Part 9
Fall Protection

Highlights

- Section 138 allows rescue personnel involved in emergency rescue training or in providing emergency rescue services to use equipment and services other than those specified in this Part.
- Section 139 requires employers to ensure that workers use a fall protection system under these conditions:
  - if a worker could fall 3 metres
  - if a worker could fall *less than* 3 metres and there is an unusual possibility of injury. An unusual possibility of injury refers to the potential for a worker to sustain injuries more serious than those likely to result from landing on a solid, flat surface.
- Section 140 requires employers to prepare a fall protection plan if a worker at a work site could fall 3 metres or more and is not protected by guardrails. The plan must include procedures for rescuing workers who have fallen.
- Section 141 presents comprehensive minimum worker training requirements that can serve as the basis for a training course curriculum. Both theory and hands-on components are required.
- Sections 142 through 149 list equipment requirements. The 2009 edition of the OHS Code marks the first time that Part 9 accepts fall protection equipment approved to standards from the U.S. and Europe. Fall protection equipment approved to any one of these standards is considered to offer an equivalent level of worker protection. Employers and workers in Alberta now have access to a broader range of equipment to safely meet their fall protection needs.
- Section 152 requires fall arrest anchors to have a minimum breaking strength of 16 kN (3600 lbs), a reduction from the previous value of 22.2 kN (5000 lbs), specifies the limits for free fall and maximum arresting force.
- Section 156 lists requirements applicable to boom-supported elevating work platforms and aerial devices, and forklift mounted work platforms.
- Section 158 presents requirements specific to fabric and netting leading edge fall protection systems.
- Section 160 introduces new requirements specific to work positioning.

Requirements

Section 138 Rescue personnel exemption

The “rescue personnel exemption” presented in this section does not exempt rescue personnel from using fall protection equipment and practices. It *does* exempt rescue personnel from using the equipment and practices specified in Part 9, allowing the use of alternative equipment and practices. Whereas Part 9 specifies the use of “industrial”-type fall protection equipment and practices, the exemption allows rescue personnel to use alternative equipment and practices. The practices used must provide an effective measure of worker safety and address the unique hazards that a rescue presents. A fall protection plan as required by section 140 must be prepared. The requirements of other Parts of the OHS Code, such as those dealing with personal protective equipment, continue to apply.

Section 139 General protection

Subsections 139 (1) and 139(2)

Subsections 139(1) and 139(3) refer to “temporary work areas” and “permanent work areas”. For the purposes of this Part, the words “temporary” and “permanent” describe the nature of the work being performed, not whether the work area is a temporary or permanent structure.

At fall heights of 3 metres or more, at lesser heights if there is an unusual possibility of injury, or if the fall is through an opening in a work surface, subsection 139(1) requires that workers be protected from falling, regardless of whether the work area is a temporary or permanent work area.

Situations involving an “unusual possibility of injury” may include work performed above moving water, operating machinery, open vessels containing potentially harmful substances, extremely hot or cold surfaces, etc. An unusual possibility of injury refers to the potential for a worker to sustain injuries more serious than those likely to result from landing on a solid, flat surface.

At fall heights of 1.2 metres or less, the OHS Code does not require the use of a fall protection method unless there is an unusual possibility of injury.

The concept of temporary and permanent work areas applies between the fall heights of 1.2 metres and 3 metres. When originally created, the distinction between temporary and permanent was intended to address fall safety at heights of less than 3 metres at elevated work areas such as loading docks and mezzanines.

In the OHS Code, differentiating work areas on the basis of whether they are temporary or permanent links the likelihood of injury to the concepts of exposure to a hazard and frequency of exposure to that hazard. Applying the concepts tries to place practical requirements on where and how workers are to be protected from falling. For example, a flatbed trailer may have a deck height of 1.3 metres above grade. It may not be reasonable to expect all such flatbed trailers to be equipped with perimeter guardrails or some other fall protection option given how infrequently a worker is expected to be on the deck and exposed to a fall hazard.

In some situations it may be very difficult to distinguish between a temporary work area and a permanent work area for the purposes of applying section 139. Unfortunately there is no way that a frequency of exposure can be stated for each and every possible situation involving worker exposure to a fall hazard between the fall heights of 1.2 metres and 3 metres. The following examples are intended to help readers assess their own work areas and determine if the area is a “temporary work area” or a “permanent work area”.

Example 1

Any work area at a construction site is considered to be a temporary work area.

Example 2

A worker at a chemical plant stands on an elevated platform at a height of 2.1 metres above grade, adjusting a valve once a month. The work area is a temporary work area because the work activity is done infrequently. If the valve is adjusted weekly or more frequently, then the work area should be considered to be a permanent work area.

Example 3

A worker does work while standing on the deck of a flatbed trailer that is 1.3 metres above grade. Normally, workers do not need to go onto the deck to adjust the load, straps, tarpaulins, etc. In the rare case that a worker must work while standing on the deck, then this should be considered to be a temporary work area.

If the worker is frequently on the deck, then the deck should be considered to be a permanent work area and subject to the fall protection requirements applicable to permanent work areas.

Example 4

A worker is working from a loading dock that is open on three sides and the height of the loading dock is 1.6 metres above grade. If the worker is frequently on the loading dock i.e. once every few days or more often, then the loading dock should be considered to be a permanent work area. The worker frequently accesses the loading dock as part of a routine work activity.

Example 5

A worker performs work from a highway billboard platform that is at a height of 2.1 metres above grade. The worker performs work from the platform once in every four to eight weeks, making the platform a temporary work area.

Determining the fall distance

The three metre fall distance is measured from the point on the platform, stair, working surface etc. from which a worker may fall, usually measured from the position of the feet if the worker is standing, to a lower level. Lower levels include, but are not limited to, those areas or surfaces to which a worker can fall such as the ground, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment or structures.

On a sloped roof, the 3 metre fall distance is measured in two ways:

(1) *if the worker is upslope from the eave and more than 2 metres away from a gable end*, the fall distance is measured from the top of the eave to a lower level. Lower levels include, but are not limited to, those areas or surfaces to which a worker can fall such as the ground, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment or structures. The vertical height that a worker may roll or slide down the sloped roof before he or she loses contact with the roof is not considered to be part of the "fall distance";

(2) *if the worker is within 2 metres of a gable end at any point upslope of the eave*, the fall distance is taken as the vertical distance from the worker's feet to a lower level. The assumption here is that the fall hazard is the worker falling off the gable end – the worker is much less likely to roll or slide down to the eave and then lose contact with the roof.

In the case of multi-level sloped roofs, if a worker falls from one level to the next, a distance of 3 metres for example, and then continues to fall to the next level, an additional 2.5 metres for example, the need to provide fall protection is based on the overall fall distance of 5.5 metres. The sloped roof onto which the worker falls is not considered to be a safe lower level i.e. one from which a further fall would be prevented.

Subsection 139(3)

Subsection 139(3) states the most general case for fall protection — that workers need to be protected from falling by the use of an engineering control such as a guardrail. Engineering controls eliminate the hazard of falling rather than control the hazard. Examples of other engineering controls include eliminating the need to work at height by making equipment, lighting, controls, valves, etc. accessible from ground level or from a location where there is no hazard of falling.

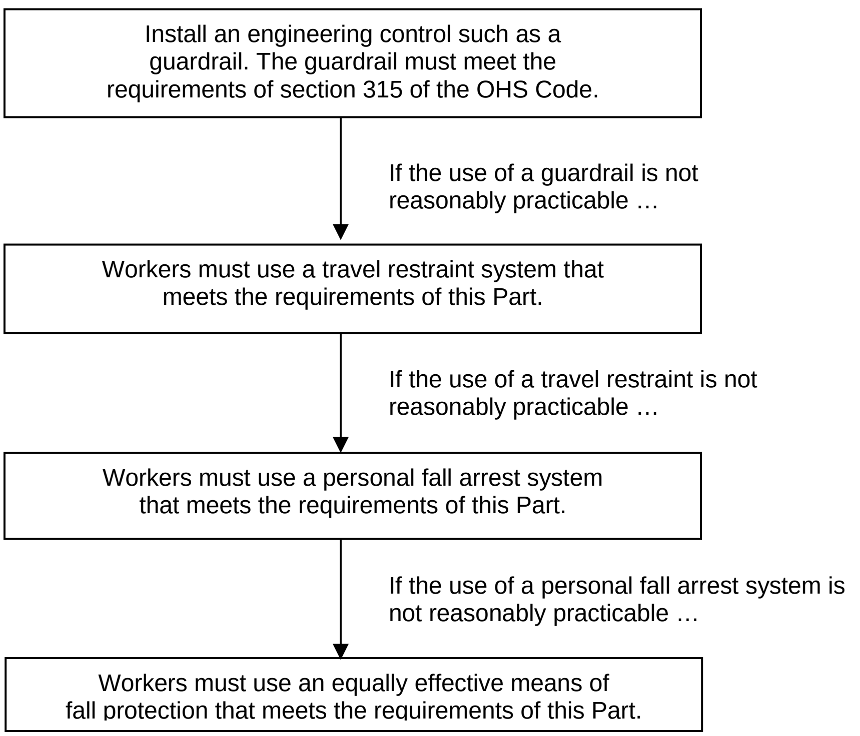
Guardrails are listed as an example in subsection 139(3) because they are often the preferred first choice for fall protection purposes. Guardrails become a permanent part of the installation, eliminating the need to equip workers with personal fall protection equipment and training those workers at periodic intervals. As such, guardrails are a type of passive fall protection system that is available at all times and does not require workers to do anything special. Guardrails can be used at any height.

If a guardrail is used, it must meet the design requirements listed in section 315 i.e. position and location of horizontal and vertical members, strength of design, etc. In the world of fall protection, guardrails are similar to a travel restraint system because they prevent a worker from getting to an edge or work location from which the worker could fall.

Subsections 139(4), 139(5), 139(6), 139(7)

These subsections specify a hierarchy for protecting workers against falling. They are intended to address the general case for preventing falls as required by subsection 139(1). The hierarchy is shown graphically in Figure 9.1.

Figure 9.1 Hierarchy of fall protection



Subsection 139(4) applies to permanent work areas in which the vertical distance a worker can fall is more than 1.2 metres but less than 3 metres. This requirement is intended to address fall safety at heights of less than 3 metres at permanent elevated work areas such as loading docks and mezzanines. While guardrails are the preferred method of preventing a worker fall, guardrails are not always practicable.

The employer's second choice is to protect workers by having them use a travel restraint system. If a travel restraint system is not practicable, the employer must ensure that workers use an equally effective means that protects the workers from falling. While a personal fall arrest system is mentioned in subsection 139(6), it will rarely be used in this height range of 1.2 to 3 metres because of lack of sufficient clearance distance to prevent worker contact with a lower surface in the event of a fall.

Subsection 139(8)

This subsection clearly states the worker's duty to use or wear the fall protection system the employer requires the worker to use or wear.

For more information

- 🕮 Ellis, NJ. *Introduction to Fall Protection*, 2nd edition. American Society of Safety Engineers, Des Plaines, II; 1993.
- 🕮 Sulowski AC. *Fall-Arrest Systems — Practical Essentials*. CSA International, Toronto; 2000.

Section 140 Fall protection plan

A fall protection plan is required if work is performed at a work site at which a fall of 3 metres or more may occur and guardrails do not protect workers. Section 8 of the *OHS Regulation* requires that the plan be in writing and available to workers. The plan must be available at the work site before work with a risk of falling begins. Figure 9.2 shows a sample fall protection plan.

As listed in subsection 140(2), the fall protection plan must specify the following information:

(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;

(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.

A fall protection plan is required if a travel restraint system is being used. Rescue procedures are not necessary in this case since a worker will not fall and be left suspended in the air.

A unique fall protection plan need not be created for each work site. If an employer faces the same fall hazards at multiple work sites, and the fall protection equipment and rescue procedures are identical at each work site, then a single plan applicable to all the work sites is acceptable. Alternatively, an employer can create a single fall protection plan that covers all of the fall hazards likely to be encountered during normal operations. Only in the event of a unique work situation arising would a new or amended fall protection plan be required.

