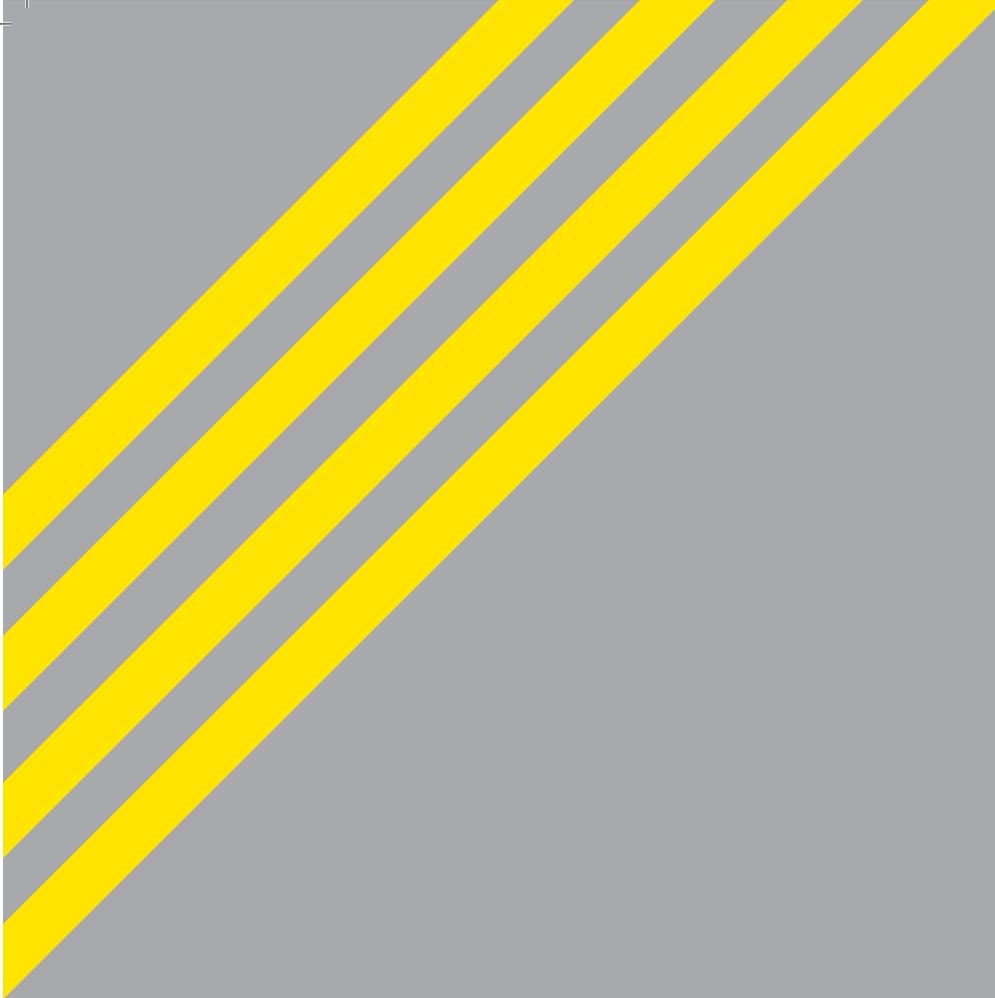


Fall Protection for Rig Work

PARTICIPANT MANUAL
VERSION 20.1





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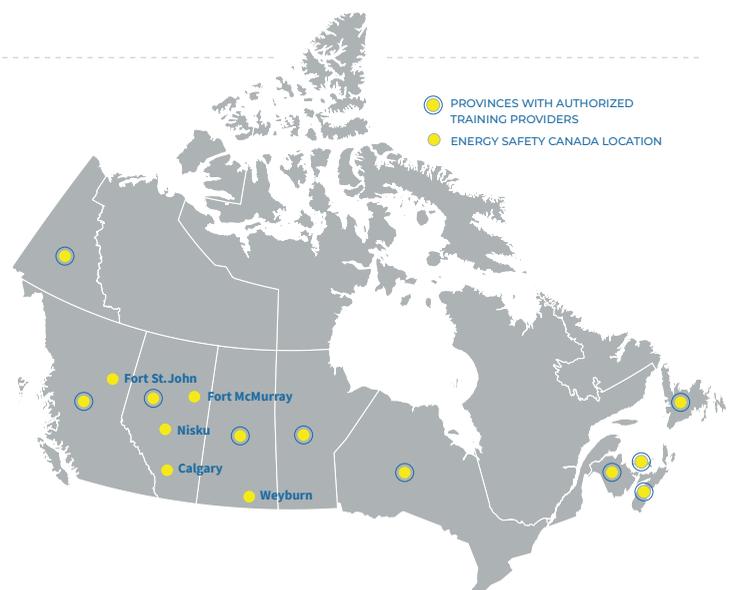
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Competency Cycle

Based upon a Health & Safety Management System



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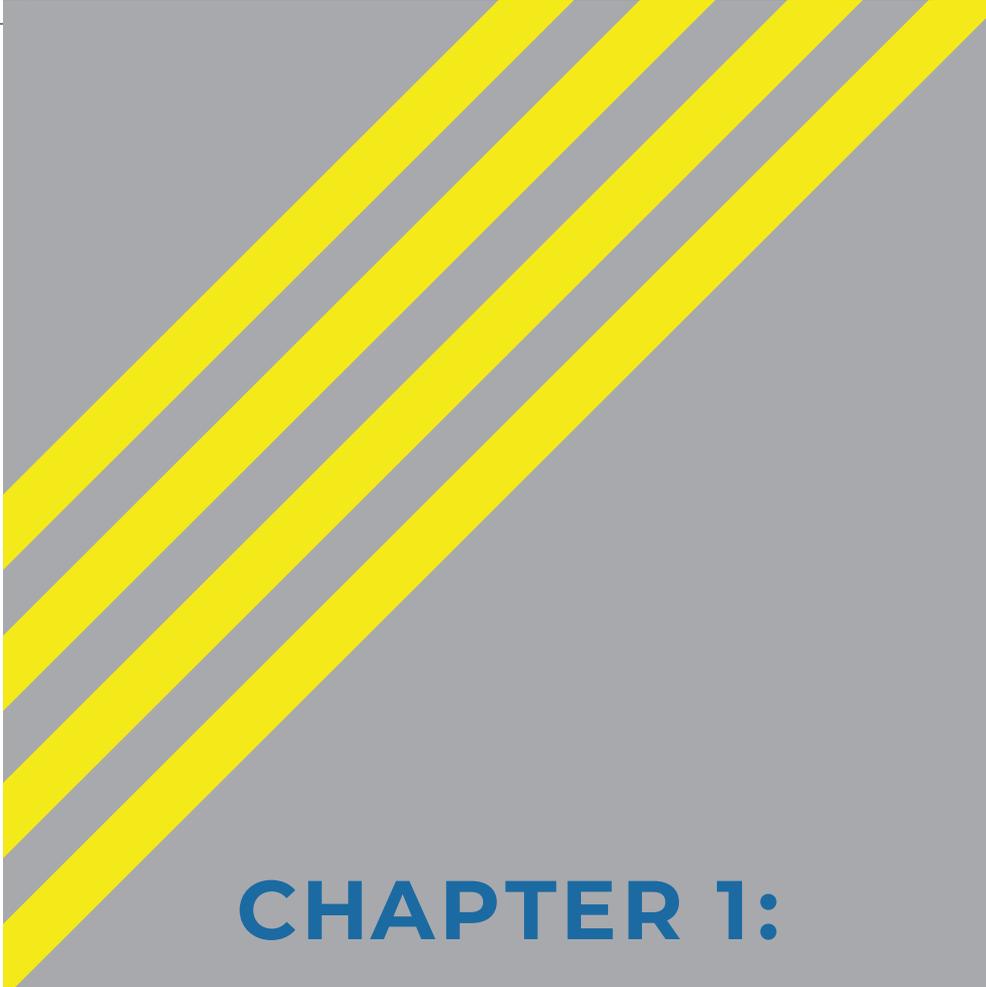
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CHAPTER 1:

Introduction to Fall Protection



OUTCOME

Summarize the basic principles of fall protection.



OBJECTIVES

1. Describe the effects of gravity on a falling body.
2. Define force values.
3. Explain the difference between a free fall and a swing fall.

WHAT IS FALL PROTECTION?

Fall protection is the method of reducing a worker's exposure to fall hazards at a worksite. It may include a personal fall arrest system, a travel restraint system, a safety net or guardrail, a control zone, or another similar system. The impact forces involved in stopping or arresting a fall can seriously injure or, in the worst case, kill a worker. Eliminating the fall hazard is always the best choice. If the task is done on the ground, the worst case scenario may be a worker slipping or tripping. If the task cannot be done on the ground, then it should be done on an elevated area where a worker may slip or trip but not fall to a lower level. If it is not possible to keep the worker falling from an elevated area, then the fall must be stopped or arrested to minimize impact forces or keep them within a safe limit.

Why is it necessary?

Workers risk injury by slipping or tripping on the same level or falling to a lower level. Fall protection is necessary to help companies and their workers avoid or minimize injuries if a worker falls. Consider this real life case when a worker was exposed to a fall hazard without any fall protection and fell causing serious bodily injury.

A Real Life Case In Support of Fall Protection

It has been three years since my accident; a lot of things are different now. I've had to make many adjustments in my life to be able to cope with the permanent physical impairments. I was thirty at the time of the accident, making me thirty-three now; but feeling like I'm going on fifty-five. My injuries, a result of falling forty feet, have left me with a two foot scar around my torso, fractured and fused vertebrae, blown-out spinal discs, as well as removed and pinned ribs. I am in fact, lucky to be here to write this letter.

We were on a rig move and began rigging-up; the day was no different than any other day in the last seven years I had worked on drilling rigs. I climbed to a height of forty feet to unbolt a boom arm without using a lanyard or fall arrest device. Unfortunately, my concentration was divided between the job I was doing and personal problems I was having at home. In a fraction of a second, I found myself falling to the rig floor and impaling myself on a two inch handrail. This was the most frightening moment I had ever experienced.

Prior to the accident, I was in very good shape. I had worked as a mechanic for eight years and had attained a journeyman certificate. I worked in the oilfield for seven years, spending five of those years working as a derrickman. I also received an advanced high school diploma in this time. I feel very confident saying I was a good hand; I was athletic, motivated, and there to do the job.

Since the accident, I find bending over to pick up my shoes harder than pulling back eight inch collars before I was injured. I am not able to change a flat tire on my car, stand in one spot long enough to wash dishes or pick up my children without suffering for it later. However, an accident like this causes more than physical pain; I feel like my character is also being challenged.

Before this accident, I spend fifteen years in the workforce; I had my share of cuts, bumps, bruises and injured fingers without ever causing a loss-time accident, or receiving workers compensation benefits. Recently however, because of this accident, I feel that any strengths I may have exhibited in my character have been overshadowed by a stigma attached to a recipient of compensation benefits. I also feel somewhat helpless and insecure of my future. The medical doctors and advisers for the Workers Compensation Board have not yet determined the degree of my permanent disabilities due to this accident, but they have set limitation to my work activities. I am not to be employed where I will be expected to do any prolonged sitting, standing, lifting or bending. These limitations do not appear to have left many doors open pertaining to my past experience and accomplishments. I have since returned to college, and although I maintain an A average, I feel my future may still be clouded by these limitations restricting my employment opportunities. I can't help thinking that this could have all been avoided had I been wearing a fall arrest device. Then maybe I would still be considered a good hand, rather than a troublesome statistic.

I would not wish these injuries or subsequent problems upon my worst enemy, and I feel the only way to minimize the chances of an accident like this happening again, is to implement training programs concerning the proper use and maintenance of personal protective equipment.

Fall Statistics

In the three western provinces of British Columbia, Alberta and Saskatchewan, falls were the third major cause of workplace related injuries in 2013. However, based on the total claim costs, fall-related injuries were the second biggest cause of accidents in Alberta and Saskatchewan. In BC, falls were the number one cause of work-related accidents, again based on total claim costs.

Falls from an elevated level or falls on the same level continue to be a major cause of injury and death. In Alberta, the second leading cause of deaths and injuries is falling and the numbers are increasing. The number of fall-related accidents in the province has been rising every year since 2010. From 2009 to 2013 there were 27,222 fall accidents in Alberta costing almost \$300 million in lost time. Approximately 15 per cent of workplace fatalities in the province are the result of falls.

Overall, out of the total number of fall injuries in 2013, 67% resulted from falls on the same level and 29% were a result of falls to a lower level. However, in BC during 2013, out of the total number of fall injuries, only about half were related to the falls on the same level.

Sources: Workers' Compensation Board Alberta (WCB AB), WorkSafe BC and Workers' Compensation Board Saskatchewan (WCB SK) 2014.

GRAVITY

Gravity is a force that causes all physical bodies or objects to fall towards the earth. The force of gravity is constant and will cause a falling object to accelerate as it moves towards the earth. All objects, regardless of their mass, will accelerate at the same rate of approximately 9.8 m/s². The only factor that will affect the rate of acceleration of a free falling object is air resistance. This is why a feather falls slower than a steel weight, or a parachutist falls slower than a free falling human being.

All objects in free fall will be continually accelerated by gravity. This means if you fall off an elevated level your body will continue to accelerate until your fall is arrested by your fall protection system or you hit a lower level.

The following are the general effects of gravity on a falling body:

- » The farther you fall, the faster you fall.
- » The faster you fall, the more energy is generated.
- » The more energy generated, the more energy it takes to stop the fall.

NOTE: If two workers free fall the same distance they will not generate the same force. Even though a 100 kg (220 lbs) and a 150 kg (330 lbs) worker will fall at the same rate, the heavier worker generates greater force and will be exposed to more force in order to slow and arrest a fall.

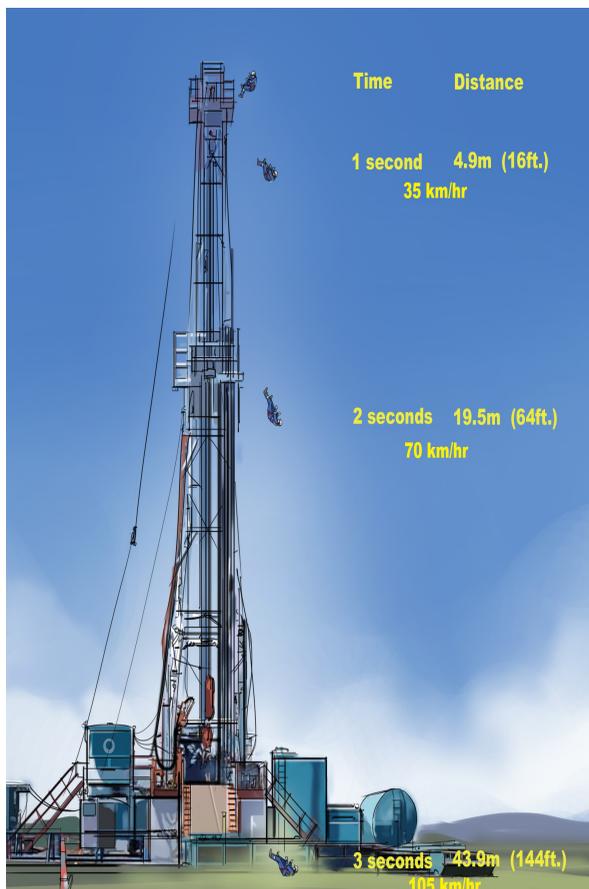


Figure 1-1: Fall Acceleration

It would take you about 3 seconds to reach the ground if you fell off from the crown of a triple drilling rig and only about 2 seconds from a single rig.

Stopping a Falling Body

In order to stop the motion of a falling body, a force equal to the energy of the body in motion must be applied in the opposite direction. The further you fall the more energy it takes to stop you. How much energy generated, how it is absorbed and where it is distributed is critical to your survival. Suddenly arrested by hitting the floor of the rig versus being gradually arrested vertically in a full body harness will have two very different outcomes.

If you are going to expose yourself to the risk of a fall it is crucial to decrease the force of the fall by:

- » reducing free fall.
- » gradually arresting the fall.

Reducing Free Fall

Reducing energy generated in a fall is in your best interest. The best way to reduce energy is to minimize free fall distance. This is done by combining your attachment with the location of the connection to the derrick (anchorage). By using the shortest attachment possible and attaching it to an anchorage equal or higher to the attachment on your harness (shoulder height or higher) you minimize the force you would experience if you fell.

Gradually Arresting a Fall

Using energy absorbers in your attachment to the anchorage gradually arrests a fall. However, it comes at a cost. Energy absorbers extend and gradually arrest a fall but do so by increasing the distance you will need between the anchorage and level below.

FORCE VALUES

Critical

A 100 kg (220 lbs) worker potentially has the equivalent of 1 kN (kN = kilonewton, one kilonewton = 225 lbs) of force at rest. Even a short free fall can quickly multiply the force generated. Research has shown that the human body is capable of absorbing and surviving forces generated in a free fall if the force is low enough and absorbed vertically. For example, falling while wearing a properly fitted full body harness. However if the forces absorbed are high enough, typically 10kN (2,250 lbs) or higher, critical or fatal injury to the body will occur.

Maximum Arresting Force (MAF)

MAF is the short duration “stopping force” a person experiences when they fall. Increasing the deceleration time or slowing the stop is important in reducing the “stopping force” or MAF. In order to minimize injuries most legislation worldwide have determined that the MAF a worker should be exposed to is 6 kN (1,350 lbs) while wearing a full body harness.

Target force

Manufacturers of fall protection equipment must take maximum arrest force limits into consideration. The design process and subsequent testing by a certification agency will be based on a manufacturer’s target force. This force is determined by combining the intended maximum free fall and maximum potential weight of the worker for the manufacturer’s intended use of the system or device. The most common target arrest force for a personal fall arrest system is 4 kN (900 lbs).

Fall arrest systems are designed to limit how far a person falls and to slow their stop by stretching and absorbing energy. In other words, the systems are designed to limit the arresting forces on a person’s body (MAF) to a safe level. The other component is how the body absorbs the force. A safe and properly fitted full body harness transmits force to the body along the vertical axis.

TYPES OF FALLS

Free Fall

A free fall is a fall either on the same level or from an elevated height to a level below. In a same level fall the free fall is extremely limited. However you can be injured and the severity is directly proportional to how much free fall occurs and how it is arrested.

With falls from various elevated levels, significant free fall occurs. As we have learned, the greater the rate of acceleration the more force the body will be exposed to during a fall arrest. Being arrested quickly by hitting a level below is not an option as the body will be exposed to critical level forces. Arresting a fall is done by your fall protection system.

When using a fall protection system, free fall begins the moment you begin to fall from an elevated level. Free fall ends with tension being applied to the fall protection system.



Figure 1-2: Free Fall

Swing Fall

When using a fall protection system another type of accelerating fall can occur. This is called a swing fall. A swing fall occurs when the worker attached to a fall protection system moves sideways away from a position directly below the anchorage location and then falls. The worker will still experience free fall until their attachment tightens. At this point the worker will start to swing and accelerate in an arcing path (radius) around the fall arrest anchor. The energy generated in the swing fall is the same as the energy generated if the worker experienced free fall equal to the swing drop distance. The swing drop distance of a swing fall is measured vertically from the height the swingfall initiated to the bottom of the arc path. In Alberta, swing-drop distance should be limited to 1.2 metres (4 ft.) or less.

The worker will continue pendulum swings until the fall energy is gone or the worker slams into an obstruction. This collision creates a sudden loss of the fall energy but may seriously injure the worker. The worst case scenario would be the attachment being severed by a sharp edge in the derrick causing more free fall and sudden stop with the body again experiencing critical levels of force.

Typical Fall Hazard on a Rig

Fall protection systems are planned to minimize the injuries a worker might suffer should they fall while working at heights where falls have the potential for injury. The following are some work related tasks where fall protection is recommended either as safe practice or is mandatory depending upon local legislation.

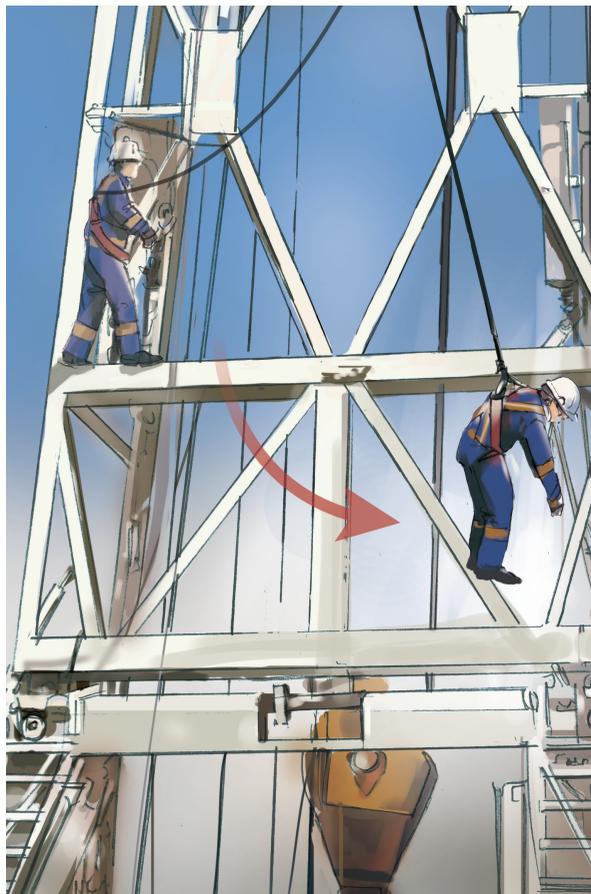


Figure 1-3: Swing Fall

DRILLING	DRILLING	SERVICING
Rigging up/down fall protection equipment	Installing belly pad for tubing in triple derrick	Running/pulling tubulars
Erecting substructure	Working from ladder	Disconnecting horse head on pump jack
Washing/working on top of buildings	Working from scaffolding	Working on rod board
Climbing crown stands when derrick down	Hanging blocks	Inspect, nipple up, nipple down BOPs
Coiling and uncoiling lines on top of derrick	Scrubbing derrick	Installing flow line
Hanging easy rider line	Maintaining derrick lights	Installing escape buggy
Walking drilling line back to draw works during rig up	Installing cement head, circulating head and test head	Working on cat walks (no rails)
Pinning top of a-legs	Hoisting using man-rated hoist	
Installing missing floor boards	Rigging up rescue equipment and carry out rescue	
Setting handrails	Installing escape buggy	
Bridle up and bridle down	Servicing	3rd party equipment
Hanging/disconnecting kelly hose	Stump testing (BOPs)	Servicing centrifuges
Erecting and dismantling prefabs	Hanging wire line sheaves (free pointing), tube testing	Climbing 400 barrel tanks
Rigging up line spooler	Installing hand rails	Working on premix tanks
Rigging in survey line	Rigging up rescue equipment and carrying out rescue	Servicing top drive
Installing prefabs monkey board	Chaining/unchaining blocks	Using pipe handling equipment
Working on/above mud tanks	Rigging snubbing units	Picking up pipe/rods off high boy trailer for wireline and swabbing
Working around open pits/sumps	Rigging in pack-off hoses	
Greasing blocks, swivel, crown	Locking BOPs (high well heads)	
Installing stabbing board	Greasing crown, installing flags	
Running casing	Positioning secondary retractable	
Opening/closing mud tanks gates	Rigging in pipe handling equipment (using scissor lifts)	

DRILLING	DRILLING	SERVICING
Running high collars above monkey board	Switching from 4-6 lines or 6-4 lines derrick standing	
Retrieving stand from across derrick	Nippling up on high well heads	
Washing inside/outside of subs	Plugging or unplugging top section	
Install/remove cable trays	Maintaining derrick lights	
Install/remove grasshopper trays	Working from ladder	

SUMMARY: REVIEW

Answer the following questions. You can use your book for help if necessary.

1. Which of the following is a correct statement concerning the force of gravity?

- a. The force of gravity causes increasing velocity by accelerating a falling body.
- b. The force of gravity is caused by the air resistance slowing you down.
- c. The force of gravity keeps you attached to the structure.
- d. The force of gravity can cause you to trip or slip.

2. Which of the following statements best describes a swing fall?

- a. Begins with the failure of a worker's secondary attachment.
- b. Occurs once the primary system tightens and the fall accelerates.
- c. Begins with the worker moving vertically from the anchor position.
- d. A fall followed by a pendulum swing with possibly greater impact when the worker hits an obstruction.

3. What is the most common target force for a personal fall arrest system?

- a. 2 kN (450 lbs)
- b. 4 kN (900 lbs)
- c. 8 kN (1800 lbs)
- d. 12 kN (2700 lbs)

4. What does MAF mean?

- a. Mean Arrest Force.
- b. Maximum Arresting Force.
- c. Minimum Arrest Force.
- d. Maximum Available Force.

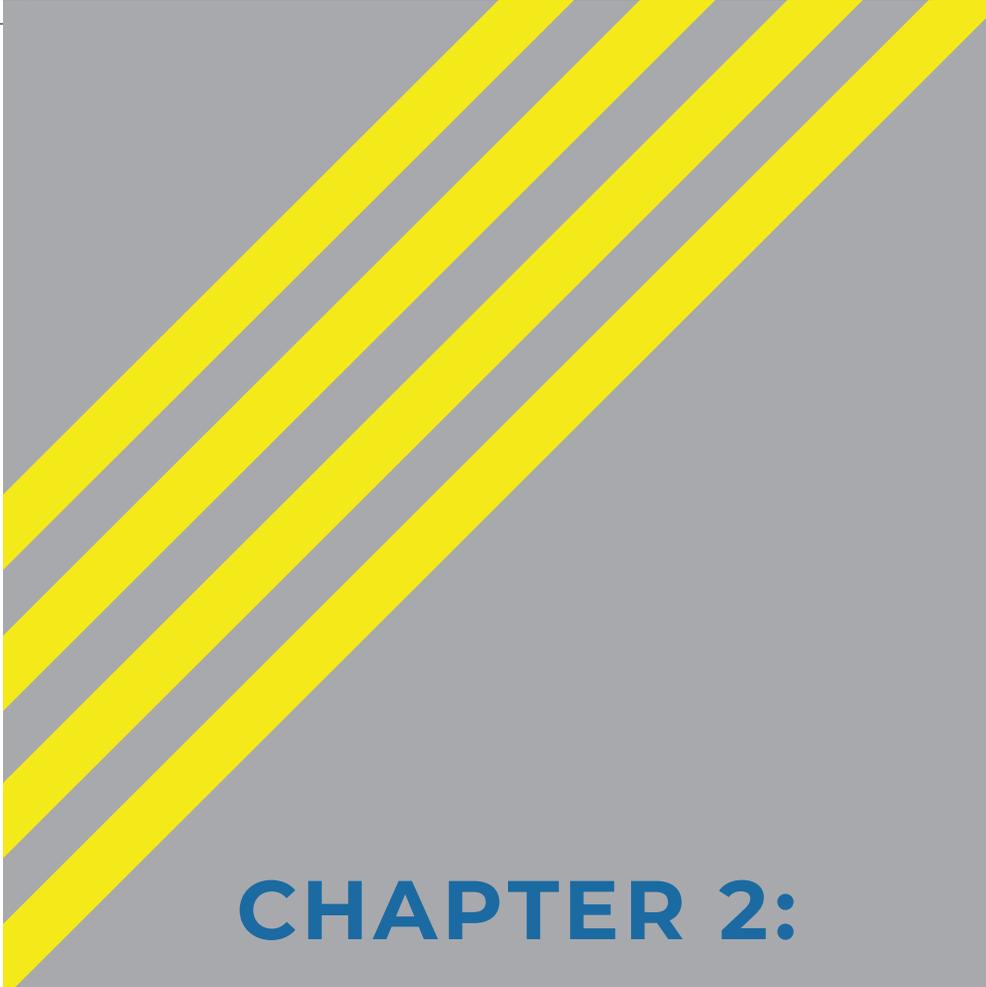
5. When using a fall protection system, when does a free fall end?

