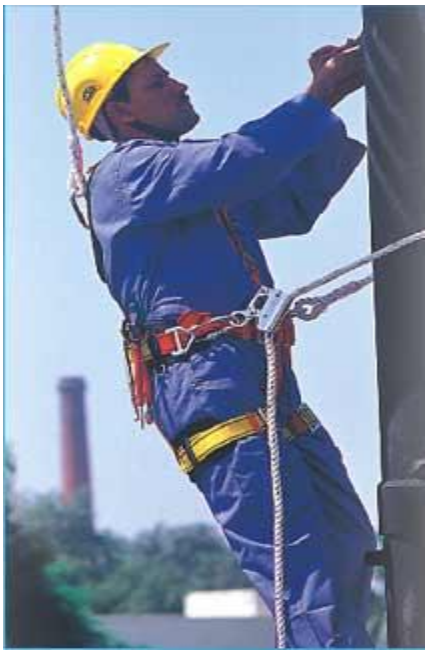
attaching a six foot lanyard to the shock pack the potential free fall when anchoring at shoulder height is now approximately 7'6" versus the normal 6'. As most manufacturers allow for a maximum freefall of 6' this becomes a serious issue.

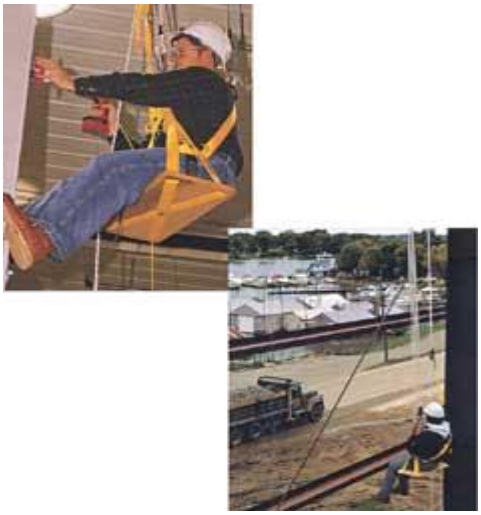
Remember that due care and attention is always necessary as no fall arrest system totally eliminates all the risk of injury. It is imperative where an energy absorber is used in conjunction with an SRL that the manufacturer's guidelines are followed and that where necessary the manufacturer has been contacted and approval is granted for this application (see appendix B, DBI technical bulletin for sharp edges).

7.2 Work Positioning

If a worker uses a work positioning system, the vertical free fall distance is restricted by the work positioning system to 600 millimeters (1.96 feet) or less.

If the worker's centre of gravity using a work positioning system extends beyond an edge from which the worker could fall, or if the work surface presents a slipping or tripping hazard because of its state or condition, a back-up personal fall arrest system must be used in combination with the work positioning system.





<http://www.karamsafetech.com/work_positioning_systems/WPS-rhino-pg001.htm>

<http://www.versafety.com/harnesses/dbi/general_info.html>

7.3 Equipment compatibility

All components of a fall protection system must be compatible with one another and with the environment in which they are used.

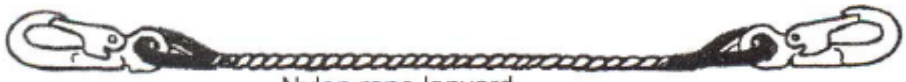
7.4 Equipment Requirements and Applicable Standards

Lanyards
A lanyard used by a worker is made of wire rope or other material appropriate to the hazard if a tool or corrosive agent could sever, abrade or burn a lanyard in use. If a worker works near an energized conductor or in a work area where a lanyard made of conductive material cannot be used safely, another effective means of fall protection must be used.

if manufactured on or after July1, 2009:
CSA Standard Z259.11 ‑ 05, Energy absorbers and lanyards,
ANSI/ASSE Standard Z359.1 ‑ 2007, Safety requirements for personal fall arrest systems, subsystems and components, or
CEN Standard EN 354: 2002, Personal protective equipment against falls from a height — Lanyards.

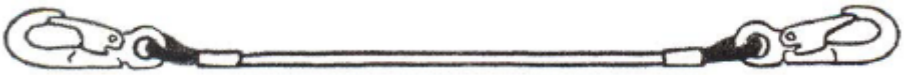
Adjustable lanyard for work positioning
An adjustable lanyard manufactured on or after July1, 2009 and used by a worker as part of a work positioning system must be approved to
(a) CSA Standard Z259.11-05, *Energy absorbers and lanyards*, as a Class F adjustable positioning lanyard, or
(b) CEN Standard EN 358: 2000, *Personal protective equipment for work positioning and prevention of falls from a height — Belts for work positioning and restraint and work positioning lanyards.*

Examples of lanyards

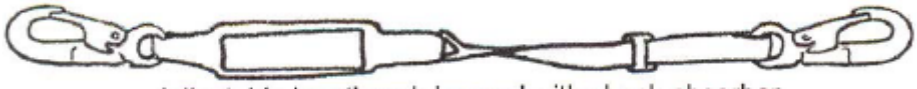


Nylon rope lanyard

Synthetic web lanyard

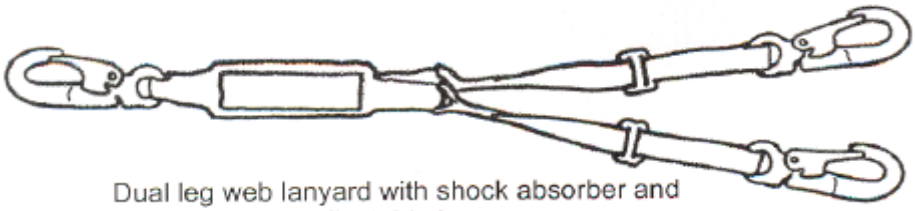


Wire rope lanyard



Adjustable length web lanyard with shock absorber

Fixed length web lanyard with shock absorber



Dual leg web lanyard with shock absorber and adjustable legs

Web lanyard with shock absorber

Shock absorbing lanyard

Shock Absorber/ Energy Absorber

The newest edition of CSA Standard Z259.11-05, *Energy absorbers and lanyards,* creates two categories of shock absorber (re-named as energy absorber by CSA), known as E4 and E6. An E4 shock absorber is equivalent to the type of shock absorber that has been in use for many years i.e. it limits the arresting force to 4 kN under normal conditions and allows the arresting force to increase to 6 kN if the shock absorber is wet and frozen.

An E6 shock absorber limits the arresting force to 6 kN under normal circumstances, allowing it to increase to 8 kN when the shock absorber is wet and frozen. CSA created the two ratings to better protect workers of different body weights**. The E4 shock absorber is intended for use by workers weighing 45-115 kg (100-254 lbs) while the E6 shock absorber is intended for use by workers weighting 90-175 kg (200-386 lbs).**

CAN/CSA –Z259.11-M92 (R1998) *Shock Absorbers for Personal Fall Arrest Systems*
if manufactured on or after July1, 2009:
CSA Standard Z259.11 ‑ 05, Energy absorbers and lanyards;
ANSI/ASSE Standard Z359.1 ‑ 2007, Safety requirements for personal fall arrest systems, subsystems and components; or
CEN Standard EN 355: 2002, Personal protective equipment against falls from a height – Energy absorbers.