Workers affected by the fall protection plan must be trained in all its elements and the plan must be made available to them.

Where a fall protection plan is not necessary

A fall protection plan is not necessary for

(1) permanent work areas equipped with guardrails, and

(2) situations involving the use of a boom-supported elevating work platform or the use of a fork-mounted elevating work platform intended to support a worker. These situations leave no choice as to the means of fall protection, and the rescue of a worker on the platform is generally straightforward — the platform can simply be lowered.

Figure 9.2 Sample fall protection plan

FALL PROTECTION PLAN

Company / Work Site Name:		
Address / Location:		
FALL HAZARDS Identify all existing & potential fall hazards associated with the work site		
FALL PROTECTION SYSTEMS TO BE USED Identify the fall protection systems to be used at the work site to protect workers from the fall hazard (i.e. travel restraint, personal fall arrest system, safety net, control zone, etc)		
ANCHORS TO BE USED DURNG THE WORK Identify the anchors, both engineered and improvised, that workers are to use		
CLEARANCE DISTANCE(S) TO BE CONFIRMED Clearance distances must be sufficient to prevent a worker from striking the ground, an object, or level below the area		
PROCEDURES Identify detailed procedures to assemble, inspect, use, maintain & dismantle the fall protection system identified above		
RESCUE PLAN Describe the procedures that will be followed if a worker falls and needs to be rescued		
This fall protection plan was developed by:		
Name:	Signature:	Date:

Workers sign the second page of this form to acknowledge that they have reviewed and understand this fall protection plan.
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FALL PROTECTION PLAN

Workers must be trained in the safe use of fall protection equipment and the procedures they must follow to ensure their personal safety while using this equipment. This training must include the procedures to assemble, maintain, inspect, use and disassemble the fall protection system or systems in use (refer to section 15 of the *OHS Regulation*). Workers expected to rescue a worker who has fallen and is suspended by a fall protection system must be trained in rescue procedures. These procedures should be practiced at regular intervals.

Workers signing this form acknowledge that they have reviewed and understand this fall protection plan.			
Date	Print Name	Signature	Trained in the safe use of the fall protection equipment?
			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐
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			YES ☐ NO ☐
			YES ☐ NO ☐
			YES ☐ NO ☐

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Rescue after a fall

The OHS Code requires written rescue procedures. After an arrested fall, the fallen worker remains suspended in mid-air from his or her full body harness, awaiting rescue. In most cases, the worker is not injured and can alter body position within the harness to be more comfortable.

Unfortunately, a worker suspended in a near upright position with the legs dangling in a harness of any type is subject to what has come to be known as "suspension trauma". This is one of the reasons that the fall protection plan must include rescue procedures.

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 below.

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.

For more information

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.

Commentary on the use of 911 for rescue

In the case of rescues involving workers in confined spaces and workers suspended in the air after a fall, calling 911 alone and awaiting the arrival of rescue services personnel is considered to be an insufficient emergency response. The employer must have some basic level of on-site rescue capability — see section 55 for confined spaces — in the event that rescue services personnel are delayed or unable to attend the scene.

In some situations, rescue services personnel may not have the equipment or skills to perform a rescue e.g. a worker in a confined space deep below ground level in a horizontal tunnelling operation or a worker suspended 100 metres above ground level following the failure of a swingstage scaffold. In such cases the employer's on-site rescue capability must be such that the work site is virtually self-sufficient in returning a rescued worker to safe ground.

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;

(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.

Section 141 Instruction of workers

Workers must be trained in the safe use of fall protection equipment and the procedures they must follow to ensure their personal safety while using this equipment. This training must include the procedures to assemble, maintain, inspect, use and disassemble the fall protection system or systems in use (see section 15 of the *OHS Regulation*). Workers expected to rescue a worker who has fallen and is suspended by a fall arrest system must be trained in rescue procedures.

Section 142 Full body harness

Full body harnesses are the only type of harness allowed in personal fall arrest systems. Full body harnesses have four main functions:

(1) to securely hold the worker’s body during free fall, deceleration and final arrest;

(2) to distribute arrest forces to those parts of the body able to absorb the forces without significant injury. Full body harnesses with straps that pass across the buttocks are particularly good at doing this;

(3) to keep the body in an upright or near upright position after the fall and until the worker is rescued; and

(4) to allow workers to do their work without restricting their movement.

Chest harnesses without leg straps, and sit harnesses having only leg and waist straps (no shoulder straps) are not permitted for fall arrest. Sit harnesses commonly used in mountaineering are unacceptable. Only full body harnesses approved to one of the listed standards are acceptable.

For compliance purposes, the full body harness must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the harness has been approved to the requirements of the Standard. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

The 2009 edition of the OHS Code marks the first time that Part 9 accepts fall protection equipment approved to standards from the U.S. and Europe. Fall protection equipment approved to any one of these standards is considered to offer an equivalent level of worker protection. Employers and workers in Alberta now have access to a broader range of equipment to safely meet their fall protection needs. Readers are referred to section 3.1 for information about previous editions of the standards.

Section 142.1 Body belt

Body belts have their use restricted to travel restraint and fall restrict systems. The use of body belts in a fall arrest system is prohibited due to the possibility of death or injury resulting from a worker falling out of the belt or abdominal injuries.

Travel restraint systems prevent workers from reaching an edge or work location from which they could fall. Travel restraint systems have no fall arresting capabilities. Fall restrict systems offer limited fall arrest in combination with a work positioning system.

For compliance purposes, the body belt must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the body belt has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

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Section 142.2 Lanyards

For compliance purposes, lanyards must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI etc. as evidence that the lanyard has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

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Whenever possible, a lanyard used for fall arrest should be equipped with a shock absorber. The shock absorber helps to limit fall arrest forces so that they do not exceed the injury threshold of the human body. The only fall arrest system in which a shock absorber or shock absorbing lanyard is not desired is one in which the added fall distance (1.1 metres [3.5 feet] for North American shock absorbers, 1.75 metres [5.75 feet] for European shock absorbers) created by the shock absorber fully extending creates a greater risk of injury than if the shock absorber were not used. A shock absorber should not be used where this added distance could result in worker injury.

A lanyard incorporating a shock absorber may be used for travel restraint as it takes considerable force e.g. approximately 600 lbs, before the shock absorber's stitching begins to release.

A wire-rope lanyard should be used in any situation that involves welding, cutting with a torch or other similar operations. Synthetic fibre lanyards can be cut, burned, melted or otherwise damaged during such operations. In the event that a worker works near an energized conductor or in circumstances where a lanyard made of conductive material cannot be used, the worker must use another effective means of fall protection. See Figure 9.3 for examples of lanyards.

The lanyard length must be as short as possible for the work involved, yet allow reasonable maneuverability and working convenience. When in use, all lanyards, whatever their length, must not allow a worker to drop more than the free fall distance specified in section 151.

Lanyards must not be "daisy-chained" to extend the distance that a worker can move. The fall arrest system must be repositioned to extend or alter worker movement. Daisy-chaining is unacceptable because it can greatly increase a worker's fall distance, resulting in arrest forces capable of injuring the worker or allowing the worker to contact a lower level.

Section 142.3 Shock absorbers

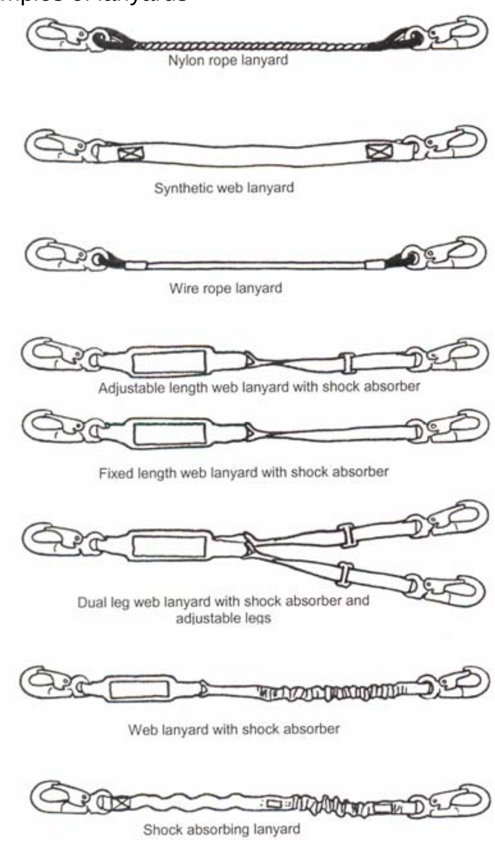
Subsection 142.3(1)

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).

In the case of a heavy worker, an E4 shock absorber may be unable to absorb all the energy of a big fall, causing the worker to “bottom out” and be jolted with the residual energy. Heavier workers should be using an E6 shock absorber. In the case of a heavy worker who takes a long free fall, perhaps because the only anchor location was at the worker’s feet, a European shock absorber may be a better choice. Because of its 1.75 metre (5.75 foot) elongation, it should be able to absorb all the energy of the fall.

Figure 9.3 Examples of lanyards



For compliance purposes, the shock absorber must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the shock absorber has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

The 2009 edition of the OHS Code marks the first time that Part 9 accepts fall protection equipment approved to standards from the U.S. and Europe. Fall protection equipment approved to any one of these standards is considered to offer an equivalent level of worker protection. Employers and workers in Alberta now have access to a broader range of equipment to safely meet their fall protection needs. Readers are referred to section 3.1 for information about previous editions of the standards.

Subsections 142.3(2) and 142.2(3)

Situations may arise in which a personal fall arrest system must be used without a shock absorber. The most common circumstance encountered is a lack of adequate clearance distance. All else being equal, eliminating a shock absorber reduces the required clearance distance by 1.1 metres (3.5 feet) to 1.75 metres (5.7 feet) depending on the type of shock absorber used (see Figure 9.14).

If the shock absorber is removed from the personal fall protection system, then the worker’s free fall distance is limited to 1.2 metres. Even with this fixed distance, employers and workers need to be aware that, depending on the type of lanyard selected, the maximum arresting force of 6 kN stated in subsection 151(3) can be exceeded.

It is crucial that the employer carefully select the type of lanyard used in such situations and determine the maximum arresting force so that workers are not endangered.

Subsection 142.3(4)

No explanation required.

Section 143 Connectors, carabiners and snap hooks

Carabiners, D-rings, O-rings, oval rings, self-locking connectors and snap hooks used to interconnect the components of a personal fall arrest system are subjected to the full maximum arresting force developed during a fall. The failure of any portion of this connecting hardware can lead to the failure of the entire fall arrest system. Carabiner users must remember that the forces stamped on the body of a carabiner represent the ultimate strength of the product, not the working load or safe working load. See Figure 9.4 for examples of carabiners.

For compliance purposes, carabiners, D-rings, O-rings, oval rings, self-locking connectors and snap hooks must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the connector has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with one or both of the listed CEN European standards.

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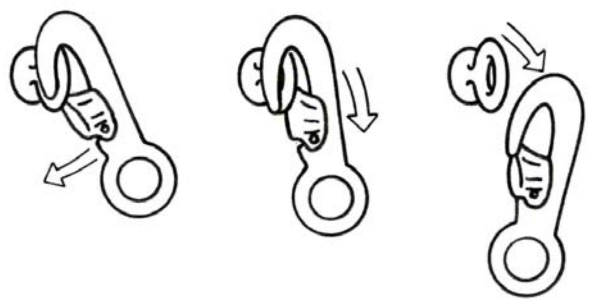
Figure 9.4 Examples of carabiners

Carabiners and snap hooks used as interconnecting hardware in fall arrest systems must be self-closing and self-locking. This prevents unintended detachment of fall protection system components resulting from a worker forgetting to close or lock a carabiner or snap hook. For these connecting components to be acceptable for use, their gates require at least two consecutive, deliberate actions to open.