- a. At the end of the arrest of the fall.
- b. After your attachment becomes tight.
- c. When your fall protection system starts to arrest the fall.
- d. After your fall protection system arrests the fall.

6. How do you limit a free fall?

- a. Selecting a body harness that is CSA approved.
- b. Select the length of lanyard that will permit unimpeded performance of the job.
- c. Select the shortest length lanyard and secure it to an anchor point no lower than shoulder height or as high as reasonably practicable.
- d. Select an anchor that will ensure a minimum fall arrest of 3 metres (10 ft) or less if there is unusual possibility of injury.

NOTES



CHAPTER 2:

Fall Protection Legislation and Standards



OUTCOME

Outline the key elements of fall protection legislation and a fall protection plan.



OBJECTIVES

1. Identify key provincial legislative requirements for worksite fall protection, including worker's responsibilities.
2. Outline the various elements of a company fall protection plan.
3. Perform fall clearance calculations.
4. Summarize pre-work training requirements.
5. Identify when fall protection is needed.
6. List the standards used for labelling/tagging and inspecting fall protection equipment.

BASIC LEGISLATION REQUIREMENTS

Purpose

In Canada, 42,000 workers are injured annually due to fall accidents resulting in great financial loss, pain and suffering and often death (Canadian Centre for Occupational Health and Safety, 2013). In many cases, this does not have to happen. Legislation has been put in place to protect workers and supervisors who are required to work at locations where there is a risk of a fall. Workplace legislation governing fall protection varies from province to province and this legislation is the minimum level of compliance towards a safe workplace. Although the legislative wording varies by province, the intent of the legislation is similar throughout Canada. In Alberta, British Columbia and Saskatchewan workplace legislation governing fall protection is found in the province's OH&S (Occupational Health and Safety) Acts, Regulations, and Codes. Both employers and workers must follow these standards and understand their own responsibilities. Industry best practices should be targeted to meet or surpass provincial laws.

Table 2-1: OHS in AB, SK, BC

PROV.	OH&SRESPONSIBILITY	PUBLIC FACE	WEBSITE
AB	AB Government	Alberta Employment & Immigration (together with Work Safe Alberta)	employment.alberta.ca
BC	WCB	Work Safe BC	www2.worksafebc.com
SK	SK Government	Saskatchewan Advanced Education, Employment & Labour (together with Work Safe Sask.)	www.qp.gov.sk.ca

FALL PROTECTION REQUIREMENTS

In Alberta, British Columbia and Saskatchewan workplace legislation requires that an employer must ensure that workers are protected from falling at a temporary or permanent work area if a worker may fall 3 metres (10 ft) or more, a vertical distance of less than 3 metres (10 ft) if there is an unusual possibility of injury, into or onto a hazardous substance or object, or through an opening in a work surface. The definition of “unusual possibility of injury” is if the injuries incurred are more severe than falling the same distance onto a flat, solid surface. Some examples of objects causing more severe injuries would be rotating equipment, substructure supports, and hazardous substances, etc.

Also, an employer must ensure that workers at a permanent work area are protected from falling by a guardrail if the worker may fall a vertical distance of more than 1.2 metres (4 ft) and less than 3 metres (10 ft). If a guardrail is not reasonably practicable, an employer must ensure that a worker uses a travel restraint system that meets legislative requirements. If a travel restraint system is not reasonably practical, an employer must ensure a worker uses a personal fall arrest system that meets legislative requirements. If a personal fall arrest is not reasonably practicable, an employer must ensure that a worker uses an equally effective fall protection system that meets legislative requirements.

General legislated responsibilities of the employers, workers and suppliers differ only in wording and the intent of the legislation is similar throughout Canada. Fall hazards need to be mitigated together with any other hazard at a worksite that is part of an employer’s OHS program. An employer’s Fall Protection Program must specify how fall hazards are mitigated.

Employer Responsibilities

In Alberta, British Columbia and Saskatchewan employers are responsible for providing certified, inspected and compatible fall protection equipment and training on its use and maintenance. Fall protection plans for specific fall hazards must be created and shared with the worker. Regardless of the jurisdiction this must be in place prior to the worker being exposed to any fall hazards.

Currently, Alberta workplace legislation is more specific about the requirement of a fall protection plan and what is included in fall protection training beyond equipment use and maintenance. Training should also include examining the short duration “stopping force” effects on a falling body (MAF or maximum arrest force), the purpose of energy absorbers, and swing and free falls. In addition, the worker should have practice in inspecting, fitting, adjusting and connecting components of fall protection systems. Workers should also have practice in emergency response procedures prior to entering a worksite with potential fall hazards.

Worker Responsibilities

Every worker plays a role in an employer’s OHS program. The same can be said for fall protection programs. The worker must follow safe work task performance guidelines and procedures. Workers need to use and take care of the fall protection equipment provided. If a worker identifies a task at height that has no plan or is not protected then the worker must tell their employer and work together to mitigate the hazard.

In Alberta, additional responsibility falls on workers to:

- » Limit the swing drop distance to 1.2 metres (4 ft).
- » Select anchor location and lanyards that limit the vertical distance of a fall.
- » Use anchor connectors appropriate to the task.
- » Safely secure themselves to an anchor that meets the requirements of Alberta's OHS Code.
- » Ensure the connections they make are compatible.

FALL PROTECTION PLANS

In Alberta, British Columbia and Saskatchewan, workplace legislation requires that fall protection plans be in place if work is performed at a worksite at which falls from a specified level may occur and guardrails are not in place to protect workers. Saskatchewan and Alberta use the 3 metres (10 ft) or higher or unusual risk of injury while British Columbia uses 7.5 metres (25 ft) or higher.

While the minimum requirement to have a fall protection plan differs in the three jurisdictions the intent does not. Fall protection plans are not just required by legislation for employers but more importantly as a tool for workers.

In Alberta, a fall protection plan must specify:

- a. the fall hazards at the work site;
- b. the fall protection system to be used at the work site;
- c. the anchors to be used during the work;
- d. that clearance distances below the work area, if applicable, have been confirmed as sufficient to prevent a worker from striking the ground or an object or level below the work area;
- 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. (Source: OHS AB 140(2))

NOTE: For those workers working in BC or Saskatchewan, please refer to the provincial Occupational Health and Safety guide for particular fall protection plan specifications in your province.

CLEARANCE CALCULATIONS

It is important for workers to understand that fall arrest systems need clearance from the anchorage to the level below. The fall must occur and be arrested before the worker's feet contact that level. Therefore, any calculation must include how far the worker's feet are below the worker's attachment on the full body harness. This is usually referred to as the D-ring height (B).

The total fall distance (TFD) is a sum of the free fall distance (FFD) and the stopping or de-acceleration distance. In other words, the TFD is the distance the full body harness D-Ring has traveled after the fall has been arrested. The clearance requirement (CR) must take the D-ring height of the worker and the total fall distance into account. In order to take into account different body types and fit of full body harness on individuals, an additional safety margin (SM) of 0.6 metres (2 ft) is used.

Acronyms:

Please be aware that there are a number of different abbreviations used by workers to make fall calculations. It really does not matter which abbreviations you use, as long as you are able to make accurate calculations. Your life may depend on it.

The following information is based on CSA Z259.16-04, Design of Active Fall Protection Systems.

TFD: Total fall distance

FFD: Free fall distance

CR: Minimum clearance required

SM: Safety Margin between bottom of feet to a level below (typically 2' {0.6 meter}) or 3' {0.9 meter})

SAE: Shock absorber extension

DS: D-ring slippage

L: Length of lanyard, shock absorber and connecting hardware

B: Distance from the feet to the full body harness D-ring

C: Distance between working level and anchorage level

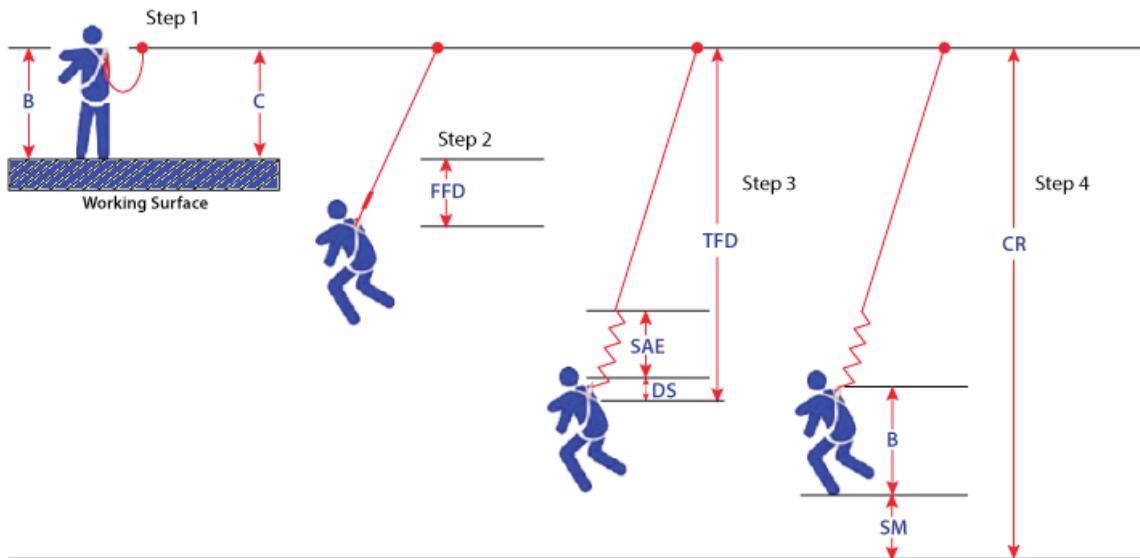


Figure 2-1: Fall Clearance Calculations

Step 1: Whenever possible, choose an anchorage above the dorsal D-ring.

Step 2: Free Fall Distance (FFD): $L + B - C$

Step 3: Total Fall Distance (TFD): $FFD + DS + SAE$

Step 4: Required Minimum Clearance (CR):
 $TFD + B + SM$

Depending on the components used in the fall protection system, the de-acceleration distance will vary and therefore different systems will have different clearance requirements. It is crucial for the worker to know if the system being used will have sufficient clearance.

ACTIVITY

Here are a few free fall distance calculation exercises for you to complete.

Free Fall Distance (FFD) Calculation

Remember, when a fall occurs the free fall distance equals the distances between the heights of the D-ring (C) before the fall begins to the point where the fall protection equipment begins to arrest the fall (note: solid anchor point).

C = Anchor point = 5 ft (1.5 metres)

B = D-Ring height = 5 feet / 1.5 metres

L = Lanyard length 6 feet / 1.8 metres

FFD = L + B - C

Imperial

FFD = _____

Metric

FFD = _____

Total Fall Distance (TFD) Calculation

The TFD is the distance the full body harness D-Ring has traveled after the fall has been arrested.

$$TFD = FFD + DS + SAE$$

$$TFD = (L + B - C) + DS + SAE$$

C = Anchor point = 5 ft (1.5 metres)

B = D-Ring height = 5 feet / 1.5 metres

L = Lanyard length 6 feet / 1.8 metres

$$FFD = L + B - C$$

Imperial

$$FFD = \underline{\hspace{10em}}$$

Metric

$$FFD = \underline{\hspace{10em}}$$

DS = 1 foot / 0.3 metres (estimated for this demonstration)

SAE = 4 feet / 1.2 metres (estimated for this demonstration)

$$TFD = FFD + DS + SAE$$

Imperial

$$TFD = \underline{\hspace{10em}}$$

Metric

$$TFD = \underline{\hspace{10em}}$$

Minimum Clearance Required (CR) Calculation

The Minimum Clearance Required (CR) is a total of the Total Fall Distance (TFD) plus the distance from the surface to the D-Ring before the fall (B) plus a safety margin (SM) of at least 2 feet / 0.6 metres (note: 3 feet / 0.9 metres is also commonly used).

Question 1: Calculate the Minimum Clearance Required (CR). Use the Total Fall Distance calculation (TFD total from Question above) and the D-Ring before the fall (B: 5 feet or 1.5 metres).

$$CR = TFD + B + SM$$

Imperial

$$CR = \underline{\hspace{10em}}$$

$$CR = \underline{\hspace{10em}}$$

Metric

$$CR = \underline{\hspace{10em}}$$

$$CR = \underline{\hspace{10em}}$$

EQUIPMENT STANDARDS

With equipment standards in place, manufacturers can design proper fall protection equipment and legislators can enact effective workplace legislation. By having legislation require standards for fall protection components, workers can be assured that when the components are used as designed they will absorb the forces generated and protect the worker from serious injury or death.

For personal fall protection equipment, Alberta recognizes CSA (Canadian Standards Association), ANSI (American National Safety Institute) and CE (Conformité Européenne) and personal protective equipment bearing those testing agency's marks.

British Columbia recognizes CSA and/or ANSI standards while Saskatchewan recognizes that all fall protection PPE (personal protective equipment) is required to be certified and have the testing agency's marks on an attached label or packaging.

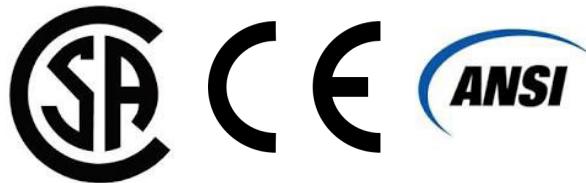


Figure 2-2: Manufacturer's Labels

Inspection of Equipment

Standards and testing ensure equipment designs meet the worker's needs. While this meets the initial needs, all three jurisdictions and the equipment manufacturers understand this is not enough. Manufacturer's instructions for use include the need for inspection. Legislation regarding inspection either defers to the manufacturer's instructions or sets minimums on when they occur, whichever is less. There are two types of inspections that legislation requires: pre-use inspection and formal inspection.

Pre-Use Inspection

Workers must inspect all fall protection equipment prior to use. At a minimum this means at the start of the worker's shift. This inspection is intended to detect obvious damage and inadequate functional aspects of the equipment. A pre-use inspection is intended to be a quick inspection by the worker

and is required by the equipment manufacturers and legislation. Pre-use inspection requirements for each fall protection item are provided in the manufacturer's instructions.

Formal Inspection

In addition to a pre-use inspection, all fall protection equipment requires a formal inspection to be carried out by a competent person or qualified inspector, other than the worker, on a regular basis as required by the manufacturer. At a minimum, there must be an annual inspection of all fall protection equipment. A formal inspection is a much more thorough inspection of all components of each piece of fall protection equipment. All inspection findings must be documented and the inspector must date and sign the documentation as well as mark the tagging system on each inspection. The purpose of this formal inspection is two-fold. To make sure the equipment can still perform its intended function and to identify if the equipment in a particular environment requires more frequent inspections or needs to be replaced..

Formal inspections re-certify each piece of equipment for use within the time frame between formal inspections. During a pre-use inspection, if a worker finds equipment that does not have a formal inspection that is up to date, the equipment must be removed from service and referred for a formal inspection.

Removal from Service

Legislation is quite clear in determining when and why fall protection equipment should be removed from service: either the system has arrested a fall or is damaged. The requirement for pre-use and formal inspections act in concert by detecting equipment that has arrested a fall or becomes damaged.

Employers are required to remove any fall arrest system that has arrested a fall and not return it to service unless the manufacturer or professional engineer certifies it is safe to use. Alberta legislation goes a step further by having employers destroy equipment that has arrested a fall and therefore cannot be certified to be returned to use.

If during an inspection or use equipment is damaged or comes in contact with substances that could

damage it, the equipment needs to be removed from service and cannot be returned until a competent qualified person, as recognized by the manufacturer, designates it as safe for use.

LABELLING AND TAGGING SYSTEM

CSA, ANSI, or CE product certification requires all manufacturers of fall protection equipment to attach a labelling system that displays information about the device as specified within that standard.

The purpose of the labelling system is to ensure the supplier, purchasers, users and inspectors are able to obtain information about the device through reference to the labelling system. Information on the labels must refer to the supporting manufacturer's documentation for each device. This ensures the records of service and inspections, and the manufacturer's instructions will support each individual device through its useful lifetime of service.



Figure 2-3: Manufacturers' Labelling and Tagging Systems

Employers are required to ensure the labelling system remains attached to the device during use. One option that employers have with their fall protection equipment is to attach an alternative employer tagging system. This type of employer tagging system is a backup for the manufacturer's labels in the event the manufacturer's labels become unreadable or are missing.

Employer tags may use codes that users can read to indicate the device's manufacturer, type, size, in service dates, etc. Employer tags must identify the device and refer the user or inspector to the manufacturer's documentation for that individual device.

There are various tagging methods that may be used by employers including bar codes, metal tags, or manufacturer approved marking pens used on non-load bearing portions of the device (a web padding strap, or strap end that will not become loaded during a fall arrest.) This information should be recorded in a log book kept readily available at the worksite.

Employer tagging systems must be attached to devices in ways that do not compromise its function or strength.

Any device, other than some anchorage connectors (see CSA Z259.16 and CAN/CSA-Z271 for requirements for such anchorage connectors), that does not have a labelling / tagging system attached, either the manufacturer's or the employer's, must be removed from service and have a formal inspection performed and the employer's tag attached.

For workers, information found on labels provide crucial information such as:

- » Maximum weight of worker and equipment
- » Length
- » Maximum deployed length of energy absorber
- » Material
- » Stopping distance
- » Possibly record of formal inspection

For more on Fall Protection legislation, please refer to your provincial Occupational Health and Safety guide.



Figure 2-4: Employers' Labelling and Tagging Systems

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. Which one of the following is a responsibility of the worker?

- a. To ensure inspection, maintenance and retirement programs for all fall protection/rescue equipment.
- b. Select anchor location and lanyards that limit the vertical distance of a fall.
- c. Ensure all workers at the worksite are aware of their duties and responsibilities.
- d. To do formal inspections of fall protection equipment.

2. Which is not part of a clearance requirement calculation?

- a. Free fall distance.
- b. De-acceleration distance.
- c. Safety margin distance.
- d. Swing fall.

3. When is fall protection required at a work area?

- a. If a worker may fall 1 metre (3.3 ft) or if there is an unusual possibility of injury.
- b. If a worker may fall 2 metres (6.6 ft) or if there is an unusual possibility of injury.
- c. If a worker may fall 3 metres (10 ft) or if there is an unusual possibility of injury.
- d. If a worker may fall 3 metres (10 ft) or more and if an unusual possibility of injury if they fall less than 3 (10 ft) metres.

4. What would you do if there was no company fall protection plan for a task you are about to perform on the rig 10 metres (33 ft) high?

- a. Ensure that you have secondary fall protection
- b. Have a buddy verify your selection of an appropriate anchorage
- c. Use a cable anchor sling
- d. Consult with your supervisor

5. List the six (6) items that must be addressed in a fall protection plan?

- 1) _____

- 2) _____

- 3) _____

- 4) _____

- 5) _____

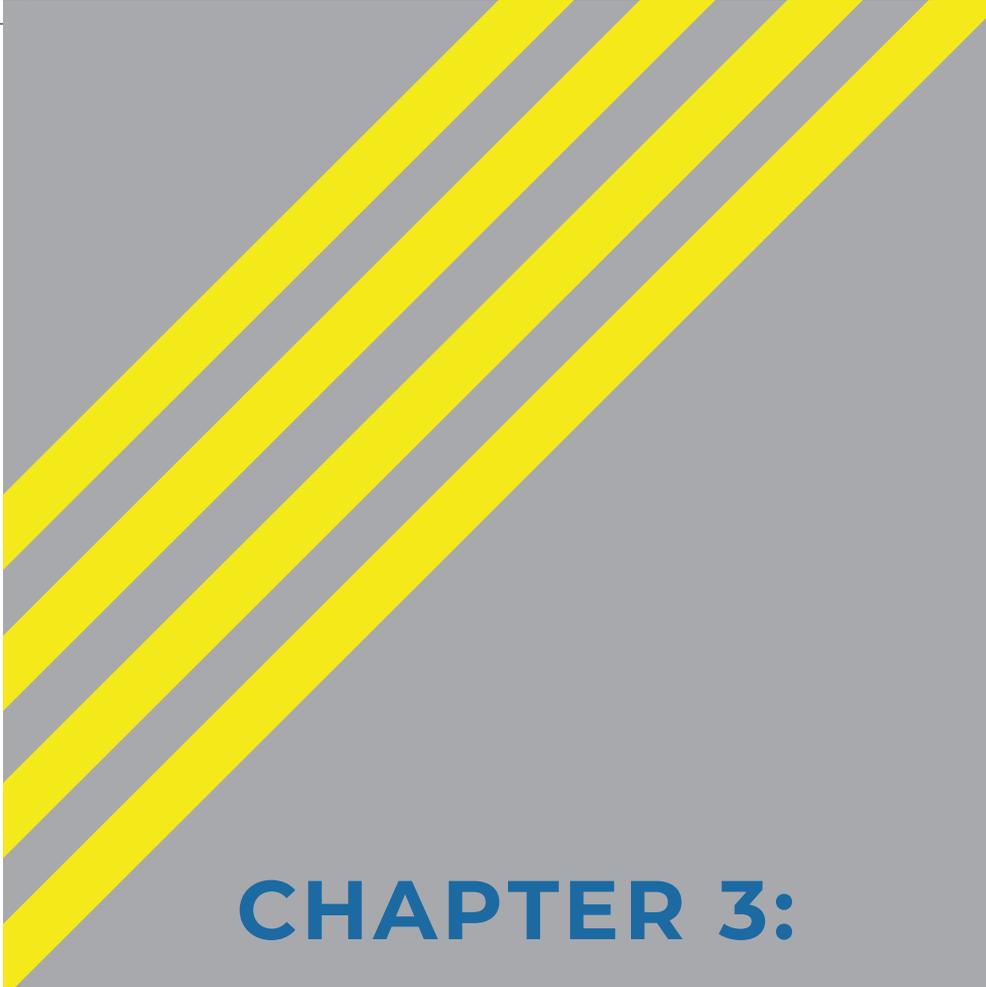
- 6) _____

6. What fall protection training are employers required to provide workers before allowing work in an area where a fall protection system must be used?

- _____
- _____
- _____
- _____
- _____

7. When must fall protection equipment/a fall protection system be removed from service?

- a. When the equipment or system is not required in the fall protection plan.
- b. When the equipment or system is determined to be defective, after a fall arrest system has stopped a fall, or after the improper use of the equipment.
- c. When the system has been in service for longer than 12 months or when required by the manufacturer.
- d. When no longer in use.



CHAPTER 3:

Basic Concepts and Elements of Fall Protection



OUTCOME

Identify and describe some of the basic concepts and elements related to fall protection systems



OBJECTIVES

1. Outline the methods used for controlling hazards leading to slips, trips and same level falls.
2. Identify passive and active fall protection systems.
3. Define the components of fall protection systems.
4. Identify hazards associated with an anchorage.
5. Describe travel restraint, work positioning and fall arrest.
6. Differentiate between primary and secondary methods of attachment to a structure.
7. Identify vertical and horizontal fall arrest systems.

CONTROLLING FALL HAZARDS

In the oil and gas industry, fall protection systems are planned to minimize the number of falls as well as the extent of injuries a worker might suffer should they experience a fall. While fall hazards may be predictable, individual falls are almost never predictable. Fall protection systems are in place for unpredictable events, reducing risks, and minimizing worker injuries.

In controlling fall hazards, there is a hierarchy of controls based on workers' fall risk exposure. The first priority is for the worker to work in a safe environment and never fall. If this is not practical, the next priority would be to use measures that prevent the worker from falling from the level they are working on. The last option is arresting the worker's fall.

Eliminating the Fall Hazard

Engineering controls that eliminate fall hazards is the first choice. Engineering controls include, but are not limited, to the following:

- » Modifications of workplaces that move task locations to the ground.
- » Devices that extend a worker's effective reach without forcing them to directly access the work location, for example, computerized equipment or something as simple as the light bulb changer pole.

Preventing Falls from an Elevated Level

If there is a fall, the worker is arrested on the same level the fall occurs. These falls are limited to a slip or trip and the worker is prevented from falling by the use of TRS (Travel Restraint Systems). These systems either prevent a worker from reaching the edge and falling off (think of a dog on a leash) or if a worker reaches the edge the system prevents the worker from falling off (think of a dog in a fenced yard).

Arresting the Fall

If you cannot prevent a fall from an elevated level, then you must be prepared to arrest the fall and keep the force absorbed by the body below legal limits. This is done through the use of Fall Arrest Systems.

Reducing Slips and Trips

You can prevent slips and trips by:

- » Maintaining good housekeeping.
- » Taking due care and attention.
- » Protecting yourself with appropriate PPE (personal protective equipment) to ensure you have good traction and grip, and to reduce the impact of same level falls. Never forget the importance of properly tied footwear.

FALL PROTECTION SYSTEMS

When fall protection systems are properly installed, used and maintained in accordance with manufacturer's instructions, they will:

- » Increase worker confidence
- » Reduce falls and fall related injuries
- » Increase worker productivity and ability to focus on task at hand

Passive Systems

When a fall protection system is needed due to the impracticality of eliminating the fall hazard then the preferred method is using passive systems. Passive systems are engineered systems that once in place do not require worker intervention and provide continuous protection. Examples are walkways, covers for openings and guardrails.

Guardrails are an excellent example of a passive system. The worker does not need additional PPE and guardrails can be used with multiple workers. Guardrails prevent the worker from travelling to the edge and falling off the level the worker is on (guardrails are not fall protection when being installed or removed).

To ensure the worker is safe, guardrails must be engineered to occupational health and safety requirements for strength and design (height to top of rail, post spacing, gaps, etc.).