Full Body Harness- **Use of Safety Belts prohibited at the U of C**, all Fall Protection Systems must use Full Body Harness equipped with a rescue step
manufactured on or after July1, 2009 is approved to
CSA Standard CAN/CSA Z259.10 ‑ 06, Full Body Harnesses,
ANSI/ASSE Standard Z359.1 ‑ 2007, Safety requirements for personal fall arrest systems, subsystems and components, or
CEN Standard EN 361: 2007, Personal protective equipment against falls from a height — Full body harnesses,

Life Safety Rope- Section 147 (1)
A life safety rope used in a fall protection system:
(a) extends downward to within 1.2 meters of ground level or another safe lower surface,
(b) is free of knots or splices throughout the travel portion except for a stopper knot at its lower end,
(c) is effectively protected to prevent abrasion by sharp or rough edges,
(d) is made of material appropriate to the hazard and able to withstand adverse effects, and
(e) is installed and used in a manner that minimizes the hazards of swinging and limits the swing drop distance to 1.2 meters if a worker falls.
f) only one worker is attached to a life safety rope at any one time unless the manufacturer's specifications or specifications certified by a professional engineer allow for the attachment of more than one worker

Can/CSA Z259.2.1-98, *Fall Arresters, Vertical Lifelines, and Rails*
manufactured on or after July1, 2009 and used in a fall protection system is approved to
a) NFPA Standard 1983, Standard on Life Safety Rope and Equipment for Emergency Services, 2006 Edition, as light ‑ use or general ‑ use life safety rope,
b) CEN Standard EN 1891: 1998, Personal protective equipment for the prevention of falls from a height — Low stretch kernmantle ropes, as Type A rope, or
meets the requirements of:
i. CSA Standard CAN/CSA ‑ Z259.2.1 ‑ 98 (R2004), Fall Arresters, Vertical Lifelines, and Rails, or
ii. ANSI/ASSE Standard Z359.1 ‑ 2007, Safety requirements for personal fall arrest systems, subsystems and components.

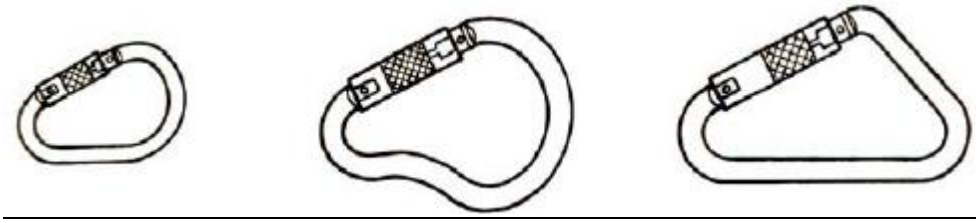
Flexible Horizontal Lifeline and Rigid Horizontal Fall Protection Systems
CSA Z259.13-04, *Flexible Horizontal Lifeline Systems*
CSA Z259.16-04, *Design of Active Fall Protection Systems*

Connecting Components
A carabiner or snap hook:
(a) must be self-closing and self-locking,
(b) may only be opened by at least two consecutive deliberate manual actions, and
(c) is marked with its breaking strength in the major axis, and the name or trademark of the manufacturer.

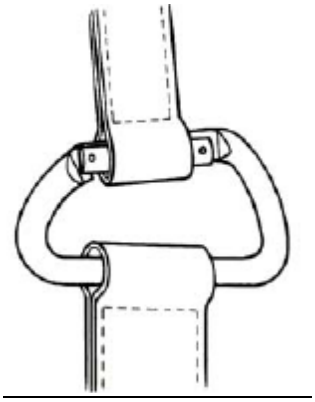
Carabiners, D-rings, O-rings, oval rings, self-locking connectors and snap hooks manufactured **on or after July1, 2009 are approved, as applicable, to**

a) CSA Standard Z259.12 - 01 (R2006), Connecting Components for Personal Fall Arrest Systems (PFAS),
b) ANSI/ASSE Standard Z359.1 - 2007, Safety requirements for personal fall arrest systems, subsystems and components,
c) CEN Standard EN 362: 2004, Personal protective equipment against falls from a height – Connectors, or
d) CEN Standard 12275: 1998, Mountaineering equipment – Connectors –Safety requirements and test methods.

Carabiner examples

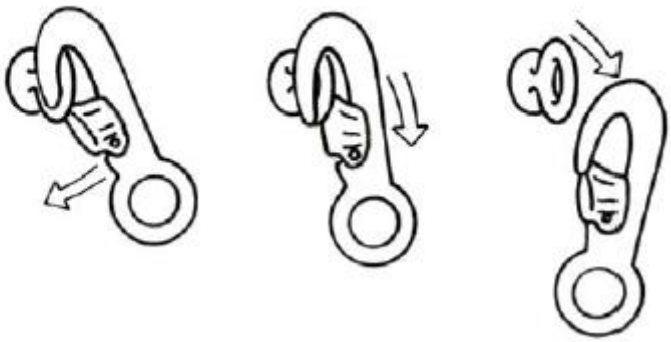


Cross-loading of a carabiner gate must also be avoided. Carabiners are designed to handle the maximum loads in line with the long axis.
Example of a cross-loaded carabiner gate



The other reason for having this self-closing, self-locking requirement is to prevent “roll-out” (see Figure 9.5). When a force is applied on the top of a non-locking gate, the gate opens, releasing the mating hardware. The most typical roll-outs have been known to occur between snap hooks and D-rings.

Example of accidental roll-out of a snap hook

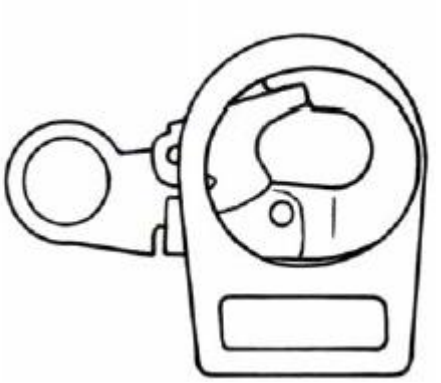


False connection

Connecting components can create a serious hazard when they engage improperly or incompletely. Such a hazard is possible when the internal dimensions of the D ring of the full body harness or body belt are very close to the external dimensions of the snap hook being connected to it (see Figure 9. 6).

A false connection relies on a friction fit between the two closely dimensioned components. The worker thinks that the components are properly connected while in fact the snap hook only sits inside the D-ring. This improper or incomplete connection — unseen by the worker if it involves the D-ring on the worker's back — is unsafe and likely to come apart during the arrest of a fall or sudden jerk on a travel restraint system.

Example of improper or incomplete connection



Workers need to be aware that aluminum carabiners and snap hooks should not be connected directly to wire rope and slid along the rope's length. Being softer than steel, aluminum wears and the carabiner or snap hook loses some of its strength.
Steel carabiners or snap hooks should be used in such cases. Manufacturers of horizontal lifelines commonly provide special steel rings or rollers into which a safe, non-wearing connection can be made.

Fall Arresting Devices

(1) **Manual Fall Arresters** are the simplest type. They are well suited to positioning systems on sloped roofs or travel restraint and may also be used for fall arrest systems. In positioning systems on sloped surfaces, the worker's weight may be supported some of the time. In travel restraint, the worker needs to correctly position the device on the life safety rope so that it is impossible to reach an unprotected edge.

