

Part X FALL PROTECTION

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Section	Title	Revision Date
E138	<u>Definitions</u>	September 2009
E140	<u>Fall protection systems</u>	May 2014
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E142	<u>Fall arrest system</u>	September 2009

Explanations

The Standards listed below are referenced in this Part of the Regulations.

Standard Agency	Standard Number	Standard Title
ANSI	A10.11	<i>Safety Nets Used During Construction, Repair and Demolition Operations</i>
CSA	CAN/CSA Z259.10	<i>Full Body Harnesses</i>
CSA	CAN/CSA Z259.11	<i>Energy Absorbers and Lanyards</i>
CSA	CAN/CSA-Z259.1	<i>Safety Belts and Lanyards</i>
CSA	Z259.2.1	<i>Fall Arresters, Vertical Lifelines, and Rails</i>
CSA	Z259.2.2	<i>Self-Retracting Devices for Personal Fall-Arrest Systems</i>
CSA	Z259.2.3	<i>Descent Control Devices</i>
CSA	Z259.12	<i>Connecting Components for Personal Fall Arrest Systems (PFAS)</i>
CSA	Z259.13	<i>Flexible Horizontal Lifeline Systems</i>

CSA	Z259.16	<i>Design of Active Fall Protection Systems</i>
CSA	CAN/CSA Z259	<i>Body Belts and Saddles for Work Positioning and Travel Restraint</i>

Section E138 Definitions

Subsection E138(a) Anchorage point – means a secure point of attachment for a lifeline or lanyard.

It can also be defined as a connection point on a permanent structure or part of a structure, engineered and/or designed to withstand any fall arrest forces imposed on it. The anchorage system must safely endure the forces applied during the use of a fall protection system during a fall, as well as the rescue equipment that may need to be employed to afford a rescue.

The general 'Rule of Thumb' is that any anchor (anchorage point) should be able to withstand a minimum arrest force of 22kN (5000 lbs). The actual strength of an anchor is dependent on:

- The design of the anchor
- The orientation of the anchor relative to the direction of loading
- The condition of the anchor
- The connection of the anchor to the supporting structure
- The adequacy of the structure to resist the imposed loading

If an employer proposes to use an anchor for a personal fall protection system in a temporary fall arrest system with an ultimate load capacity of less than 22 kN (5,000 lbs), the employer must demonstrate that the anchor has an ultimate load capacity of two times the maximum arrest force (MAF) at the particular location. In some cases, and especially on complex fall protection systems, a professional engineer will design the system and calculate the expected MAF. Most manufacturers consider the upper limit of an acceptable MAF to be 8 kN (1,800 lbs).

By using other methods to reduce the arrest forces in conjunction with the anchor, the employer may not need to obtain engineering advice. At work locations where that expertise is not readily available, the employer may choose to use a manufactured product that indicates on the label and within the product instructions what the MAF will be in the circumstances in which it is used. Shock absorbers are an effective way to reduce and control the MAF that can occur in the event of a fall. In the absence of advice from a professional engineer, a shock absorber should be included in a fall arrest system when connecting to an anchor that has a load capacity of less than 22 kN (5,000 lbs) but is designed to resist two times the maximum arrest force.

Standard CAN/CSA-Z259.11, Energy Absorbers and Lanyards, requires that a shock absorber must limit the maximum arrest force to 4 kN (900 lbs) when at room temperature and dry.

As the calculation of the MAF in any situation can be complex and dependent to some degree on the particular circumstances of the place where the equipment is used, simply using such a product may not suffice. A person selecting an energy absorber is to consider his or her weight, atmospheric conditions, and fall distance in order to make the correct choice. Additional detail is available in the new CSA Standard Z259.16-04 Design of Active Fall-protection Systems.

Anchors

A temporary anchor should be removed upon completion of the work for which it was intended.