Figure 3-1: Passive Fall Protection System

Active Systems

If it is not possible to use a passive fall protection system, the next choice would be an active system. Active systems use equipment that the worker is connected to and are used for both keeping the fall on the same level (like a dog on a leash) and arresting the fall from an elevated level.

Travel Restraint Systems

A TRS (travel restraint system) is a fall protection system that connects the worker to the structure preventing the worker from getting into a fall hazard area no matter where they travel. A TRS can be as simple as a harness and lanyard connected to an appropriate anchorage that prevents the worker from reaching the edge of a working area.



Figure 3-2: Travel Restraint

Fall Arrest Systems

An FAS (fall arrest system) is designed to protect the worker if they fall off the level they are working on. The placement of the FAS assumes that a worker may fall from this work location.

All FAS are designed to protect a worker by minimizing the forces experienced during the arrest of a fall and preventing the worker from hitting a lower level or any other obstructions.

A fall arrest system has the following characteristics:

- » It is the backup system ready to protect a worker in the event of a fall.
- » Stops the worker from hitting a lower level after falling.
- » It is designed to minimize free fall and the energy that is applied to the worker and the fall arrest system.
- » Controls the forces applied to the worker at an acceptable level (below the legal limit of 6 kN (1350 lbs), with the target being 4kN (900 lbs) or as low as possible) by gradually arresting the fall.
- » Suspends the worker vertically after arresting the fall.
- » System includes components that meet fall arrest requirements, adhere to recognized standards, and are compatible.

FAS are designed to allow workers to work on a vertical or horizontal plane. A combination of systems may be in place or rigged as needed to protect workers who are accessing levels vertically and then moving horizontally to access the work location.



Figure 3-3: Fall Arrest System

Vertical Fall Arrest Systems

The vertical fall arrest system allows the worker to climb (moving up and down) and perform tasks at height with fall protection. There is not much allowance for horizontal movement with a vertical system. The worker would be exposed to the risk of a swing fall after moving away from directly below the FAS anchorage.



Figure 3-4: Vertical Fall Arrest Systems

Horizontal Fall Arrest Systems

The horizontal fall arrest system provides workers with a range of horizontal movement and fall protection. A specified number of workers that may attach to this system at any given time. One example of this system is a horizontal lifeline that protects workers on the back of the derrick coiling lines while the derrick is laid down. It is important to remember that these systems are for side to side (horizontal) movements and not for vertical use.



Figure 3-5: Horizontal Fall Arrest System

COMPONENTS

All fall protection systems must include components that meet all the requirements as specified in legislation, including identified jurisdictional standards, manufacturer's specifications and employer's fall protection task plans.

Even though fall protection components meet identified jurisdictional standards, the system designer and users must ensure that all components are compatible when connected with each other.

Each active fall protection system, whether it be travel restraint or fall arrest, will include the following components:

- » Anchorage
- » Body Support Device
- » Connecting Means
- » Rescue

Anchorage

Anchorage in this industry are typically the derricks. However, any structure that is in the right location and possesses adequate strength for the forces generated in the arrest of a fall is considered the anchorage. Anchorages allow the worker to secure the remaining components of their fall protection system.

Strength requirements for anchorages depend on the type of fall protection system and the jurisdiction where it is used. The forces developed in a travel restraint system are potentially lower than fall arrest systems and the legislation reflects this condition. Some jurisdictions also consider whether the use of anchorages is temporary or permanent. To avoid confusion, some jurisdictions also insist anchorages are permanently marked.

Designation of Anchorages

The employer will designate the anchorages in the FPP (Fall Protection Plans). If the anchorage is not identified in the FPP, the worker should consult their supervisor. The purpose is for workers and employers to work together and determine the appropriate anchorage to ensure workers are protected.

Selection of Anchorages

Adequate strength and location of anchorages must be taken into consideration when selecting appropriate anchorages. To minimize free fall, anchorages should be located shoulder height or higher. To avoid swing fall, anchorages should be located directly above the work location.

Table 3-1: Minimum Anchorage Strength Requirements by Province

	ALBERTA		BRITISH COLUMBIA		SASKATCHEWAN	
Fall Arrest System	16 kN (3600 lbs) or 2 x MAF		Temporary 22.2 kN (5000 lbs) or 2 x MAF	Permanent 22.2 kN (5000 lbs)	22.2 kN (5000 lbs)	
Travel Restraint System	Temporary 3.5 kN (790 lbs) permanently marked	Permanent 16 kN (3600 lbs)	3.5 kN (790 lbs) or 4 x workers weight		Temporary 3.5 kN (790 lbs) permanently marked	Permanent PERM 8.5 kN (1910 lbs) permanently marked

Rules for selecting anchorage are as follows:

- » Consult the FPP.
- » Shoulder height or higher to minimize free fall.
- » Directly above the work area to minimize swing fall.
- » Adequate strength (able to support the weight of a ½ ton truck or 7-inch drill collar).
- » Avoid sharp edges.
- » If uncertain, consult your supervisor.

There are some parts of a rig structure that absolutely should NOT be connected to for fall protection purposes. If the anchorage cannot support a ½ ton truck, DO NOT use it.

NEVER attach fall protection equipment to:

- » Moving parts (that are not specifically used for fall protection).
- » Safety pins.
- » Safety chains or cables that are attached to lights, sheaves, etc.
- » Hydraulic lines.
- » Handrails or Guardrails.
- » Light brackets.
- » Electrical boxes, cords or conduit.
- » Vertical or angled structural girders.
- » Sharp edges or rough welding slag.
- » Broken or bent structural girders.
- » Heavily corroded structural girders.

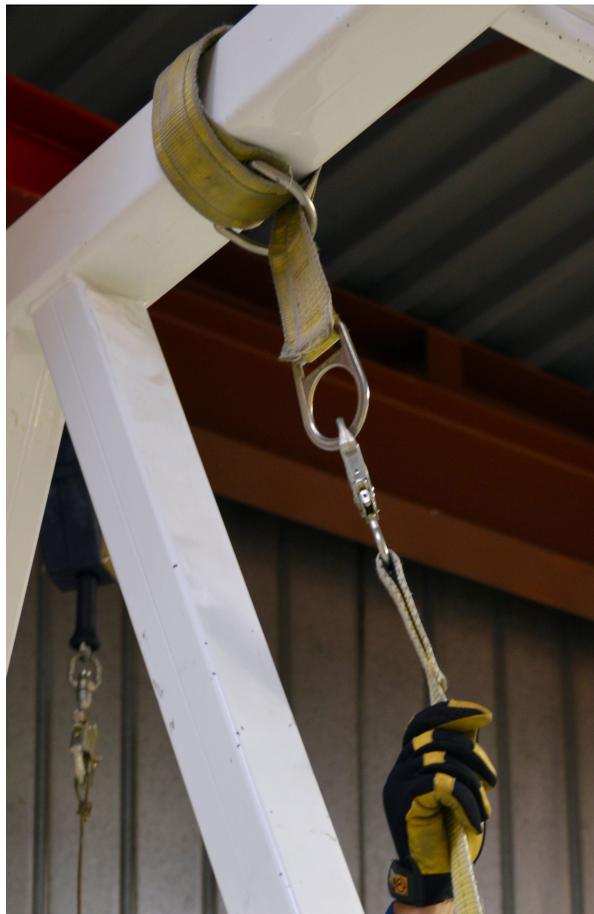


Figure 3-6: Anchorage (with Anchor Connectors)

Body Support Devices

In this industry the body support device is a full body harness. They are designed to vertically transmit forces that are created in a fall arrest. This is the best way the human body can absorb energy, survive, and minimize injury.

Body support devices will be discussed in greater detail in Chapter 5.

Connectors

This equipment connects the worker's harness to the anchorage. There are many assorted components and subcomponents that attach and they include:

- » Snap hooks/carabiners
- » Anchorage connectors
- » Lanyards
- » Shock/energy absorbers

Connectors will be discussed in greater detail in Chapter 6.

Rescue

Rescue is a crucial component of a fall protection systems. A worker suspended at height is at risk the longer they are suspended. It is for this reason that rescue is a component. Not all rescues involve lowering the worker to a lower level. The safe level might be a higher level. All rescues will involve the fall protection of the rescuer and the casualty (the suspended worker), the removal of the worker from their fall arresting system when necessary, and then lowering or raising of the worker to a safe level. Being suspended in a harness for an extend period of time can be hazardous to your health.

NOTE: Adequate rescue plans, equipment, training and practice must be in place in order to rescue suspended workers in a prompt or timely manner. Any worker assigned to fall rescue requires proper training.

All fall protection system components must meet certain requirements, including:

- » Anchorage engineered or designated by the employer must have sufficient strength for each worker connected to the travel restraint or fall arrest system.

- » Body support devices must meet the jurisdictional standards for certification whether they be CSA, ANSI, or CE.
- » Connecting components and devices must meet the jurisdictional standards for certification whether they are CSA, ANSI, or CE.

For more on fall rescue, Energy Safety Canada offers a one-day Fall Rescue for Rig Work course.

PRIMARY AND SECONDARY ATTACHMENTS

Primary

Persons at risk of falling typically prevent their fall by maintaining a firm attachment using their feet on a flat surface, hands and feet on a more vertical surface, or a combination of hands and feet with some external device (such as a work positioning lanyard) that may support a worker in a vertical work location. These types of attachments to a structure are the methods of primary attachment. As long as a worker's primary attachment is maintained the fall hazard is mitigated.

Work Positioning

Work positioning is a support technique that allows the worker to have either one hand or both hands free to perform a task. Therefore, a work positioning system maintains a worker's attachment to the structure at height while allowing both hands to be free to perform the task. It is also considered a form of primary fall protection (ie. 3 point contact). If a worker falls due to failure of the work positioning system, the fall arrest system arrests the fall. The following are characteristics of a work positioning system:

- » Work positioning involves the use of waist level attachments between a worker harness and a structure.
- » Work positioning increases worker comfort, confidence and safety while working at heights.
- » Work positioning should be utilized as much as possible while performing work at heights.
- » Work positioning also has a fall arrest system.



Figure 3-7: Work Positioning



Figure 3-8: Primary and Secondary Attachment

Secondary

Unfortunately, primary attachments sometimes fail and the person who was firmly attached to the structure falls and suffers the consequences. Therefore, a successful fall protection system must have a secondary form of attachment in order to minimize injuries in the event of a fall. This is called a secondary fall protection system.

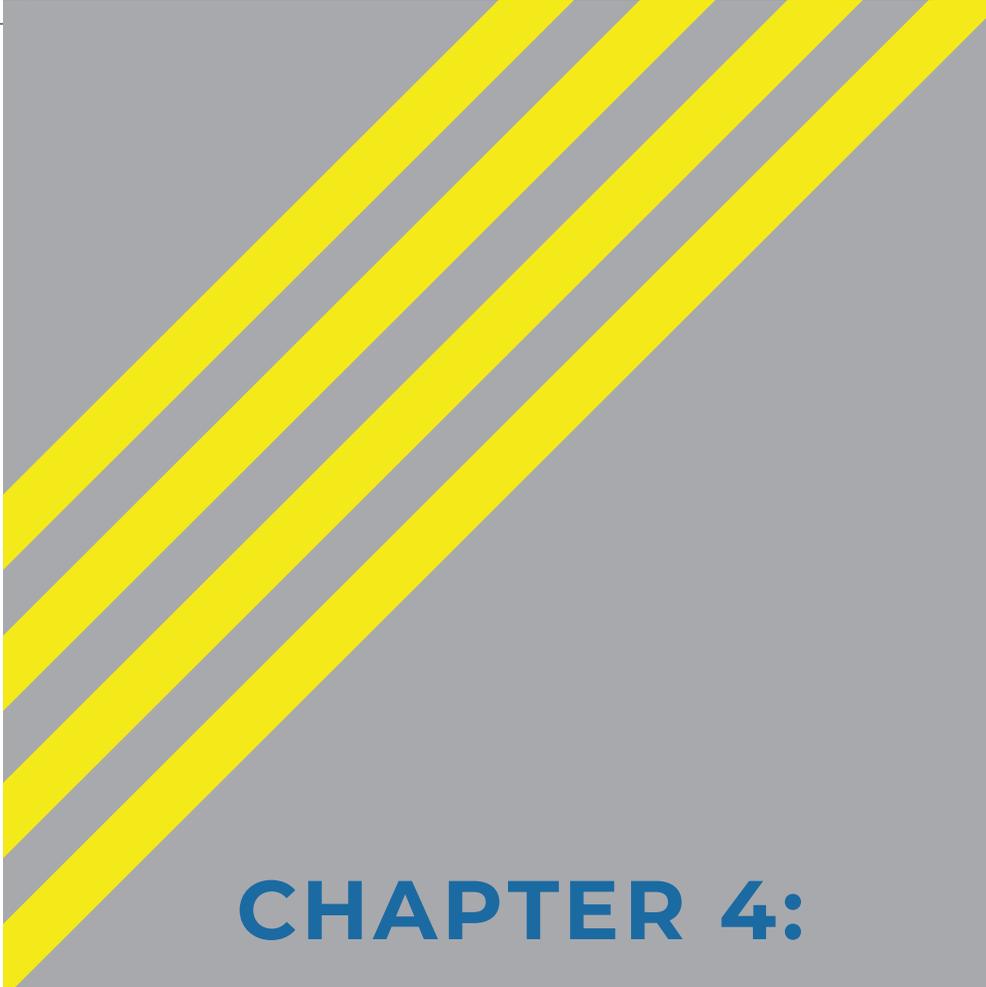
A secondary fall protection system consists of a number of external components that are combined to form either a travel restraint or a fall arrest system. A secondary system is used solely to protect the worker in the event the primary attachment fails.

NOTE: Guardrails/Handrails should NEVER be climbed upon unless the worker is using another means of fall protection.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. **What is a TRS (travel restraint system) designed for?**
 - a. To arrest a worker who falls off a level.
 - b. To eliminate injury of a worker during a fall.
 - c. To prevent the possibility of a fall off the level the worker is on.
 - d. To provide a fall arrest anchorage.
2. **What are the three levels/priorities of fall hazard control?**
 - a. FAS (fall arrest systems), Fall Protection and Engineering
 - b. Engineering out the hazard, TRS (travel restraint system), and FAS (fall arrest systems).
 - c. FRS (fall restraint systems), FAS (fall arrest systems), (FAS) and Rescue.
 - d. Fall Protection, Fall Hazards, and Fall Rescue
3. **On which work location could you use a TRS (travel restraint system)?**
 - a. On the derrick.
 - b. On the rig floor.
 - c. On the crown.
 - d. On the ladder.
4. **What is a FAS (fall arrest system) designed to do?**
 - a. To eliminate injuries that could happen in a fall.
 - b. To minimize injuries a worker could receive during a fall.
 - c. To stop a worker from falling more than 3 metres (10 feet).
 - d. To prevent the worker from falling.
5. **In which of the following applications would you expect to encounter a horizontal fall arrest system?**
 - a. When required to move horizontally along the structure in order to perform a task at a location where a worker could fall.
 - b. While running tubing.
 - c. While climbing a 400 bbl. tank.
 - d. While changing light bulbs on the derrick.
6. **When will you use a vertical fall arrest system?**
 - a. When required to move back and forth in order to perform a task at locations where a worker could fall.
 - b. Climbing a derrick.
 - c. While coiling lines on the back of the derrick.
 - d. While moving along the entire edge of the substructure assembling prefabs.
7. **Which of the following statements best describes a free fall?**
 - a. Begins with failure of a worker's primary attachment and is followed by a downward accelerating fall.
 - b. Occurs once the secondary system becomes tight and the worker accelerates in an arching path.
 - c. Begins with worker moving horizontally away from the anchor position.
 - d. A fall followed by a pendulum swing of the worker until the fall energy dissipates.
8. **List the four (4) components of a Fall Protection System:**
 - 1) _____
 - 2) _____
 - 3) _____
 - 4) _____



CHAPTER 4:

Fall Protection Equipment Inspection and Care



OUTCOME

Inspect and use fall protection equipment safely and properly



OBJECTIVES

1. Outline the proper cleaning, storage and retirement criteria for a variety of fall protection equipment including body harnesses, connecting components and devices.
2. Describe a pre-use inspection of fall protection equipment.
3. Complete a pre-use inspection of selected fall protection equipment and identify if the equipment passes or fails the inspection.

EQUIPMENT SELECTION

Workers have a duty to use the fall protection equipment provided by the employer. Employers have a duty to create fall protection programs that effectively deal with the fall hazards at the worksite. In combination, these duties ensure workers are provided with fall protection equipment and use the equipment properly to allow them to safely work at height. The Fall Protection Plan identifies which equipment they must use.

Pre-Use Inspection

It is the duty of both employers and workers to inspect fall protection equipment prior to use. Employers must have their workers do pre-use inspections and workers must complete the inspections prior to being exposed to the risk of a fall.

What is to be included in a pre-use inspection is determined by the manufacturer since the manufacturer designed the equipment for its intended use. Workers must know the manufacturer's instructions regarding pre-use inspections. At first glance this might seem onerous but fall protection equipment has similar materials and components such as:

- » Snap hooks
- » Carabineers
- » Connecting rings
- » Stitching
- » Fall arrest indicators
- » Grommets
- » Webbing
- » Synthetic rope
- » Wire rope
- » Terminations – thimble eyes, tucks, ferrules
- » Insertion and adjusting buckles
- » Energy absorbers

Once workers are familiar with pre-use inspecting these materials and components, an effective pre-use inspection can be done in a less than a minute.

At the very minimum, fall protection equipment must be pre-use inspected prior to use on each work shift. If the equipment is used by multiple workers or where risk of exposure to contaminants or hazards exists, the equipment must be inspected prior to each donning. An adequate pre-use inspection may be done in a very short time. The pre-use inspection consists of a quick top to bottom examination of the component using your hands and eyes. Workers must look for obvious defects, damage, missing parts and any possible malfunction that may lead to equipment failure.

How and What to Look For

A pre-use inspection can be divided into five basic parts:

1. Right Type and Size
2. Formal Inspection Up to Date
3. Obvious Damage
4. Missing Part(s)
5. Proper Function

Right type and size refer to determining if it is the proper equipment required in the Fall Protection Plan. A recent formal inspection indicates if the equipment is still within the certification period according to the company's fall protection program. The last three points cover the worker looking and feeling for any defects or damage.

The best approach to pre-use inspection is to be systematic. Start at one end or one section of the equipment and complete it before moving on to the next section.

If it has connectors (snap hooks, carabiners, rings) check for deformity and obvious damage. With snap hooks and carabiners also check for missing parts, ease of operation and auto-locking.



Figure 4-1: Serviceable Connectors



Figure 4-2: Unserviceable Connectors

There are two kinds of stitching to look for. Fall Arrest or Fall Load indicators are a line or two of stitching keeping a fold of webbing length together. When the component is exposed to the forces of a fall, the stitching easily tears. The second type of stitching pattern is designed for strength, like joining webbing together or creating a loop around a connector.



Figure 4-3: Serviceable Fall Arrest Indicators



Figure 4-4: Unserviceable Fall Arrest Indicators



Figure 4-5: Serviceable Stitching



Figure 4-6: Unserviceable Stitching

Grommets are typically found in body harness leg straps and waist belts. During the arrest of a fall they can become deformed.



Figure 4-7: Serviceable Grommet



Figure 4-8: Unserviceable Grommet

With webbing you are looking and feeling for tears, cuts, frays, burns, staining, abrasion damage, narrowing or thinning of the web, chemical or sunlight damage, stiff or brittle areas, and discoloration.



Figure 4-9: Serviceable Webbing



Figure 4-10: Unserviceable Webbing

When checking wire, use gloves while looking and feeling for wickers, heavy corrosion, frays, cuts, burns, kinks, or abrasion damage. With synthetic rope you are also looking for frays, cuts, burns, kinks, or abrasion damage and pulled portions of any strands, or sunlight damage. You also need to check for kinks or hackles. Kinks or hackles form when the rope is loaded and stretched which removes a portion of the twist from the rope. When the load is released, the twist may return to individual strands but not to the rope as a whole. This causes one or more strands to separate or untwist (hackle) and also to possibly form a kink at the separation.



Figure 4-11: Hackled Rope

Terminations are how wire and synthetic rope form to create high strength connections. When loaded, these terminations can be deformed. With rope the plastic insert is flattened or missing. The same can occur at swaged ferrule wire rope terminations. There is an additional consideration with braided rope terminations. Typically, the termination must have a minimum of 5 tucks in the braid and the ends taped. Termination particulars can be found in the manufacturer's instructions.

Insertion buckles are typically found on harnesses and adjustment buckles on harnesses and adjustable lanyards. Like any metal component, you are looking for obvious defects, damage, missing parts and proper function.



Figure 4-12: Serviceable Buckle



Figure 4-13: Unserviceable Buckle

Energy absorbers are a combination of webbing, stitching and connectors. These components are pre-use inspected in the same fashion. However, two additional components need to be identified for signs of deployment: the energy absorber wrap and the absorber itself. Manufacturers will often use fall arrest stitching indicators on the wraps and/or fall indicator flags that are exposed if the energy absorber experiences sufficient force.



Figure 4-14: Serviceable Energy Absorber



Figure 4-15: Partially Deployed Energy Absorber

Example Guideline for Pre-Use Inspection of an Adjustable Web Lanyard with Energy Absorber

- » Check the labels or tags for certification and make sure the device is certified for current use (formal inspection in the last year).
- » Check to make sure the lanyard's length is not obviously longer than its manufactured length (stated on the tag)
- » Check the length of the lanyard for deformity, obvious damage and missing parts as follows:
 - Check connectors for damage, deformity, missing parts, function and auto locking.
 - Checking the sewn loops that secure the snap hooks or carabiners.
 - Check adjusting hardware for deformity, heavy corrosion, cuts, nicks, cracks, sharp edges, or missing parts.

- Check the stitching for torn, cut, frayed, burned, discoloured or brittle stitched areas.
- Check the energy absorber for obvious damage to the wrap or the web portions, and for any signs of extension including fall arrest indicators.
- Check the web itself by passing it through your hand while looking and feeling for tears, cuts, frays, burns, staining, abrasion damage, narrowing or thinning of the web, chemical or sunlight damage, stiff or brittle areas and discolouration.

CAUTION: Check for wrinkled or accordion style lanyard strength in the wrinkled tube or jacket. Extend the lanyard to fully check the webbing.

What to do if Equipment Fails Pre-Use Inspection

If a lanyard:

- » is missing the tagging system that provides information such as CSA, ANSI or CE certification, date of manufacture and date of last formal inspection, or
- » has obvious damage or missing parts or
- » has been used for any purpose other than fall protection, then remove it from service and consult your supervisor. This is the worker's responsibility.

Your supervisor will then ensure that it is formally inspected, repaired, replaced or destroyed.

Re-certification and Formal Inspections

If a lanyard is involved in arresting a fall, remove it from service and give it to your employer. They will have it destroyed to prevent any further use.

While the users do not complete formal inspections, they must know if formal inspections have been done. This informs the worker if a certain component they are about to use has been re-certified for use for the certification period. At a minimum there must be an annual inspection. Formal inspections in combination with pre-use inspections ensure the components will function when needed.

Cleaning and Storing

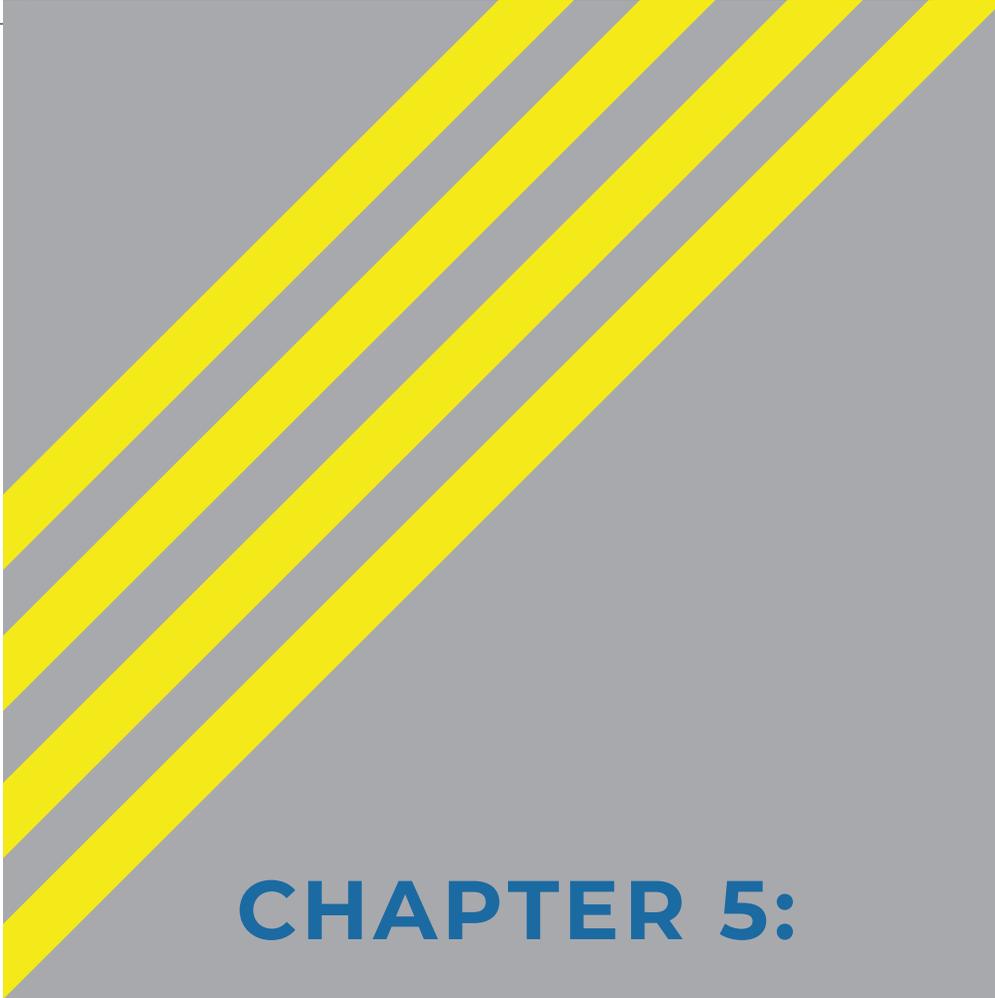
Regular cleaning and drying, protection from exposure to chemicals and mechanical damage, along with proper storage of equipment between uses will help to prolong the life and the strength of fall protection equipment. Typical cleaning and storage instructions are:

- » Using a mild soap and water solution, scrub the device with a soft bristle brush or a sponge.
- » Rinse all detergent from the device with clean water from a low-pressure supply.
- » Do not force-dry the device by hanging it in front of a steam heater or radiator.
- » Store the dried fall protection equipment in a cool, dry, dark location.