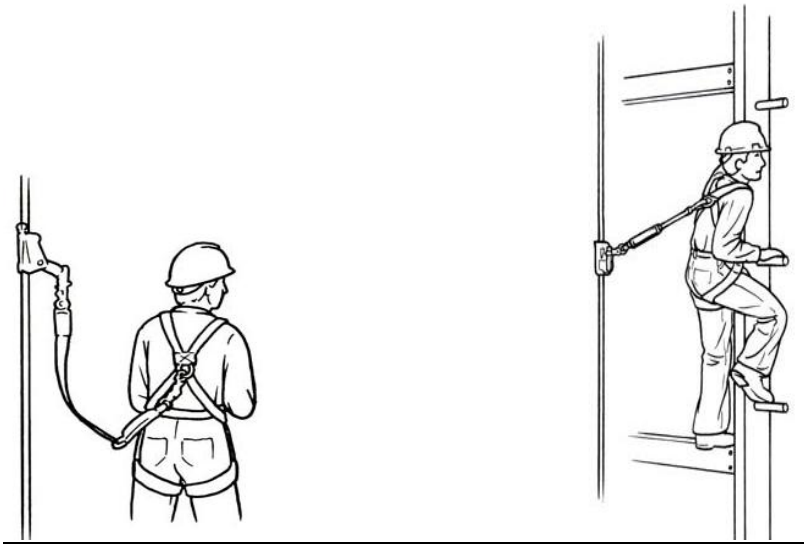
Manual fall arresters must be continually manually repositioned on the life safety rope as the worker moves. There is a danger that if a worker falls while manipulating the device, the worker may panic and squeeze the device — “Panic Grab” — holding it open and preventing it from locking onto the rope. To protect against “Panic Grab”, it is recommended that manual fall arresters be selected that have integral panic hardware that prevents this from happening.
Workers should be reminded to reposition their fall arrester frequently to eliminate unnecessary slack which increases fall distance, clearance requirements, and impact forces.

(2) **Automatic Fall Arresters** trail up and down the life safety rope as workers move vertically providing “automatic” protection. Workers do not need to manipulate these devices while moving up and down, so there is a reduced danger that the worker will “Panic Grab” the device.

The disadvantage of automatic fall arresters is that the free fall distance is increased. The standards permit the lock-off distance of the device to be up to 1 meter in the case of the referenced CSA standard and 1.4 meters for the referenced ANSI standard. In addition, when automatically trailing the worker’s movements, the device will sometimes be a lanyard length below the worker at the start of the fall, creating a free fall of twice the lanyard length plus the lock off distance of the device.

CSA Z259.2.1-98 *Fall Arresters, Vertical Lifelines and Rails*
If manufactured on or after July1, 2009 is approved to
a) CSA Standard Z259.2.1 ‑ 98 (R2004), Fall Arresters, Vertical Lifelines, and Rails,
b) ANSI/ASSE Standard Z359.1 ‑ 2007, Safety requirements for personal fall arrest systems, subsystems and components, or
c) CEN Standard EN 353 ‑ 2: 2002, Personal protective equipment against falls from a height – Part 2: Guided type fall arrestors including a flexible anchor line.

A rope adjustment device manufactured on or after July1, 2009 and used by a worker as part of a work positioning system must be approved to
(a) CSA Standard Z259.2.3-99 (R2004), *Descent Control Devices*,
(b) CEN Standard EN 341: 1997, *Personal protective equipment against falls from a height – Descender devices*, or
(c) NFPA Standard 1983, *Standard on Life Safety Rope and Equipment for Emergency Services*, 2006 Edition, classified as general or light duty.



Self Retracting Devices (SRD's)/ Self Retracting Lifelines (SRL's)
An SRL/ SRD must be anchored above the worker's head unless the manufacturer's specifications allow the use of a different anchor location, it is used in a manner that minimizes the hazards of swinging and limits the swing drop distance to 1.2 meters if a worker falls.

CSA Z259.2.2-98 *Self Retracting Devices for Personal Fall Arrest Systems*
If manufactured on or after July1, 2009 and used with a personal fall arrest system is approved to CSA Standard Z259.2.2 - 98 (R2004), Self - Retracting Devices for Personal Fall - Arrest Systems,

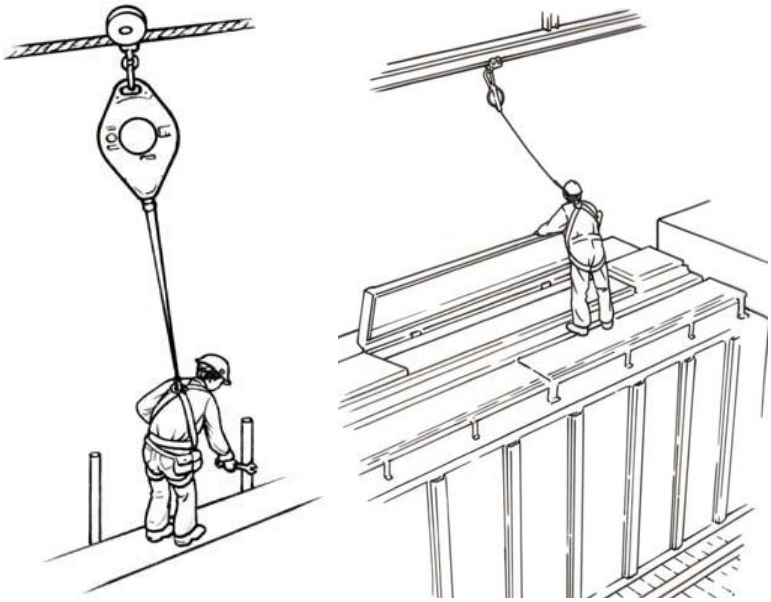
This standard requires that Type 2 and Type 3 SRDs be inspected two years after being placed into service, and annually thereafter.

CSA classifies SRDs into three types as follows:
Type 1 Self - Retracting Device (SRD)
This is a compact and lightweight SRD having a working length of 1.5 to 3.0 meters. The internal locking mechanism of a Type 1 SRL is not capable of absorbing significant amounts of energy since it does not operate as a dynamic brake, thus it should be used with a separate shock absorber if not already equipped with an integral one. The deceleration distance of a Type 1 is very short and the maximum arresting force will therefore be greater than if a Type 2 or Type 3 SRD were used.

Due to the possible high arrest force if there is any free fall (anchored below D-ring) it is recommended that Type 1 SRDs only be used where the device is anchored above the worker.

Type 2 Self - Retracting Device (SRD)
This type is heavier than a type 1, usually with a working length greater than 3 meters, that incorporates an internal brake mechanism to reduce impact forces. This type must have a visual load indicator to indicate if it has been subjected to a fall. If so, they are repairable.

Type 3 Self - Retracting Device with Retrieval Capability (RSRD)
This type of SRD performs the same fall arrest function as a Type 2 device and has a visual load indicator. However, a Type 3 device incorporates a rescue winch that permits a single rescuer to raise or lower the victim to a safe level.



Self Retracting Devices must not be used in a travel restraint system unless the length

of the lifeline prevents the worker from reaching the edge from which he or she could fall!