Snap hooks and carabiners that are not self-closing or self-locking cannot be used as connecting hardware in fall protection systems and must be removed from use and storage. Such components can be used in other applications that do not involve fall protection. These other applications should not allow the connectors to mistakenly make their way back into use as fall protection components. Screw gate carabiners that rely on the user to twist a collar across the gate opening cannot be used in personal fall arrest systems.

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. Although no manufacturer in North America or Europe uses non-locking snap hooks anymore, thousands of them may still be in service. Employers must remove this equipment from use and storage if it is used or could be used for fall protection.

Figure 9.5 Example of accidental roll-out of a snap hook

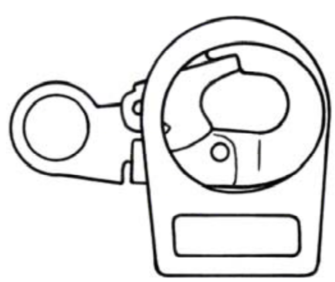


False connection

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.

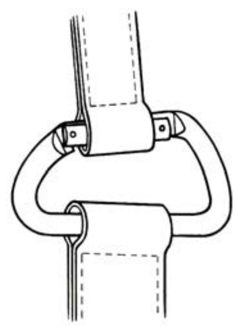
Figure 9. 6 Example of improper or incomplete connection



Gate cross-loading

Snap hooks and carabiners are designed to handle maximum loads in line with their long axes. However, because of their shape or circumstances of use e.g. loops of webbing or rope coming to rest across the gate and then being placed under tension, snap hooks and carabiners can be subjected to gate cross-loading, resulting in much lower breaking strengths (see Figure 9.7). Connections between hardware components must be made carefully when using snap hooks and especially carabiners.

Figure 9.7 Example of cross-loading a carabiner gate



Compatibility of materials

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.

Section 144 Fall arresters

Fall arresters, commonly referred to as rope grabs or cable grabs, are used when workers need to move vertically, normally over substantial distances (see Figure 9.8) Typical users include window washers suspended from swingstages and in growing numbers, workers climbing tall ladders (see Figure 9.9). A fall arrester travels along a life safety rope or rail, following the worker's movements. The friction created between the device and the life safety rope or rail during a fall arrests the fall. A sliding hitch knot or other system incorporating a knot is not a fall arrester.

It is important to recognize that no fall arrester can safely be used on every life safety rope. For this reason, fall arresters must only be used on compatible ropes as described in the manufacturer's instructions. In general, there are two classes of fall arrester.

(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 metre in the case of the referenced CSA standard and 1.4 metres 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.

For compliance purposes, fall arresters must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the fall arrester has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

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Figure 9.8 Example of a fall arrester in use

Figure 9.9 Example of a fall arrester in use on a vertical structure

Section 145 Self retracting device

CSA Standard Z259.2.2-98 (R2004), *Self-Retracting Devices for Personal Fall-Arrest Systems*, defines a self-retracting device (SRD) as a fall arrest device that performs a tethering function while allowing vertical movement (below the device) to the maximum working length of the device (see Figure 9.10). SRDs are designed to arrest a fall while minimizing fall distance and impact force. An SRD has a housing that is normally attached to the anchor of a fall arrest system. The housing contains a drum-wound lifeline.

The retracted end of the lifeline unwinds from the drum under the tension created by the worker's normal movement below the device. When tension is released, the drum automatically retracts the lifeline. Once the speed at which the lifeline pays out reaches approximately 1.5 metres per second (5 feet per second), a velocity-sensing device engages a brake or locking mechanism that arrests the worker's motion.

Only self-retracting devices approved to CSA Standard Z259.2.2-98 (R2004), *Self-Retracting Devices for Personal Fall-Arrest Systems*, are acceptable. This standard requires that Type 2 and Type 3 SRDs be inspected two years after being placed into service, and annually thereafter. Because of their critical importance to the safety of workers using them, and the mechanical workings inside the housing, these units need to be inspected regularly according to the manufacturer's specifications. Because it is the only standard known to require such follow-up maintenance, it is the only standard listed in this section. For compliance purposes, the self-retracting device must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that it meets the requirements of the Standard.

Figure 9.10 An example of a self-retracting device used in the vertical position

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 metres. Early versions of these devices resembled an automotive seatbelt mechanism and have a web-type lifeline. 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. The resulting deceleration distance is very short and the maximum arresting force will therefore be greater than if a Type 2 or Type 3 SRD were used.

Because of this greater arresting force, a Type 1 SRD should be used with a separate shock absorber if it is not already equipped with an integral shock absorber. Employers using these devices should carefully read the manufacturer’s specifications to confirm the conditions under which these devices can be used i.e. indoors versus outdoors, in dusty workplace settings. Many of these devices have markings that state that the peak impact force will be below 4 kN, but this is only tested by the manufacturer with the device overhead. Therefore, it is recommended that Type 1 SRDs only be used where the device is anchored above the worker. Like a standard lanyard, an SRD subjected to the force of a fall must be retired from service.

Type 2 Self-Retracting Device (SRD)
This is a heavier SRD, generally having a working length of more than 3 metres. It has an internal brake to minimize impact forces. The SRD must have a visual load indicator that allows the worker intending to use the SRD to determine if it has arrested a fall. Type 2 SRDs are repairable after a fall incident and are subject to a manufacturer’s service schedule. This type of SRD is also sometimes referred to as a self-retracting lifeline.

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. Type 3 devices have a working length of more than 3 metres. This type of SRD is also sometimes referred to as a self-retracting lifeline.

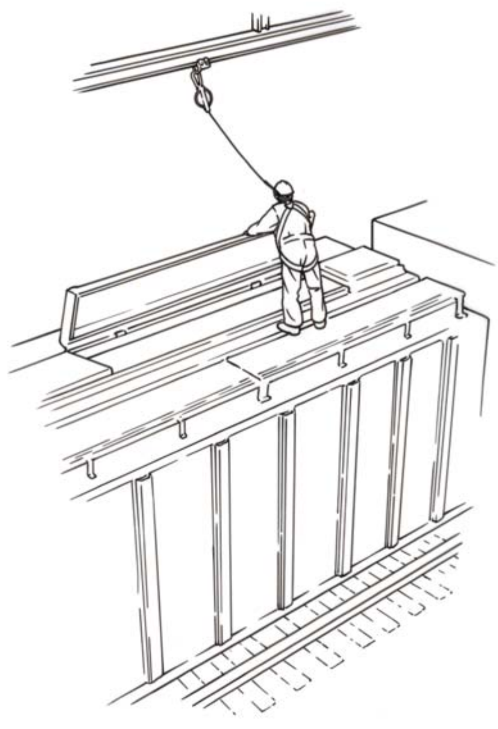
Test before using

Workers should field test the locking feature of an SRD before using it by pulling down on the line quickly and forcefully. The visual load indicator on a Type 2 SRL or Type 3 RSRL should also be inspected. If the device does not lock or the visual load indicator has been activated, the SRD should be removed from service and returned to the manufacturer for re-certification. Only the manufacturer is capable of disassembling, refurbishing and re-certifying an SRD.

Proper use

To minimize free fall distance when using an SRD, the device must be anchored above the worker's work location and there should be no slack in the lifeline (see Figure 9.11). The lifeline should not ride over any sharp edges. When under the tension of a fall, a lifeline in contact with the edge of an I-beam or hatchway opening can be damaged to the point of complete failure. The risk of damage and failure can be reduced by physically protecting the lifeline where it passes over an edge and using a shock absorber positioned between the worker's D-ring and the free end of the SRD.

Figure 9.11 Example of a self-retracting device in use



Self-retracting devices and travel restraint systems

Self-retracting devices must not be used in a travel restraint system unless the length of the lifeline on the drum of the unit prevents the worker from reaching the edge from which he or she could fall. If a worker approaches the edge and there is some lifeline still spooled on the drum, the worker could go past the edge and fall.

Section 146   Descent control device

Descent control devices are designed and intended to be used and operated by one person for personal descent or to lower another person from an elevation. A descent control device may be used for egress (exit), for work positioning, or both. Descent control devices can be either automatic or manual. Once engaged, an automatic descent control device lowers the worker at a constant speed and the worker has no ability to stop or control the rate of descent. A manual descent control device gives the user control over the rate of descent and the ability to stop the descent.

For compliance purposes, descent control devices must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the descent control device has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

The 2009 edition of the OHS Code marks the first time that Part 9 accepts fall protection equipment approved to standards from the U.S. and Europe. Fall protection equipment approved to any one of these standards is considered to offer an equivalent level of worker protection. Employers and workers in Alberta now have access to a broader range of equipment to safely meet their fall protection needs. Readers are referred to section 3.1 for information about previous editions of the standards.

Section 147 Life safety rope

Subsection 147(1) Standards

This edition of the OHS Code marks the introduction of the term “life safety rope” as an alternative to the more familiar terms “vertical lifeline” (still used in some sections within the OHS Code) or “fall protection rope”. The new term reinforces the importance of the rope as a component of a fall protection system on which workers rely for their safety and perhaps their lives. The term is widely used by persons involved in rope rescue and industrial rope access activities.

For compliance purposes, NFPA- and EN- compliant life safety ropes must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the life safety rope has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

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Ropes meeting the requirements of the CSA and ANSI standards are simply required to “meet the requirements of” these standards as these standards are not associated with certification programs. Manufacturers normally “declare” or “self-attest” that their products meet the requirements of the standards. CSA does certify life safety ropes under CSA’s fall arrester standard but only when supplied with a manufactured end termination and supplied with a fall arrester. Users are required to use the rope supplied with the fall arrester.

CEN Standard EN 1891

CEN Standard EN 1891: 1998, P*ersonal protective equipment for the prevention of falls from a height. Low stretch kernmantle rope*, applies to low stretch textile rope of kernmantle construction from 8.5 mm to 16 mm in diameter, for use by persons in rope access including all kinds of work positioning and restraint, for rescue and in caving. Low stretch kernmantle ropes are defined as Type A and Type B.

Kernmantle rope is a textile rope consisting of a core enclosed by a sheath. The core is usually the main load-bearing element and typically consists of parallel elements that have been drawn and turned together in single or multiple layers, or of braided elements. The sheath is braided or woven and protects the core from, for example, external abrasion and degradation by ultraviolet light.

Type A rope is designed for general use by persons in rope access including all kinds of work positioning and restraint, rescue and caving. Type B rope is of a lower performance than Type A rope, requiring greater care in use.

Type A rope has the following performance characteristics:

(a) elongation (stretch) must not exceed 5 percent under test conditions;

(b) static strength without terminations – at least 22 kN;

(c) static strength when terminated with a knot or other method – at least 15 kN; and

(d) fall arrest peak force must not exceed 6 kN under the test conditions.

NFPA Standard 1983

Chapter 5 of NFPA Standard 1983: 2006, *Standard on Life Safety Rope and Equipment for Emergency Services,* presents requirements for life safety rope. The rope must have the following performance characteristics:

(a) elongation must be at least 1 percent but not more than 10 percent at 10 percent of minimum breaking strength;

(b) the breaking strength of light use rope must be at least 4500 lbs (20 kN);

(c) the breaking strength of general use rope must be at least 9000 lbs (40 kN);

(d) light use rope must have a diameter of not less than 3/8 in. (9.5 mm) and not more than ½ in. (13 mm);

(e) general use rope must have a diameter of not less than ½ in. (13 mm) and not more than 5/8 in. (16 mm); and

(f) fibre used in rope must have a melting point of not less than 4000^0 F (2040^0C).

CSA Standard Z259.2.1 and ANSI Standard Z359.1

Life safety rope meeting the minimum requirements of these standards is allowed to stretch up to 22 percent when loaded to a force of 8 kN and have a minimum breaking strength of 27 kN.

Subsection 147(2) Safe use of life safety ropes

1.2 metre distance

The purpose of the 1.2 metre distance is to ensure that a worker on a suspended work platform, such as a boatswain's chair or swingstage scaffold, can be secured to a life safety rope through the full range of travel of the work platform.