After anchor connectors that are attached by wrapping to the structure are cleaned and dried, they should be stored in a clean and dry environment, away from direct sunlight, free of chemical fumes, and protected from damage.

ACTIVITY

Pre-inspect web, rope and wire rope lanyards, energy absorbers, harnesses and connectors, and identify any damage found.



CHAPTER 5:

Body Support Devices – Harnesses



OUTCOME

Demonstrate the safe and proper way to select, pre-use inspect, don, fit and conduct a buddy system check for a full body harness



OBJECTIVES

1. Describe full body harness classification and selection criteria as well the CSA approved designated attachment points.
2. Identify some of the hazards of using a full body harness, including when and where it should be donned (put on) or doffed (taken off).
3. Summarize the guidelines for the selection, pre-use inspection, donning and adjusting of a full body harness including a buddy system check.
4. Explain the need for a timely rescue of a suspended worker.
5. Demonstrate a suspension relief technique while suspended.

CHARACTERISTICS OF A FULL BODY HARNESS

A full body harness is a device made primarily out of web straps, steel attachment hardware, and buckles. This allows for containment of the torso and pelvic area to support the worker after the arrest of an accidental fall and during rescue operations.

Full body harnesses have shoulder straps and leg straps connected together, along with an upper dorsal suspension assembly. The arrangement of the shoulder straps can differ according to manufacturers and models with most harnesses having an additional sub pelvic strap joining the leg straps together.

NOTE: Waist belts are NOT acceptable for use in the oil and gas industry.

The full body harness is professionally designed and manufactured to an existing standard. The design of the harness ensures the impact forces of a fall are transmitted vertically in the same axis as the spine and primarily onto the workers buttocks – the sub-pelvic region (the region of the body that can sustain the highest initial forces). Other areas of the body that receive reduced impact forces during arrest of a fall include the shoulders, chest and legs. The distribution pattern of these fall arrest forces greatly decreases the potential for sustaining serious bodily injury.

Properly adjusted, the full body harness may increase suspension time depending upon the suspended worker's age and fitness level. Properly adjusted harnesses will support a suspended body in an upright position making it easier to carry out a rescue.

Designated Attachment Points on a Full Body Harness

Different types of full body harnesses can provide different means of attachment to properly support the worker, depending upon the harness' design classification and certification.

It is very important that you understand the different classifications and their intended uses. For example, a full body harness that provides the proper attachment points for limited access / confined spaces entry uses different attachment points than those required for controlled descent or for use with ladder climbing systems. Using the wrong type of harness for a given job can lead to an improper attachment and potentially result in a serious or fatal injury.

HARNES CLASSIFICATIONS (CSA STANDARDS)

CSA tests and certifies 5 different classes of full body harnesses that you must know. Harness classes are identified using a lettering system consisting of the letters: A, D, E, L and P. The classification will be indicated on the same tag, along with other manufacturer's information. All harness categories must include an 'A' signifying a dorsal attachment point (D-ring) for fall arrest. Additional uses are identified with one or a combination of these letters.

CSA also indicates the location of attachment points for each of the classes based on an imaginary line between the undersides of the wearer's armpits.

These locations are identified as:

- » Dorsal
- » Sternal (Frontal)

There are several reasons for identifying these areas. For the manufacturer and CSA, it provides standardization for the testing process. For the worker, properly placed D-rings distribute force as intended and arrest the worker in an upright position.

Class A: Fall Arrest

Class "A" type harness is used exclusively for Fall Arrest.



Figure 5-1: Class A Harness with Dorsal D-ring

The main characteristics of the Class “A” harness are all full body CSA approved harnesses are at a minimum Class “A” and they have one attachment point located in the dorsal area (called the dorsal D-ring).

Class D: Suspension and Controlled Descent

Class “D” harnesses are designed for use in suspension and descent control and have one sternal (frontal) D-ring.

Class “D” harnesses are designed to also meet group “A” requirements for fall arrest.



Figure 5-2: Class D Harness with Sternal D-ring

Class E Harness: Limited Access

Class “E” harnesses are designed to support the worker during entry and exit from limited access space usually involving lowering and raising the worker. The Class “E” harness provides a sliding D-ring on each shoulder strap to be used with a spreader bar assembly to facilitate lowering and raising the worker. Class “E” harnesses are also designed to meet Class “A” requirements for fall arrest.



Figure 5-3: Class E Harness

Class L: Ladder Climbing

Class “L” harnesses are designed for use with a fall arrest system comprised of a cable or rigid rail mounted on or ladders or towers. An arrester (grab device) is attached to the cable or rail systems and connected to the “L” attachment on the harness.

If attached to a chest strap, the chest strap must be fixed and non-sliding. Class “L” are also designed to meet Class “A” requirements for fall arrest.



Figure 5-4: Class L Harness

Class P: Work Positioning

Class “P” harnesses are designed to position the worker during work at an elevation and are therefore referred to as work positioning harnesses. These harnesses provide positioning D-rings located at waist or hip level for use with work positioning lanyards to allow “hands free” operations. Class “P” harnesses are also designed to meet Class “A” requirements for fall arrest.

Full body harnesses should always be worn by any worker who is at risk of falling from the level on which they are working or where there is unusual risk of injury from a fall. All full body harness workers must follow a process to correctly select, then inspect, the harness prior to use. Following appropriate selection and pre-use inspection, the worker must don and adjust the harness to ensure proper fitting.



Figure 5-5: Class P with Back Ring



Figure 5-6: Class P with Side Rings

SELECTING A HARNESS

Always consult the Fall Protection Task Plans or your supervisor to determine the correct type of harness for each task. When selecting the appropriate harness for the task, confirm that it is the type or class of harness required by checking the tag system, and then ensure that the harness is the appropriate size. If a fall protection plan does not address the specific task you are about to undertake or there is no fall protection plan at your work site, consult your supervisor.

All reputable manufacturers provide various harness sizes to achieve the correct fit for most body sizes. It is very important that the worker wears the proper size harness in order to correctly fit the harness to their body and prevent risk of malfunction in the event of a fall. If the sub-pelvic strap cannot be adjusted to fit directly under your buttocks while maintaining the correct position of the dorsal D-ring, it is the wrong size for you.

Fit or adjustments problems, such as twisted leg loop webbing, uneven shoulder straps and improperly located sternal, dorsal or frontal D-rings, can result in unnecessary injury during a fall and possibly shorten suspension time.

If a worker cannot adequately fit into any harness size, it will be necessary to acquire a custom fit harness for that particular individual. If you are unsure of the appropriate harness size for use, consult your supervisor.

Harnesses are also designed for a maximum user weight including clothing and tools. Exceeding these limits is not an option. In the arrest of a fall, the fall protection equipment and/or system may not function as intended or designed. This may expose the worker to critical arrest forces leading to serious or fatal injury. A possible solution is a system designed by a professional engineer for the user's weight and fall hazard.

WHEN AND WHERE TO DON A HARNESS

Workers must use great caution when donning and fitting harnesses around moving machinery. Loose straps or dangling lanyards must be secured to the worker to avoid entanglement in machinery and moving parts.

Always don and fit your harness away from moving parts. Typically you should be at least 3 metres (10 feet) away from any moving parts while donning or doffing a harness and never closer than 1 metre (3 feet) when wearing a harness. Harnesses and/or lanyards should not be worn if no longer needed. The CSA standard for strength of straps on harnesses is 22.2 kN (5000 lbs); your body will break before the strap will.

DONNING A FULL BODY HARNESS

After selecting the correct harness class and size and pre-inspecting the harness, the worker must fit and adjust the harness. The harness design will determine the best way to adjust the harness. Harnesses that are a universal fit are more adjustable than a single size harness. An explanation of a particular harness fit and adjustment are written in the manufacturer's instructions.

Proper adjustment and fit involves the correct placement of dorsal, frontal and sternal D-rings as well as leg, shoulder, chest and sub-pelvic straps. Shoulder and chest strap tightness prevents straps from coming off the shoulders. Leg straps should be located high in the groin and tight enough to allow the fingers of your hand to pass between the straps and your thighs but not loose enough to make a fist. In a fall arrest this will prevent the leg straps from accelerating up your legs, and potentially causing serious injury.

After all straps have been buckled, tighten all buckles so that harness fits snug but allows full range of movement. Pass excess strap through loop keepers.

Note: Adjustable chest straps without connectors are best placed at mid sternum. In a fall arrest the body settles in the harness and straps move up. A high chest strap location may become a choking hazard. A low chest strap may allow shoulder straps to come off ones shoulders.

Once all adjustments are made, use keepers on the straps to reduce any entanglement hazard.

DONNING A HARNESS

Step 1

Hold harness by back D-ring. Shake harness to allow all straps to fall in place.



Step 2

If chest, leg and/or waist straps are buckled, release straps and unbuckle at this time.



Step 3

Slip straps over shoulders so D-ring is located in middle of back between shoulder blades. The sub-pelvic strap should be below the buttocks.



Step 4

Pull leg strap between legs and connect to opposite end. Repeat with second leg strap. If belted harness, connect waist strap before leg straps.



Step 5

Connect chest strap and position in mid-chest area. Tighten to keep shoulder straps taut.



Step 6

After all straps have been buckled, tighten all buckles so that harness fits snug but allows full range of movement. Pass excess strap through loop keepers.



Figure 5-7: Donning a Harness

(Images courtesy of Miller Fall Protection)

BUDDY CHECK

Finally, complete a buddy check to ensure the harness is properly fitted and all keepers are properly positioned, especially the parts that cannot be seen by the wearer prior to beginning their task. A buddy is a fellow worker or supervisor who is trained in the use of fall protection equipment. The buddy check is another set of eyes checking:

- » Straps for tightness, twists, entanglement hazards and location.
 - Sub-pelvic, leg, shoulders and chest.
- » D-Rings for location.
 - Sternal (frontal), dorsal.

If possible, a buddy can also check proper attachments to other fall protection components. An example would be a fall protection lanyard connected to the dorsal D-ring of the worker's harness.

NOTE: Immediately after donning and adjusting the harness, the worker should always ensure their selection and fit is buddy checked by another worker or supervisor that is trained in fall protection. **REMEMBER, SAFETY IS EVERYONE'S RESPONSIBILITY**

HAZARDS

In order for the full body harness to appropriately distribute forces during a fall arrest, it must be selected, inspected and used appropriately. Major hazards involved in using a full body harness include:

- » Attachment to incorrect or non-fall arrest points on the harness.
- » Exceeding the manufacturer's maximum designed weight limits.
- » Entanglement/tripping due to loose straps or dangling lanyards.
- » Improper sizing and/or fit and adjustment.
- » Suspension trauma.

SUSPENSION TRAUMA

Further injury can result after a fall when the worker is suspended awaiting rescue. Vertical suspension allows gravity to pool the worker's blood supply in their legs. If the worker is motionless, then there is no muscle action to pump the blood back to the core causing inadequate blood supply to major organs. The problem can be compounded by the pressure of the leg straps on the worker's groin, restricting blood flow in each leg. Changes in circulation begin immediately after the onset of suspension and cannot be prevented. Prolonged insufficient blood flow to major organs can lead to fatal injury and death. Relieving suspension by bringing the fallen worker to a safe level as soon as possible is critical.

The maximum suspension time depends on the proper selection and fitting of the full body harness and the condition of the fallen worker (injury sustained during arrest as well as the worker's age, fitness, and health condition). Workers may withstand motionless suspension from the dorsal D-ring for anywhere from 5 to 15 minutes on average.

The best way to prevent serious or fatal injury is to bring the worker to a safe level. You cannot prevent these circulatory changes but you, as a suspended worker, can mitigate their effects. You can delay the onset of suspension trauma while waiting for rescue by:

- » Getting your feet back on the derrick/structure if possible.
- » Using suspension straps
 - Some models have straps stored at the sides of the harness which the suspended worker can deploy
 - These can be used to alleviate pressure, delay symptoms, and provide support for muscle pumping
- » Bring your knees to your chest then slowly extend your legs while contracting your thigh muscles.

Rescuers can also help workers increase suspension time by:

- » Throwing them a line to swing them back onto the derrick/structure
- » Providing a loop for the fallen worker

NOTE: Rescue of a suspended worker should be planned and practiced prior to a worker being exposed to the risk of a fall.

ACTIVITY

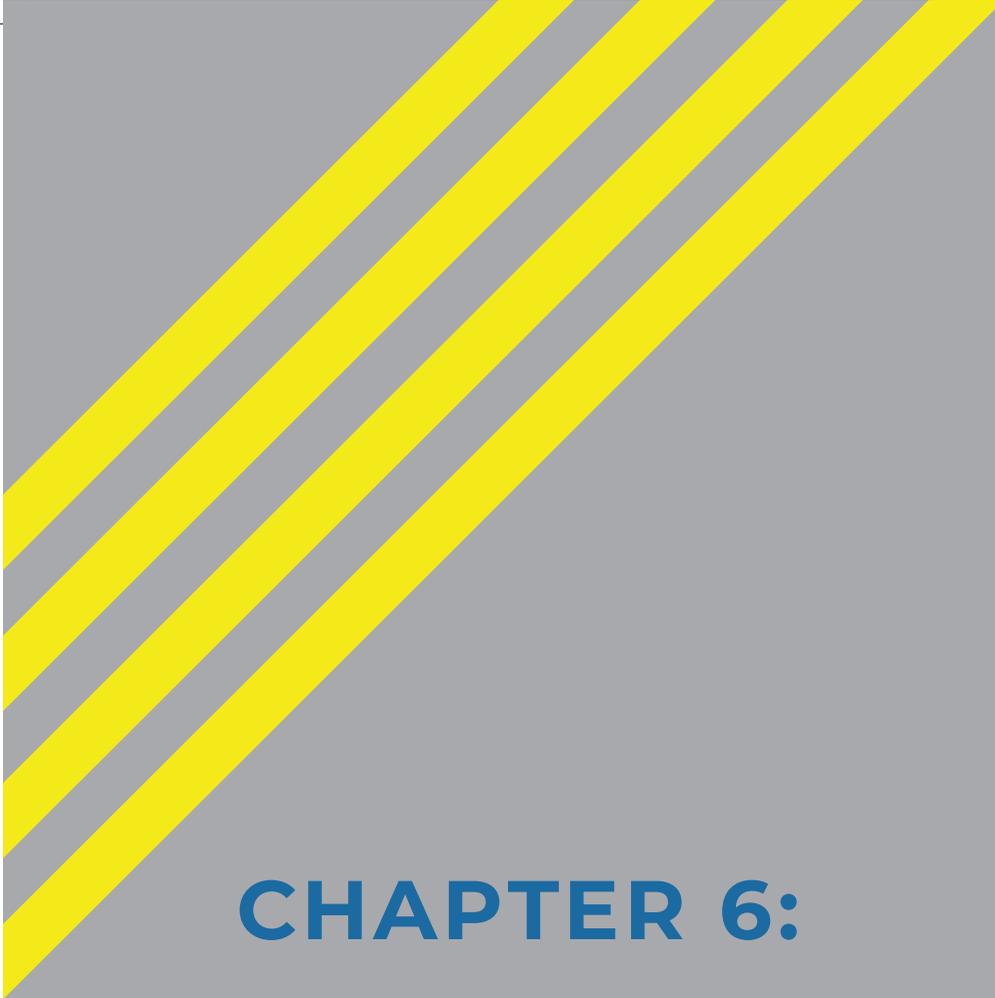
1. Select, pre-use inspect, don and adjust a full body harness including a proper buddy check.
2. Demonstrate a suspension relief technique.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. **What fall arrest equipment is designed and approved to allow connection to a variety of fall protection systems?**
 - a. Waist Belt
 - b. Full Body Harness
 - c. Tag Line
 - d. Class “AL”
2. **For harnesses designated as Class “AL”, what does the “L” represent?**
 - a. Ladder climbing by attachment of sternal or frontal ring to a ladder safety system.
 - b. Work positioning.
 - c. Fall arrest.
 - d. Frontal attachment for lowering/raising into confined space.
3. **How do you know what type or designation of harness to wear?**
 - a. Always wear a multi-purpose harness.
 - b. Selection of a harness to carry out a specific task is determined in the Fall Protection Task Plan or by consulting your supervisor.
 - c. Always wear a Class “A” harness.
 - d. When carrying out any task, always wear a type of harness that allows “hand free” operations
4. **What techniques can a suspended worker use to delay the onset of suspension trauma?**
 - a. As long as your harness fits well, do nothing.
 - b. Remain as motionless as possible.
 - c. As long as you are not hurt in the fall arrest, there is no need to increase suspension time.
 - d. Get your feet back on the structure if possible.
5. **When performing a buddy check, what are you checking harness straps for?**
 - a. Loose ends, placement, twists and tightness.
 - b. Color, tightness, twists and keepers.
 - c. Placement, tightness, keepers and colour.
 - d. Loose ends, placement, twists and strength.
6. **Match the group of harnesses listed in the left hand column with the correct description/use listed in the right hand column.**

Harness Class	Description/Use
a. AD _____	1. Fall Arrest
b. AP _____	2. Fall Arrest and Confined Space
c. AE _____	3. Fall Arrest and Ladder Climb
d. AL _____	4. Fall Arrest and Work Position
e. A _____	5. Fall Arrest and Lateral Control
	6. Fall Arrest and Descent Control



CHAPTER 6:

Connecting Components and Devices



OUTCOME

Select the appropriate fall protection connecting components for the job and connect them safely and properly



OBJECTIVES

1. Describe the different types and uses of FP (fall protection) connecting components.
2. Select the appropriate connecting components for the job.
3. Assess secure attachments and the compatibility of connectors.
4. Identify false connections (including phantom hooking).
5. Identify the hazards and risks associated with incompatible connectors.
6. Assemble a temporary anchor connector.

CONNECTING COMPONENTS AND DEVICES: OVERVIEW

The A,B,C,Rs represent the components of a complete Fall Protection System. “A” signifies the anchorage and “B” the worker’s full body harness. “C” signifies the connector or connectors in combination that connect a full body harness to an anchorage. “R” represents fall rescue.

Connectors can be divided into 4 main types:

- » Anchor Connectors
- » Snap Hooks and Carabineers
- » Lanyards
- » Energy Absorbers

These components are connected together in combination to create the attachment between the worker's harness and the anchorage. The length of the connection and requirement of an energy absorber depend on the hazard's potential arrest force and available clearance. Connector material choice – wire, synthetic rope or synthetic webbing – is based on the work environment.

Selection

Selection of the appropriate connecting devices begins with the fall protection plan or direction from the supervisor. This is followed by identifying and selecting the specified device(s) from storage.

Selection criteria require compatible connectors that allow one worker to connect to an appropriate anchorage on the structure. The criteria to consider include:

- » Material, size, shape and strength compatibility.
- » Energy absorber requirement in the fall protection system.
- » Manufacturer's maximum weight and free fall limits.
- » Manufacturer's connection type specification and requirement (auto locking snap hook or carabiner).
- » Possible hazards – sharp edges, heat, electricity, etc.

Snap hooks and some carabiners are integral (built in) components of connecting devices.

ANCHOR CONNECTORS

In this industry anchor connectors, whether permanent or temporary, are usually attached to the derrick /structure. The worker attaches another connector or combination of connectors between it and their full body harness. Fall protection anchor connectors must only be used for fall protection and must be rated for the minimum strength for the jurisdiction where you are working. (See Chapter 2).

Permanent Anchor Connectors

Permanent anchor connectors are created by bolting or welding a connector, often a D-ring, to a suitable structure to provide an attachment point for other connecting components.

Examples of permanent anchor connectors are:

Pad eyes: a ring or round opening on a plate welded or otherwise fixed to a part of a derrick structure.

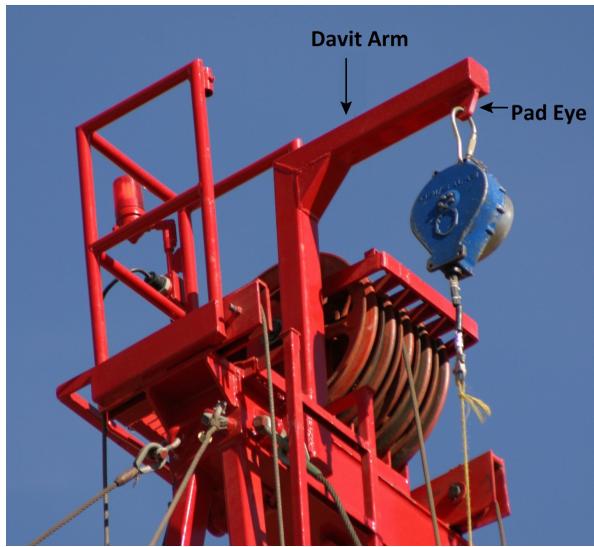


Figure 6-1: Davit Arm with Pad Eye

D-ring plates: bolted or welded onto the structure.



Figure 6-2: D-ring Plate

D-ring bolts: bolt-like devices with a D-ring attached to the head for fall protection. They are fastened to an anchorage with a nut and lock washer.



Figure 6-3: D-ring Bolts

Temporary Anchor Connectors

Temporary anchor connectors are installed by the worker prior to a task. They are removed after the task is finished. These are either clamped to the anchorage, or girthed or wrapped in a basket fashion around the anchorage.

Beam Clamps Sliding and Non-sliding



Figure 6-4a: Beam Clamps Sliding



Figure 6-4b: Beam Clamps Non-sliding

Removable Davit Arms

Typically used for confined space entry and exit work.



Figure 6-5: Removable Davit Arm

Web or Cable Anchor Connectors

There are a variety of web and cable configurations with pre-attached hardware for secure connections.

Examples

Web Pass Thru Adapters

These adapters have 2 D-rings (standard and larger) on the ends: the standard ring passes through the larger ring after being wrapped around an anchorage. The web strap length varies and has padding sewn on. The padding protects the load-bearing web from damage due to edge contact on the structure as well as abrasion along its length.

To attach a web pass thru adapter, place the strap over the anchorage with the padding positioned to protect the load-bearing portion of the strap from edge damage or abrasion during contact. The standard D-ring is passed through the larger D-ring on the first pass and may be left hanging in this position for attachment with the lanyard. If the worker wishes to raise the attachment point, to decrease connector length, the standard D-ring and strap may be wrapped around the anchor connector several times with the each consecutive wrap passing again through the larger D-ring.



Figure 6-6: Web Pass Thru Adapter

Web Choker

The web choker has 1 D-ring with both ends of a loop of webbing attached. It is looped around an anchorage point with the D-ring girthed through the webbing loop.

There is no padding to protect the web strap that bears the load secured to the anchorage. The worker must ensure there are no sharp edges or abrasions that could damage the webbing.

To attach a web choker, place the loop over the anchorage bringing the loop back toward the D-ring. Pass the D-ring down through the loop of web to secure it to the anchorage in a girth hitch configuration.



Figure 6-7: Web Choker

Cable Choker

A length of cable is secured to 2 O-rings (one standard size ring and one larger ring.) While cable makes a more durable connector, it can still be damaged by sharp edges that are not padded or protected.



Figure 6-8: Cable Choker

To attach a cable choker, place the cable over the anchorage and bring the ends together to pass the standard size ring through the larger ring. The sling may also be wrapped more than once to raise the point of attachment. The first and each consecutive wrap must pass through the large ring.

Cable Anchor Connector

A cable of varying lengths that has the ends formed into 2 thimbled eyelets secured with a carabiner. The cable usually has a plastic coating to resist wear around sharp edges.



Figure 6-9: Cable Anchor Connector

To attach a cable anchor connector, hang it over the anchorage ensuring both Flemish eyes are equal and of sufficient length to create the correct angle between them. Most manufacturers set the angle of the legs at 45 degrees or less and use a carabiner as a compatible connector to secure the legs. Longer cable connectors will decrease the angle. They can be used on smaller diameter anchorages by wrapping the cable around the anchorage. However, both legs need to hang down equally to share forces and maintain the correct angle.

Cable connectors must be protected from sharp edges on anchorages with padding. Refer to the manufacturer's instructions for the carabiner type to use and the maximum angle at which the cable and eyelets form once wrapped around the anchorage.

Attachment Method

Attaching a connector to an anchorage should only be done if the anchorage has been pre-use inspected. Workers must be cautious of sharp edges as they may still cause damage to anchor connectors. You must follow the manufacturer's instructions on how to attach a connector. Once the connector is attached to the anchorage, a compatible snap hook or carabiner from the next connecting device is attached to the standard D-ring or O-ring.

Hazards

Major hazards using anchor connectors include:

- » The worker (including clothing, tools, etc.) exceeding the maximum designated weight.
- » Anchor attachment:
 - Possibility for a swing fall.
 - Angled attachment (could slide down anchorage in a fall arrest).
 - Insufficient strength
 - Too low and not allowing sufficient clearance
 - Abrasive, sharp surfaces are present
 - Work environment where chemical, heat, fire, electricity or moving equipment may weaken or damage the connector.
- » Incompatibility with anchorage or other connectors.
- » Phantom hooking.
- » Tying directly back through the anchor connector to a webbing lanyard that is not specified by the manufacturer's instructions.
- » More than one fall protection system connected to the anchor connector.
- » Unequal loading of cable connector legs.
- » Anchor attachment slack around anchorage can increase fall distances.
- » Exceeding maximum cable anchor leg angle.

SNAP HOOKS AND CARABINERS

Snap hooks and carabiners are devices used in fall protection to join anchor connectors, lanyards and energy absorbers to full body harnesses. They also connect vertical and horizontal fall protection systems to anchor connectors and fall arresters. Often they are integral to lanyards or fall protection

systems. Non-integral carabiners are often used in rope access and rescue due to their versatility.

Snap hooks and carabiners require at least 2 separate actions to open and automatically close and lock when released. This provides attachment strength and security and minimizes the risk of roll out when connected to other compatible hardware.

Connectors are designed to be loaded along their spine (long axis). As a result, the gate strength (minor axis) – either directly on face or side loaded – is significantly less. For this reason, connectors are not designed to be connected together since forces in a fall arrest may be applied to the gates.

NOTE: It is crucial that you know the capabilities of your connector. All connectors are not equal. In the event of a fall arrest and minor axis loading your connector might fail and disconnect.

Snap hooks and carabiners are normally made of either dropped forged steel or aluminum. Aluminum has the advantage of being lighter than steel. Steel handles wear and tear and mechanical impact damage better than aluminum.

Snap Hook Types

There are two types of snap hooks – Standard Hooks and Heavy Duty Hooks.