Descent Control Devices (Automatic and Manual)
Descent Control Devices are intended for use by an individual to descend on a line or to lower another person. Workers must be trained in the safe use of descent control devices and selection of the right device for the job.
Window Washing is an example of when a Personal Descent Device is necessary, however this work and use of these devices will be performed by a qualified contractor. Use of these devices is not covered as part of a regular U of C Fall Protection course.

CSA Z259.2.3-99 *Descent Control Devices*
If manufactured on or after July1, 2009 and used with a personal fall arrest system is approved to
(a) CSA Standard Z259.2.3 ‑ 99 (R2004), Descent Control Devices,
(b) CEN Standard EN 341: 1997, Personal protective equipment against falls from a height – Descender devices, or
(c) NFPA Standard 1983, Standard on Life Safety Rope and Equipment

Wood Pole Climbing Equipment
Wood Pole Climbing is not a normal practice performed by U of C workers and will be performed, if necessary, by qualified contractors with appropriate equipment.

7.5. Equipment maintenance and inspection

Equipment used as part of a fall protection system is
(a) inspected by the worker as required by the manufacturer before it is used on each work shift,
(b) kept free from substances and conditions that could contribute to deterioration of the equipment, and
(c) re-certified as specified by the manufacturer. Inspections shall be carried out prior to use and by a competent person, trained in the inspection of that equipment and knowledgeable of the manufacturer's requirements for inspection at least annually.

7.6. Removal From Service

Equipment is removed from service and either returned to the manufacturer or destroyed if:
(a) it is defective, or
(b) it has come into contact with excessive heat, a chemical, or any other substance that may corrode or otherwise damage the fall protection system.
c) It has stopped a fall,
d) equipment removed from service is not returned to service unless a professional engineer or the manufacturer certifies it is safe to use.

7.7. Contractor's Usage of University Fall Protection Equipment

Contractors may use available Fall Protection Equipment belonging to the University of Calgary i.e.: Free Standing Constant Force Posts and Safety Rail, with the exception of Harness, Self Retracting Lifelines (SRL's), Rope Grabs and Lanyards. Request for availability of University Fall Protection Equipment must be submitted to University Representative 5 working days prior to beginning of project. (Exception: Emergency repairs)

8. DESIGN STANDARDS – New Construction and Renovations

For all new building construction, fall hazards shall be eliminated, where at all possible, through the building design. This shall be achieved through the following design criteria:

1. Guardrails or roof parapets protecting roof edges meeting the requirements of a guardrail in The Alberta OH&S Code
2. Roof/ Ladder Access Points- will be designed to protect a worker from a fall hazard and/or falling through an opening. As per the OH&S Code 2009 Part 9 access ladders, platforms and hatches will have a self-closing double bar Safety gate, floor openings and roof hatches shall also have guardrails protecting the remaining 3 sides. Fixed Ladders shall over 3 metres in height shall incorporate an integral Fall Protection System.
3. Mechanical Units- If guardrail or equivalent parapet is not used, will be located within the building or, if on the rooftop, a worker will not be required to be within 2 meters from the roof edge to perform work
4. Skylights – incorporate Fall Protection screens if not of sufficient strength to sustain the impact of a falling worker
5. Where workers will be exposed to a Fall Hazard within 2 meters of an unguarded edge a Fall Protection system suitable for 2 workers, max 310 lbs each inclusive of tools and equipment shall be:
    a) Designed and installed to be utilized for Travel Restraint and Fall Arrest
    b) Allow for continuous connection while exposed to a Fall Hazard, preference for Horizontal Lifelines wherever possible over Single Point anchors

Environment Health and Safety (EHS) shall be consulted prior to the design stage of Fall Protection and Suspension Systems.

Permanent anchorages meeting the requirements of The Occupational Health and Safety Code are installed or designated on
(a) all new structures
(b) existing structures that undergo significant physical alterations, renovations or repairs.

The U of C will ensure that a sufficient number of anchorage connectors for the number of workers performing the work are installed or designated
(a) to eliminate swing falls wherever it is reasonably practical to do so, or
(b) where it is not reasonably practical to prevent swing falls, the swing drop distance does not exceed 1.2m.

Temporary Anchorage for U of C workers shall be achieved through the use of portable ballasted anchors, supplied by the University.

Suspension Anchors shall be supplied where required independent of Fall Arrest Anchors, unless designed by a Professional Engineer so that a failure of one

anchorage will not impact the other anchorage or connecting components.

9. RESCUE FROM HEIGHTS

While calling 911 may be *part* of a rescue response, Workplace Health and Safety expects an employer to have some means of basic rescue capability at the work site.
Basic means of rescue may include:
(a) having access to a manlift or scissor lift at the work site that is capable of reaching a suspended worker. Someone must be able to competently operate the equipment;
(b) having ladders on site that are capable of reaching a suspended worker;
(c) equipping workers with leg loop extensions for their full body harnesses i.e. suspension relief straps. These attach to the full body harness, providing foot loops into which a suspended worker can place his or her feet and then raise the legs. Doing so allows blood pooling in the legs to circulate. Using the foot loops may help the worker to remain comfortable until he or she returns to safe ground; All U of C Fall Protection harness' shall be equipped with relief steps
(d) from above the fallen worker's suspended position, having a worker lower a loop of rope into which the worker can place his or her feet and then stand up.
As in (c), the goal is to make the worker more comfortable by relieving the pressure of the harness straps on the legs and offering the legs something to push against to pump pooled blood back into circulation. Using the loop may help the worker to remain comfortable until he or she returns to safe ground. It may also allow the worker to connect to a descent system followed by disconnection from the fall arrest system;
(e) using Type 3 self retracting devices that include an integral hand winch that allows the suspended worker to be raised upwards or lowered to safe ground. Use of this device does not require the suspended worker to be conscious; and
(f) equipping workers in certain situations with self rescue devices such as specialized descenders that allow the suspended worker to remove themselves from their lanyard and descend to safe ground using one of these devices.

If a work platform or personnel basket is suspended from a crane or hoist, a fall protection plan must be in place for the rescue of the occupant(s) in the event that the crane or hoist is unable to lower the work platform or personnel basket.

The Calgary Fire Department is the primary responder for rescue at height. In the event of a fall and/or suspended worker that is unable to perform an extraction unassisted, the second person on site identified on the Fall Protection Permit shall call 911 and 403.220.5333 Campus Security immediately. It is vitally important to specify that it is a high angle rescue or rescue from height in the call and the ***exact location*** as time is of the essence to combat the onset of ***suspension trauma***.
If worker can be rescued by other workers or perform an assisted rescue with a ladder or man lift, the equipment must be at the site inspected and ready to be placed into service immediately. This includes having a competent operator for a mobile work platform
The suspended worker will deploy the harness rescue step to reduce the effects of Suspension Trauma while awaiting rescue or a line with loop will be lowered for the worker to stand in.

<http://www.millerfallprotection.com/fall-protection-products/accessories/relief-step-safety-device> Miller Fall Protection

Suspension trauma death is caused by orthostatic incompetence. A soldier standing almost motionless at attention for a long period of time and then fainting is an example of the problem. What happens with orthostatic incompetence is that the circulation of blood is reduced because the legs are immobile and the worker is in an upright position.
Gravity pulls the blood into the lower legs, which have a very large storage capacity. Enough blood eventually pools in the legs that return blood flow to the right side of the heart is reduced. This causes blood supply problems for both the heart and the brain. Normally the person faints at this point and falls to the ground. Now that the person is horizontal, blood from the legs flows back to the heart and on to the rest of the body.