In some circumstances it is not practicable or safe for the life safety rope to extend to within 1.2 metres of the lower landing spot. For example, if a work platform is rigged over an underground parking entrance and the lower end of the life safety rope came to within 1.2 metres of the roadway, there would be a danger of the rope being caught by a vehicle unless access was blocked. Blocking access may not be practicable in which case the life safety rope must be terminated at a safe distance above the danger area. The work platform must also be rigged to prevent it being lowered below a level at which the fall protection equipment becomes ineffective and traffic is a danger to the work platform.

Knots and splices

Life safety ropes must be free of knots or splices along their travel portion so that rope strength is not reduced and fall arresting devices such as fall arresters i.e. rope grabs, can move freely. This requirement is not intended to prohibit the use of a knot at the upper end of the rope where the rope is secured to an anchor either directly or via a connecting device such as a carabiner. Ropes with a manufactured termination eliminate the need for workers to know how to tie a secure anchor knot, reducing the chances of the rope separating for the anchor. The stopper knot at the life safety rope's lower termination serves to prevent the fall arrester from sliding off the rope.

Abrasion protection and hazard selection

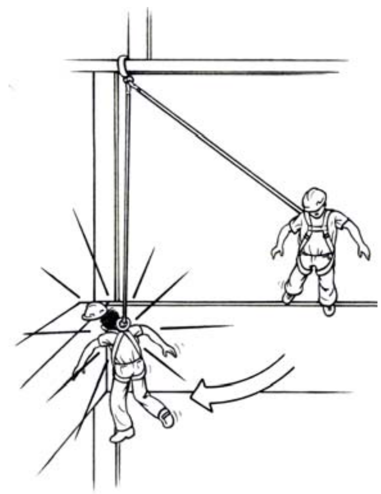
When under the tension of a fall, a life safety rope in contact with the edge of an I-beam or hatchway opening can be damaged to the point of complete failure. The risk of damage and failure can be reduced by physically protecting the life safety rope where it passes over a sharp or rough edge. The risk of damage can be altogether eliminated if the life safety rope can be repositioned away from contact with any sharp or rough edges.

Tools, chemicals and work processes such as welding can sever, abrade, melt, burn or otherwise damage a typical life safety rope. Where such hazards are present, life safety ropes made of wire rope or other material appropriate to the hazard must be used.

Swing fall hazard

Anchor selection and routing of lifelines over and around structures must take into consideration swing fall hazards. Ideally, work should be performed directly below the anchor. The further away a worker is from this ideal position, the greater the potential for the worker to swing as a pendulum into objects if a worker falls (see Figure 9.12).

Figure 9.12 Example of worker falling and swinging like a pendulum into a fixed structure



In situations where swinging cannot be avoided, but where several equally good anchor locations are available, the anchor selected should direct the swing fall away from objects rather than into them. Where there is a choice among anchors, the one offering the least amount of swing should be selected.

Subsection 147(4) One worker per life safety rope

Unless designed for simultaneous use by multiple workers or as part of an engineered fall arrest system on a fixed ladder, only one worker can be attached to a life safety rope at any one time.

Swing drop distance

Subsection 147(2)(e) now includes a 1.2 m (4 ft) swing drop distance based on a requirement appearing in CSA Standard Z259.16. The limitation tries to reduce the potential for injury in a swing fall by limiting how far a worker will drop during the swing. The velocity of a worker that swings into a structure is determined by the height dropped from the start of the swing to the point of contact. Since the worker has the greatest degree of control over the swing fall hazard, this requirement applies to the worker.

Section 148 Adjustable lanyard for work positioning

Once a worker moves to a preferred work location at height, an adjustable lanyard for work positioning is used to secure the worker to a structure to maintain a stable work position. Work positioning lanyards are usually made of rope and are designed to limit movement or to allow hands-free work while in position. Work positioning lanyards may be fixed length or adjustable, and have connecting components at both ends to allow for connection to the side D-rings of a worker's full body harness. Adjustable work positioning lanyards allow a worker to cinch up or adjust the lanyard to optimize the worker's position.

For compliance purposes, adjustable lanyards for work positioning must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the adjustable lanyard has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

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Section 148.1 Rope adjustment device for work positioning

To get to a preferred work location at height, a worker may use a rope adjustment device i.e. a type of descent control device, approved to one of the listed standards. Attached to a life safety rope, the rope adjustment device uses friction within the device to control and alter the worker's position.

For compliance purposes, rope adjustment devices for work positioning must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the rope adjustment device has been approved to the requirements of the Standards. Products bearing a CE mark also comply with this section. The CE mark — Conformité Européenne — indicates that the company manufacturing the product has met the requirements of one or more European directives. The product also complies with the listed CEN European standard.

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Section 149 Wood pole climbing

CSA Standard Z259.14-01, *Fall Restrict Equipment for Wood Pole Climbing*, specifies the requirements for testing the performance and strength of fall restrict equipment for wood pole climbing. This equipment is for use by a single worker exposed to the hazard of falling when ascending or descending, moving around and working on or from a wood pole. Fall restrict equipment is most commonly used by linepersons in the electrical/utility, telecommunications, and construction sectors.

The main parts of a fall restrict system are a modified pole strap, rigid but articulated frame, and connecting hardware (see Figure 9.13). The fall restrict system allows a worker to remain at his or her work position with both hands free. The system performs a limited fall arrest function when the worker loses contact between his or her spurs and the pole. According to the CSA Standard, a Type A system cannot be used on icy poles; a Type AB system can be used on icy poles.

Figure 9.13 An example of fall restrict equipment used when working on or from a wood pole

Only fall restrict equipment approved to CSA Standard Z259.14-01, *Fall Restrict Equipment for Wood Pole Climbing*, is acceptable. For compliance purposes, the equipment must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the equipment meets the requirements of the Standard. Fall restrict equipment in use before April 30, 2004 does not need to be approved to this standard.

CSA Standard Z259.3-M1978 (R2003), *Lineman's Body Belt and Lineman's Safety Strap*, specifies the minimum strength and safety requirements, sizes, markings, and packaging for body belts and safety straps. The equipment is intended for use by workers in the power and communication utilities.

Only lineman's body belts approved to CSA Standard Z259.3-M1978 (R2003), *Lineman's Body Belt and Lineman's Safety Strap*, are acceptable. For compliance purposes, the body belt must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the equipment meets the requirements of the Standard. This requirement for approval to the Standard does not apply to lineman's body belts in use before April 30, 2004.

Although it may be common practice to wear a lineman's body belt as part of a fall restrict system, a full body harness does a better job of distributing fall arrest forces to a greater portion of the worker's body. Because of this better distribution of forces, many linemen already use full body harnesses for other work-related activities.

This section allows the use of either a full body harness or lineman's body belt while using fall restrict equipment. This recognizes that industry is in the process of making the transition to full body harnesses. Industry is encouraged to continue with this transition and eventually replace all lineman's body belts with full body harnesses.

Section 150 Equipment compatibility

Compatible system components can be safely interconnected e.g. carabiners and harness D-rings, ropes and ascenders, etc. without compromising equipment function or worker safety. It is also important that components be compatible with the environment in which they are being used i.e. high heat, corrosive, exposed to welding spatter, etc.

Section 150.1 Inspection and maintenance

It is essential that all load-bearing equipment is inspected before each use to ensure it is in safe condition and operates correctly. The manufacturer's specifications should be consulted to determine the equipment's inspection and maintenance requirements.

Section 150.2 Removal from service

It is important that there is a procedure in place for ensuring that defective or suspect equipment withdrawn from service does not get back into service without inspection and approval by a professional engineer or the manufacturer. Any equipment considered to be defective should be cut up or broken before being disposed of. This ensures that the defective equipment cannot be retrieved and used again.

Section 150.3 Prusik and similar knots

A Prusik sling, using a properly tied prusik knot, creates a sliding hitch knot that can be used in place of a fall arrester. Many other sliding hitch knots can also be made. Because its construction, effectiveness and safe use are so dependent on the user's knowledge and experience, the knots' use is restricted to competent rescue or emergency services personnel, or in an emergency situation to a worker trained in its use and limitations. With the exception of workers involved in tree care operations (see Part 39) and workers involved in work requiring rope access (see Part 41), the use of prusik or similar hitches is prohibited under normal working conditions. A fall arrester meeting the requirements of section 144 must be used.

Section 151 Clearance, maximum arresting force and swing

Subsection 151(1) Clearance distance

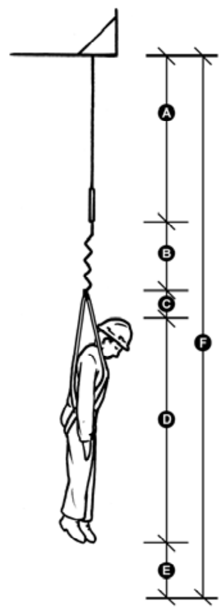
To ensure the safety of a fallen worker, two conditions must be met. The first condition is that the worker's personal fall arrest system is arranged so that the worker cannot hit the ground, an object which poses an unusual possibility of injury, or a level below the work area. The second condition is there must be sufficient clearance distance including a safety factor. Figure 9.14 shows that using a 1.8 metres long (6 feet) lanyard, a worker needs approximately 5.7 metres (18.5 feet) to 6.8 metres (22.1 feet) of clear space below the level of the anchor point. -

Clearance distance using a vertical life safety rope

The most important consideration when using vertical life safety ropes to arrest falls is knowing how much clearance is required. In general, vertical life safety ropes require more clearance than self retracting devices and should therefore only be used when large clearances are available.

The lock-off distance of the fall arrester, lanyard length, stretch of the vertical life safety rope, swing drop, deployment of the shock absorber and the type of harness that the worker is wearing all contribute to the required clearance distance. The following example illustrates how to calculate the required clearance distance below the working platform in accordance with the methods described in CSA Standard Z259.16-04, *Design of Active Fall-Protection Systems.*

Figure 9.14 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 (220 lbs).

A Length of lanyard – 1.8 m (6 ft.)

B Shock absorber pulling apart: 1.1 m (3.6 ft.) CSA E4 or ANSI-compliant shock absorber; 1.75 m (5.7 ft.) CSA E6 or European EN-compliant shock absorber;

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

D Height of worker – 1.8 m (6 ft.)

E Safety factor – clearance below feet of 0.9 m (3 ft.)

F A+B+C+D+E
Minimum clearance distance varies between 5.7 m (18.5 ft.) and 6.8 m (22.1 ft.) depending on the components used in the system.

Clearance distance example:

A worker uses a Class E4 energy absorbing lanyard that is 1.8 metres long and can deploy up to 1.07 metres at a force of 4 kN. The lanyard connects the dorsal D-ring on the worker's harness to an automatic fall arrester that is known to lock onto the vertical lifeline within 0.3 metres. The automatic fall arrester will initially hang the lanyard length (1.8 m) below the D-ring on the harness. The rigid anchorage of the vertical lifeline is 29.7 metres above the location of the fall arrester at the onset of the fall. The lifeline is known to stretch 22 percent at 8 kN and 15 percent at 4 kN. The worker is 8.4 metres laterally from the anchor and therefore subject to a swing drop distance of 1.2 metres. The worker is wearing a "comfort" harness that will stretch 0.75 metres at peak fall arrest forces, and may fall from a kneeling position.

The length of lifeline above the fall arrester after it has locked onto the lifeline = 29.7 metres + 0.3 metre lock-off distance for the fall arrester = 30 m

Clearance calculation:

Free fall = 2 x lanyard length + lock off of the fall arrester = 2 x 1.8 m +0.3 m	3.90 m
Stretch of the vertical life safety rope = 15% of the rope length = 15% of 30 m	4.50 m
Maximum deployment of the shock absorber	1.07 m
Swing Drop	1.20 m
Stretch of the harness	0.75 m
Stretch-out of the worker (falling from a kneeling position)	0.75 m
Mandatory Safety Buffer	0.60 m
Total Required Clearance below the working platform	12.77 m

While the above example is an extreme case, it illustrates how choices of equipment and equipment configuration affect the required clearance distance. It also provides a template for calculating clearances for other configurations and choices of equipment.