- » Standard Hooks with 22.2 kN (5000 lbs) major axis strength and 1 kN (225 lbs) face and 1.5 kN (340 lbs) side gate loading.
- » Heavy Duty Hooks with 22.2 kN (5000 lbs) in all axis and gate loading



Figure 6-10: Snap Hooks

Attachment Method

Snap hooks have 2 types of opening mechanisms. The first is often referred to as a pistol grip. Begin by squeezing the “trigger” with your index finger and then drawing back the “hammer” with your thumb to open it. To open the second mechanism, first push the opening mechanism on the spine with your palm and then squeeze the gate open with your fingers.

Carabiner Types

Carabiners come in many different sizes and shapes. The methods used to open auto-locking carabiners are varied but all use a twisting motion. They are often referred to as twist lock carabiners. Carabiners are designed to be loaded only along the major axis or spine. Some carabiners have 3 actions to open them and are referred to as tri-locking carabiners.

Some carabiners are available with a pin that allows the carabiner to be connected to other components in a captive eye configuration ensuring loading along the spine only. If the carabiner does not have a captive eye, the user must ensure that they are placed so they load only in an end- to- end fashion.

Attachment Method

To attach carabiners, hold it with the spine in the palm of your hand. Open the gate and hold it open then place the mating connector (D-ring) inside the hook portion of the carabiner. Release the gate allowing it to close and lock securing the mating component inside the carabiner. ALWAYS double check to ensure that the carabiner gate is closed and locked before use. When placing the carabiner in a loading position, ensure the long axis or spine of the carabiner is pointing in the direction of the load being applied. Also ensure that obstructions cannot place contact pressure on the gate of the carabiner.



Figure 6-11: Carabiners

ACTIVITY 1

Inspect a variety of snap hooks and carabiners (new and used) provided by your instructor and identify those that should be removed from service. You will also need to justify your choices.

Hazards

Other hazards to avoid are:

- » Connecting snap hooks or carabiners to objects or openings that may scrape or wear down the connector material.
- » Making incompatible connections, such as:
 - Connecting snap hooks or carabiners to each other
 - Connecting 2 snap hooks or carabiners to 1 D-ring
 - Connecting directly to a horizontal lifeline, unless designed for that purpose
 - Roll out
 - Phantom hooking
 - Tri-loading
 - Cross-gate loading
- » Trapped clothing, webbing or other material preventing a snap hook or carabiner from closing.

Compatibility

Compatible components are components that can be safely connected to each other. With compatible components, there is no risk of the material, size or shape of the connecting links damaging any of the components during use or impact loading from a fall. Employers have a duty to provide systems that have compatible components. Workers also have a duty to

ensure the connections they make are compatible. (See Chapter 2)

When connecting fall protection components together, workers must check that their connections are compatible with each other and compatible to the anchorage. Workers must check the connections by manipulating the connection to see if there is any possible damage to the connector or gate pressure prior to use.

Connections are considered compatible if they can safely be joined to each other and there is no risk of damage to the connector or the connector gate. Any risk of damage may lead to a failure and a possible disconnection during a fall arrest. A risk of failure may occur by having:

- » Gate pressure with the connector and connecting ring.
- » Gate pressure with the structure.
- » Dissimilar materials (i.e. aluminum carabiner attached to a wire rope).

Structure Contact

Workers need to imagine what would happen to connectors in a fall. If connectors contact the structure there is danger that the connectors could be damaged. If there is pressure on the gate, this could lead to a forced hook roll out. (See Figures 6-12 and 6-13)



Figure 6-12: Gate Pressure with the Connector and Connecting Ring



Figure 6-13: Gate Pressure with the Structure

Incompatible Connections

Forced Hook Roll Out

A roll out is an accidental disconnection of a snap hook or carabiner from its connector. It is caused by the snap hook gate being depressed under torque or by the carabiner sleeve being turned or unscrewed with the gate subsequently released.

Side pressure on the gate can damage the gate. Forces applied against the side of the hook can cause it to bend sideways allowing the gate to open as the hook is bent. Also, forces applied against the gate face can cause it to crush inward and open. Once the gate opens any twisting motion of the hook may cause it to roll out and release from its attachment.

Possible sources for a roll out are:

- » The mating device (e.g.: D-ring, O-ring, Flemish eyes, snap hook, carabiner).
- » Any obstruction such as an I-beam or angle iron that presses on the gate.
- » The structural member is too small.

Workers have been injured and killed by roll outs. To avoid a roll out check your connection. Move the connector in all directions of travel to see if the connection could become incompatible.



Figure 6-14: Forced Hook Roll Out

Tri-loading

When carabiners and snap hooks are attached to connectors that have two legs (i.e. cable anchor connectors), tri-loading may occur. As the angle between the legs increases so does the force on each leg. These forces combined with forces not being applied along the spine can cause the carabiner to be pulled in 3 directions.



Figure 6-15: Tri-loading

Cross Gate Loading

Cross gate loading usually happens with non-captive eye carabiners. When a worker moves and the carabiner is not under load, it can turn sideways. If it remains in this position due to friction and there is a fall, carabiners may weaken and possibly fail.



Figure 6-16: Cross Gate Loading

Materials

An aluminum carabiner moving horizontally on a steel cable while under tension will wear away material thereby weakening the carabiner. It is important that the materials and the work environment are compatible. Kevlar resists heat better than nylon. Therefore, Kevlar should be used instead of nylon in high heat situations.

Phantom Hooking

Phantom hooking (also called a “false connection”) may be either the result of a tight fit between the inside of the D-ring and the outside of the hook or carabiner, or a protrusion on the connector that catches on the inside of the D-ring. A risk of phantom hooking occurs when connecting a snap hook or carabiner to a D-ring or O-ring that cannot be seen, such as the dorsal D-ring of a body harness.

For example, a worker inserts a snap hook or carabiner through a D-ring or O-ring and the gate closes without the mating component secured inside the hook. The worker gives a quick pull to check the connection. Since the connector is very snugly fit inside the D-ring, the tug produces insufficient

force to disengage the hook or carabiner. The worker incorrectly believes the attachment is secure.



Figure 6-17: Phantom Hooking

However, when the worker falls the snap hook or carabiner pulls out the ring leading to serious or critical injury or even death.

Always check to ensure your connection is secure. If you cannot see the ring inside the closed snap hook or carabiner, feel for the ring inside the closed snap hook or carabiner. Alternatively, try and get buddy checked by a fellow worker or supervisor.

ACTIVITY 2

Your instructor will be show you a variety of connectors. You will need to test them for compatibility.

Energy Absorbers

Energy absorbers (shock absorbers) are a length of webbing, which is gathered into a shorter length. Most manufactures of energy absorbers gather and absorb energy in 2 ways.

- » Gathered in a pouch that rips down the middle or with an additional strap that rips.
- » Gathered by wrinkle or accordion style and stretches to deploy.

The energy absorber limits the force applied to the worker when a fall occurs. The gathered portion extends as it rips, tears or stretches absorbing the kinetic energy of the fall as the worker is stopped. This

is done in a gradual, controlled manner without the worker bouncing when stopped. The shock absorber prevents or reduces both injury to the worker and the amount of force transferred to the lifeline and anchor.

The rated capacity of an energy absorber refers to the amount of force a worker would experience if the fall reached the design maximums for:

- » Worker weight, including clothing and tools
- » Energy absorber extension
- » Free fall

Manufacturers make energy absorbers for workers with varying weight and free fall limits. CSA classifies energy absorbers for their ability to absorb the energy from a fall according to the weight of workers. While CSA has a maximum extension for energy absorber to meet in each class, the actual maximum deployed length will be recorded on the labeling system of each particular energy absorber.



Figure 6-18: Energy Absorbers

NOTE: It is critical for workers to know the actual deployed length of the energy absorber they are using in their systems when calculating clearance requirements.

The two classes are:

- » Class E4: worker and gear weighing 45-115 kg (100-255 lbs) 4 to 6 kN MAF (900-1350 lbs) with an extension of 1.2 m (4 ft).
- » Class E6: worker and gear weighing 90-175 kg (200-385 lbs) 6 to 8 kN MAF (1350-1800 lbs) and an extension of 1.75 m (6 ft).

Most energy absorbers require at least 2 kN to begin deployment. Energy absorbers do not always fully deploy. Deployment distance depends on the amount of force generated in the fall. It is important to keep the free fall force and the user weight design within the legal limits.

Selection

Like all connectors in a fall protection system, energy absorber requirements will be identified in the Fall Protection Plan for the task at height. Selection will also depend on the worker's weight and available clearance. If sufficient clearance is available, energy absorbers should be a part of your fall arrest system. With even small free fall distances it is extremely difficult to keep the MAF below the legal limit without energy absorbers.

Attachment Method

Attach the energy absorber to the dorsal D-ring on the full body harness. Ensure a secure and compatible connection has been made. Attach other connectors between the anchorage and the energy absorber. If the energy absorber is integral to a lanyard, connect the energy absorber end to the harness and the other lanyard end to the anchor connector or other fall arrest systems.

Having the energy absorber attached to the worker is important if the worker's connection goes over an edge during arrest. If the energy absorber is not attached to the worker, edge contact will decrease the energy absorber's effectiveness or even prevent it from fully deploying. In both cases, the worker will experience more arrest force than anticipated and may be injured.

Hazards

When using an energy absorber, there are a number of hazards to consider. They include:

- » Entanglement
- » Sharp edges
- » Edge contact
- » Increased fall clearance required
- » Exceeding free fall and weight limits
- » Two energy absorbers connected in a series
- » Energy absorber connected to anchorage vs. energy absorber connected to a body harness

LANYARDS – DESCRIPTION AND PURPOSE

Lanyards extend the length attachment of a worker to an anchorage or anchor connector. Lanyards come in different lengths, sizes, connectors and materials. They can also be fixed length or adjustable. Some also have integral shock/energy absorbers.

In this industry lanyards with integral shock/energy absorbers are used for fall arrest and recommended for travel restraint if there is a risk of a fall through any floor openings or off the edge of the structure. If the worker falls through an opening or off a level an energy absorber is available to reduce the forces during a fall arrest. This system will only work properly if there is sufficient clearance and the fall is arrested vertically by dorsal attachment to the body harness.

Lanyards can be categorized in many ways. For our purposes we will categorize them by materials, function and types of integral connectors.

Lanyards are made of different materials:

- » Rope
- » Web
- » Cable

Lanyard types include:

- » Fixed length lanyards
- » Adjustable lanyards
- » Energy absorbing lanyards
- » Tie back lanyards
- » Double Leg lanyards

Lanyards have the following integral connectors:

- » Energy absorbers
- » Standard snap hooks
- » Heavy duty snap hooks
- » Scaffold snap hooks
- » Carabineers

There are many different lanyard configurations and names. For example; an adjustable energy absorbing web lanyard with standard snap hooks.

Rope Lanyards

Rope lanyards are used mainly for work positioning but can be used in travel restraint and fall arrest. They are synthetic, made primarily of nylon or polyester. Many continuous small diameter filaments are wound into 3 main strands laid in a spiral wind. Eye splices are formed around thimbles securing auto locking snap hooks of various configurations (most common) or carabiners at each end.



Figure 6- 19: Rope Lanyard

The elasticity of the synthetic fibers and winding of the strands allows the rope to stretch as a load is applied and energy is absorbed. However they should not be used in place of energy absorbers. The repeated stretch and recoil during fall arrests causes bouncing and thus an arrest force at the bottom of each bounce. The stretch in the rope will increase both the total fall distance and the fall clearance requirement.

Rope lanyards are also excellent in minimizing the risk of electrical shock when dry. Most rope lanyards are not adjustable.

Web Lanyards – Adjustable and Fixed Length

Standard web lanyards are made of nylon, polyester or Kevlar. They vary in length and width and may be adjustable in length. Web lanyards are durable, abrasion-resistant and very strong.

All web lanyards that are used for fall arrest should have a shock/energy absorber attached to minimize the impact forces and the energy applied to the worker and the fall protection system. Web lanyards also resist electrical shock when dry. Two basic models are adjustable and fixed length web lanyards.

Adjustable

The adjusting buckle allows the lanyard a range of adjustment to allow for appropriate length to:

- » Prevent a worker from reaching an edge in all directions of travel restraint.
- » Allow a worker to work hands free in a work positioning location.
- » Allow for work while minimizing free fall.



Figure 6- 20: Adjustable Web Lanyards

Fixed Length

Fixed length web lanyards are also excellent for fall arrest, travel restraint and work positioning if the attachment length does not need to be adjusted.



Figure 6-21: Fixed Web Lanyards

Cable Lanyards

Most cable lanyards are a length of cable with eyelets on each end that secure a snap hook on one end and a shock absorber and snap hook at the other end. If the cable lanyard is used for fall arrest, it must have a shock/energy absorber attached due to the lack of stretch and high impact forces.

These are very strong and durable lanyards and are used where abrasion, heat, burns, chemical contact, sunlight damage or mechanical impact hazards are present.



Figure 6-22: Cable Lanyard

Tie Back Lanyards

Lanyards that are designed with the capability to wrap around the anchorage and connect or tie back to themselves do not require an anchor connector. Tie back lanyards combine an anchor connector and lanyard, thereby reducing equipment training and the number of required formal inspections. The lanyard's webbing is more durable and/or protected from abrasion damage when in contact with anchorages. However, sharp edges still need to be padded or avoided. These lanyards come in 2 basic configurations:

- » Heavy-duty web with an adjustable D-ring and standard snap hooks. One snap hook attaches to a worker's harness while the other wraps around the anchorage and makes a compatible connection adjustable D-ring.



Figure 6-23: Tie Back Lanyard with Heavy-duty Web, Adjustable D-ring and Standard Snap Hooks

One with a length of heavy-duty web with a specially designed, heavy-duty snap hook (22.2 kN or 5000 lb. strength in all directions). The hook attaches back onto the lanyard itself. Being a heavy-duty hook protects it from damage that may occur during gate or side or cross loading.



Figure 6-24: Tie Back Lanyard with Heavy-Duty Web and a Heavy-Duty Snap Hook

NOTE: Unless specifically designed, lanyards CANNOT be used in tie back configurations. Connecting lanyards this way risks an incompatible connection that could lead to forced hook roll out.

SELECTION FOR TRAVEL RESTRAINT, WORK POSITIONING AND FALL ARREST

All fall protection system components, including lanyards, will be identified in the Fall Protection Plan for the task at height. The work environment will determine which lanyard material will be used. The fall protection system – travel restraint or fall arrest – and the clearance requirement, will determine the lanyard length.

Work positioning lanyards may also be found in the fall protection plan. They can be used on any task performed at height. Selection greatly increases the worker's comfort and safety by minimizing the risk of a fall while performing the task.

The Canadian Association of Oil Well Drilling Contractors (CAODC) committee on fall protection recommends that a worker have a shock/energy absorber present in every fall arrest system.

Attachment Method (General)

A worker is responsible to ensure:

- » They have selected and pre-use inspected the right lanyard for the job.
- » Connections to harness D-ring(s) and the anchor connector are compatible.
- » Single energy absorber in the system is attached to the body harness dorsal D-ring.
- » The length of the lanyard is adjusted to:
 - minimize free fall potential.
 - prevent a worker from reaching an edge and falling off the level, regardless of where the worker travels.

Some full body harnesses will have an integral energy absorber attached to the dorsal D- ring. Lanyards with integral energy absorbers are attached into the harness D-ring, not the energy absorber D-ring. Lanyards without energy absorbers are attached directly to the energy absorber D-ring. When workers confirm their clearance requirement, the maximum deployment length of the integral energy absorber must be included.



Figure 6-25: Lanyard with Energy Absorber Attached to D-ring



Figure 6-26: Cable Lanyard with Energy Absorber Attached to D-ring

When using lanyards and anchor connectors to connect to the anchorage, the maximum free fall potential is twice the length of that attachment. The farther the connection to the anchorage is located below the dorsal D-ring height of the worker, the closer the maximum free fall potential connection is reached. Legislation and the requirement for limiting the worker's free fall (limits to the fall energy) dictate that anchors be shoulder height or higher whenever possible and the connecting lanyard should be short as possible allowing unimpeded work. In other words, workers should NOT select a long lanyard when a shorter lanyard will do (See Chapters 1 and 2).

The practice of tying back a lanyard for direct anchorage attachment can only be done with lanyards and snap hooks/carabiners specifically designed for this type of attachment. With tie back lanyards, place the snap hook end of the lanyard over the anchorage and wrap so that either the hook comes back and connects to the D-ring (ensure no risk of gate damage to the hook by being pressed against the anchorage) or by connecting the reinforced hook back onto the lanyard itself. The manufacturer's instructions will specify the use of any lanyard model.

Work positioning lanyards have NO shock/energy absorber. They are usually attached to the worker's waist level work positioning rings. However, other rings can also be used such as frontal or sternal. The intent is to work hands free with feet and work positioning connected creating a stable contact with the structure. A work positioning lanyard should be placed to avoid interfering with the worker's task.

For example:

A derrick hand on the monkey board would have great difficulty pulling or catching pipe if they did not create a stable contact with their feet and a properly adjusted work positioning lanyard connecting the rear work positioning D-ring of the harness and the back structure of the monkey board. Feet and work positioning lanyard contact with the structure allow the derrick hand to lean out over the end of the diving board to maneuver the pipe.



Figure 6-27: Work Position with Three Point Contact Rear Attachment

A worker might also connect a work-positioning lanyard from one hip side D-ring around the structure and connected into the opposite hip side D-ring. This allows the worker to lean back against the support provided from the direct PRIMARY attachment to the structure to perform various tasks such as changing light bulbs, installing other fall protection equipment, or other maintenance/inspection tasks.



Figure 6-28: Work Position with Three Point Contact Frontal Attachment

NOTE: Workers using a work-positioning lanyard also require a SECONDARY or backup fall arrest system.

Hazards

Hazards with lanyards vary according to the lanyard types, lengths, and use. General lanyard hazards include:

- » Entanglement
 - Moving machinery
 - Tripping
- » Sharp edges
- » Incompatibility
 - Connections
 - Materials
 - Work environment
- » Insufficient fall clearance
- » Excessive length in lanyard allowing:
 - A worker to reach and fall off a working level.
 - The legal limit of the MAF to be exceeded.
 - Insufficient clearance for fall arrest.
- » Tying knots to shorten the length. Knots can reduce the strength of the lanyard up to 50%.

ACTIVITY 3

Move to the classroom training devices and select anchorages for permanent and temporary travel restraint and fall arrest. You will need to justify your choices.

Don a body harnesses following the steps learned in Chapter 4. Connect your harness to an anchor with a fall protection connecting device for travel restraint.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. Match the device listed in the left hand column with the definition provided in the right hand column.

Device	Definition
_____ Pass Through Adaptor	a. Typically used for confined space entry and exit
_____ D-Ring Plate	b. Mounts on I beams, and are adjustable for beam size”. Delete: “and can be mounted in any position
_____ D-Ring Bolt	c. A bolt like device with a D-ring attached to the head for fall protection
_____ Beam Clamps	d. Either bolted or welded onto a structure and provides an attachment point for other connecting components
_____ Removable Davit Arm	e. A web type anchor device with two different size D-rings at each end that passes through each other in order secure to an anchorage.

2. Match the device listed in the left hand column with the definition provided in the right hand column.

Lanyard Type	Definition
_____ Standard Web	a. Are made of nylon or polyester and consist of many small fibres that are wound into 3 main strands laid in a spiral wind.
_____ Rope	b. Are made of nylon, polyester or Kevlar. Vary in length and width and may be adjustable. Durable, abrasion resistant and very strong.
_____ Tie Back	c. Are constructed from heavier strength webbing and come with either standard or heavy duty snap hooks.
_____ Cable	d. Either bolted or welded onto a structure and provides an attachment point for other connecting components. e. Are plastic coated stainless steel or galvanized wire rope and are resistant to burns, chemicals, sunlight damage as well as abrasion and mechanical impact damage.

3. What type lanyard would you use for fall arrest?

- A lanyard that is as short as possible and equipped with a shock/energy absorber.
- A lanyard that is short enough to prevent me from reaching the edge in any direction of travel.
- A lanyard connected to my waist without a shock/energy absorber.
- A lanyard connected to my waist with a shock/energy absorber.

4. What type lanyard would you use for travel restraint?

- a. A lanyard that is as short as possible and equipped with a shock/energy absorber
- b. A lanyard that is short enough to prevent me from reaching the edge in any direction of travel
- c. A lanyard connected to my waist without a shock/energy absorber
- d. A lanyard connected to my waist with a shock/energy absorber

5. What type lanyard would you use for work positioning?

- a. A lanyard that is as short as possible and equipped with a shock/energy absorber
- b. A lanyard that is short enough to prevent me from reaching the edge in any direction of travel
- c. A lanyard connected to my waist without a shock/energy absorber
- d. A lanyard connected to my waist with a shock/energy absorber

6. Knots tied in a lanyard can reduce the lanyard's strength up to_____.

- a. 10%
- b. 20%
- c. 30%
- d. 50%

7. Which of the following statements best describes a Class E4 type shock (energy) absorber?

- a. Shock/energy absorbers are designed to limit impact force to 22.2 kN(5000 lbs)
- b. Shock/energy absorbers are devices that protect the worker by absorbing energy involved in arresting a falling worker by limiting impact force to no greater than 6kN (1350 lbs).
- c. Shock/energy absorbers used for fall protection must close and lock automatically when arresting a fall
- d. Used to eliminate injuries during the arrest of a fall

8. Which of the following statements best describes compatible components?

- a. Components that can be safely joined to each other with no risk of the size or shape of the connecting links being responsible for damaging the components during impact loading from a fall
- b. Components that are either forged steel or aluminum
- c. Components that are intended for two person loads
- d. Components that are likely to lead to failure of the device

9. Match the component listed in the left hand column with the definition provided in right hand column.

Component

Definition

_____ Carabiner

a. Automatically locking hooks that provide strength and security of attachment and minimize the risk of failure and roll out when connected to other compatible hardware.

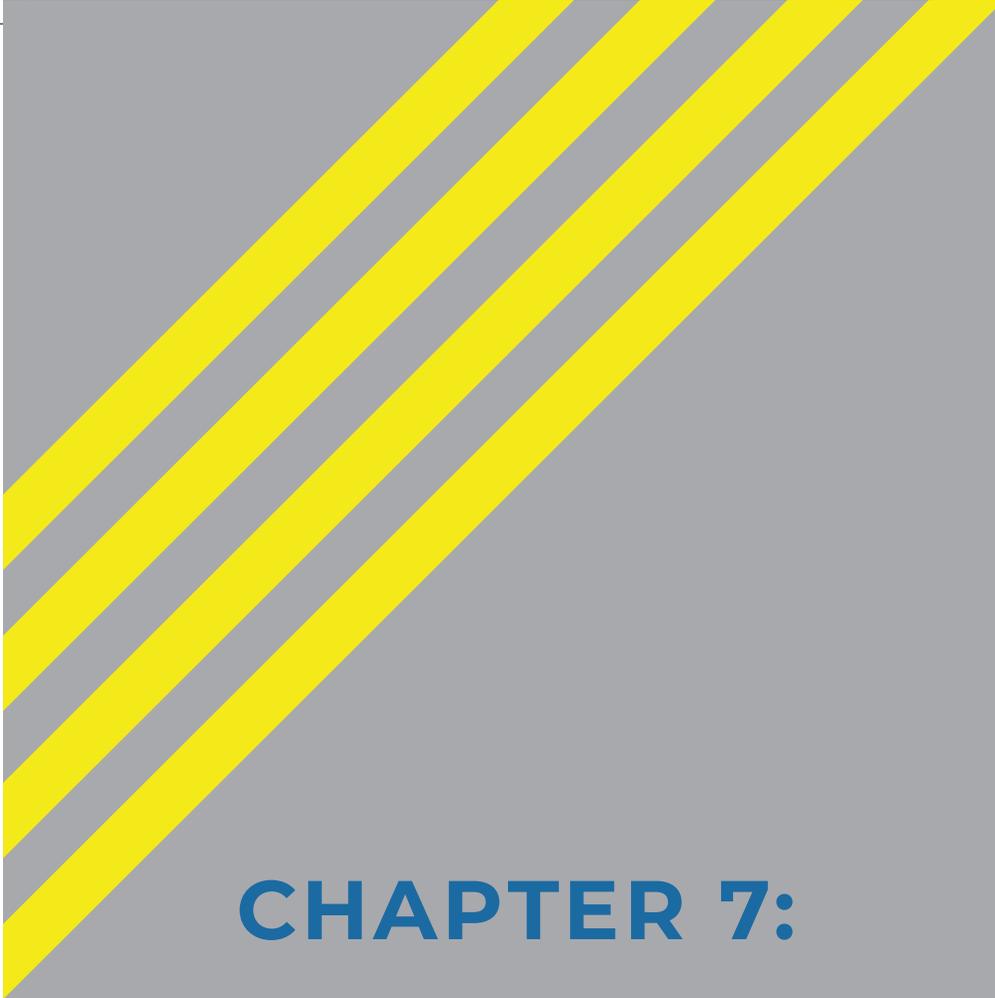
_____ Snap Hook

b. Automatically locking devices that may take the place of snap hooks on some fall protection equipment and are very often used in rescue operations.

_____ Shock (Energy) Absorber

c. Are designed for 20 kN (4500lb) minimum breaking strength when a load is applied in any direction.

d. Devices that protect the worker by absorbing energy from a fall.



CHAPTER 7:

Double-leg Lanyards and Work Positioning



OUTCOME

Demonstrate the safe and proper use of a double-leg lanyard



OBJECTIVES

1. Demonstrate the use of a double-leg lanyard while climbing.
2. Demonstrate work position from a ladder at height.
3. Complete a Fall Protection Plan.

DOUBLE-LEG LANYARDS

Double-leg lanyards are a type of web lanyard designed to provide 100% fall protection for workers while they are exposed to the risk of a fall. Double-leg lanyards use a 'Y' shape design. The twin legs allow one leg to be attached to an anchorage or anchor connector before release of the other leg. This practice ensures the worker is always connected while moving up and down or side to side along the structure. These devices are excellent for the installation or removal of other fall protection systems and for rescue.

These models either have both legs attached to one energy absorber or each leg has its own energy absorber.



Figure 7-1: Double-leg Lanyards with Energy Absorbers

The legs are terminated with snap hooks of various sizes, heavy-duty snap hooks or carabiners. The variety of terminations allow attachment to anchor connectors and anchorages of different sizes. Lanyards terminated with standard snap hooks allow attachment to anchor connectors or horizontal lifelines. The larger snap hooks, often referred to as scaffold hooks, attach directly onto anchorages with the required strength, including ladder rungs, round tubing or square tubing. In this way workers can connect directly to an anchorage eliminating the need to place anchor connectors.



Figure 7-2: Double-leg Energy Absorbing Lanyard with Scaffold Hooks

Webbing is either heavy duty or standard duty. Heavy-duty webbing is used with tie back lanyards with heavy-duty snap hooks or sliding adjustable D-rings and standard hooks.