While suspended in a harness however, the worker cannot fall into a horizontal position. The worker's problem is that he or she is being held vertical while motionless. Fall victims can slow the onset of suspension trauma by pushing down forcefully with the legs, by positioning their body in a horizontal or slightly leg‐high position, or by standing up. However, the design of the harness, the attachment points used, and the presence of fall injuries may prevent these actions.

The suspended worker faces several problems
(1) the worker is suspended in a near upright posture with legs dangling;
(2) the safety harness straps exert pressure on leg veins, compressing them and reducing blood flow back to the heart; and
(3) the harness keeps the worker in a near upright position, regardless of consciousness.
Rescue must happen quickly to minimize the dangers of suspension trauma. According to information summarized in the July 2008 issue of the *Journal of Occupational and Environmental Medicine,* suspension trauma begins within 3.5 to 10 minutes in most subjects, with a few very fit subjects developing symptoms after 30 minutes. This time increases significantly if the suspended person can move their legs against resistance during suspension.

Symptoms have been described as starting with a feeling of general physical discomfort, then intense sweating, nausea, dizziness, and hot flashes. Symptoms progress to difficulty breathing, increasing heart rate, and progressively worsening heart function. Eventually the person loses consciousness. A person who is motionless and suspended in a harness is considered to be a medical emergency. If a worker is suspended long enough to lose consciousness, rescue personnel must be careful in handling such a person or the rescued worker may die anyway. This post‐rescue death is apparently caused by the heart's inability to tolerate the abrupt increase in blood flow to the right side of the heart after removal from the harness.

Current recommended procedures are to take from 30 to 40 minutes to move the victim from kneeling to a sitting to a laying down position. A physician should examine the rescued victim. Among other things, the reduction in blood flow while suspended can affect the kidneys and lead to permanent damage. For more information about suspension trauma, readers are referred to the sources listed in the References.

A motionless, suspended victim suggests serious injury and a rescue must be performed quickly. A non‑breathing, motionless victim must be ventilated within four minutes of when they stop breathing in order to prevent irreversible brain damage.

10. DEFINITIONS

Active fall-protection system - a means of providing fall protection that requires workers to take specific actions, including wearing (and otherwise using) personal fall-protection equipment, following prescribed procedures. Examples include travel restraint and fall-arrest systems.

Anchor Point- A secure point of attachment for lifelines, lanyards, or deceleration devices. An anchor point must be capable of supporting at least 5000 pounds/ 22.2 kN (3600 pounds/ 16 kN if engineered/certified by a qualified person) per person and must be independent of any anchorage being used to support or suspend platforms.

Anchorage - a secure connecting point capable of safely withstanding the impact forces applied by a fall-protection system or anchorage subsystem.

Notes:

(1) *A fall-arrest or restraint anchorage is independent of any anchorage used to support or suspend workers or work platforms.*

(2) *An anchorage is generally a structural member such as a beam, girder, column, floor, or wall.*

Anchorage connector - a component or subsystem for coupling a personal fall-arrest system to an anchorage.

Anchorage subsystem - a subsystem of a complete active fall-protection system to which workers connect their personal equipment.

Note: *Examples of anchorage subsystems include fixed-anchor points, VLLs, HLLs, rigid rails, and ladder-climbing systems. An anchorage subsystem may allow one or more workers to be attached to it, depending on its design. Anchorage subsystems are separated into two classes in this Standard: flexible and rigid.*

Flexible anchorage subsystem - an anchorage system, such as a VLL or an HLL, that appreciably deflects, deforms, or stretches when a fall-arrest impact occurs. For the purposes of this Standard, a flexible anchorage subsystem is one where the deflection or stretch exceeds 100 mm when the peak impact force from the worst-case fall arrest or travel restraint loading is applied to the subsystem.

Rigid anchorage subsystem - an anchorage system, such as a rigid rail system or a single point of attachment, that does not appreciably deflect, deform, or stretch when a fall-arrest impact occurs. For the purposes of this Standard, a rigid anchorage subsystem is one where the deflection or stretch is not more than 100 mm when the peak impact force from the worst-case fall-arrest or travel-restraint loading is applied to the subsystem.

Authorized Person- A person approved or assigned by the employer to perform a specific type of duty or duties or to be at a specific location or job site (i.e., building maintenance, roof repair, etc.).

Ballasted anchor - an anchorage that rests on, but is not mechanically connected to, an underlying structure.

Note: *A ballasted anchor uses its own weight and/or the lateral friction it develops with the underlying structure to resist the imposed forces.* The Mansafe Constant Force Portable Anchor is a ballasted anchor.

Buddy System- a system of organizing employees into work groups so that each employee of the work group is designated to be observed by at least one other employee in the work group.

Certified - meeting the requirements of a Standard, as attested by a certification organization accredited by the Standards Council of Canada or the Occupational Safety and Health Administration.

Clearance Distance- the distance from a specified reference point, such as the working platform or anchorage of a fall-arrest system, to the highest obstruction that a worker might encounter during a fall

Clutching self-retracting lanyard (SRL) - a type of SRL that uses a clutch or other mechanism to dissipate fall energy by deploying additional lifeline at a relatively constant force after the device has locked off (see Clause 5.4.4.2.4).

Competent Person- A person capable of identifying existing and predictable hazards in the surroundings or working conditions, which are hazardous or dangerous to employees. A person who has the authorization to take prompt corrective action to eliminate such hazards.

Connecting means - a lanyard, SRL, or other device used to connect a body holding device to an anchorage or anchorage subsystem, to provide protected mobility for an elevated work task.

Connector- A device which is used to couple (connect) parts of the personal fall arrest system together.

Deceleration Device- Any mechanism, such as a rope grab, rip-stitch lanyard, a specially woven lanyard, tearing or deforming lanyard, automatic self-retracting lifeline/lanyard, etc., which serves to dissipate a substantial amount of energy during a fall arrest.

Deceleration Distance- The additional vertical distance a falling worker travels excluding lifeline elongation and free fall distance, before stopping, from the point at which the deceleration device begins to operate. It is measured as the distance between the location of an employee's body harness attachment point at the moment of activation of the deceleration device during a fall, and the location of that attachment point after the employee comes to a full stop.

> **Note:** *The deceleration distance is determined by the response and interaction of all of the components of the fall-arrest system (including deployment of PEAs, stretching of lanyards and lifelines, sagging of HLLs, etc.)*

D-ring - a connector used integrally in a harness as an attachment element or fall-arrest attachment, and in lanyards, energy absorbers, lifelines, and anchorage connectors as an integral connector.

Energy absorber - any device that dissipates kinetic energy and does not return it to the system or into the human body.

> **Note:** *Elastic devices such as springs are not classified as energy absorbers under this Standard because they temporarily store the energy and return it to the system when the applied forces are reduced. Examples of energy absorbers include PEAs, clutching SRLs, and HLLEAs.*

Energy-absorbing lanyard - a lanyard that includes an integral Personal Energy Absorber.

Fall arrest - stopping a fall.