Strategies for reducing the required clearance distance include using short lanyards, low stretch life safety rope and conventional harnesses (0.3 metre stretch). Workers can also be trained to manually "park" the fall arrester as high up the rope as possible once they get to their working position. This will help reduce their free fall distance in the event of a fall.

The above methodology will show that approximately 3.0 metres is the minimum achievable clearance when falling from a standing position while using an automatic fall arrester with a 0.3 metre shock absorbing lanyard, even if the vertical life safety rope has negligible stretch and there is no potential for swing falls.

Note that the above calculation assumes full (1.07 metre) deployment of the shock absorber, which is the worst case scenario.

Subsection 151(2)

Situations may arise in which a personal fall arrest system must be used without a shock absorber. The most common circumstances encountered is a lack of adequate clearance distance. All else being equal, eliminating a shock absorber reduces the required clearance distance by up to 1.1 metres (3.5 feet) (see Figure 9.14).

If the shock absorber is removed from the personal fall protection system, then the worker's free fall distance must be limited to 1.2 metres. Even with this fixed distance, employers and workers need to be aware that, depending on the type of lanyard selected, the maximum arresting force of 6 kN stated in subsection 151(3) can be exceeded. To determine the arresting force, the following equation should be used:

$$F = mg\left(1 + \sqrt{1 + \frac{2AE}{mg}\frac{h_{ff}}{ly}}\right)$$

A = cross sectional area of lanyard (in^2)

E = rope modulus of elasticity of lanyard, or lifeline (lb/in^2)

F = maximum arrest force, MAF (lb)

f = $\frac{h_{ff}}{ly}$, fall factor, the distance the worker falls relative to the lanyard length, $0.1 \leq f \leq 2$

h_{ff} = free fall distance (ft). Defined as the distance from the point where the worker would begin to fall to the point where the fall arrest system would begin to cause deceleration of the fall

h_{ly} = lanyard length or active length of lanyard (ft)

ly = lanyard length or active length of lanyard (ft)

mg = weight of worker (lbs)

It is crucial that the employer carefully select the type of lanyard used in such situations and determine the maximum arresting force so that workers are not endangered.

Subsection 151(3) Maximum arresting force

Maximum arresting force is the short-duration (milliseconds to tenths of a second), peak dynamic force acting on a worker's body as the worker's fall is arrested. The maximum arresting force to which a worker can be exposed during fall arrest in Alberta is limited to 6 kN (1350 lbs).

Research studies have shown that the short duration forces that happen during fall arrest are unlikely to cause injury if they act vertically upwards through the buttocks and spine and are limited to no more than 9 kN (2000 lbs). The 6 kN limit is therefore considered safe, but as was discovered during the studies, is subject to the following conditions:

(a) the maximum arresting force is applied upwards through the pelvic area;

(b) the worker's physical condition is sufficient to withstand such a jolt; and

(c) the duration of the maximum arresting force is limited to a fraction of a second.

A fall arrest system that correctly uses a shock absorber will limit the maximum arresting force under normal circumstances to either 4 kN (900 lbs) or 6 kN (1350 lbs), providing a margin of safety.

Maximum arresting force is determined by the worker's weight, the length of the lanyard, and the ability of the fall arrest system to absorb the energy of the fall. The anchor should be above the work position, the length of the lanyard kept as short as possible (while still permitting the work to be performed safely) and the fall arrest system should almost always include a shock absorber. Readers are referred to the explanation for subsection 151(2) to see the equation often used to calculate the arresting force.

This edition of the OHS Code accepts a maximum arresting force (MAF) of 6 kN under normal circumstances because

(a) the 6 kN MAF value has been successfully used in Europe and other jurisdictions for many years. The 8 kN value previously cited in the OHS Code appears to have been a North American phenomenon,

(b) the lower MAF is technically achievable with today's fall protection equipment, and

(c) the lower MAF means that workers are exposed to a lower arresting force, reducing the potential for injury.

Subsection 151(3) incorporates this change but includes a condition that reflects the fact that under worst case conditions (a wet and then frozen shock absorber), the MAF can be as great as 8 kN for a type E6 shock absorber. Readers are referred to section 142.3 for a discussion of E4 and E6 shock absorbers.

Subsections 151(4), 151(5) and 151(6)

As required by subsections 151(4) and 151(5), a worker must use the shortest length lanyard that still allows the worker to perform his or her work safely and the lanyard must be attached to an anchor no lower than the worker's shoulder height unless an anchor at shoulder height is not available. When an anchor at shoulder height is not available, the lanyard must be secured to an anchor point as high as reasonably practicable.

Tying to an anchor at foot level is dangerous. A shock absorber approved to the CSA Standard for shock absorbers will safely absorb energy based on a 2 metre fall of a 100 kg worker. But tying a 1.8 metre lanyard at foot level can subject the shock absorber to a 3.6 metre free fall. Unless specifically designed for this type of free fall, the shock absorber's webbing may fully extend without absorbing all the energy of the fall, resulting in a "bounce" at the bottom. The remaining energy (and there could be a great deal of it) goes into the worker, potentially causing serious injury.

Shock absorbers approved to CEN Standard EN 355: 2002 are currently available in the marketplace that will accommodate a 3.6 metre free fall and still limit the maximum arresting force on a 140 kg worker to 6 kN. Employers using these products must take into account the extra clearance that these products require. A European shock absorber will elongate up to 1.75 metres (5.75 feet) in a fall.

The problem of securing the lanyard to an anchor at an appropriate height may be solved by using a horizontal lifeline passing across the work area (see Figure 9.15), a hitching post that raises the anchor point, or a self-retracting device attached to an anchor located well above shoulder height. Other solutions may be possible.

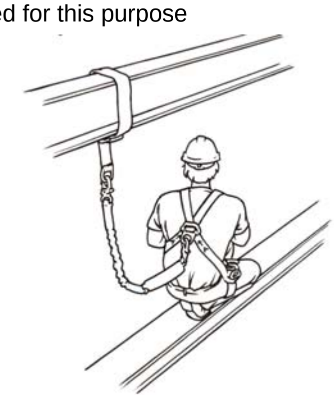
Figure 9.15 Example of using a flexible horizontal lifeline to safely move through a work area

Sections 152 to 152.4 General comments about anchors

Parts of structures located in the vicinity of where a worker is working are often used as improvised anchors (as opposed to engineered anchors) for travel restraint and fall arrest systems (see Figure 9.16). Improvised anchors are not manufactured to any technical standard. Improvised anchors may include a beam, struts of a communication tower, a concrete Jersey barrier, a sizeable tree, a locked out and chocked vehicle, or other similar, robust structures.

Workers required to use fall protection equipment must be trained to understand how to safely protect themselves. These workers must be able to assess an anchor's strength, stability and location.

Figure 9.16 Example of I-beam used as an anchor point with sling specifically designed for this purpose



Workers may tug or reef on a potential anchor as a test to see if it will hold. This “test” is completely inadequate as the force generated during a tug rarely approaches even half the worker’s body weight. A better approach might be to imagine a passenger vehicle being supported from the anchor by a lanyard. If the vehicle, having a weight approaching 1600 kilograms (3600 pounds) can be held, then the anchor is a good one. The anchor must be “bomber” or “bomb-proof”.

If an anchor is located on a mobile or erected structure such as a bucket truck, manlift or scaffold, the stability of the structure needs to be considered in the event of a fall. The structure must not topple over and create more safety problems.

Swing fall hazards must be considered when selecting an anchor. Ideally, work should be performed directly below the anchor. The further a worker is away from this ideal position, the greater the potential for the worker to swing like a pendulum into objects if the worker falls (see Figure 9.14). In situations where swinging cannot be avoided, but where several equally good anchors are available, the anchor selected should direct the swing fall away from objects rather than into them. Where there is a choice among anchors, the one offering the least amount of swing should be selected.

A drop during a swing may result in the worker impacting the ground or other obstructions. Furthermore, the horizontal speed at the bottom of the swinging arc is exactly the same as the vertical speed if the worker had fallen the height dropped during the swing. For this reason, the CSA Standard Z259.16 recommends establishing anchorage locations so that the swing-drop distance is limited to 1.2 m or less.

Table 9.1 summarizes the strength requirements of anchors as required by sections 152 and 152.1

Table 9.1 Summary of anchor strengths required by section 152 and 152.1

Fall Arrest Anchor Strength (temporary or permanent)	**Travel Restraint Anchor Strength**	
	Temporary	Permanent
16 kN or 2 x Maximum Arresting Force (MAF)	3.5 kN	16 kN or 2 x MAF Since there is no category for “permanent travel restraint anchor” , these anchors default to being fall arrest anchors.

Section 152 Anchor strength – permanent

Anchors used for attachment of a personal fall arrest system must have a minimum breaking strength of

(a) at least 16 kN (3600 lbs) per worker attached, in any direction required to resist a fall, or

(b) two times the maximum arresting force per worker attached, in any direction required to resist a fall.

The required anchor strength required by this edition of the OHS Code was reduced from the previous 22.2 kN (5000 lbs) to the present 16 kN (3600 lbs) for the following reasons;

(a) with today's equipment, lower forces are readily achievable;

(b) most jurisdictions in Canada use a lesser value;

(c) despite the previous requirement for a 22.2 kN anchor strength, any worker using a self-retracting device (SRD) today is effectively being protected by a fall arrest system limited to a maximum strength of approximately 16 kN. This is the strength of the wire rope used in the SRD, which sets the limit for the entire fall arrest system. The wire rope strength is limited to 16 kN as a compromise between safety and minimizing the weight and bulk of the SRD;

(d) the lesser value of 16 kN is used throughout the countries of Europe, in Australia, and New Zealand. The value is incorporated in the legislated standards of these countries; and

(e) a lesser value of anchor strength allows for the use of lighter and smaller anchors (without compromising worker safety). The change in required anchor strength potentially increases the variety of fall arrest solutions available to Alberta workers and employers by opening the Alberta market to products that are otherwise currently unavailable.

As pointed out in subsection 152(2), the 16 kN minimum breaking strength requirement does not apply to anchors installed before July 1, 2009. Anchors installed before this date should be rated to 22.2 kN or twice the maximum arresting force that they will experience.

The requirements of this section apply to anchors used in personal fall arrest system; anchors used with horizontal lifeline systems may require greater strengths and must meet the requirements of subsection 153(1).

Two times the maximum arresting force

The two times maximum arresting force approach to rating an anchor i.e. the 2:1 safety factor approach, is particularly useful in cases where workers must be protected from falling but the structure on or from which they are working, such as a power transmission tower, cannot accommodate the 16 kN minimum breaking strength for anchors. When the two times maximum arresting force criterion is applied using the force limit of 6 kN (1350 lbs) required by subsection 151(3), the required strength of the anchor decreases to 12 kN (2700 lbs).

A fall arrest system using an E4 shock absorber that is approved to the CSA Standard for shock absorbers limits the worker's weight to 115 kilograms (including tools and personal accessories), and restricts the free fall distance to less than 2 metres during certification testing, is capable of limiting the arresting force to 4 kN (900 lbs). The resulting required anchor strength decreases further to 8 kN (1800 lbs).

This "two times maximum arresting force" approach should only be used in accordance with the manufacturer's specifications or under the supervision of a professional engineer who can accurately determine the peak forces and the available anchorage strength. If shock absorbers become wet and frozen, peak impact forces can approach 8 KN (1800 lbs).