Selection

Selection of the appropriate connecting devices begins with the Fall Protection Plan or direction from the supervisor, followed by identifying and selecting the specified device(s) from storage.

Selection criteria require compatible connectors that allow one worker to connect to an appropriate anchorage on the structure. The criteria to consider include:

- » Material, size, shape and strength compatibility.
- » Energy absorber requirement in the fall protection system.
- » Manufacturer's maximum weight and free fall limits.
- » Manufacturer's specification and requirement of connector type (auto locking snap hook or carabiner).
- » Possible hazards – sharp edges, heat, electricity, etc.

Attachment Method

Double-leg lanyards with an integral energy absorber are always attached directly to the dorsal D-ring of the harness whether or not the harness has an integral energy absorber. Another option would be to select a lanyard without a shock/energy absorber and attach it to the D-ring of the harness' shock energy absorber. If this option is chosen the additional distance added to the connection must be taken into account for clearance requirements and free fall maximums of the energy absorber.

Double-leg lanyards will be attached in the same fashion as single lanyards according to the type of lanyard. The sequence in which they are attached ensures a worker remains safely attached to one anchor point while connecting to another anchor point.

Double-leg lanyards with scaffold hook terminations are often referred to as "first climb" devices or systems. They are used to climb the derrick ladder to retrieve the Self Retracting Lifeline (SRL) or rescue someone suspended on the ladder SRL.

USING A DOUBLE-LEG LANYARD FOR CLIMBING

When climbing a ladder do not take any unnecessary risks. Climb the ladder using solid footing and maintain a continuous 3-point attachment. In order to minimize your free fall, climb or descend a ladder always connected to a ladder rung that is no lower than face height.

Place and release hooks prior to moving up or down a ladder.. Although it is important to be efficient, working quickly may lead to an accident.

When using a double-leg lanyard to climb, select a lanyard with large snap hooks. Follow the steps listed below:

Ascending

- » Attach a double-leg lanyard with large snap hooks to the dorsal D-ring of the harness and have it buddy checked.
- » Pre-use inspect the ladder (rungs).
- » Attach one hook of the lanyard on a rung at face height.
- » Attach the other hook 2 rungs higher.
- » Climb up to face height with the top hook, and assume a 3-point attachment with 1 hand and 2 feet. Remove the lower hook and re-position it 2 rungs higher.
- » Continue using this procedure to climb to working level.



Figure 7-3: Climbing with a Double-leg Lanyard

POSITIONING FOR WORK ON A LADDER

- » Place the bottom hook as high as possible on a different rung than the face high hook to minimize free fall.
- » Install the work positioning lanyard.
 - Remove the work positioning lanyard from storage on your hip.
 - With one end connected to work positioning ring, wrap the lanyard around rails and rungs.
 - Connect the end to the opposite work positioning ring on your hip.
 - Adjust to evenly divide support between your feet and the work positioning lanyard.



Figure 7-4: Work Positioning Lanyard

Descending

- » Descend by placing the highest hook 2 rungs below the lower hook and descend to face height with the lower hook.

- » Assume a 3-point attachment with 1 hand and 2 feet. Remove the upper hook and re-position it 2 rungs below the lower hook.
- » Once again, descend to face height with the lower hook, and assume a 3-point attachment with 1 hand and 2 feet. Remove the upper hook and re-position it 2 rungs below the lower hook.
- » Using this procedure descend to the ground or floor level.

Hazards

Hazards are similar for all fall protection lanyards and connectors.

- » Excessive free fall
- » Insufficient fall clearance
 - Near levels or obstacles
- » Entanglement
 - Moving machinery, tripping, under shoulder during fall
- » Incompatible connections
- » Having an idle leg attached back to your harness

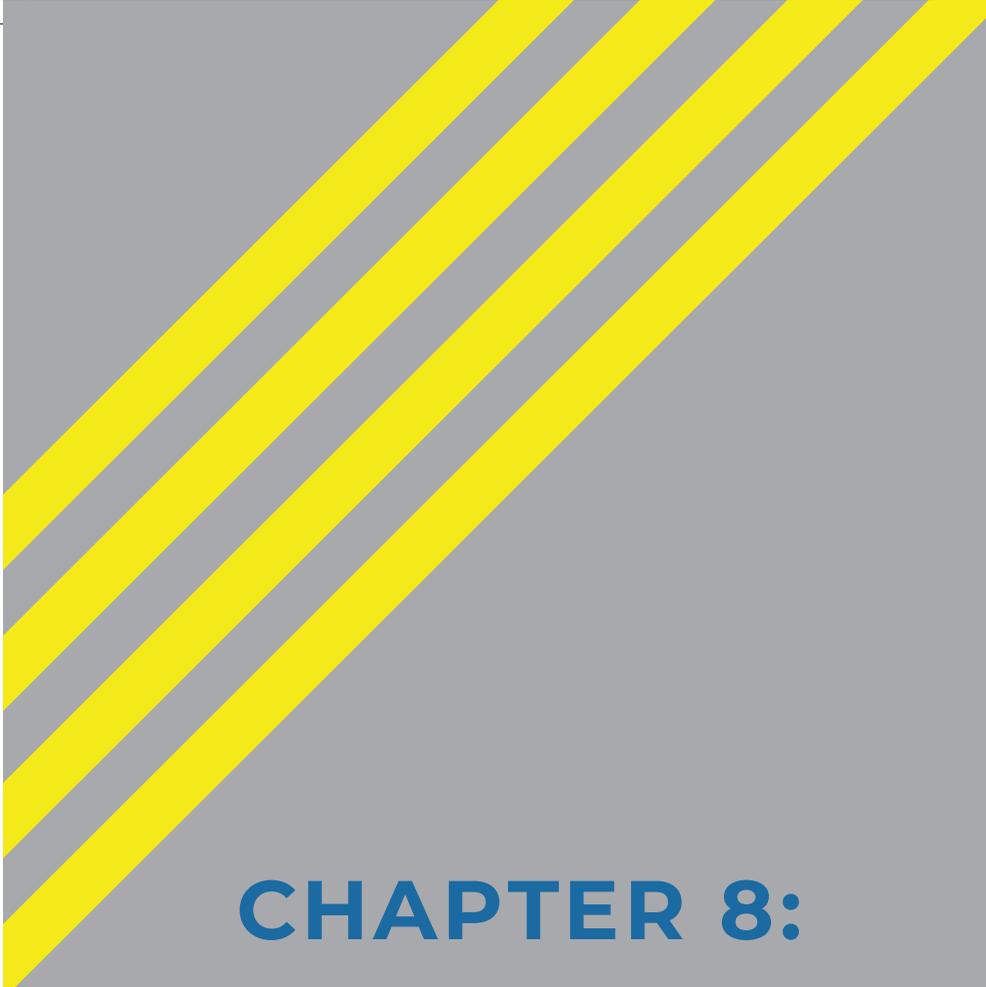
Double-leg Lanyards as a First Climb System

The length of the lanyard legs and continual moving of anchorage attachments can lead to free fall and fall clearance issues. It is very easy for a worker to misplace or move above a hook and accidentally fall. If there is a fall arrest, the worker will be exposed to significantly more force than anticipated and may be severely injured. If the fall occurs early in the climb or near an obstacle there will be insufficient clearance for the added free fall. The fall will likely be fatal.

ACTIVITY

- » Complete and review the Fall Protection Plan on the next page.
- » Climb and descend a ladder using a double leg lanyard with scaffold hooks.
 1. Pre-use inspect the fall protection system components.
 2. Install the work positioning lanyard for hands free work.
 3. Use the techniques to minimize free fall while working hands free.

PLAN # 1 Company Name: Energy Safety Canada	Exercise: Ladder climbing double-leg lanyard and work positioning
Work Site Address or Location: 1803 – 11 Street, Nisku, Alberta (east end of Nisku on south side of main road) Location on site or directions: Climbing (hands on training) device located in the shop area of the main building, see Instructor or office staff for directions.	
Describe work to be done: Climb ladder on training device and position as required to work safely with hands free at height Fall hazards to be protected against: » Incompatible and/or false connections » Falling while climbing and descending the ladder » Falling while working hands free from the ladder » Freefall greater than 1.8 m (6 ft)	
Fall protection system(s) used: first climb system, work positioning system (redundant SRL while learning technique) Anchor/Anchorage location(s): ladder rungs Full body harness: a CSA approved class AP (minimum) harness with positioning rings at each hip or each side at waist level, ensuring the formal inspections certify the harness for current use and it is the right size Connecting devices: 6 foot or shorter shock absorbing double leg lanyard with ladder snap hooks, 6 foot work positioning lanyard (web or rope) with standard snap hooks. Redundant SRL while learning technique of use.	
Rescue plan: Have 1 student report the situation to the front office staff to activate internal emergency response and 911 for response from Nisku Fire Dept and Leduc EMS. Muster all other students to the classroom away from the climbing device. Have any other students at height immediately make their way safely to ground level and to the muster location. Instructor to use alternate access and fall protection system to reach the patient, then install rescue and fall protection systems for the patient (Rollgliss, type 3 SRL or pre-rigged Spencer system). If possible use SRL for the casualty's fall protection. If the SRL is not useable during rescue, install and attend a belay system with assistance from competent site personnel who must be on standby status during the climbing exercise.	
Worker(s) instruction required: * Purpose of climbing * Hazards present * Fall protection system(s) and PPE required * Method of pre-use inspecting all gear * Method of attachment to connect the worker to the anchorage * Method of re-positioning the attachments while climbing * Method of work positioning on the ladder * Purpose of redundant attachment to SRL system while learning technique	Clearance Calculations $FFD = L + B - C$ $TFD = FFD + DS + SAE$ $CR = TFD + B + SM$ Climb until face high 2 rungs from top of ladder. Last reposition of ladder snap hook is on top ladder rung 17' above floor. This will place anchor point 2' above dorsal D ring and 7' above feet, which is the working level 10' above floor. $FFD = 6 + 5 - 7 = 4$ $TFD = 4 + 1 + 4 = 9$ $CR = 9 + 5 + 2 = 16$ 16' Clearance required from anchor, 17' available. Final reposition of ladder snap hook must be a minimum of 1' above dorsal D ring at this working height
Have all workers been trained in the safe use of the fall protection equipment? Yes ____ No ____	
Have all affected workers been made aware of this plan? Yes ____ No ____	
Instructor's signature: _____ Date: _____	



CHAPTER 8:

Cable Ladder Climbing Systems



OUTCOME

Demonstrate the safe and proper use of cable ladder climbing systems from pre-use inspection to climbing to height



OBJECTIVES

1. Describe cable ladder climbing systems (both permanent and temporary).
2. Describe fall arresters and summarize the guidelines for their selection, pre-use inspection, function testing and methods of attachment.
3. Summarize the CSA requirements for cable ladder climbing systems.
4. Summarize the industry guidelines for using vertical systems.
5. List the standards used for labelling/tagging and inspecting fall protection equipment.

CABLE LADDER SYSTEM

These systems are composed of a vertical lifeline made of wire rope or rigid rail. The lifeline has a sliding sleeve (more commonly known as “cable grabs” or “fall arresters”) and the worker attaches their full body harness to it. In the event of a fall, the connection on the sleeve grabs the lifeline and arrests the fall.

Permanent rigid rail and wire rope systems are permanently attached to the ladder. Temporary wire rope systems are installed prior to performing a task and removed after the task is completed. Rigid rail systems use a flat bar or tubing in place of the cable. Ladder safety systems typically run up the centre of the ladder.

Wire rope or cable systems use an 8–10 mm (5/16–3/8"). lifeline that is anchored as per the manufacturer's instructions to an employer designated anchorage at the top of the ladder. The cable must have an energy absorber at the attached anchorage using the manufacturer's recommended connector. The harness connection cannot have a lanyard or energy absorber attached to it and the harness carabiner cannot be a length of more than 77/8 inches (0.2 metres). The lower end of the lifeline must also be weighted or anchored as required in the manufacturer's instructions.

Due to the very short length of the connector and the stopping distance, the clearance requirement is less than other ladder climbing systems. (See Chapter 1)

Permanent Ladder Safety Systems

Ladder safety systems may be found permanently attached to the rig ladders to provide fall protection while climbing. These may also be found on 400 BBL tanks or centrifuges.

A permanent system is attached at the top and bottom with brackets and a tensioning device such as a turnbuckle. They may be rated for more than one user at a time. These details will be found in the manufacturer's specifications. It is important for workers to know the system capabilities prior to use.



Figure 8-1: Permanent Ladder Safety System

Temporary Ladder Safety Systems

A temporary ladder safety system is attached prior to performing a task and removed once the task is complete. These systems attach to an anchor connector or a permanent D-ring attached to an appropriate anchor point. Rig workers must follow the manufacturer's instructions as well as consult with the Fall Protection Plan when installing and using temporary ladder safety systems. Temporary cable ladder systems are used by only one worker at a time.

Whether temporary or permanent, these are engineered systems and workers should not be changing or modifying these products. Only use components provided by the manufacturer.



Figure 8-2: Temporary Ladder Safety System

FALL ARRESTERS – STERNAL

Arresters that are used with cable and rigid rail systems are attached to Class “L” worker harness D-rings. These rings must have a connecting linkage of 0.2 metres (7 7/8 inches) or less, which allows for just one manufacturer specified carabiner or other specified component between the worker’s harness and the arrester. Lifeline size, connector type and length are all matched to the arrester. You cannot use an arrester designed for an 8 mm cable on a 10 mm cable.



Figure 8-3: Sternal Fall Arrester

Fall arrester orientation must be marked with an arrow indicating the up position. Manufacturers include a gravity-sensing device that will prevent attachment of the device to a lifeline when in the upside down position. The user must install the arrester in the proper orientation on the lifeline and ensure it works as intended. To install or remove the arrester you will have to activate the devices safety and then open the arrester. It could be as easy as removing the connector or unlatching the safety to open a cover. It is important to understand how the arrester functions prior to use.

Installation and Function Test

In addition to your pre-use inspection of anchorage, anchor connector, lifeline and harness you will need to install and test the function of the arrester prior to connection. Some providers of these systems will have the arresters pre-attached. Even if they are already attached, a prior function test is still required. Be sure to follow manufacturer’s procedure for installation.

Function Test

- » Slide arrester up and down with connector.
 - Does it move freely?
- » Slide arrester up and quickly lower lever arm with connector.
 - Does it stop immediately?
- » If the system passes the pre-use inspection and function test, attach to the Class “L” D-ring on your harness and begin your climb.

Method of Use

Arresters travel on the cable when the arrester arm pivots up. The arrester’s weight maintains this position as a worker climbs. Falling causes the lever arm to pivot down grabbing the cable. Any climbing motion while descending that moves the arrester lever arm down, for example leaning out from the ladder, will cause an inadvertent activation. It is important that the worker immediately stops, takes a step up to re-orientate the lever arm, and then continues climbing down. Do not attempt to reset the arrester with your hand. If you slip while holding the arrester lever arm you will be in danger of holding the arrester in the open position and it will not activate.

These systems are only used for fall arrest. If work positioning is required it must be done with an additional work-positioning lanyard. Loading the arrester to grab cable to maintain your position will kink the cable.

Hazards

Ladder safety system hazards include:

- » Incorrect connector
 - Connection incompatibility
 - Arrester, connector and lifeline are not matched.
 - Connector length is too long causing an excessive free fall.
- » Swing fall
 - This is a vertical system, and moving horizontally will create a swing fall.
- » Panic grip
 - If a worker holds an arrester open and then falls, the falling worker is more likely to hold on than let go.
- » Tripping on a cable or rail while climbing
- » Using the ladder safety system for work positioning
- » Installing an arrester up side down.

CSA REQUIREMENTS FOR LADDER CLIMBING SYSTEMS

For more on CSA Requirements for Cable Ladder Climbing Systems, please refer to Chapter 9: Vertical Rope Lifelines, “CSA Requirements”.

Guidelines for Use

Ladder climbing systems use matched components. Increasing connector length by using a lanyard will create excessive forces the system is not designed to handle. Fall forces during an arrest will seriously injure a worker. Longer connectors than the system is designed for will increase the clearance needed and the worker risks hitting the ground or lower level. Longer connectors also give the worker the ability to move away from the lifeline but this can lead to serious swing fall issues. Read the manufacturer’s specification for the system and use the specified components for the system.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. Which system may be rated for use by more than one worker?
 - a. Temporary Ladder Safety System
 - b. Permanent Ladder Safety System
2. When must a fall arrester be function tested?
 - a. When purchased.
 - b. Prior to use.
 - c. Immediately after a climb.
 - d. Before it is cleaned and stored.
3. True or False: Fall arresters can be used alone for work positioning.
True _____ False _____
4. What are two possible consequences of using longer connectors than the system is designed for?

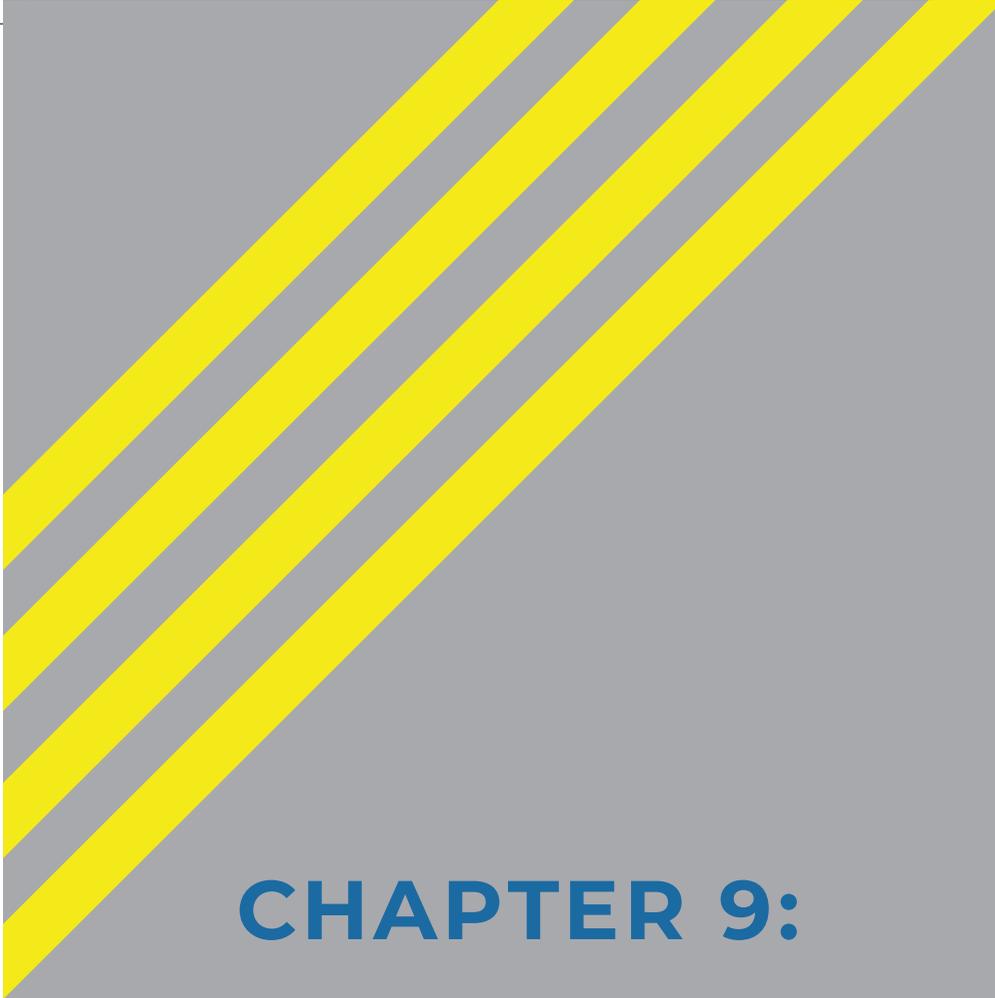
- 1) _____

- 2) _____

ACTIVITY

- » Complete and review the Fall Protection Plan on the next page.
- » Climb and descend a permanent and temporary cable ladder climbing system.
 1. Pre-use inspect the fall protection system components.
 2. Perform a function test of the arrester.
 3. Show the technique to release an advertent activation of the cable arrester.

PLAN # 2 Company Name: Energy Safety Canada	Exercise: Ladder climbing using cable ladder system
Work Site Address or Location: 1803 – 11 Street, Nisku, Alberta (east end of Nisku on south side of main road) Location on site or directions: Climbing (hands on training) device located in the shop area of the main building, see Instructor or office staff for directions.	
Describe work to be done: Climb a ladder using a cable ladder system as fall protection during ascent and descent Fall hazards to be protected against: » Falling while climbing, installing and removing the systems – incompatible or false connection » Excessive freefall due to wrong connecting means » Improper attachment of arrester to lifeline causing malfunction	
Fall protection system(s) used: SRL or first climb system during installation and removal, cable ladder system during exercise Anchor/Anchorage location(s): Located directly above and in the centre of the ladders. Full body harness: a CSA approved class AL (minimum) harness ensuring the formal inspections certify the harness for current use and it is the right size Connecting devices: Cable lifeline secured to anchorage with system manufacturer specified connecting link (carabiner) attaching front harness D-ring to fall arrester secured to cable ladder system (lifeline to be tensioned to ensure arrester travels as designed).	
Rescue plan: Have 1 student report the situation to the front office staff to activate internal emergency response and 911 for response from Nisku Fire Dept. and Leduc EMS. Muster all other students to the classroom away from the climbing device. Have any other students at height immediately make their way safely to ground level and to the muster location. Instructor to use alternate access and fall protection system to reach the patient, then install rescue and fall protection systems for the patient (Rollgliss, type 3 SRL or pre-rigged Spencer system). If possible use SRL for the casualty's fall protection. If the SRL is not useable during rescue, install and attend a belay system with assistance from competent site personnel who must be on standby status during the climbing exercise.	
Worker(s) instruction required: * Purpose of climbing * Hazards present * Fall protection system(s) and PPE required * Method of pre-use inspecting all gear * Method of attachment to connect the lifeline to the anchorage * Method of attaching the arrester and tensioning the lifeline * Method of attaching the worker to the arrester * Purpose of use and release and inadvertent activation of arrester on lifeline	Clearance Calculations $FFD = L + B - C$ $TFD = FFD + DS + SAE$ $CR = TFD + B + SM$ Climb until face high with top ladder rung. This will place sternal D ring / anchor point at 16' above floor. Sternal D ring will be 4' above feet. Working level 12'. $FFD = *(.5 + .5) = 1 + 4 - 4 = 1$ $TFD = 1 + 1 + 0 = 2$ $CR = 2 + 4 + 2 = 8$ 8' Clearance required from anchor, 16' available. *Based on connector length (carabiner) of .5' and lock off distance of cable grab .5' (150 mm).
Have all workers been trained in the safe use of the fall protection equipment? Yes ____ No ____	
Have all affected workers been made aware of this plan? Yes ____ No ____	
Instructor's signature: _____ Date: _____	



CHAPTER 9:

Vertical Rope Lifelines (VRLs)



OUTCOME

Demonstrate the safe and proper use of vertical rope lifelines from pre-use inspection to climbing to height



OBJECTIVES

1. Describe vertical rope lifeline systems.
2. List the uses and risks of a rope lifeline system, along with the components required for a complete vertical rope lifeline system.
3. Describe fall arresters and summarize the guidelines for their selection, pre-use inspection, function testing and methods of attachment.
4. Summarize the industry guidelines for using vertical systems.

VERTICAL LIFELINE SYSTEMS

Vertical lifeline systems provide secondary fall protection to workers while they climb and work at various levels on the derrick or under the substructure. Once connected to the lifeline, workers can move without the need to disconnect and reconnect as they climb. This allows vertical work along the entire length of the lifeline.

With vertical lifeline systems, anchorage requirements are located above the worker. Information on anchorage requirements is found in the manufacturer's instructions. The user must work within the manufacturer's requirements for each system in order to obtain adequate fall protection and minimize the risk of swing and free fall.

Vertical rope lifelines are temporary systems that are quickly rigged up and out to perform a task or a rescue. Vertical rope lifelines provide continuous fall arrest protection to workers when a shoulder height anchorage is not available at their work location, but require greater clearance distances.

A vertical rope lifeline system includes:

- » Appropriate anchorage
- » Lifeline of required length – reaches to within 1.2 metres (4 ft) of a safe level
- » Termination with integral snap hook or carabiner
- » Tension weight
- » Fall arrester
- » Energy absorbing lanyard – maximum length depends on the manufacturer
- » Approved full body harness

Vertical rope lifelines are made of synthetic fibres. Lifelines may be equipped with an attachment at one or both ends depending on the design.

Rope Lifelines

Applications

Rope lifelines may be used in a number of applications, including:

- » Vertical and sloped fall arrest
 - Free fall is allowed in the system.
- » Travel restraint
 - There can be no free fall in the system.

Anchorage

Anchorage strength must meet minimum legislative requirements, as well as the fall arrest or travel restraint requirements within each jurisdiction (see Chapter 2). Once the anchorage has the correct strength requirements it also needs to have the correct location for the application.

The best location for travel restraint would be equal distance from all edges of the working level. In this way only minimal arrester adjustments on the lifeline are needed. However, arrester adjustability allows more flexibility in anchorage placement giving it an advantage over non-adjustable systems.

Anchorage location for free fall should be located directly above the work location to prevent the danger of swing fall.

Tension

As arresters travel up the lifeline some friction is created. If the weight of the lifeline below the arrester's attachment is insufficient, the lifeline will

bend. As a result, the arrester will not move freely and “grab” the lifeline. Securing or tensioning the lifeline using some form of weight prevents this from happening. The lifeline is tensioned with the weight provided or by tying it off at a safe level. Manufacturers usually supply a tensioning-weight with the system. When installing any tensioning-weight make sure it is suspended.

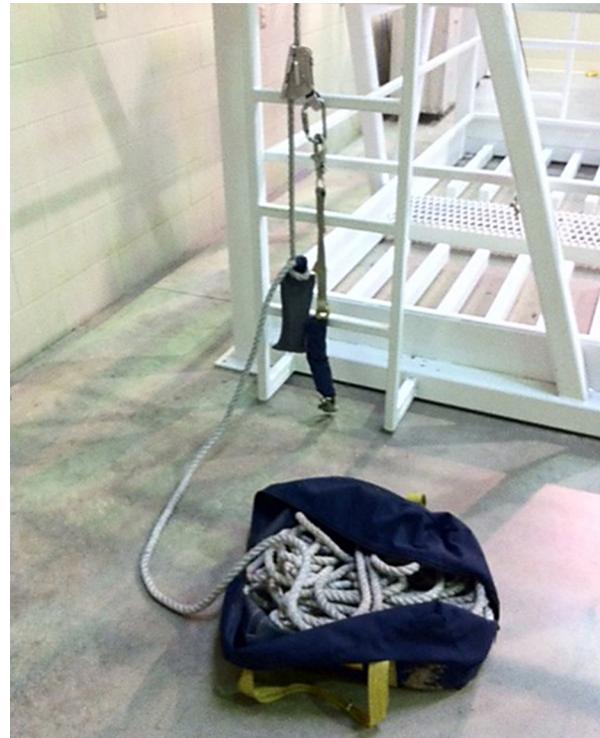


Figure 9-1: Tension Created by Weight

Fall Arresters (Rope Grabs)

In addition to anchors, full body harnesses, energy absorbers, lanyards and other connecting devices, vertical rope lifelines incorporate fall arresters. Fall arresters are devices that attach the full body harness to the lifeline. The arresters come in various styles allowing them to move freely along the lifeline automatically. Fall arresters should not be used for work positioning.