- A permanent anchor should be made of stainless steel, hot dipped galvanized steel, or other corrosion-resistant material having similar structural properties.
- An anchor should be located so a lifeline attached to it is not deflected over a guardrail or other part of the structure which has insufficient strength to support the maximum potential load from a fall arrest.
 - A vertical lifeline, lanyard, or safety strap should be effectively protected at points of attachment and elsewhere, as necessary, to prevent chafing or abrasion caused by contact with sharp or rough edges. When a tool is used that could sever, abrade, or burn a lifeline, lanyard, or safety strap, the lifeline, lanyard, or safety strap should be made of wire rope.
- An anchor in concrete should be cast in place or through-bolted with a backing plate for adequate load distribution.
- An anchor mounted on concrete with drilled in fasteners (expansion or adhesive type) should use a group of at least three fasteners supporting an anchor plate, sized, and arranged so that if any one fastener in the group is assumed to be carrying no load, the remaining fasteners will have a design capacity to carry the full design load of the anchor.
- An anchor should be located on a line perpendicular to the building edge at the drop location to eliminate the swing fall hazard. Where this is not practicable, an anchor may be offset so the angle between the line perpendicular to the building edge at the drop location and the suspension line or lifeline is no greater than 22 degrees.

Section E140 Fall protection systems

Fall protection systems consist of, but are not limited to, the following:

1. Fall Restraint Systems (also called Travel Restraint),
2. Fall Arrest Systems (including Self-Retracting Devices (SRD)),
3. Control Zones,
4. Safety nets.

1. Fall restraint systems (also called Travel Restraint)

Fall restraint normally means a fall protection system arranged such that a worker cannot fall lower than the surface on which the worker was supported before the fall started. For example, a personal fall restraint system for a worker on an elevated flat surface would be arranged so the worker could go up to the edge of the work surface, but not beyond the edge in the event of a slip or fall. The system, in the event of a slip or fall, would result in the worker landing on the work surface, and perhaps very close to going over the edge. Other work positioning arrangements, such as a firefighter secured to an aerial ladder, or a tree trimmer or power line technician using a climbing belt and pole strap, will normally result in the worker going through some vertical drop in the event of a slip. To allow their fall protection to be considered as fall restraint, their equipment should be arranged to limit the vertical drop as much as possible, and in no case, should the total fall distance be more than 30 centimetres (1 foot).

A fall restraint system should only be used where a worker likely can regain footing or otherwise self-rescue immediately after a slip or fall. Fall protection equipment and components that are intended only for fall restraint applications should be clearly and permanently marked to indicate such a limitation.

2. Fall arrest systems (including Self-Retracting Devices (SRD))

If the equipment cannot be arranged to limit the vertical drop to 30 cm, then the personal fall protection system should be a fall arrest type, and the system will need to address the additional requirements for fall arrest. For example, Section 142 of the OHS Regulations requires workers to wear a full body harness when using a personal fall protection system for fall arrest.

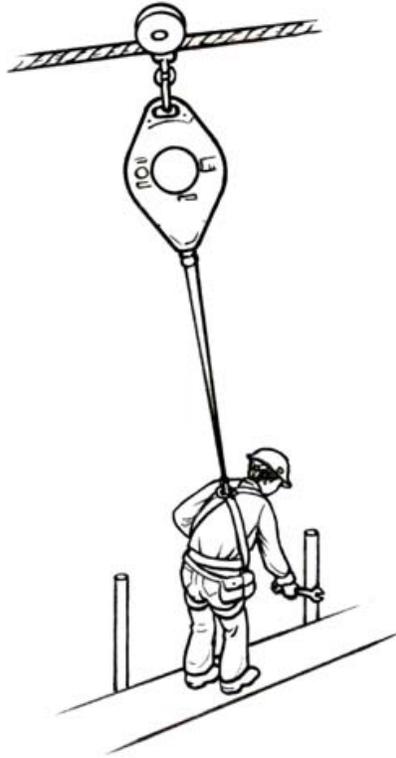
Self – retracting devices are permissible as a form of fall arrest; however it should never be used as a form of fall (travel) restraint.