Users of this approach must realize that using shock absorber arrest force performance to set anchor strength has several important limitations:

(1) the 115 kilogram weight limit can easily be exceeded if a large worker is required to wear personal protective equipment, a tool belt, and carry equipment, additional tools or supplies. This worker may be required to use an E6 type shock absorber which limits maximum arresting force under optimal conditions to 6 kN;

(2) the free fall limit distance of 1.8 metres may not always be practically achieved. Workers often use lanyards having a length of 1.8 metres. Connected to an appropriate anchor located above standing shoulder height, the 2 metre limit can be met. However, if the lanyard is attached at a lower level, the 1.8 metre free fall distance against which the lanyard's performance was verified is exceeded. The lanyard may be unable to limit the fall arrest to 4 kN; and

(3) fall arrest equipment is used under a variety of environmental conditions. When wet, or frozen after being wet, a shock absorber's maximum arresting force increases. CSA Standard Z259.11 allows the maximum arresting force of an E4 shock absorber, under these conditions to increase to 6 kN (1350 lbs); the maximum arresting force of a wet and frozen E6 shock absorber increases to 8 kN (1800 lbs). This needs to be taken into consideration as a

limiting factor if there is a chance that the shock absorber will get wet or freeze after being wet.

Having all anchors comply with the 16 kN per attached worker option is the preferred choice as there is no confusion as to the strength of the anchor. The second option requires the anchor point to be "*designed, installed and used in accordance with the manufacturer's specifications or specifications certified by a professional engineer*".

For more information

📖 Sulowski AC. *Fall-Arrest Systems — Practical Essentials*. CSA International, Toronto; 2000.

Section 152.1 Anchor strength – temporary

Subsection 152.1(1) Temporary travel restraint anchor

In temporary applications, travel restraint anchors must be designed to have a minimum breaking strength of 3.5 kN (800 lbs) and be installed, used and removed according to the manufacturer's specifications or specifications certified by a professional engineer.

To prevent a worker from confusing a travel restraint anchor with an anchor intended for fall arrest, the temporary anchor must be permanently marked as being for travel restraint only. Upon completion of the work project or within the time period specified by the manufacturer or professional engineer, the anchor must be removed so it is not forgotten and, over time, permitted to deteriorate to the point that it is unable to provide the expected degree of protection.

Subsection 152.1(2) Temporary fall arrest anchor

Temporary fall arrest anchors such as wire rope slings, synthetic webbing slings, I-beams sliders, I-beam clamps, etc. must have a minimum breaking strength of

(a) at least 16 kN (3600 lbs) per worker attached, in any direction required to resist a fall, or

(b) two times the maximum arresting force per worker attached, in any direction required to resist a fall.

Temporary fall arrest anchors must be installed, used and removed according to the manufacturer's specifications or specifications certified by a professional engineer. Upon completion of the work project or within the time period specified by the manufacturer or professional engineer, the anchor must be removed so it is not forgotten and, over time, permitted to deteriorate to the point that it is unable to provide the expected degree of protection.

Section 152.2 Duty to use anchors

To be effective, personal fall arrest and travel restraint systems must be safely secured to an anchor i.e. lanyard or self-retracting device must be clipped in. Workplace Health and Safety is aware of many instances of workers being equipped with the appropriate fall protection equipment but failing, for whatever reason, to clip in to an anchor. Subsection 152.2(1) requires the worker to clip in to an anchor that meets the requirements of Part 9.

Prior to clipping in, a worker is required to visually inspect the anchor he or she is planning to use to make sure that the anchor is in sound condition and free of damage. The anchor must be securely fastened to its substrate and be free of any damage that could compromise its ability to function properly. If an anchor is damaged, the worker must not use it until the anchor is repaired, replaced or re-certified by the manufacturer or a professional engineer.

Anchorage connectors such as carabiners, snap hooks, quick links, etc. must be appropriate for the work being undertaken. Some connectors will be more suitable than others for a given situation. Size, type and style of connector may need to be considered to avoid sizing mismatches and improve system ease of use.

Section 152.3 Independence of anchors

The anchor to which a personal fall arrest system is attached must not be the same anchor that supports or suspends a platform. Independent anchors are required so that if the anchor supporting or suspending the platform fails, then the worker does not fall along with the platform. Note that it is acceptable to use engineered anchors that have two or more loops on a single device that function independently of one another. A platform can be supported by one loop and a worker by another loop.

Section 152.4 Wire rope sling as anchor

Many industries use wire rope slings to create fall protection anchors by wrapping the slings around substantial structural members and then clipping into one or both of the end terminations depending on how the sling is positioned around the structural member. The requirements of subsection 152.1(2) apply to wire rope slings as slings are generally used as temporary fall arrest anchors. As such, these slings must be rated to a minimum breaking strength of at least 16 kN or two times the maximum arresting force per worker attached.

Wire rope slings used as anchorage connectors must be terminated at both ends with Flemish eye splices rated to at least 90 percent of the wire rope’s minimum breaking strength.

Section 153 Flexible and rigid horizontal lifeline systems

A horizontal lifeline (HLL) consists of a synthetic or wire rope rigged between two substantial anchors. These lifeline systems allow a worker to move horizontally while safely secured to a fall arrest system. Synthetic rope HLLs should be considered temporary because they are usually subject to deterioration resulting from use, exposure to the elements, and exposure to other potentially damaging hazards. Wire rope HLLs may be either temporary or permanent. Rigid rail horizontal fall protection systems are almost always permanent (see Figures 9.17 and 9.18).

Figure 9.17 Example of wire rope used as horizontal lifeline

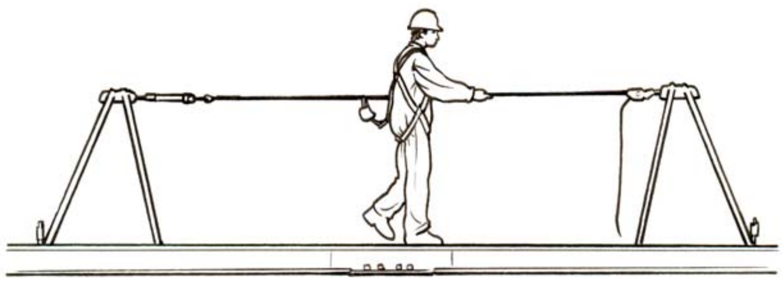


Figure 9.18 Example of rigid rail

Because of their complex performance characteristics, flexible horizontal lifeline systems must meet the requirements of CSA Standard Z259.13-04, *Flexible Horizontal Lifeline Systems*, or the applicable requirements of CSA Standard Z259.16-04, *Design of Active Fall-Protection Systems*.

CSA Standard Z259.13-04, *Flexible Horizontal Lifeline Systems*, specifies requirements related to the performance, design, testing, labeling, and provision of pre-engineered flexible horizontal lifeline systems for the attachment of personal fall protection systems. The Standard states design limitations that are necessary for safe and durable service. It also specifies strength requirements for lifeline system anchorages but not strength-testing requirements for these anchorages.

CSA Standard Z259.16-04, *Design of Active Fall-Protection Systems*, is intended for professional engineers with expertise in designing fall protection systems. The standard specifies requirements for the design and performance of complete active fall protection systems, including travel restraint and vertical and horizontal fall arrest systems.

The performance characteristics of rigid horizontal fall protection systems are less complex than those of flexible horizontal lifeline systems. Such systems must be designed, installed and used in accordance with

(a) the manufacturer’s specifications, or

(b) specifications certified by a professional engineer.

Manufacturers and designers may wish to refer to Standard Z259.16-04, *Design of Active Fall-Protection Systems* for helpful advice.

Section 153.1 Installation of horizontal lifeline systems

A vital aspect of the safe use of horizontal lifeline systems is that they be installed properly. This section requires that before the horizontal lifeline system is used, it is certified in writing as having been properly installed according to the manufacturer’s specifications or the certified specifications of a professional engineer. This certification of the installation can be performed by a professional engineer, a competent person authorized by the professional engineer, the manufacturer, or a competent person authorized by the manufacturer. This competent person could be one of the employer’s workers, trained and authorized by the lifeline manufacturer to certify the installation.

Often overlooked by employers and installers of horizontal lifeline systems is whether or not there is sufficient clearance below the installed system. If there is any doubt, employers should contact the equipment manufacturer or involve a professional engineer who can assess the available clearance in accordance with the requirements of CSA Standard Z259.16.

Section 154 Fixed ladders and climbable structures

For the purposes of subsection 154(1), a worker ascending or descending a fixed ladder is not actually “working from or on a fixed ladder” and thus fall protection is not required. If a worker stops on the ladder to, for example take measurements, operate a valve, open a hatch, paint a surface, etc., and can fall a distance of 3 metres or more, a fall protection system must be used.

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 type of fall protection.

A climbable structure is an engineered or architectural work where the primary method of accessing the structure is by climbing the structure with the principle means of support being the climber’s hands and feet. Examples of climbable structures include power transmission towers, communication towers, large units of powered mobile equipment such as dump trucks, cranes and crane booms, etc. Due to the variety of structure climbing access techniques and the associated hazards, it is essential that a worker be given sufficient instruction to perform the required skills that are needed to safely access a structure and be compliant with this Part.

A worker climbing, working, resting, transitioning between work and rest positions, or transferring from one distinct structure to another on a climbable structure needs to use an appropriate fall protection system that provides the worker with continuous fall protection.

Section 155 Fall protection on vehicles and loads

This section recognizes that it is not always reasonably practicable for an employer to provide a “hard” fall protection system that uses guardrails, a harness-lanyard-anchor combination or some other approach. Despite the employer taking steps to eliminate or reduce the need for a worker to climb onto a vehicle or its load, a worker may still need to go up on a vehicle or load. In such cases, the employer is allowed to use procedures in place of fall protection equipment as long as the load is secured against movement before a worker climbs onto the load. The procedures must meet the requirements of section 159.

Readers should note that the use of procedures in place of fall protection equipment is based on the employer determining that it is not reasonably practicable to provide a fall protection system for use by workers. The justification as to why it is not reasonably practicable, particularly when the employer’s work site has structures to which a fall protection system could be added or has the space to install a permanent or temporary system, should be noted.

Section 156 Elevated work platforms, aerial devices, personnel baskets

Subsection 156(1) Boom-supported work platforms

Experiences at Alberta workplaces involving ejections has resulted in this subsection explicitly requiring that workers use a personal fall arrest system when working from a boom-supported elevating work platform, boom-supported aerial device or forklift truck work platform e.g. telescopic fork handler (see Figures 9.19 and 9.20). Since ejections can happen at any height, particularly when the boom is in its stowed condition and the unit is moving or being loaded or unloaded off a trailer, the requirements apply even though the worker's position above grade may be less than 3 metres in height.

Figure 9.19 Example of an articulated boom-supported aerial device (insulated or non-insulated)

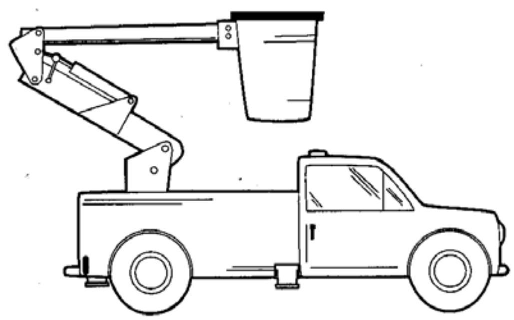
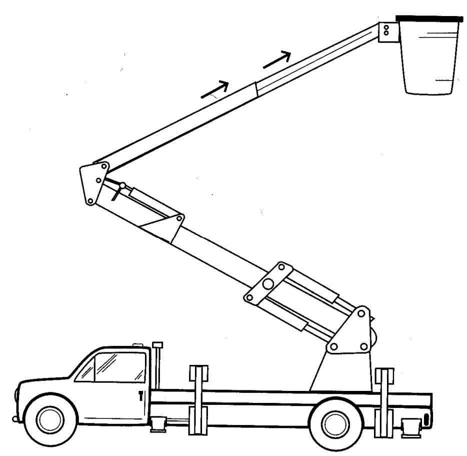


Figure 9.20 Example of a hybrid aerial device — articulated aerial device with extendible (telescopic) boom



To reduce the likelihood of a worker being ejected from the work platform, 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 (usually because the unit is very old), then an anchor point certified by a professional engineer 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 anchor sling can be safely used without affecting the stability of the machine.