> **Note:** *For the purposes of this Code of Practice, fall arrest is the instant when a falling body is first stopped. Fall arrest coincides with the greatest forces and deflections of the fall-arrest system.*

Fall arrester - a device that locks onto a lifeline, cable, or rigid track to arrest a fall. It travels vertically on the lifeline, cable, or rigid track and follows either manually or automatically the vertical movements of the worker.

Fall Arrest System- an assembly of components joined together so that when the assembly is connected to a fixed support, it is capable of arresting a worker's fall; consists of a full-body harness with back-mounted "D" ring, a energy absorbing lanyard, a lifeline, connecting hardware and anchorage point(s). A potential for injury will exist if the worker falls.

Fall Protection- specialized personal protective equipment designed to prevent falls from height or to bring a worker to a safe and controlled stop after falling.

Fall-protection system - any secondary system that prevents workers from falling or, if a fall occurs, arrests the fall. Examples include guardrail, travel-restraint, safety net, and fall-arrest systems.

Fall Restricting System- a type of fall arrest system that has been designed to limit a worker's fall to a specific distance.

Free Fall: - The act of falling before a personal fall arrest system begins to apply force to arrest the fall.

Free-fall distance (FFD) - the vertical distance from the onset of a fall to the point where the fall-arrest system begins to apply force to arrest the fall.

> **Note:** *Free fall is often measured by following the D-ring of the full-body harness.*

Full Body Harness- Webbing/straps which are secured about an employee's body in a manner that will distribute the fall arrest forces over the thighs, pelvis, waist, chest and shoulders. Having means for attaching it to other components of a personal fall arrest system, preferably at the shoulders and/or middle of the back.

Hazard – means a situation, condition, process, material or thing that may be cause of an injury or illness to a worker.

Horizontal lifeline (HLL) - a component of an HLL system that extends horizontally from one end anchorage to another and consists of a flexible line made from wire, fibre rope, wire rope, or rod, complete with end terminations.

> **Note:** *Intermediate anchorages may be used on long HLL systems to reduce sags.*

Horizontal lifeline energy absorber (HLLEA) - an energy absorber, in line with an HLL, that is used to reduce the MAL imparted to the end anchorages of the HLL during a fall.

Horizontal lifeline system - a fall-protection system that uses an HLL to which one or more workers may attach their personal fall-arrest systems using a suitable connecting means.

> **Note:** *An HLL may be used as part of a travel-restraint system but more commonly is part of a fall-arrest system. An HLL allows horizontal movement parallel to the HLL but may also allow protected vertical movement below the HLL if an SRL is used as the connecting means.*

Horizontal track system - a form of rigid rail system that typically encloses a trolley inside a formed channel or track.

> **Note:** *Horizontal track systems are usually mounted overhead in fall-arrest systems but may be mounted at lower heights as anchorages for travel-restraint systems.*

Inspection - a thorough examination of equipment or systems, including but not limited to verification of general conformance to required standards.

kiloNewton (kN) - a unit of force, approximately equivalent to 225 pounds of force.

Lanyard: A flexible line of rope or strap that has self-locking snaphook connectors at each end for connecting to body harnesses, deceleration devices, and anchor points.

Lifeline - a component consisting of:

(a) a flexible line for connection to an anchorage or anchorage connector at one end to enable the line to hang vertically (a VLL); or

(b) a flexible line for connection to anchorages or anchorage connectors at both ends to enable the line to span horizontally (an HLL).

Low Slope Roof - A roof having a slope of less than or equal to 4 in 12 (vertical to horizontal). A roof with approximately a 19.5 degree slope or less.

Manual fall arrester - a fall arrester that will remain locked where it has been positioned on a VLL until deliberately repositioned by a worker.

Manual rope grab - see **Manual fall arrester**.

Maximum arrest force (MAF) - the peak force exerted on a worker or test weight when a fall-arrest system stops a fall (see Figure 3).

Maximum arrest load (MAL) - the peak force applied to an anchorage by an active fall-protection system when arresting a fall.

> **Note:** *The MAL is a force vector that is co-linear with the cable in an HLL (see Figure 3). The MAL equals MAF in a vertical system.*

Passive fall-protection system - a means of providing fall protection that does not require workers to wear or otherwise use fall-protection equipment or to have any special knowledge or skills related to this system. Examples include guardrail systems and nets.

Personal Fall Arrest System- A system used to arrest (catch) an employee in a fall from a working level. It consists of an anchorage location, connectors, a body harness, and may include a lanyard, deceleration device, lifeline, or any combination of the before-mentioned items.

Positioning lanyard - a lanyard used to connect a worker to an anchorage or anchorage subsystem for the purpose of holding or suspending the worker at the desired location.

> **Note:** *Positioning lanyards may be fixed length or adjustable and are part of a positioning system.*

Positioning system - a system of components, including suspension lines, boatswain's chairs, descent controllers, and/or positioning lanyards, used to support or suspend a worker at a working point. Positioning systems are primary systems and are not fall-protection systems.

Pre-tension - the initial force (tension) in an HLL cable immediately before a fall occurs. Pre-tension of the HLL balances the weight of the cable, holding it to its initial sag.

Primary system - in fall-protection terminology, the main mechanism that allows a worker to maintain his or her desired position.

> **Note:** *Primary systems are typically considered to comprise the worker's balance, his or her climbing skills, and the safety of the platform, surface, or structure that supports him or her. Fall protection is a secondary form of protection in case the primary system fails.*

Professional Engineer - a person who holds an engineering license or temporary engineering license in the province of Alberta.

Proof test - a test to prove the structural integrity of a component or system.

Qualified Person- An individual, who by possession of a recognized degree, certificate, or professional standing or who by extensive knowledge, training, and experience, has successfully demonstrated his/her ability to solve or resolve problems relating to the subject matter, work, or project.

Required clearance below the anchorage - the minimum distance between the anchorage of a fall-arrest system and the highest obstruction a worker might encounter during a fall (see Figure 6).

Required clearance below the platform - the minimum distance between the working platform and the highest obstruction a worker might encounter during a fall (see Figure 6).

Rescue - the process of evacuating a worker after a fall to a safe location where he or she can receive medical attention.

Restraint anchorage - an anchorage used in a travel-restraint system.

Restraint lanyard - a lanyard that has been manufactured or adjusted to a specific length, such that when coupled between a restraint anchorage and a worker's body-holding device, the worker cannot reach an unprotected edge or unprotected opening.

Restraint system - see **Travel-restraint system**.

Rigid rail system - a fall-protection system that uses one or more trolleys on a horizontal track (often an I-beam or slotted tube).

> **Note:** *In a rigid rail system, a connecting means is attached between the worker's full-body harness and the trolley. Rigid rail systems allow horizontal movement parallel to the rigid rail but may also allow vertical movement if an SRL is used as the connecting means.*

Roll-out - unintended disconnection of connection hardware.

Rope grab - see **Fall arrester**.

Safety margin - a clearance factor of safety defined as the distance between the lowest extremity of the worker's body at fall arrest and the highest obstruction the worker might otherwise make contact with during a fall (see Figure 6).

Safety Net- a safety net that complies with OH&S Code Part 22 section 320 (1), ANSI Standard A10.11 – 1989 (R1998) *Construction and Demolition Operations – Personnel and Debris Nets,* is located and supported in such a way that it arrests the fall of a worker who may fall into it without endangering the worker.