CSA Standard Z259.2.2, 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 10.1). SRDs are designed to arrest a fall while minimizing fall distance and impact force. An SRD has a housing, 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, Self Retracting Devices for Personal Fall-Arrest Systems, are acceptable. 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 10.1 - An example of a self-retracting lifeline used in the vertical position



CSA classifies SRDs into three types as follows:

Type 1 Self-Retracting Lanyard (SRL)

This is a compact and lightweight SRD having a working length of 1.5 to 3.0 metres. It resembles an automotive seatbelt mechanism and has 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 SRL 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). Like a standard lanyard, an SRL subjected to the force of a fall must be retired from service.

Type 2 Self-Retracting Lanyard (SRL)

This is a heavier SRD, generally having a working length of more than 3 metres. It has an internal shock-absorbing mechanism that works with the brake to

minimize impact forces. The SRL must have a visual load indicator that allows the worker intending to use the SRL to determine if it has arrested a fall. Type 2 SRLs 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 Lanyard with Retrieval Capability (RSRL)

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".

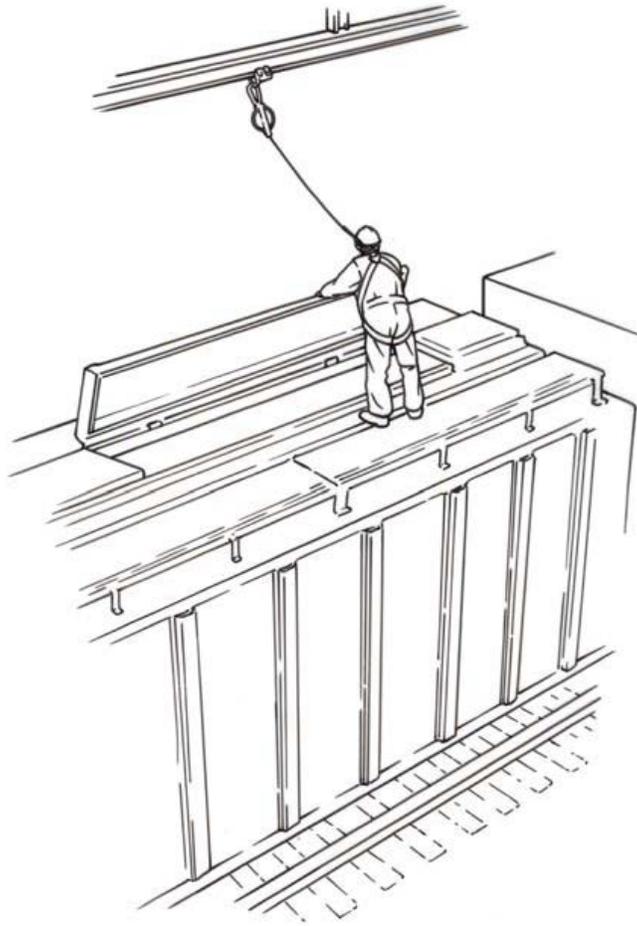
Test before using

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 10.2). 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 10.2 Example of a self-retracting lifeline in use



Self-retracting lifelines and travel restraint systems

Self-retracting lifelines **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.

3. Control Zones

In this guide:

"Control zone" means the area between an unguarded edge of a building or structure and a line which is set back a safe distance of at least 2 meters.

A control zone may be used as the means of fall protection under Subsection 141(h), as any other means of fall protection that provides a level of safety equal to or greater than a fall arrest system.

The control zone method of fall protection is intended for level or low-sloped work surfaces. It is not to be used on a working surface where the slope of that surface exceeds 4 vertical in 12 horizontal, or for skeletal structure work or scaffold erection and removal. If workers will **at all times** remain further from the unguarded edge than the width of the control zone, the use of a raised warning line is acceptable around the work area.

Width of the Control Zone

The width of a control zone is to be at least 2 metres (6.5 feet), with additional distance if any of the following conditions exists:

- The working surface is slippery or sloped.
- The work is carried out at an elevation relative to the unguarded edge.
- The risk is increased by the use of equipment near the control zone.