Fall arresters are often called “rope grabs.” The worker attaches their harness to a lever arm. In the event of a fall, movement of the lever arm causes the device to grab the rope. The device then grabs the lifeline and it slides down the lifeline until the fall is arrested. Slippage depends on the force generated in free fall. Certification agencies set that distance at a maximum. It is important that the worker

understands the maximum slippage for their arrester. Clearance requirements will change depending on type and manufacturer. Each fall arrester is designed to provide fall protection for a maximum user weight, including clothes and tools. Only single worker use is allowed for each fall arrester.

Fall arresters must not come off the lifeline unless the user deliberately removes it. Fall arresters are supplied with or without the lanyards or other components that connect them to the worker.



Figure 9-2a: Fall Arresters for Rope Grabs



Figure 9-2b: Fall Arresters for Rope Grabs

A fall arrester and an energy absorber are connected to the dorsal D-ring of a full body harness. There are 2 types of arresters: panic proof and non-panic proof.

Identification of non-panic proof (integral lanyard)

Non-panic proof arresters must have a 0.6 metres (2 ft) or shorter energy absorbing lanyard. Any non-panic proof arresters without an integral lanyard must be removed from service and destroyed or returned to the manufacturer to be fitted with the correct length integral connector. By making the lanyard integral it is unlikely it could be removed and replaced with a longer one.



Figure 9-3: Automatic Non-Panic Proof Fall Arrester

Panic Proof

In the event the worker did grab the device and hold it open during a fall, a panic proof arrester would still function normally and arrest the fall.



Figure 9-4: Automatic Panic Proof Fall Arrester

Installation and Function Test

In fall arrest applications, rope lifelines may extend vertically from as high as the crown down to the floor level. They must reach to within 4 feet or 1.2 metres of a safe level from which a worker can connect to the system.

Pre-Use inspection

For information regarding pre-use inspection of vertical rope lifelines, please refer to Chapter 4: Inspection and Care of Fall Protection Equipment.

Method of Use

The following is a step-by-step procedure for the installation of a vertical rope lifeline on a ladder.

- » Consult the Fall Protection Plan for the task including:
 - Anchorage location.
 - First climb fall protection system components (See Chapter 7).
 - Rescue plan.
- » Pre-use inspect:
 - The vertical rope lifeline.
 - Fall system components and work positioning lanyard.
- » Use the double leg lanyard with scaffold hooks to access the identified anchorage location for a vertical lifeline.
- » Attach the lifeline, appropriate anchor connector and work positioning lanyard to the side D-rings on your harness.
 - Alternatively, take a tagline to your work location.
 - Lower the tagline down and connect the anchor connector and lifeline to the tagline.
- » Use work positioning while installing to the anchor connector and the lifeline to the appropriate anchorage.
 - Install the lifeline according to the manufacturer's instructions.

- » Protect the lifeline from contact or abrasion damage by either suspending the lifeline so there is no contact with any abrasive surface, or by using edge protectors and/or padding on the abrasive surface itself.
- » Descend to the ground or floor.
- » Properly anchor or tension the lower end of the lifeline.

Function and Panic Proof Test

The following is a step-by-step procedure for a panic proof arrester.

- » Properly attach the matched fall arrester while at ground level.
 - Ensure the lifeline diameter and arrester match.
 - Follow the manufacturer's instructions for installation.
- » Hold the installed arrester by the lever arm.
 - Disengage the arrester by moving the arrester up.
 - Check to see if the arrester travels freely up and down the lifeline.
 - Check to see if the arrester grabs the lifeline.
 - Slide the arrester up and move the lever arm down.
- » Check for panic activation.
 - Hold the arrester body in hand keeping the lever arm up.
 - Move the arrester up and down so the arrester travels freely.
 - Quickly move the arrester down.
 - The arrester should grab the rope.

If the arrester fails any of the above steps remove it from service, and notify your supervisor for a formal inspection. If the arrester passes pre-use inspection, attach the manufacturer specified lanyard to the dorsal D-ring of the harness. Ensure there is a compatible secure connection.



Figure 9-5: Using a Vertical Rope Lifeline

Using a Temporary Vertical Rope Lifeline

Every system will specify the maximum length and type of connector required for the system. The maximum free fall for the system is also identified. Workers can use climbing and descending techniques that minimize free fall and keep clearance requirements at a minimum. This is especially important at the beginning of the climb or when approaching obstacles in your potential fall path. The closer you are to these levels the less clearance is available to arrest your fall. Once you have determined the lifeline and arrester are safe to use, follow this procedure to minimize free fall and reduce clearance requirements.

- » Position the arrester as high as possible prior to climbing.
 - Grab the arrester or lanyard at the arrester and slide the arrester up the lifeline.
 - The arrester will engage on the lifeline.
 - Less slack in the lanyard equals less free fall potential.

- » Climb until the arrester reaches head level.
 - Maintain good primary attachment with your feet and hands to avoid the hazard of a slip or trip on the ladder.
- » Re-position the arrester as high as possible.
- » Repeat the above procedure until sufficient clearance is created between you and any obstacle or working level.
- » If climbing farther and sufficient clearance exists, drape the lanyard over the top of the arm and the arrester will travel automatically.
- » Climb to the work location level.
- » Position the arrester as high as possible without loading the arrester.
- » Install the work positioning lanyard from storage on to your hip.

Descent from Work Positioning

- » Assume a 3-point stance and disconnect the work position lanyard and return it to storage.
- » To prepare for descent, maintaining a 3-point stance with your feet and one hand.
- » Lift up the lever arm to unlock the device allowing it travel freely.
 - You can minimize free fall by draping the lanyard over the top of your arm and the arrester will travel automatically.
 - Alternately, you can allow the arrester to transfer freely as designed.
- » Disconnect from the lifeline and remove all components and store them away.

Hazards

Hazards involved in using vertical rope lifelines include:

- » Knots in the lifeline's working length:
 - Can reduce the strength of the lifeline up to 50%.
 - Can prevent the arrester from travelling.
- » Incompatible connection to anchorage:
 - Forced hook rollout.
- » Improperly tensioned lifeline:
 - The arrester grabs the lifeline as the worker climbs and the chance of a free fall increases.
- » Swing fall:
 - Moving horizontally from anchorage, the worker may be injured and the lifeline may be damaged.

- » Sharp edges and abrasions:
 - Damages or cuts to the lifeline and/or anchor connector.
- » Lifeline stretch increases clearance requirements:
 - Amount of stretch depends on the:
 - Rope diameter.
 - Wet or dry conditions.
 - Length of lifeline between the anchor connector and the arrester.
- » Excessive free fall causing higher arrest forces:
 - The lanyard is too long for the system.
- » Lanyard connection with arrester is incompatible:
 - There is a forced hook rollout.
 - The energy absorber connected to the arrester interferes with deployment.
 - There is phantom hooking with the worker's dorsal D-ring.
- » Insufficient clearance
- » Falling while holding a non-panic proof fall arrester open.
- » Incorrect arrester installation:
 - Absent or incorrect function test fails to detect faulty arrester.
 - The arrester is installed upside down.
- » Entangled with:
 - Moving machinery.
 - Worker's legs, arms and/or work positioning lanyard.
- » Falling with the lanyard tucked under the worker's arm leading to an injury.
- » Improper use of lifelines:
 - Vertical rope lifelines are used as horizontal lifelines.

Care, Maintenance and Storage

For information regarding care, maintenance and storage, as well as removal from service criteria, please refer to Chapter 4: Inspection and Care of Fall Protection Equipment.

CSA REQUIREMENTS

All fall arresters, vertical lifelines and rails are matched components and, for certification purposes, are dealt with as a group. This includes synthetic rope and sloped applications like roofing. CSA requirements for vertical lifelines that are used in a vertical or sloped application include:

- » A tensile strength of at least 27 kN (6070 lbs).
- » May be cable, rope or webbing.
- » The end of the lifeline must have a thimble-eye forming the point of attachment.
- » The termination (knot or splice or compression ferrules or stitching) must ensure they do not compromise lifeline strength by maintaining 22 kN (5000 lbs) of minimum breaking strength (MBS).
- » The lifeline itself must be free of any knots or splices except at the terminations.
- » Rope stretch is allowed – up to 22% (when dry) under a load of 8 kN (1800 lbs) – 15 % at 4kN (900 lbs).
- » The stretch of the lifeline must be considered when determining clearance. This is required to prevent contacting any obstructions or the level below.
- » Must be attached to an appropriate anchorage (as per legislative and manufacturer requirements).
- » Must be protected from sharp edges, abrasion, heat and chemicals that may compromise their integrity.

Guidelines for Use

Arresters and vertical rope lifelines are designed as matched systems. Workers must read and understand the manufacturer's instructions prior to use. Only a manufacturer's specified equipment use and components are allowed. For example, using an arrester designed for a 16 mm (5/8") rope on a smaller diameter rope will increase arrest distances. Using this arrester on a large diameter lifeline will inhibit its movement as it travels.

These are temporary systems used for both fall arrest and travel restraint. For travel restraint it is important for the worker to understand where the anchorage is located and orientate the arrester accordingly. The worker must ensure the length of connection does not bring the worker over an edge no matter where they travel.

Workers should employ good climbing techniques that limit free fall and minimize clearance requirements. This is especially important near the ground, near other working levels, and close to any objects in a worker's potential fall path.

Clearance requirements must take into account the following:

- » Lifeline stretch.
- » Anchorage height.
- » Energy absorber deployment length.
- » Dorsal D-ring height from worker's feet.
- » Harness stretch and D-ring movement.
- » Arrester engagement and arrest distance, including a safety margin of at least 1 metre (3 ft).

When determining the required length of lifeline, the ability to safely connect and disconnect to the system must be taken into account. Lifelines should reach within 1.2 metres (4 ft) of a safe level so workers can access the lifeline without the risk of a fall.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. **Which of the following statements best describes a vertical lifeline system?**
 - a. Vertical lifelines can only be used for fall protection and not fall rescue situations.
 - b. Vertical lifelines require an anchorage immediately above the worker.
 - c. Vertical lifelines do not require an approved anchorage.
 - d. Vertical lifelines provide primary fall protection to workers as they climb.
2. **What are vertical lifelines primarily used for?**
 - a. Travel restraint and work positioning
 - b. Work positioning and fall arrest
 - c. Fall arrest
 - d. Only for travel restraint
3. **What would likely happen if you were to use an arrester designed for an 18 mm rope on a smaller diameter rope?**
 - a. There would be an increase in arrest distance.
 - b. The movement of the arrester would be inhibited as it travels.
 - c. There would be a decrease in arrest distance.
 - d. The movement of the arrester would accelerate as it travels.
4. **How far should a lifeline reach so a worker can access it without risk of a fall?**
 - a. Within at least 2 metres of a safe level.
 - b. Within at least 1.2 metres of a safe level.
 - c. Within arm's length of a safe level.
 - d. Within jumping distance of a safe level.

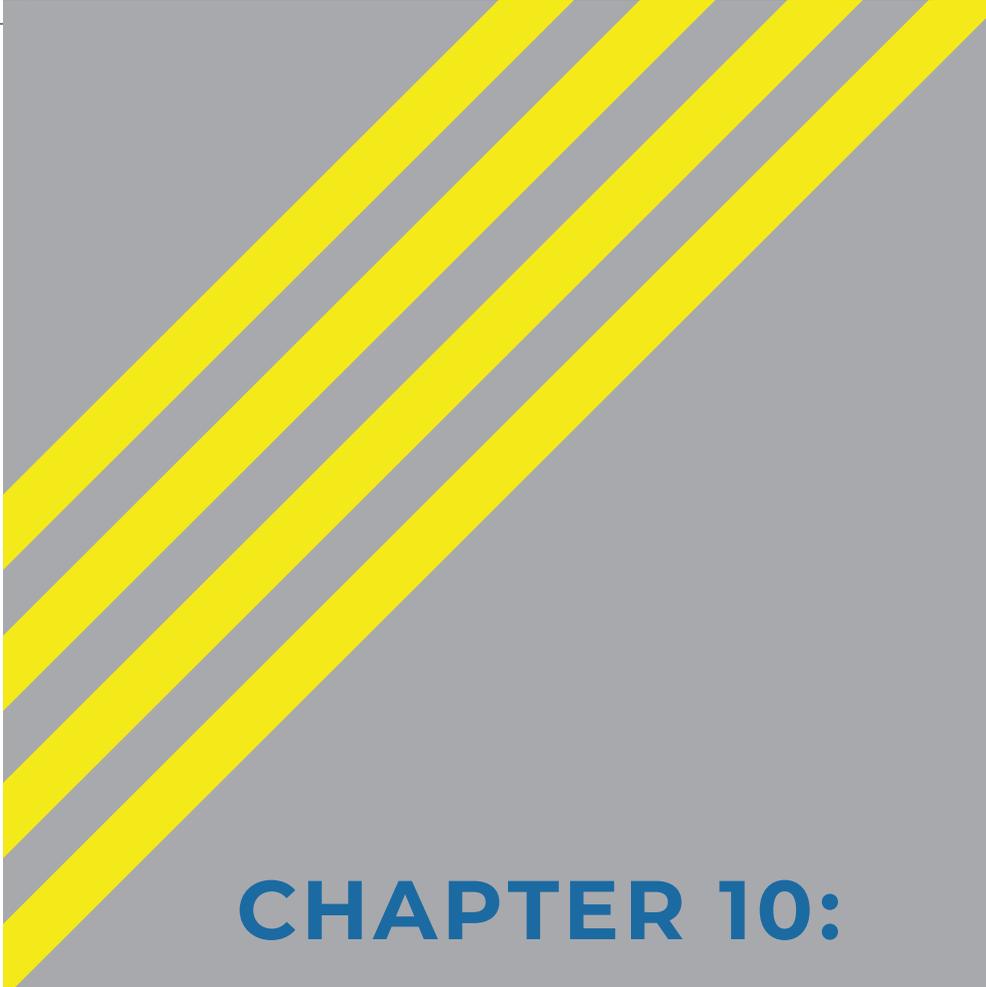
ACTIVITY

- » Complete and review the Fall Protection Plan on the next page.
- » Climb and descend a ladder using a vertical rope lifeline.
 1. Pre-use inspect and attach fall protection system components.
 2. Function test an arrester and ensure it is panic proof.
 3. Install a work positioning lanyard for hands free work.
 4. Use the correct technique to minimize free fall while working hands free.
 5. Use the correct technique to minimize free fall while climbing and descending.

PLAN # 3 Company Name: Energy Safety Canada	Exercise: Vertical rope lifeline use with work positioning off ladder
<p>Work Site Address or Location: 1803 – 11 Street, Nisku, Alberta (east end of Nisku on south side of main road)</p> <p>Location on site or directions: Climbing (hands on training) device located in the shop area of the main building, see Instructor or office staff for directions.</p>	
<p>Describe work to be done: Install vertical rope lifelines and use as fall protection system while climbing the ladder. Employ a technique to minimize freefall when leaving the ground and when at the top of the climb, then attach a positioning lanyard as required to work safely at height with both hands free. Remove vertical rope lifelines upon completion of the exercise.</p> <p>Fall hazards to be protected against:</p> <ul style="list-style-type: none"> » Falling while climbing, installing and removing the system – swing fall » Stretch in the lifeline affecting fall clearance – edge contact on the lifeline and fall arrest lanyard » Incompatible and/or false connection » Freefall greater than 1.8 m (6 ft) 	
<p>Fall protection system(s) used: SRL or first climb system during installation and removal, vertical rope lifeline system and redundant SRL during exercise</p> <p>Anchor/Anchorage location(s): Above the top of the ladders, attached to fixed anchors on end of overhead beams</p> <p>Full body harness: a CSA approved class AP (minimum) harness with positioning rings at each hip or each side at waist level, ensuring the formal inspections certify the harness for current use and it is the right size</p> <p>Connecting devices: Rope lifeline secured to anchor with system manufacturer specified connecting means attaching dorsal harness D-ring to fall arrester secured to rope lifeline system (lifeline to be tensioned to ensure arrester travels as designed).</p>	
<p>Rescue plan: Have 1 student report the situation to the front office staff to activate internal emergency response and 911 for response from Nisku Fire Dept and Leduc EMS. Muster all other students to the classroom away from the climbing device. Have any other students at height immediately make their way safely to ground level and to the muster location. Instructor to use alternate access and fall protection system to reach the patient, then install rescue and fall protection systems for the patient (Rollgliss, type 3 SRL or pre-rigged Spencer system). If possible use SRL for the casualty's fall protection. If the SRL is not useable during rescue, install and attend a belay system with assistance from competent site personnel who must be on standby status during the climbing exercise.</p>	

Continued on page 95

<p>Worker(s) instruction required:</p> <ul style="list-style-type: none"> * Purpose of exercise * Hazards present * Fall protection system(s) and PPE required * Method of pre-use inspecting all gear * Method of installation and removal * Method of attachment to connect the worker to the anchorage * Method of positioning the arrester to minimize freefall * Method of work positioning on the ladder * Purpose of redundant attachment to SRL system while learning technique 	<p>Clearance Calculations</p> <p>$FFD = L + B - C$</p> <p>$TFD = FFD + DS + SAE$</p> <p>$CR = TFD + B + SM$</p> <p>Climb until face high with top ladder rung at 17' above floor. This will place dorsal D ring 5' above feet. Working level at feet is 12' above floor. Lock rope grab 1' above dorsal D ring achieving an anchor height of 18', and at the top of the lifeline resulting in no lifeline stretch. At this working height there can be no more than 6' of lifeline above rope grab to achieve clearance requirement due to 15% lifeline stretch at 4 KN.</p> <p>$FFD = (3 + 3) = 6 + 5 - 6 = 5$</p> <p>$TFD = 5 + 1 + 4 = 10$</p> <p>$CR = 10 + 5 + 2 = 17$</p> <p>17' Clearance required from anchor, 18' available.</p> <p>NOTE: Rope grab must be locked a minimum 1' above dorsal D ring at this height, and not allowed to trail below harness in order to meet clearance requirements.</p> <p>*Rope grab may take up to 3' including slippage to arrest a fall. Maximum 3' lanyard.</p>
<p>Have all workers been trained in the safe use of the fall protection equipment? Yes ____ No ____</p>	
<p>Have all affected workers been made aware of this plan? Yes ____ No ____</p>	
<p>Instructor's signature: _____ Date: _____</p>	



CHAPTER 10:

Horizontal Lifelines (HLLs)



OUTCOME

Identify when and where horizontal lifelines should be used as well as describe how they are used



OBJECTIVES

1. Identify the compatibility of HLL components.
2. Identify specific manufacturer's requirements regarding HLLs.
3. Describe pre-use inspection and use of horizontal fall protection systems.
4. Describe cautions in access and use of horizontal lifeline systems.

HORIZONTAL LIFELINES

Components

Horizontal Lifelines (HLLs) are systems comprised of a flexible line or rigid rail connected horizontally between at least 2 anchorages. They are used on relatively flat surfaces to not exceed a slope of 5 degrees. Flexible Horizontal Lifelines (FHLLs) are made of wire or synthetic rope. Rails used in Rigid Horizontal Lifelines (RHLLs) are made of metal. Components of HLLs may include energy absorbers, tensioning devices and force impact indicators.

System designs are either:

- » Single span with two end anchorages and anchor connectors, or
- » Multiple spans with two end anchor connectors and a number of intermediate anchorages and anchor connectors.

Many intermediate and end anchorages are raised stands or stanchions. The HLLs are used in a relatively straight- line application. They are only allowed to deflect at each intermediate stanchion by a 10 degree angle.

Intermediate stanchions are designed to absorb force during a fall arrest, and often they will have a by-passible anchor connector. This allows the worker to manipulate the lanyard connector and bypass the stanchion without disconnecting.

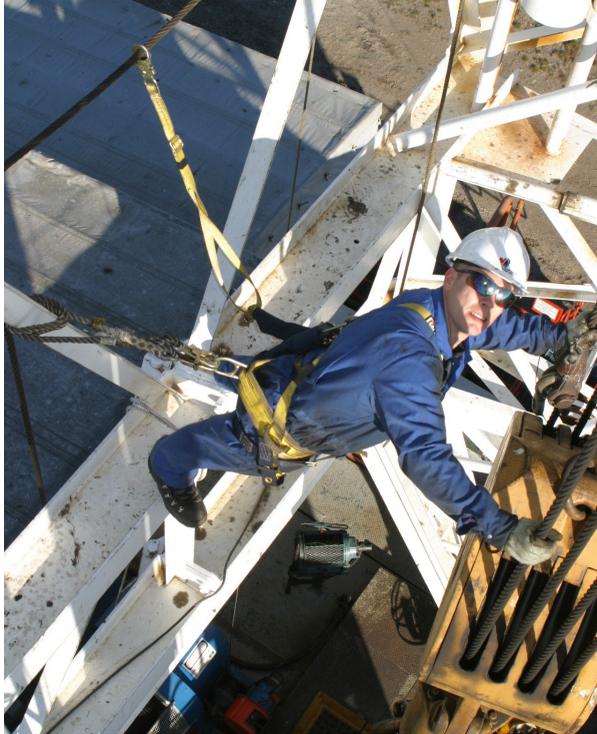


Figure 10-1: Horizontal Lifeline

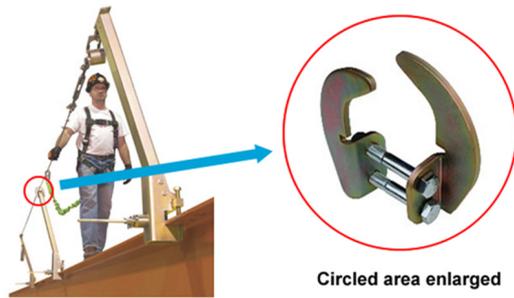


Figure 10-2: Stanchion with Bypass Connector

Single and multiple span systems can be designed for single or multi-users. A manufacturer or a professional engineer will specify the maximum number of spans and users per span. This allows multiple workers to work horizontally back and forth along a structure safely.

Workers connect to the HLL using a mobile attachment device making it easier for them to move. Typically, energy absorbing lanyards or

SRLs are used. Connectors have thick or wear-resistant material to minimize wear and extend their serviceable life.

HLLs are used for fall arrest and travel restraint systems. When used for fall arrest, clearance requirements for HLLs can be easily overlooked. FHLLs have more variables than rigid systems. Line flexibility factors like pre-tension in the line, single versus multiple span, and multiple users arrested on a span will all affect the maximum dynamic deflection distance. Other factors may add further complications, including: the height of the HLL above the structure, the dorsal D-ring height of the worker, harness stretch, D-ring movement, free fall, activation and arrest distance if SRLs are used, and a safety margin of at least 1 metre.

Manufacturers and professional engineers who design these systems are required to provide information to help the user ensure clearance requirements. This information is found on equipment labeling and in the system instructions, whether it is a kit type system installed by the purchaser or user or a system installed by the manufacturer and their authorized installer.

HLLs are designed tested systems. Components can only be altered or replaced by the designer, whether it is the manufacturer or a professional engineer.

Permanent Horizontal Lifelines

Permanent HLLs are made of either rigid rail or wire rope. Rigid rail HLLs are permanently installed. It takes a lot of time and expense to continually install and remove HLLs. Their design, use and installation are less complex than FHLLs and they are installed according to a manufacturer's or professional engineer's instructions.

The composition of rigid rails and wire ropes is designed for permanent installation. The composition provides damage resistance from:

- » Use
- » Exposure to the elements
- » Working environment

Temporary Horizontal Lifelines – FHLLs

Synthetic webbing and rope are designed for temporary installations. The material is not strong enough to resist long exposure to use, nature's elements, and other harsh working conditions.

When choosing wire and synthetic rope and webbing for temporary systems, the ease of setup and removal is always an important consideration.

FHLLs are more complex and varied than rigid rail systems. Manufacturers and professional engineers must have their designs tested to ensure they meet CSA standards: Z259.13-04, Flexible Horizontal Lifeline Systems, or the applicable requirements of CSA Standard Z259.16-04, Design of Active Fall-Protection Systems.

FHLL systems can be installed in one of three ways:

- » The purchaser or user following the manufacturer's instructions, or
- » The manufacturer or manufacturer's authorized installer, or
- » A professional engineer or authorized competent person professionally designed for custom applications.

With the complexity of FHLLs it is crucial these tested designed systems are installed properly to ensure their safe use. Prior to their use it must be certified in writing that their installation meets the designer's specifications. Only the designer, manufacturer or professional engineer, or a competent person who is authorized by the designer may inspect and certify the installation. Alberta OHS identifies a competent person as: adequately qualified, suitably trained and with sufficient experience to safely perform work without supervision or with only a minimal degree of supervision.

FHLL systems must only be used as intended. Workers must read and understand the designer's instructions and be trained in the use of the system prior to its use.

Pre-Use Inspection and Maintenance of FHLLs

All component subsystems of the FHLLs must be inspected as per manufacturer instructions. In addition to the FHLL and its components, the anchorages and the component subsystem to connect to the lifeline must be pre-use inspected.

These items are often not supplied with the system and are generic connectors such as energy absorbing lanyards, snap hooks, carabiners and/or SRLs and full body harnesses. Manufacturer's instructions outline what is required when doing a pre-use inspection on these components. (See Chapter 4 and 11)

Frequency

FHLL sub-components pre-use inspection requirements are included in the manufacturer's instructions and an inspection must be done prior to use by a competent person. Systems that are left installed for periods of time must be pre-use inspected at least daily prior to use and then inspected monthly. If conditions or use dictate a monthly inspection requirement is insufficient then the inspection schedule it is adjusted accordingly.

Manufacturer's instructions identify the steps to be taken during these inspections. They will include such components as: line housing, energy absorbers, tensioning devices, impact force indicators, and line and reserve line indicators for adjustable length systems.