Secondary system - in fall-protection terminology, the back-up mechanism that protects a worker if the primary system fails.

> **Note:** *Secondary systems include guardrail, travel-restraint, and fall-arrest systems.*

Self-retracting lanyard (SRL) - a connecting means that automatically adjusts its length under light tension as the worker moves toward or away from the anchorage. It stops a fall.

> **Note:** *The SRL housing typically contains a spring-loaded drum on which a line (made of rope, wire rope, or webbing) is wound and unwound. The device has a mechanism to lock the drum if the worker falls by pulling cable out of the device at a speed greater than the device's lock-off speed.*

Self-retracting lifeline - see **Self-retracting lanyard**.

Snaphook- A connector comprised of a hook-shaped member with a closed keeper which may be opened to permit the hook to receive an object and when released, automatically closes to retain the object. Snaphooks must be self-closing with a self-locking keeper which remains closed and locked until unlocked and pressed open for connection or disconnection, thus preventing the opportunity for the object to "rollout" of the snaphook.

> **Note:** *A snap hook is mechanically spliced as the end termination of a lanyard or lifeline and may be used, as appropriate, to connect to anchorages, D-rings, and other components of a fall-protection system.*

Steep Slope Roof- A roof having a slope greater than 4 in 12 (vertical to horizontal). A roof with a slope greater than 19.5 degrees.

Supervisor – means the individual that directs or oversees a person, group, department, organization, or operation from the University of Calgary.

Suspended equipment - machines, platforms, or other equipment suspended by support lines.

Swing-drop distance - the vertical drop in height experienced by the worker using a fall-arrest system from the onset of the swinging motion to the point where the user can initially make contact with a structure.

> **Note:** *Swing-drop distance is measured by following the D-ring of the harness.*

Swing fall - the hazard of swinging into an obstruction after falling. A pendular motion experienced by the worker using a fall-arrest system, resulting from the anchorage not being directly above the user at the onset of a fall.

Swing-fall distance - the vertical drop in height experienced by the worker using a fall-arrest system from the onset of the swinging motion to the lowest point reached during the swing.

> **Note:** *Swing-fall distance is measured by following the D-ring of the harness.*

Toeboard- A low protective barrier that will prevent the fall of materials and equipment to lower levels, usually 10 cm or greater in height. If the roof edge has a parapet of over 10 cm, no additional toeboard need be used.

Total Fall Distance (TFD) - The maximum vertical change in distance from the bottom of an individual's feet at the onset of a fall, to the position of the feet after the fall is arrested. This includes the free fall distance and the deceleration distance.

> **Note:** *Total-fall distance is often determined as the displacement of the dorsal D-ring on the full-body harness and is the sum of the free fall and the deceleration distance. It also includes any applicable swing-fall distance.*

Travel Restraint System- an assembly of components capable of restricting a worker's movement

on a work surface and preventing the worker from reaching a location from which he or she could fall; equipment designed to keep a person away from the location of the fall hazard; a mechanism which restricts the movement of a worker on a work surface; consists of a full-body harness, a lifeline or retractable lanyard, and an anchorage point; also referred to as fall restraint.

> **Note:** *An active fall-protection system couples the workers' body-holding device(s) to an anchorage using a suitable means, such as restraint lanyards. A guardrail is a passive travel-restraint system.*

Trolley - a mobile anchorage device that travels along a track (horizontal track system), structural beam (rigid rail system), or cable (HLL system).

Unprotected Sides and Edges- Any side or edge of a walking or working surface (e.g., floor, roof, ramp, runway, etc.) where there is no guardrail at least 0.92 meters high, 1.07 meters is preferable.

Vertical lifeline (VLL) - a length of rope with a manufactured termination at the top end. It may or may not include a means to tension the line, such as a small weight at the bottom end.

Vertical lifeline system - a fall-arrest system that uses a VLL, fall arrester, connecting means, and body-holding device.

Warning Line System- A barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, which designates an area in which work can be conducted without the use of guardrails, personal fall arrest systems, or safety nets to protect employees in the area. This will be utilized on any roof greater than 6 meters wide and placed no closer than 4 meters to the edge.

Worker - for the purposes of this Code of Practice, any person who is protected from falling by an active fall-protection system, or in the case of a fall-arrest system, any person who might fall while attached to the system. Any person engaged in work at the University of Calgary, including employees, contracted workers, volunteers, and graduate students.

11. REFERENCES

Alberta Occupational Health & Safety Code, Explanation Guide

Fundamentals of Fall Protection by Andrew C. Sulowski, 1991

Roof Access Program

Hot Works Program

Suspension Trauma:
www.hse.gov.uk/research/crr_htm/2002/crr02451.htm
Harness suspension: review and evaluation of existing information (A very comprehensive review of the topic, prepared for the Health and Safety Executive, United Kingdom)
 www.cdc.gov/elcosh/docs/d0500/d000568/d000568.html
Will your safety harness kill you?
 Schwerha JJ. Workers at Height are Required to Use Fall Prevention Systems. What are the Health Risks From Being Suspended in a Harness? *Journal of Occupational and Environmental Medicine.* Vol. 50(7), July 2008.

12. APPENDIX

12.1. APPENDIX A – Fall Protection Plan

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DBI SALA Fall Protection Experts PROTECTA

Technical Bulletin No. SRL007

Subject: Self-Retracting Lifelines on Drilling and Service Rigs

There is a recognized hazard where the available anchorage and necessary movement of a worker using a self-retracting lifeline (SRL) on a drilling and/or service rig is such that the cable or webbing of an SRL could come in contact with a structural edge of the rig (column and/or girder). The use of DBI/SALA SRL's for fall protection on drilling and/or service rigs(or similar applications where the SRL is not located directly overhead of the work area and the risk of contacting a structural edge is apparent) is acceptable under certain circumstances provided special precautions are taken as described in this bulletin.

The following guidelines must be followed when using SRL's in areas where structural edges are in abundance:

1. Swing fall hazards may exist, especially when working near corners, or out away from the SRL. Added fall clearance distances may be required, depending on the swing fall hazard. Collision with objects during a swing fall should be guarded against.

2. The total fall distance may be greater than if the SRL were mounted directly overhead. Therefore, increased clearance distances will be required to prevent striking a lower level or obstruction.

3. Where the potential to impact on a structural edge exists, a separate in-line energy absorber must be installed between the end of the lifeline and the harness to reduce the arrest forces resulting from falling over an edge. This energy absorber is connected in-line between the harness dorsal d-ring and the SRL's snap hook. If the harness being used does not have an integral shock absorber attached to the rear "D" ring, DBI/SALA and Protecta offers a special model energy absorber (part number 1220362) for this purpose that includes a snap hook on one end and a d-ring on the other to ensure compatible connections can be made. DO NOT use energy absorbing lanyards for this purpose. See bulletin SRL002. DBI/SALA also offers a leading edge type SRL that contains heavier wire rope lifeline and a built in energy absorber for added protection against lifeline damage when contact is made with sharp edges.

4. Sharp edges which the lifeline may contact during a fall could cut or damage the SRL's lifeline. Sharp edges must be avoided or covered over. Falls where the lifeline may slide along a sharp edge must be guarded against.