Raised warning line

If a worker will be working within 2 metres (6.5 feet) of the control zone, a line defining the control zone is to be established by a raised warning line or other equally effective means at all times during such work. For example, an acceptable raised warning line includes a line:

- Of high-visibility material, or a line flagged or clearly marked with high-visibility materials at intervals not exceeding 2 metres (6.5 feet), and
- Rigged and maintained to be between 0.85 metres and 1.15 metres (34 and 45 inches) above the working surface.
- Easily detected when a worker touches it.

4. Safety Nets

As outlined in Section 143 of the OHS Regulations.

Section E141 General requirements

Subsection E141(b) Situations involving work “above a surface or thing” may include work performed above moving water, operating machinery, extremely hot or cold surfaces, etc. This Subsection is applicable where an injury resulting from a fall onto the “surface or thing” may be worse than an injury from landing on a solid, flat surface.

The selection of a method for fall protection under Section 141 depends on what is practicable. Employers are expected to make reasonable assessments and use good judgment in making this decision. What is practicable depends on the

circumstances of each workplace and is a matter of assessment and judgment. The following examples cover some typical situations:

- Guardrails will generally be considered practicable in work areas where numerous workers are working at or near the edges of elevated floors and roofs on buildings or structures under construction.
- Where a roof is under repair, it may not be practicable to install guardrails because of such factors as the small number of workers involved and the short duration of the job. In this situation, it may be practicable to use a fall restraint system that consists of a harness and a lifeline connected to a suitable anchor and rigged to prevent the worker from going beyond the unguarded edge(s).
- When a worker needs to be on or near the top plate of a wood frame structure to facilitate part of the erection process, such as to position and fasten joists or trusses to the plate, fall protection is required if the fall distance will be 3.05 metres or more. Generally this condition will exist along the outer side of the perimeter walls. It will normally be practicable to erect guardrails along the outer side of the wall, or to work from a single pole scaffold (with guardrails if necessary) from either side of the wall, or to use another method of fall restraint or arrest.
- It may be necessary to remove a guardrail to accommodate work. If so, only that portion of the guardrail necessary to allow the work to be done may be removed. Workers exposed to a fall hazard must be protected by another fall protection system when the guardrail is absent. The guardrail should be replaced when the unguarded area is left unattended, and after the work is completed if the circumstances still require guardrails.
- If guardrails currently exist, an employer cannot tear them down and substitute another form of fall protection, such as a control zone system, simply because it will make the work easier. The fact that guardrails currently exist suggests that it is practicable to use that form of fall protection.
- A fall arrest system will likely be practicable where there is no sizable work platform (for example, on a bridge girder) or where it would be cost-prohibitive to build platforms on which guardrails or other fall restraint systems could be used because the work is of short duration and uses relatively few workers.

Section E142 Fall arrest system

Subsection E142(1)(a) A worker's safety can only be assured if his or her personal fall arrest system or travel restraint system is securely attached to an anchor point. The worker is responsible for making sure that the connection is made.

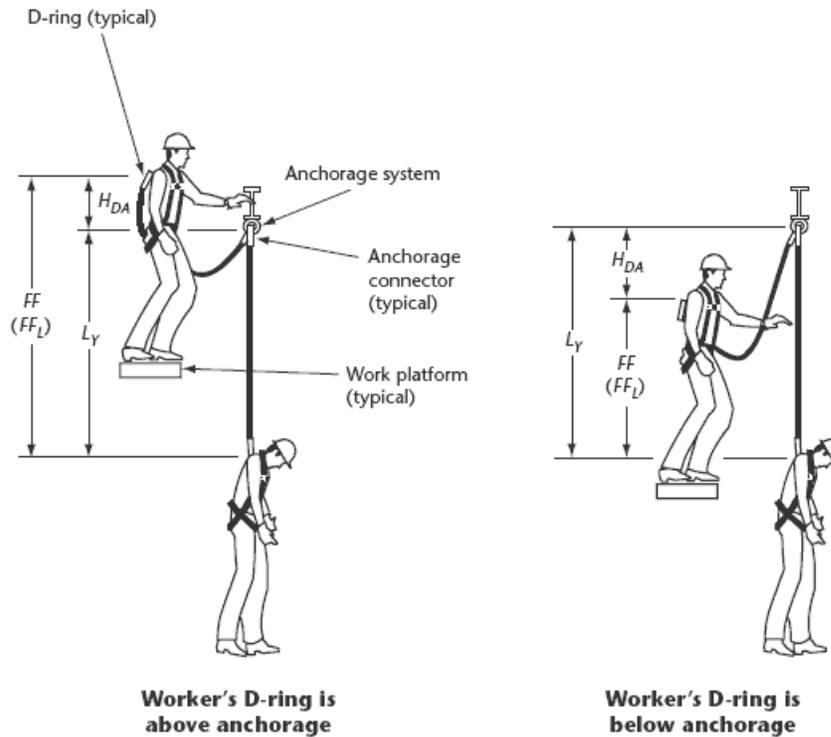
Subsection E142(1)(c)(i) Free fall distance is the actual distance fallen. It is the measurement between a harness' D-ring before and after a fall. See Figure 10.3 to observe that a 1.22m lanyard attached at any point below the D-ring (shoulder level) will create a free fall distance of between 1.22m and 2.44m. Therefore, unless a 1.22m lanyard is attached level with or above the users D-ring, a shock absorber must be used in the fall arrest system.