The worker's lanyard, if reasonably practicable, needs to be short enough to prevent the worker from being ejected yet be long enough to allow the worker to perform his or her 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 his or her work unimpeded. The result may be a compromise.

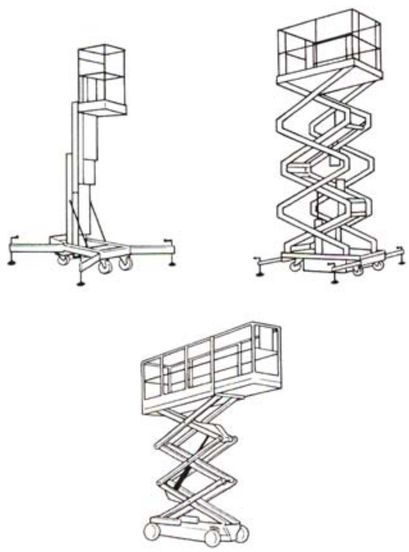
The required personal fall arrest system, which must include a shock absorber as required by subsection 142.3(2), can function as a travel restraint system preventing the worker from being ejected. However, if the lanyard is too long to prevent ejection, then the shock absorber will help limit arrest forces on both the worker and the platform's anchor point in the event of an ejection and fall.

The referenced CSA Standard Z259.16-04, *Design of Active Fall-Protection Systems*, specifies requirements for the design and performance of complete active fall protection systems. It is intended for professional engineers with expertise in designing fall protection systems.

Subsections 156(2) and 156(3) Scissor lifts and similar work platforms

Almost all modern scissor lifts (see Figure 9.21) are equipped with anchor points. Some manufacturers recommend that a travel restraint system (consisting of a full body harness and lanyard) or a personal fall arrest system be used by workers on the scissor lift, connected to the anchor points provided. Other manufacturers recognize that when a scissor lift is correctly set up and sited, guardrails offer appropriate work protection.

Figure 9.21 Examples of scissor lifts and a similar vertical aerial platform



Some older model scissor lifts may not be equipped with anchor points. These units will very likely, in their manufacturer specifications, indicate that the unit's guardrails provide worker fall protection. Subsection (3) then applies.

Subsections (2) and (3) must be read together. Subsection (3) overrides the travel restraint system requirement of subsection (2) by recognizing that the scissor lift manufacturer may allow the worker to work from the work platform and rely on the guardrails to provide protection against falling. The manufacturer's instructions for use must state that the use of the scissor lift's guardrails as a means of fall protection is acceptable. Workplace Health and Safety agrees with this assessment.

This approach has several benefits:

(a) it defaults to the use of a full body harness and lanyard for travel restraint, which can only be overridden by the manufacturer;

(b) it reflects what may be a future trend in the aerial work platform industry without conflicting with that trend;

(c) from a compliance perspective, any worker on a scissor lift should be using a full body harness and lanyard connected to an anchor point. If the worker is not, then the employer can be requested to produce a copy of the manufacturer's operating manual and show where in the manual the manufacturer allows guardrails alone to be used. This ensures that manuals are available and initial compliance is a simple visual check to confirm that a harness and lanyard are being used; and

(d) despite warnings to the contrary, workers continue to stand on midrails (and toprails) to complete work tasks. If a worker is wearing a correctly selected and adjusted travel restraint system, there is less chance that he or she will be able to stand on the rails. As a rule of thumb, if a worker can stand on the midrail while using the travel restraint system, then he or she can fall off the platform.

Scissor lifts and similar vertical aerial platforms are generally more stable than a work platform supported by a boom. Reflecting this higher level of safety, a worker need not use a full body harness and lanyard connected to an anchor point if the scissor lift or similar vertical aerial platform is operated on a firm, substantially level surface with all of the manufacturer's guardrails and chains in place. However, if the manufacturer's specifications require the use of a travel restraint or fall arrest system when the vertical aerial platform is being used, then the manufacturer's specifications take precedence and must be followed.

Research studies

In a 2007 study of aerial lift fatalities in the U.S. for the period 1992 – 2003, there were 306 deaths – 228 involving boom lifts and 78 involving scissor lifts. Table 9.2 summarizes these deaths by manner of fall and the activity being performed at the time of the event.

Table 9.2 Aerial lift deaths by manner of fall and activity, 1992 – 2003

Activity	Fall from	Tipover/ Collapse	Ejection	Total
Boom Lifts				
Construction and repairing	27	38	31	96
Logging, trimming and pruning	18	23	19	60
Vehicular and transportation operations	5	22	16	43
Other activities	8	18	—	29
Boom Lift Total	**58**	**101**	**69**	**228**
Scissor Lifts				
Constructing and repairing	19	18	—	39
Vehicular and transportation operations	—	17	—	22
Painting and cleaning	7	6	—	13
Other activities	—	—	—	17
Scissor Lift Total	**31**	**44**	—	**78**

Source: U.S. Bureau of Labor Statistics Census of Fatal Occupational Injuries (CFO) Research File

As shown in Table 9.2, tipovers/collapses were involved in 46 percent of the fall deaths associated with boom lifts and 56 percent of fall deaths associated with scissor lifts. Failure to use a harness or belt and lanyard to tie off while performing tasks was reported in 42 of the 228 (18 percent) boom lift fatalities. In 25 deaths involving 23 boom lift ejection or tipover/collapse events, the lift was struck by a vehicle, train or crane. In nine boom lift ejections the worker or lift was struck by a falling tree. Other contributing causes to boom lift deaths included open platform doors or defective latches.

Major contributing factors for scissor lift falls included surface conditions and scissor lift motion. In six tipover events (14 percent of 44 scissor lift tipovers), uneven or sloped ground or driving on/off a flatbed truck was a factor, and in seven tipover events (16 percent) driving into holes or over a sidewalk or similar edge was a factor.

Results from this study indicated that for a significant percentage (82 percent of falls involving a different fatality database) of incidents involving a fall from height, existing fall prevention systems such as guardrails, chains, gates/doors, belts, and harnesses with or without lanyards were not being used at the time of the incident.

Source: *Pan CS, Hoskin A, McCann M, Lin ML, Fearn K, Keane P. Aerial lift fall injuries: A surveillance and evaluation approach for targeting prevention activities.* Journal of safety research 2007; 38(6): 617-25.

In a different study of deaths involving aerial work platforms used in the U.S. construction industry between 1992 and 1999, it was determined that boom-suspended work platforms accounted for almost 70 percent of deaths involving aerial work platforms. The study reported that

(a) half of all falls from boom-supported work platforms involved being ejected from the bucket or platform after being struck by vehicles, cranes, or crane loads, or by falling objects, or when the work platform suddenly jerked, and

(b) two-thirds of the deaths from tipovers/collapses of boom-supported work platforms occurred when the bucket cable or boom broke or the bucket fell. Almost one-third of the deaths were due to tipovers.

This same study found that scissor lifts accounted for over 25 percent of the aerial lift deaths. The study reported that

(a) the causes of scissor lift falls were unknown for over half of the fall deaths,

(b) in one-fifth of the falls, the worker was ejected from the scissor lift, mostly when an object struck the scissor lift. The rest of the fall deaths occurred after removal of chains or guardrails, or while standing on or leaning over railings,

(c) three-quarters of the tipovers of scissor lifts resulted in fall deaths. For the rest, workers died from being struck by the falling scissor lift, and

(d) about two-fifths of the tipovers occurred when the scissor lift was extended more than 5.5 metres (15 feet), mostly while driving the lift.

For more information

www.elcosh.org/docs/0400/d000484/d000484.pdf
Deaths from Aerial Lifts. The Centre to Protect Worker's Rights, 2001

Subsection 156(4) Movement not adequately restricted

In some cases, the travel restraint system used on a scissor lift or elevating platform with similar characteristics cannot adequately restrict a worker's movement in all directions, perhaps because of its rectangular shape. If this is the case, then a personal fall arrest system must be used.

The required personal fall arrest system must include a shock absorber as required by subsection 142.3(2). If a worker does fall off the platform then the shock absorber will help limit arrest forces on both the worker and the platform's anchor point.

Section 157 Water danger

Some work situations involve working above water where a fall into the water exposes a worker to the hazard of drowning. In such circumstances, workers must wear a life jacket or personal flotation device. If the fall protection system prevents a fall into the water, then the life jacket or personal flotation device is not required. For example, if a worker uses a safety net or personal fall protection system that arrests the fall and prevents the worker from making contact with the water, then a life jacket or personal flotation device need not be worn.

Section 158 Leading edge

Leading edge fall protection — fabric or netting panels

General

Some types of roofs are constructed using metal rolls, decking panels, or some other methods that involve "leading edges". A leading edge is the edge of a floor, roof, or formwork for a floor or deck or other walking or working surface that changes location as additional sections are placed, formed or built. A leading edge is dangerous even if workers are not actively adding materials. Workers must be protected if they are accessing those areas.

Falls may happen at unprotected edges of the metal decking, from openings in the deck, from the skeleton structure, and from access equipment such as ladders and scaffolds. Falls may occur during any of the operations connected with unloading, deck laying or fastening and when material, tools and equipment are being moved on to or off of a deck already installed. Workers should not approach the leading edge unless they are pushing a sheet of decking material in front of them.

Sides and edges are considered “unprotected” when there is no wall or guardrail system at least 920 millimetres (36 inches) high (as required by section 315 for a guardrail). This does not apply to entrances, exits and points of access.

Fabric or netting panels

A relatively new approach to providing fall protection at a leading edge is the use of fabric or netting panels specifically designed for this purpose. At present, these panels usually cover a roof’s secondary open steel structural members and offer leading edge fall protection while workers apply insulation and other roof coverings.

These panels are *not* safety nets and the requirements for safety nets do not apply to them.

If an employer wishes to use a leading edge fall protection consisting of fabric or netting panels, all of the following conditions must be met:

(a) the system can only be used to provide leading edge fall protection. The system cannot be used to provide fall protection for workers at heights above the plane or level in which the system is being installed;

(b) the system must be used and installed according to the manufacturer’s specifications, respecting any limitations that the manufacturer may impose on the system during installation and use;

(c) a copy of the manufacturer’s specifications for the system must be available to workers at the work site at which the system is being used;

(d) the fabric or netting product must be

  (i) drop-tested at the work site as described in 29 CFR Section 1926.502 (C)(4)(i) published by the Occupational Safety and Health Administration (OSHA) i.e. a 182 kg mass (400 lbs) dropped from a height of 107 cm (42 in) onto the fabric or netting, or

  (ii) certified as safe for use by a professional engineer; and

(e) all workers using the system must be trained in its use and limitations.

Section 159 Procedures in place of fall protection equipment

This section recognizes that it is not always reasonably practicable for an employer to provide a "hard" fall protection system that uses guardrails, a harness-lanyard-anchor combination or another fall protection system described in this Part. The use of procedures in place of fall protection equipment is based on the employer determining that it is not reasonably practicable to provide a fall protection system for use by workers. The justification as to why it is not reasonably practicable should be noted.

If the use of a fall protection system is practicable, it must be used e.g. if anchor points are available or a fall protection system can be rigged without exposing workers to a greater hazard, then a fall protection system must be used. The option of using an administrative procedure is not intended to allow an employer or worker to avoid using a fall protection system or some type of elevated work platform just because doing so may be inconvenient or take more time than using an administrative procedure.

A procedure-based fall protection system can *only* be used in the following situations:

(1) *installation or removal of fall protection equipment (first person up/last person down)* — typical examples may involve installing a fall arrest anchor at the peak of a roof, installing a perimeter guardrail system on a flat roof, installing a portable fall arrest post at height, etc.;

(2) *roof inspection* — applies to both flat and sloped roofs. Roof inspection includes school staff checking for and retrieving items that have been thrown on a school roof. If it is not possible to remain at least two metres from the edge of the roof while retrieving the object or toy, then a procedure-based approach can be used as long as the conditions listed below are met;

(3) *emergency repairs* — this does not include normal maintenance and service tasks;

(4) *at-height transfers between equipment and structures if allowed by the manufacturer's specifications* — examples include transferring to and from a structure from some type of elevating work platform, an electric utility lineman transferring from a helicopter to a high voltage transmission line, etc.; and

(5) *situations in which a worker must work on top of a vehicle or load* — section 155 applies in this case.