5. All applicable user instruction manuals should be reviewed and followed.

6. Employee training should be conducted to help assure a safe working environment.

3965 Pepin Avenue • Red Wing, MN 55066-1837 • 651-388-8282 • solutions@dbisala.com
A Member of the Capital Safety Group of Companies

Manufacturer's Instructions

Constant Force Freestanding Post

Free Standing CFP Installation with cable system

Free Standing Constant Force Post and portable lifeline system

Installation, Use and Inspection Instructions

BEFORE USE CHECKS

Before commissioning the anchor device and issuing certification, the following checks must be completed.

- no part of the anchor device is less than 2.5 m from any edge including roof lights, hatches etc.
- the anchor device is installed so that the rubber coated segments are always in contact with the roof.
- the anchor device is assembled using the correct number of segments.
- the roof surface is an appropriate type as described on the warning label and in these instructions.
- the warning label is present and securely attached to the post base plate.
- all bolts securing the d-ring, constant force post, cross straps and segments are tight.
- there is no damage to the complete anchor device.
- there is no damage to the roof area immediately around the anchor device.
- there is no contamination from oil, grease etc. Or by growth of algae.
- any loose chippings have been removed.
- the record card has been completed.

Constant Force Post Inspection Tag/ Record Card

SYSTEM DETAILS		
MANUFACTURER	LATCHWAYS PLC HOPTON PARK, DEVIZES WILTSHIRE, SN10 2JP, UK	TEL: +44 (0)1380 732700 FAX: +44 (0)1380 732701
IDENTIFICATION NUMBERS		
YEAR OF MANUFACTURE		
DATE OF PURCHASE		
DATE FIRST PUT INTO SERVICE		
MAINTENANCE PERIOD		
PERSONAL PROTECTIVE EQUIPMENT TO BE USED		
AUTHORIZED USER (S)		
COMMENTS		

Fixed Permanent Constant Force Post Lifeline

<http://www.latchways.com/default.aspx?item=72>

Check the tension

The correct pre-tension is achieved when the disk can be turned freely with your fingers. If this is not the case then the system will need to be adjusted prior to use.

When the correct pre-tension has been achieved, fit split pins to the long run line tenser and the swageless terminal to prevent the turning of the turnbuckle and also maintaining system pre-tension.

Always check the tension indicator before system use

Safety Rail 2000 Installation

1.

2.

3.

http://www.bluewater-mfg.com/InstallTips.htm

1. position bases into desired location

2. Insert Rails into Base Tubes

3. Insert securing pins and lock into place

- Bases are in firm contact with surface, loose debris, chips, etc. swept away from contact area
- No snow or ice present
- End of each run has 5 ft minimum outrigger
- Outrigger does not deviate more than 15 degrees from perpendicular to run of rail
- Locking pins in place and locked (2 per rail section)
- If no parapet is present, bases are placed >2.5 ft from edge

Full Body Harness Inspection

1. **Impact/ shock load indicator-** visually inspect the indicator for signs the harness has seen a shock load.

2. **Webbing—**Grasp the webbing with your hands 6 inches to 8 inches apart. Bend the webbing in an inverted "U". The surface tension resulting makes damaged fibers or cuts easier to detect. Follow this procedure for the entire length of the webbing, inspecting both sides of each strap. Look for frayed edges, broken fibers, pulled stitches, cuts, burns, and chemical damage

3. **D-Rings—**Check D-rings for distortion, cracks, breaks, and rough or sharp edges. The D-ring should pivot freely.

4. **Attachment of Buckles—**Inspect for any unusual wear, frayed or cut fibers, or broken stitching of the buckle or D-ring attachments.

5. **Tongue/Grommets—**the tongue receives heavy wear from repeated buckling and unbuckling. Inspect for loose, distorted or broken grommets. Webbing should not have additional holes punched.

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

7. **Friction and Mating Buckles—**inspect the buckle for distortion. The outer bars and center bars must be straight. Pay special attention to corners and attachment point at the center bar.

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.

1. **Hardware—**

    a. *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.

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

Steel Lanyard—while rotating the steel lanyard, watch for cuts, frayed areas, or unusual wearing patterns on the wire. Broken strands will separate from the body of the lanyard.

Web Lanyard—while bending webbing over a pipe, observe each side of the webbed lanyard. This will reveal any cuts or breaks. Swelling, discoloration, cracks and charring are obvious signs of chemical or heat damage. Observe closely for any breaks in stitching.

Rope Lanyard—Rotation of the rope lanyard while inspecting from end-to-end for any fuzzy, worn, broken or cut fibers. Weakened areas from extreme loads will appear as a noticeable change in original diameter. The rope diameter should be uniform throughout, following a short break-in period.

Shock Absorber Pack—the outer portion of the pack should be examined for burn holes and tears. Stitching on areas where the pack is sewn to D-rings. Belts or lanyards should be examined for loose strands, rips, and deterioration.

Shock-Absorbing Lanyard—Shock-absorbing lanyards should be examined as a web lanyard (described in Item 3 above). However, also look for the warning flag or signs of deployment. If the flag has been activated, remove this shock-absorbing lanyard from service.

Cleaning

Basic care of all safety equipment will prolong the durable life of the unit and will contribute toward the performance of its vital safety function. Proper storage and maintenance after use are as important as cleaning the equipment of dirt, corrosives, or contaminants. Storage areas should be clean, dry and free of exposure to fumes or corrosive elements.

Nylon or Polyester—Remove all surface dirt with a sponge dampened in plain water. Squeeze the sponge dry. Dip the sponge in a mild solution of water and commercial soap or detergent. Work up lather with a vigorous back and forth motion; then wipe with a clean cloth. Hang freely to dry, but away from excessive heat.

Drying—Equipment should dry thoroughly without close exposure to heat, steam, or long periods of sunlight.

INSPECTION CHECKLIST		
Component	**What to check for**	
Full-body harness	❑ **Webbing** frayed, cut, burned ❑ **Stitching** loose, ripped ❑ **Metal buckle** bent, cracked	❑ **Grommets** damaged, missing ❑ **Strap keepers** broken, missing ❑ **D-ring** worn, bent, cracked
Locking snap hooks	❑ **Hook** bent, cracked, twisted ❑ **Lock** not working properly	❑ **Springs** weak, broken, missing
Lanyard with shock absorber	❑ **Webbing** frayed, cut, burned, damaged by chemicals ❑ **Stitching** loose or ripped ❑ **Jacket** cut, torn, burned; signs of shock loading	❑ **End loops** cut, torn, burned, or stretched ❑ **Stretching** from shock loading ❑ **Connection** to snap hook ❑ **Knots** in rope lanyard
Rope grab	❑ **Fails** hand test ❑ **Not** used with appropriate diameter and type of rope ❑ **Springs** broken, missing	❑ **Gate** can't close fully ❑ **Locking pin** not working ❑ **Safety latch** broken ❑ **Teeth** on cams worn
Lifeline	❑ **Diameter** must match that of rope grab ❑ **Polypropylene** or equivalent ❑ **Length** reaches the ground ❑ **Rope** frayed, rotted, cut, weakened by knots	❑ **Discoloration** from sun, chemicals ❑ **Attachment** to anchor secure ❑ **Stretching** from shock load ❑ **Protection** where lifeline runs over roof edge