Shock absorbers are the braking components of the fall arrest system, designed to begin absorbing the force of the fall when the other components of the fall arrest system have deflected/tightened and the fall begins to be stopped. As a result, shock absorbers lower the maximum arrest force on the user's body during arrest of the fall, lessen or prevent damage to other fall arrest system components and lower the force acting on the fall arrest system anchor point(s).

Subsection E142(1)(c)(ii) The maximum arrest force is controlled primarily through elongation of the shock absorber, therefore, the user of a fall arrest system incorporating a shock absorber must anticipate and consider the increase in total fall distance due to deployment of the shock absorber. Failure to consider this increase in total fall distance may result in the user striking the ground or other safe surface prior to full deployment of the fall arrest system. Manufacturer's specifications outline the maximum allowable free fall distance and the maximum arrest force on the user from the deployment of the particular shock absorber.

If conditions exist that a worker will fall from a work area and contact a safe surface below the worker during the fall; the worker shall do whatever is necessary to prevent a free fall of greater than 1.22 metres. (i.e. relocate the anchorage point to reduce the free fall distance, change the scope of the work, change the equipment necessary to continue with the task, etc.)

Figure 10.3 Differences in free fall above and below the anchor



Legend:

- FF = free fall
- = FF_L
- = $HD_A + L_Y$
- FF_L = free fall resulting from lanyard/lifeline slack
- = $HD_A + L_Y$
- H_{DA} = vertical distance from the D-ring to the anchorage system end of the lanyard
 (H_{DA} is negative if the D-ring is initially below the anchorage)
- L_Y = length of lanyard

Subsection E142(5) The inspection required prior to each use is to identify defects in the fall arrest system. Items to look for include, but are not limited to:

- cut or damaged rope and webbing,
- bent rivets,
- worn or broken stitching,
- loose splices,
- broken strands,
- broken or improperly functioning hardware,
- frayed material,
- evidence of exposure to heat or corrosive chemicals including certain paints, and
- any other wear and tear that may adversely affect the integrity of the fall arrest system.

Identified defects are to be repaired by the manufacturer or authorized agent, and/or components replaced prior to further use of the fall arrest system.

Subsection E142(10)(a) & (b) Further to these two sections a “written fall protection plan” should include, but is not limited to the following sections:

1. Job Specific Information
 - a. Worksite Address or Location
 - b. Date of Review with Workers
 - c. Scope of Work
2. Responsibilities regarding implementation of Fall Protection Plan
 - a. Employer
 - b. Supervisor or Foreman (where necessary)
 - c. Employee
3. Location and Description of Fall Hazards at the Workplace
4. Description of Fall Protection System and/or Practices to be used
5. Outlined Procedures for Assembly, Maintenance, Inspection, Use, and Disassembly of chosen Fall Protection System
6. Outlined Procedures for the Prompt Rescue Fallen Worker(s)