Workers engaged in these five types of activities at height are exposed to fall hazards for very short periods of time, if at all, since they may be able to accomplish their work without going near a danger zone i.e. within 2 metres of the edge in the case of roofs. Workers engaged in such work are not continually or routinely exposed to fall hazards. As a result, they tend to be very focused on their footing, alert and aware of the hazards associated with falling i.e. more aware of their position than, for example, a roofer who is moving backwards while operating a felt laying machine, or a plumber whose attention is on an overhead pipe and not on the floor edge.

If an employer wishes to use a procedure in place of fall protection equipment, all of the following conditions must be met:

(a) *written hazard assessment* — a written hazard assessment specific to the work site and work being performed must be completed before work at height begins. This reinforces the requirements of Part 2 for hazard assessment;

(b) *written procedures* — the procedures to be followed by workers while performing the work must be in writing and available to workers before the work begins. Workers must understand the activity that they are about to undertake. The procedures must be part of the fall protection plan required by section 140;

(c) *limit number of workers exposed to fall hazard* — the work must be carried out in such a way that minimizes the number of workers exposed to the fall hazard while work is performed;

(d) *the work must be limited to light duty tasks of limited duration* — the work must be a "light duty task" such as inspection, estimating, or simple emergency repairs e.g. membrane repair on a flat roof (the repair of insulation below the waterproofing membrane is not a light duty task), etc. The work done at each work area within the work site must be less than approximately 15 minutes in duration. While doing the task, the worker should not turn his or her back to the edge and should keep the edge in sight;

(e) *worker competency* — the worker performing the work must be competent to do so;

(f) *use of procedures during inspection, investigation or assessment activities* — if procedures are used for inspections, investigations or assessment activities, the activities must take place prior to the actual start of work or after work has been completed. If the activities take place while work is going on e.g. during construction of a roof or structure, the fall protection requirements of Part 9 apply to *all* workers exposed to a fall hazard. The use of procedures in these circumstances recognizes that before work begins, or after all work has been completed and workers have left the area, there may be a need for building inspectors, owners, etc. to inspect the area and/or the work. All fall protection equipment, such as perimeter guardrail systems or safety nets, may have been removed following completion of the work. The systems need not be reinstalled a second time for inspectors; and

(g) *limit worker exposure to additional hazards* — the use of a procedure must not expose a worker to additional hazards. Working at height has inherent risks. Exposing a worker to additional hazards and therefore greater potential harm is not an acceptable practice e.g. having a worker free climb a severely sloped metal clad roof to install an anchor at the peak, having a worker inspect a difficult-to-access equipment location that could be inspected from another location using other means i.e. elevating work platform or nearby structure using optical equipment.

Section 160 Work positioning

A work positioning system is a system of components attached to a vertical life safety rope and includes a full body harness, descent controllers and positioning lanyards used to support or suspend a worker at a work position. A work positioning system allows a worker to work at height supported in *tension*, part or all of the worker's mass being supported by the work positioning system and the remainder by the surface on which the worker is standing. The worker relies on both the tension provided by the anchor and his or her feet to maintain the work position. The worker may use an adjustable work positioning lanyard to further secure his or her work position. Work positioning can be used in occupational settings such as tree climbing, residential wood frame construction, residential roofing, high rise window cleaning, Christmas light installation, snow clearing on sloped roofs, etc.

If a work positioning system is used as a means of holding a worker in position at the work location, the worker should select and use a fall protection system based on the work surface slope characteristics described in Table 9.3. If the hazard assessment required by Part 2 indicates that the work surface presents a slipping or tripping hazard because of its state or condition, the employer must ensure that an appropriate fall protection system is used that takes into account the state or condition of the surface.

When a worker uses a work positioning system, tension is maintained at all times in the life safety rope(s) to which the worker is attached and slack in positioning lanyards is kept to a minimum at all times. Doing so helps ensure that the worker's vertical free fall distance, in the event of al fall, is restricted by the positioning system to 600 millimetres or less.

Table 9.3 Selection of fall protection system to be used with work positioning, based on work surface and slope

Class	Work surface and slope characteristics	Required back-up fall protection system
I	Flat – with a slope of no more than 4 degrees	None, unless the worker's centre of gravity extends beyond the edge, in which case a back-up fall arrest system is required.
II	Slight elevation gain or loss – slope angle varies from 4 to 8 degrees	None, unless the worker's centre of gravity extends beyond the edge, in which case a back-up fall arrest system is required.
III	Sloping sharply enough that a person needs to touch a hand for balance	None, unless the worker's centre of gravity extends beyond the edge, in which case a back-up fall arrest system is required.
IV	Hands and feet or the work positioning system is required to maintain the work position on a sloping surface	Travel restraint system unless the worker's centre of gravity extends beyond the edge, in which case a back-up fall arrest system is required.
V	Vertical surface. Worker is suspended	Fall arrest system.

Figures 9.22, 9.23 and 9.24 show workers using work positioning systems in various applications.

Figure 9.22 Worker on communication tower using tower climbing harness and work positioning system

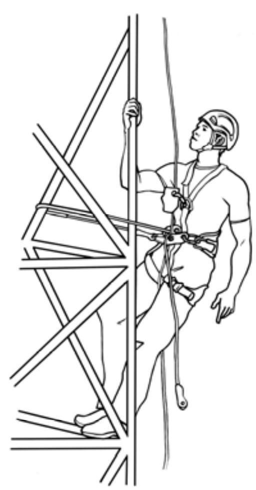


Figure 9.23 Worker repairing roof structure while using work positioning system

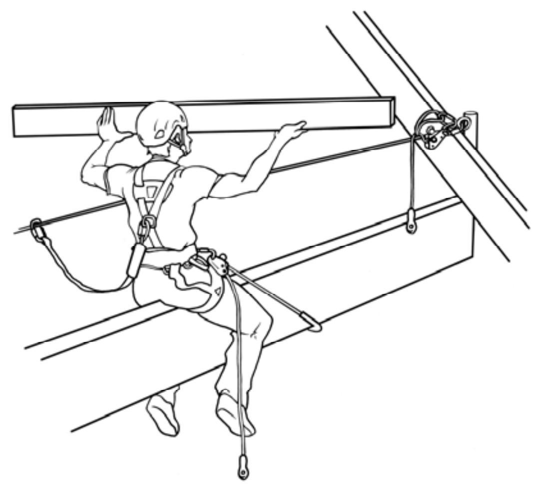
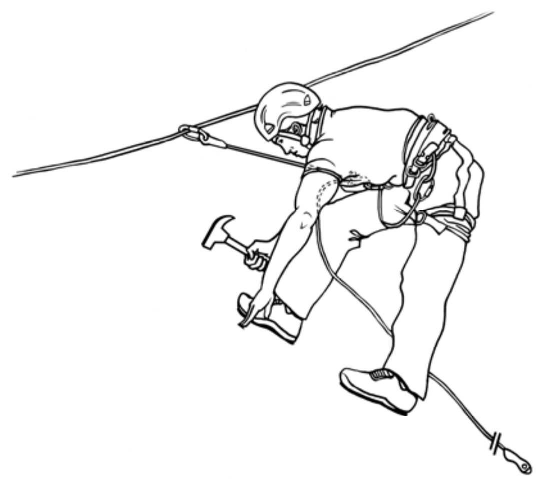


Figure 9.24 Worker using work positioning system for travel restraint on a roof



Section 161   Control zones

The use of a control zone is an approach to fall protection that places special requirements on workers and work being performed on a nearly level working surface within 2 metres of an unguarded edge from which a worker could fall. Control zones can be used on surfaces having a slope of up to 4 degrees measured from the horizontal.

If a worker works within 2 metres of the control zone i.e. within 4 metres of the unguarded edge, a raised warning ling or equally effective means is required. If a worker works within the control zone, then a travel restraint system must be used.

A control zone cannot be used if the level working surface on which work is being performed is less than 4 metres wide. In such circumstances, one of the other methods of fall protection required by the OHS Code must be used.

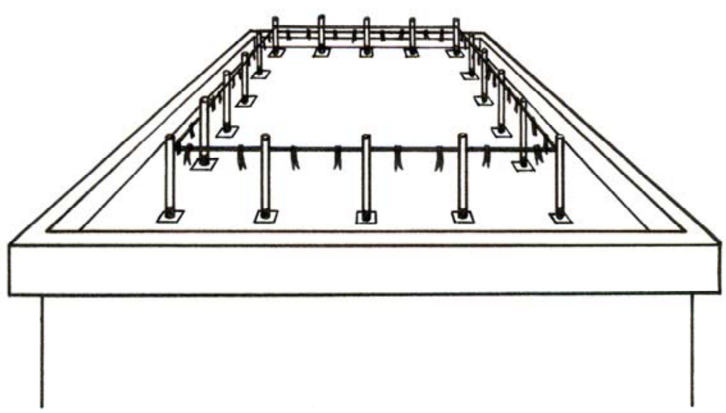
Work away from unguarded edge

Situations may arise where, on a large flat roof for example, work is performed at a significant distance away from an unguarded edge e.g. at a penthouse near the centre of the roof. With the exception of when workers enter or leave the work area at an unguarded edge, workers have no contact with the edge. Upon accessing the roof, workers must proceed directly to their work area. Under such circumstances, a line defining a control zone is unnecessary, as are the remaining requirements for fall protection that would normally apply at the unguarded edge.

Line defining the control zone

If a worker works within 2 metres of the control zone i.e. within 4 metres of the unguarded edge, a raised warning line or equally effective means of alerting the worker to the unguarded edge is required (see Figure 9.25). The raised warning line or other equally effective means such as barricades must be placed at least 2 metres from the edge. The warning method provides a visual and physical reminder of the presence of the hazard.

Figure 9.25 Example of control zone marked out on flat roof



For compliance purposes, a raised warning line can consist of ropes, wires or chains, and supporting stanchions, and should be

(a) flagged or marked with highly visible materials at intervals that do not exceed 2 metres (6.5 feet),

(b) rigged and supported so that the lowest point (including sag) is not less than 0.9 metres (34 inches) from the walking or working surface and its highest point is not more than 1.2 metres (45 inches) from the walking or working surface,

(c) attached to each stanchion in such a way that pulling on one section of the line between stanchions will not result in slack being taken up in the adjacent section before the stanchion tips over, and

(d) the rope, wire or chain must have a minimum tensile strength of 2.2 kN (500 lbs).

An “equally effective method” might be a substantial barrier e.g. pile of materials or supplies, tall parapet, building system pipes and ducts, etc. that is positioned between the worker and the unguarded edge, preventing the worker from getting to the edge. Since this substantial barrier is acting as a guardrail, it must at all time be at least 920 millimetres (36 inches) tall while the protected worker is using it.

Work within the control zone

If a worker works within the control zone, then a travel restraint system or equally effective means that prevents the worker from getting to the unguarded edge must be used. A travel restraint system is always preferred but may not be appropriate or possible in all circumstances.

An “equally effective method” might be a substantial barrier e.g. pile of materials or supplies, tall parapet, building system pipes and ducts, etc. that is positioned between the worker and the unguarded edge, preventing the worker from getting to the edge. Since this substantial barrier is acting as a guardrail, it must at all time be at least 920 millimetres (36 inches) tall while the protected worker is using it.

A control zone cannot be used if the level working surface on which work is being performed is less than 4 metres wide. In such circumstances, one of the other methods of fall protection required by the OHS Code must be used.

For more information

Ellis, NJ. *Introduction to Fall Protection*, 2nd edition. American Society of Safety Engineers, Des Plaines, Il; 1993.