Hazards

Many hazards exist using rigid and flexible HLLs. One of the easiest ways to minimize the hazards is to use the system as designed and use it with manufacturer-supplied components. For generic subcomponents the hazards associated with their use and misuse still apply (See Chapters 5, 6, 7 and 11). The added complexity of FHLLs creates additional hazards. The most overlooked hazard is insufficient clearance. Other hazards include:

- » Entanglement:
 - During a fall arrest arms and feet may become entangled.
 - Trip hazards involving a line or a lanyard.
- » Exceeding system capacity:
 - Worker weight, including clothing and tools.
 - Number of users.
 - Number of users per span.
 - Number of spans.
 - Free fall limits.
 - MAF limits.

- » Incompatible connection:
 - All component subsystems.
 - Worker
 - FHLL
- » Excessive free fall:
 - Jumping over obstacles
 - Connection to the FHLL is too long.
 - Climbing above anchorage height
 - Swing fall leaning past the FHLL.
- » Multiple users:
 - One worker falling may cause other workers to fall off the working level.
 - Single span
 - Same span of multi-span
- » Sharp Edges:
 - Abrasion and cutting leading to severing the fall arrest system components.
- » Clearance:
 - Connection to the FHLL is too long.
 - FHLL deflection on a fall arrest.

Removal from Service

To determine if HLLs are removed from service, any one of the following conditions must occur:

- » HLLs Fails Inspection:
 - Formal inspection
 - Pre-use inspection
 - Monthly or more frequent inspection, if required
- » Fall arrest indicator is deployed.
- » Used to arrest a fall.

Most HLL subcomponents can be either repaired or re-certified by the manufacturer or person authorized by the manufacturer. Generic components involved in a fall arrest that cannot be repaired or re-certified must be removed from service and destroyed.

Guidelines for Use

Horizontal Lifelines are complex horizontal fall protection systems. These component specific systems are designed to deal with multi-directional forces during an arrest in single and multi-span configurations. The number of users at any one time per span and for its entire length depends on the system being used.

Only specifically designed components can be used. Altering the HLL system could prevent the system from performing as intended. This could lead to serious or fatal injuries to users under fall arrest.

Prior to use, it is important that users confirm there is sufficient clearance to arrest all HLL system users. If there is insufficient clearance, users on the same span may cause others to fall. The maximum dynamic deflection distance must be added to the stopping distance when calculating the clearance requirement.

If accessing the HLL system exposes the users to the risk of a fall, they must be protected by a fall protection system while accessing and transferring to the HLL system.

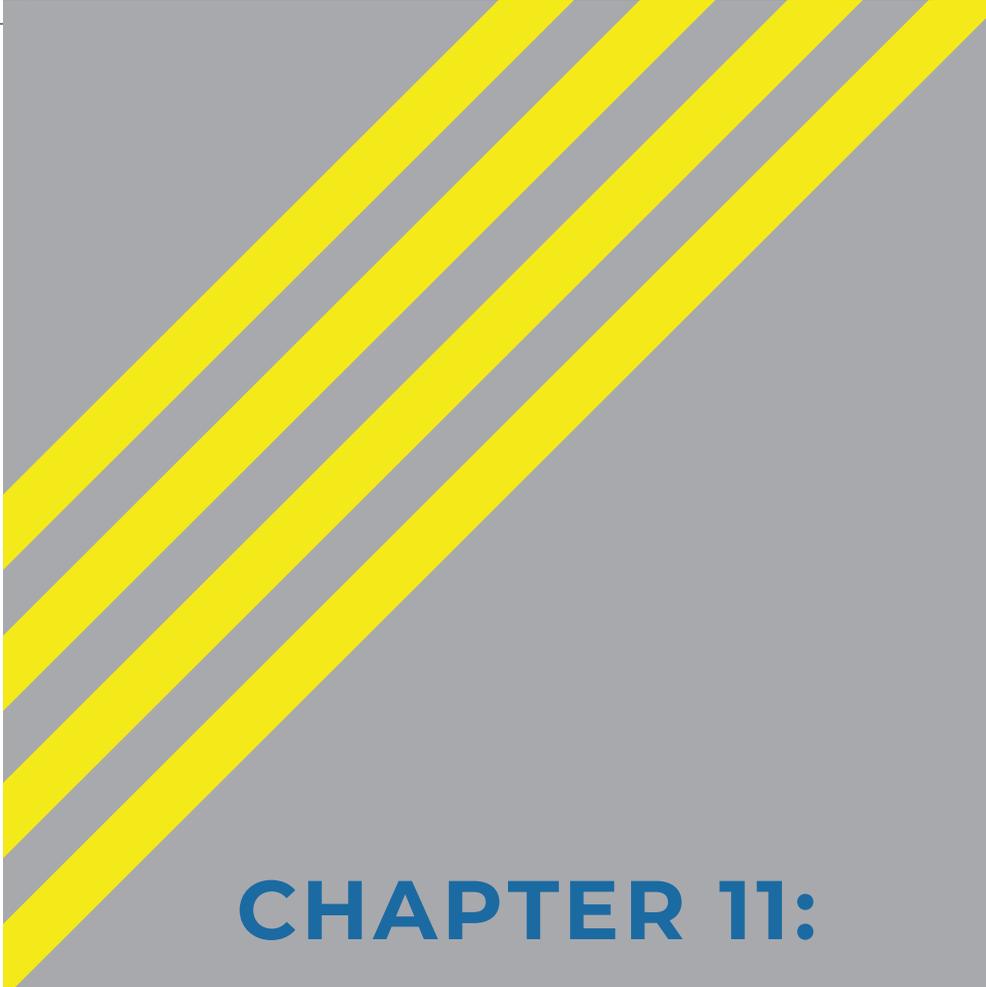
Installation of Flexible Horizontal Lifelines must be certified prior to use. They also require pre-use inspections per the manufacturer's specifications. Inspections must be performed daily prior to use and monthly while left in place. The Flexible Horizontal Lifelines must be removed when they are no longer needed.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. **Where are horizontal lifelines used in the oil and gas industry to protect workers?**
 - a. Where workers need to move horizontally along the rig while being exposed to the risk of a fall
 - b. For work positioning on the service/drilling rig monkey board
 - c. As a first climb system
 - d. When using a mechanism or roller that pinches the horizontal lifeline and produces enough friction to hold the weight of a worker should he/she fall
2. **Which of the following is a manufacturer requirement for a horizontal lifelines system?**
 - a. Testing of the arresting capability of the horizontal lifeline.
 - b. Included in a fall protection plan.
 - c. Are not required to be engineered to meet their intended service application
 - d. Limitations of the number of workers that may attach to the horizontal lifeline at one time
3. **Which of the following is a correct statement regarding temporary horizontal lifelines?**
 - a. Are installed prior to performing a task and removed immediately following the completion of the task
 - b. Are installed and remain in service indefinitely
 - c. Are not require to be engineered to meet their intended service application
 - d. Do not require training of workers in the installation, use or maintenance of the lifelines.
4. **True or False: HLL connecting components do not have to be compatible in size, shape and strength if they are only used once.**

True _____ False _____
5. **What are HLLs primarily used for?**
 - a. Fall arrest and travel restraint systems
 - b. Fall arrest and work positioning
 - c. Work positioning and travel restraint systems
 - d. Protecting workers moving up and down a drilling rig
6. **When using a HLL system, when is fall protection necessary?**
 - a. While accessing the HLL system.
 - b. While transferring to the HLL system.
 - c. While moving along the HLLL system.
 - d. In all of the above situations.
7. **What steps should be followed when completing a pre-use inspection of all component subsystems of a HLL system?**
 - a. Those outlined by your supervisor.
 - b. As per manufacturer instructions.
 - c. As per employer's specifications.
 - d. A pre-use inspection for a HLL's components and subsystem is not necessary.



CHAPTER 11:

Self-Retracting Lifelines (SRLs)



OUTCOME

Demonstrate the safe use of SRL to access the monkey board for work purposes



OBJECTIVES

1. Describe 3 types of CSA approved self-retracting lifelines.
2. Describe the industry guidelines for the proper use of SRLs (including pre-use inspection).
3. Demonstrate pre-use inspection and use of a derrick SRL system to transfer and work on a monkey board.

SELF-RETRACTING LIFELINES

A Vertical Self-Retracting Lifeline, or SRL, is used as part of a fall protection system. The lifeline, like a seat belt, pulls out and retracts with the worker's movement. If the worker slips or falls, the device locks. Release the tension and it moves freely again unless damaged.

A self-retracting lifeline contains a drum with a length of line wound onto it, a spring to re-wind the line, and a locking mechanism. Activation of the SRL is based on line exit speed. Line speed of at least 1.2 metres (4 ft) per second must be reached to engage the brake. For arrest to occur the worker must fall freely for the device to be properly activated.

The drum, braking mechanism and lifeline are housed in a case. An integral anchor connector is built into the case. The device is designed for indoor or outdoor use. Outdoor use devices will often have a weatherproof case and a protective rubber or plastic bumper over the lifeline termination to seal the unit when not in use.

The lifelines vary in length but must not exceed 60 metres (200 ft). First generation SRLs were designed like seatbelts. They were made of web and did not have a dynamic brake. The next generation SRLs are longer and have a dynamic brake that limits the arresting force. The longer lifelines are normally made of wire rope while shorter SRLs lines may be made of wire rope, synthetic web, or rope.

Wire lifelines are terminated with a ferrule enclosing an integral snap hook or carabiner. This allows a connection to taglines, lanyards, an energy absorber, or body harnesses. The connection point on a full body harness is usually the dorsal D-ring. When a worker is using the SRL for climbing ladders, some manufacturers allow an attachment to either a sternal ladder climbing D-ring or a dorsal D-ring. Check the manufacturer's instructions for the unit to determine allowed connection points. SRLs are very good at minimizing free fall as the length of the lanyard is always kept to a minimum. This keeps potential arrest forces low. Most manufacturer designs keep the arrest force to a maximum of 4 kN (900 lbs).

SRLs are often used on drilling and service rigs. While rig workers mostly work with permanently installed SRLs that have been engineered by competent personnel, they may be required to install temporary SRLs where there is no permanent SRL available.

SRLS TYPES – CSA STANDARDS TYPE 1, 2 AND 3

British Columbia OHS cites that lifelines used in their jurisdictions must be ANSI and CSA approved SRLs. Saskatchewan OHS recognizes lifelines approved by a named agency. Alberta OHS has a section specifically on Self Retracting Devices and only recognizes CSA approval due to the maintenance schedule requirement for Types 2 and 3. CSA requires that the first re-certification by the manufacturer must be done 2 years after the manufacture date and every year thereafter. CSA states this is not required in the other certification bodies. For this reason we will look at CSAs' 3 classifications: Types 1, 2 and 3.



Figure 11-1: Type 1 SRL

Type 1 SRL

Type 1 SRLs are small, compact SRLs with the following features:

- » Length of 1.5 (5 ft) to 3.0 metres (10 ft).
- » Light weight allowing attachment to either the worker's dorsal D-ring or anchor connector.
- » Limited ability to absorb energy:
 - Only designed to function if a fall arrest occurs directly below anchorage.
 - Recommended to incorporate an energy absorber
 - Energy absorber extends total fall distance and requires added fall clearance below its use.
- » Total activation and fall arrest distance is less than 1.0 metre (3 ft).
- » After a fall the SRL must be removed from service and destroyed.
 - Same as a fall arrest lanyard or a full body harness.
- » No requirement for a manufacturer's inspection.
 - Pre-use and formal inspections are still required



Figure 11-2: Type 2 SRLs

Type 2 SRL

Type 2 SRLs are heavier and mid-size with the following features:

- » Length greater than 3.0 metres (10 ft).
 - Increased weight usually prohibits a connection to the worker.
- » Dynamic braking device to limit force under 6 kN (1350 lbs).
- » Total activation and fall arrest distance less than 1.4 metre (4.5 ft).
- » After a fall arrest unweighting line will place it again in a fall arrest mode,
- » A visual load indicator:
 - Indicates that the device has seen the force of a fall.
 - Labelling states if the indicator is deployed it must be removed from service and returned to the manufacturer’s authorized service centre for repairs and re-certification before further use.
- » Required to be re-certified by the manufacturer 2 years after the manufacturer date and annually thereafter.

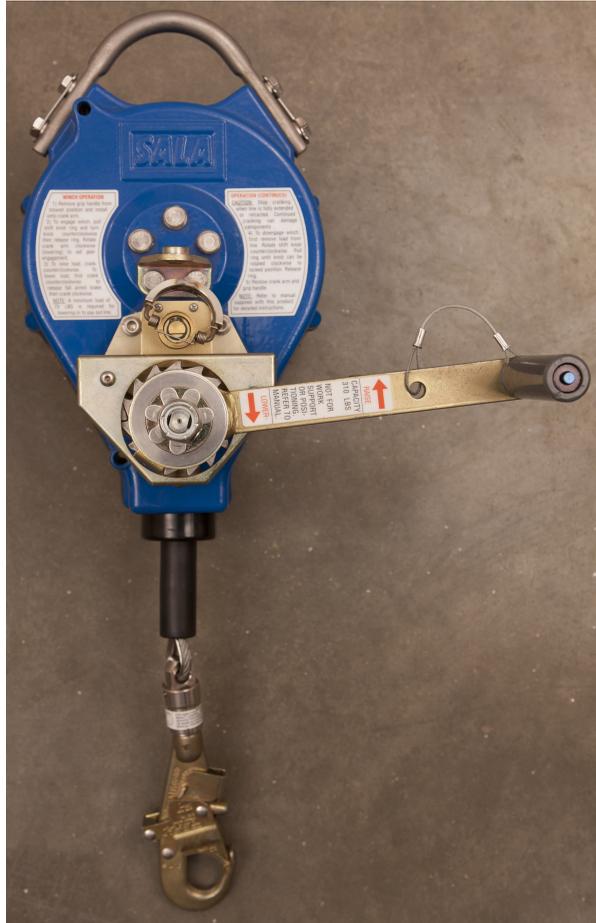


Figure 11-3: Type 3 SRL

Type 3 SRL

In addition to the Type 2 requirements, Type 3 SRLs have a retrieval mechanism. The retrieval mechanism must be able to:

- » Raise or lower the worker who is suspended after a fall arrest.
- » Maintain an arrested worker’s position upon an inadvertent release of the retrieval mechanism.
- » Minimum mechanical advantage of 3:1.

CSA also has requirements for information on the device label and in the manufacturer’s instructions. In particular, workers must be aware of: Lifeline specifications for:

- » Material
 - Allows worker to choose working conditions.
 - Synthetic lifelines will stretch adding to increased clearance requirements.

- » Maximum working load
 - Does the worker, including their clothing and tools exceed unit capabilities?
- » Date of manufacture
 - Does the unit need to be serviced?
- » Model number
 - Can it be used to identify the last inspection date in the company’s tracking system?
- » CSA classification
 - Type will be identified if the unit has desired features.
- » Only one person at a time.
 - Ensure only one worker uses it at a time.
- » Maximum arrest distance in metres.
 - Worker can confirm clearance requirements.
- » Maximum arrest force in kN.
 - Worker understands the maximum potential force.
- » Warnings:
 - Follow all manufacturer’s instructions at the time of shipping.
 - Worker reads and understand how to use, maintain and pre-use inspect the device.

Type 1

- » This device shall be removed from service when subjected to a fall arrest and destroyed.

Type 2 and 3

This device shall be removed from service when the visual load applicator is deployed and may be re-certified by the appropriate authority.

USE IN DIFFERENT SITUATIONS – TEMPORARY / PERMANENT INSTALLATIONS

SRLs may be permanently or temporarily attached. Permanent SRLs are attached to a davit arm or other solid connectors on the derrick. Typical locations include the crown to climb the derrick ladder, the rod basket or a similar attachment for use on the monkey board, and an attachment to some horizontal lifelines. SRLs are removed only when a worker falls on the system, or when they fail pre-inspection or require their annual re-certification.

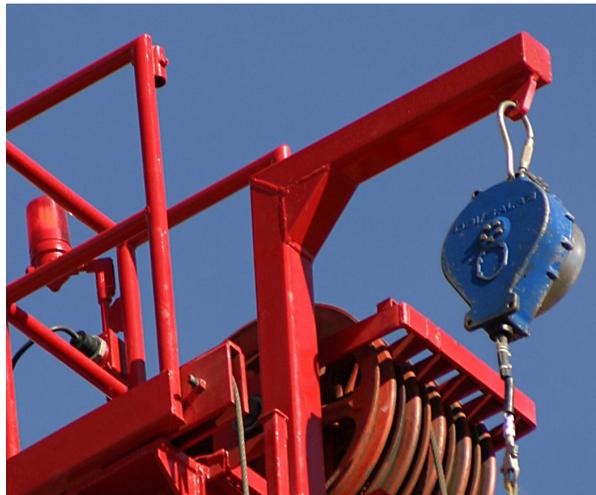


Figure 11-4: Permanent Crown and Rod Basket

Temporary SRLs can provide convenience and safety when attached to a secure overhead anchorage. They can be installed anywhere on the rig where a worker needs fall protection, a permanent installation is not available, or another form of fall protection is not appropriate.



Figure 11-5: Temporary Attachment of SRL

Ultimately, your company’s Fall Protection Plans will determine the method of use when climbing and working at heights, in accordance with their site hazard assessments and manufacturer’s instructions.

INDUSTRY GUIDELINES FOR USE – SRLS AND ENERGY ABSORBERS

CAODC recognizes the possibility of lifeline edge contact during a fall arrest causing lifeline damage on drilling and service rigs. In an effort to protect workers from possible lifeline damage, the CAODC recommends using an energy absorber between the worker's harness and the SRL connector. Manufacturers and certification agencies recognize that an energy absorber used in this fashion may help prevent severing of a lifeline when arresting over an edge, protecting both the worker and the lifeline.

Workers must prevent or protect lifelines from contacting sharp edges. Sharp edges must be temporarily or permanently padded prior to use. Workers must also realize that having an energy absorber connected to the SRL will also increase clearance requirements. There may be situations where additional clearance is not available and therefore its addition not desirable; for example, attaching a horizontal lifeline on the back of a laid down derrick. Check the Fall Protection Plan for the task you are about to perform and confirm the clearance required.

Attachment Method

Function Test

- » Use the tagline to pull down the SRL connector from the storage at unit:
 - Line should payout smoothly.
 - Pulling tagline quickly can activate the brake.
- » Grasp above the snap hook at the lifeline termination.
- » Inspect the visual length of the line for damage.
- » Function test the SRL:
 - Raise and lower termination – the unit should payout and retract line smoothly.
 - Pull down sharply and maintain tension – the brake should engage and hold preventing release until tension is removed.
 - Release tension – the unit should reset, payout and retract line smoothly.

- » Inspect snap hook:
 - Ensure the fall arrest indicator is not deployed
 - Check the snap hook swivel for full rotation.
 - Ensure the auto locking snap hook functions and it is not damaged.

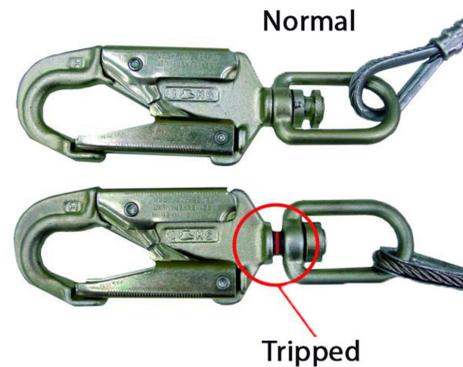


Figure 11-6: Deployed Fall Arrest Indicator

Attachment

If clearance allows connect as per CAODC recommendations. The following is an attachment to the derrick fixed ladder SRL with an energy absorber.

- » Attach the snap hook to the energy absorber connected to the dorsal D-ring of your harness:
 - Alternatively connect to the ladder climbing attachment (sternal). Always consult and follow the manufacturer's instructions prior to use.
 - Ensure compatible connection (See Chapter 6).
 - Compatible connectors
 - Phantom hooking – see it, feel it or have your connection buddy checked

NOTE: The tagline should not be removed or tied off at your location when transferring to another system. In this way it is always available to be used to access the derrick ladder in case of an emergency or assistance is needed. SRLs must be fully retracted when not in use.

TRANSFER TO ANOTHER FALL ARREST SYSTEM

When transferring from any fall protection to another, it is essential to maintain 100% protection at all times while working at height. Transfer from a SRL to another fall arrest system must be done inside the manufacturer's accepted range of movement. Range for your device will be identified in the manufacturer's instructions. Ranges are in place to help minimize the risk of swing fall and free fall. The total vertical fall distance is greater, with swing falls using types 2 and 3 SRLs, than a fall directly below the anchorage point thus increasing the total fall distance. This increases the distance and swing path area required to safely arrest the user. Swing fall is a danger with any vertical fall protection system and must be avoided. (See Chapter 1)

Derrick Ladder to Monkey Board SRLs

Pre-use and function test the derrick ladder SRL prior to connecting your harness as per the manufacturer's instructions and your company's Fall Protection Plan.

- » Connect to the derrick ladder SRL.
- » Ascend the ladder using 3-point contact climbing to the monkey board level.
- » Pull down the monkey board SRL using its tagline.
- » Function test the monkey board SRL.
- » Remove the tagline from the monkey board SRL.
 - Connect the monkey board SRL snap hook to the energy absorber attached to the dorsal D-ring of harness.
- » To minimize the risk of inadvertent release of tagline or snap hook:
 - Open the snap hook and remove the tagline from the snap hook.
 - Connect the snap hook to the harness.
 - Tie off the tagline at the monkey board to avoid an entanglement hazard.
 - Disconnect the derrick ladder SRL from your dorsal D-ring or sternal ladder climbing D-ring.
 - Use the tagline to control the retraction of the derrick ladder SRL.
 - Retracting in a controlled manner allows the proper spooling of the lifeline on the drum.

Work Positioning on Monkey Board

Transferring to the monkey board SRL provides a derrick hand with a fall arrest system. Travel restraint is not possible for a worker on the monkey board. The open end of the diving board and openings between the fingers prevent travel restraint. Pulling or catching pipe requires the derrick man to lean out over the diving board using both hands. To create a stable contact to safely perform the task, a properly adjusted work positioning lanyard connected between the rear work positioning D-ring of the harness and the back structure of the monkey board is required. Once transferred to the monkey board SRL, return the derrick ladder SRL in a controlled manner to the crown:

- » Pre-inspect the work positioning lanyard, anchor connector and anchorage.
- » Ensure a compatible connection at the anchorage, anchor connector and lanyard connector.
- » Determine work positioning lanyard length for the task.
- » Connect the other end of work positioning lanyard to the work positioning ring on your waist.
- » Ensure secure connection, reach back and obtain grip on lanyard and then place your feet firmly at the end of the diving board. Lean into the work positioning lanyard with your hips to create a feet and work positioning lanyard contact with the structure.
 - Reaching back and deflecting the work positioning lanyard prior to leaning out allows for better control.



Figure 11-7: Work Positioning on Monkey Board

Monkey Board to Derrick Ladder SRL

- » Disconnect and store the work positioning lanyard.
- » Make your way to the derrick ladder.
- » Connect to the derrick ladder SRL.
 - Pull down the derrick ladder SRL using its tagline.
 - Perform a pre-use inspection
 - Keeping the tagline on connect as per manufacturer's instructions to the harness (dorsal or sternal D-ring).
- » Remove the monkey board tagline from storage.
- » Disconnect the monkey board SRL snap hook and install the monkey board SRL tagline in the snap hook.
- » Use the tagline to control the retraction of the monkey board SRL.
 - Retracting in a controlled manner allows the proper spooling of the lifeline on the drum.
- » Descend the ladder using a 3-point contact and climb down to the floor.
- » Disconnect the derrick ladder SRL from your dorsal D-ring or sternal ladder climbing D-ring.
- » Use the tagline to control the retraction of the derrick ladder SRL.
 - Retracting in a controlled manner allows the proper spooling of the lifeline on the drum.

HAZARDS / CAUTIONS

It is important to use self-retracting lifelines safely. Some hazards to watch out for include:

- » Incompatible Connections and Materials:
 - Connections
 - With connectors and anchorage
 - Phantom hooking
 - Materials
 - Not matching working conditions.
- » Edge Contact and Abrasion:
 - Lifeline damage while using lifelines, falling damage, or failure.
 - Swing all can cause lifeline damage or failure.
 - Abrasion can affect line payout, retraction, and possibly braking when needed.
 - Falling over an edge can sever the lifeline.
 - Energy absorber use is recommended in order to minimize damage to the lifeline.

- » Excessive Free Fall:
 - Failure of a lifeline retracting but the worker continues to climb.
 - Worker climbs faster than the unit's retraction rate.
 - Worn retraction spring can lead to a slow or incomplete retraction.
 - Swing fall
 - Also increases total arrest distance.
 - Injury from the arrest force or impact force from hitting obstructions.
- » Improper Attachment to Harness:
 - Arrest by work positioning rings exposes the worker to arrest falls horizontally but not vertically (See Chapter 1).
- » Knots or Imperfections in the Lifeline:
 - Prevents a proper lifeline release, retraction, or braking.
- » Lifeline Tied off at a Work Location:
 - Storing a lifeline by tying off the lifeline can lead to a corroded and damaged line.
 - Prevents the proper lifeline release, retraction or braking.
 - Not available for emergency or assistance.
- » Weather and Cleanliness:
 - Cold, freezing rain or frost can restrict lifeline retraction.
 - Build-up of dirt impedes drum and line actions.
 - Loose tagline or lifeline entangled with moving parts.
- » Worker and gear weight exceeds the SRL limit:
 - Results in higher arrest forces than designed.

GUIDELINES FOR USE

SRLs are common devices used in this industry. Many rigs will have 2 or more permanent SRLs available for fall protection. SRLs cannot be used in travel restraint unless the amount or total line in the device prevents the worker from reaching the edge of the working level. The danger is the worker being under tension at the edge then releasing the tension. Any additional line in the SRL could allow the worker to fall off the working level and experiencing arrest forces. During the fall arrest, there would be additional edge contact on the SRL.

Clearance requirements must also take into account the maximum total activation and arrest distance of the device. This needs to be added to the total stopping distance when confirming adequate clearance.

Removal from Service

Type 1 SRLs are treated the same as lanyards regarding their removal of service. If the unit has seen a fall arrest it must be removed and destroyed. Type 2 and 3 SRLs still need to be removed from service if they have seen a fall but are repairable by the manufacturer or their authorize repair location. Like all fall protection equipment, if a unit fails a pre-use inspection including a function test it must be removed from service. The supervisor must be notified and the unit must be referred to a formal inspection. If there is no current formal inspection, it should be removed and referred for a formal inspection.

SUMMARY REVIEW

Answer the following questions. You can use your book for help if necessary.

1. Match the type of SRL listed in the left hand column to the definition provided in the right hand column

Type of SRL	Definition
___ Type 1 only	<ol style="list-style-type: none"> 1. Must be equipped with a retrieval device that allows a single worker to raise or lower the user of the device that is suspended after arresting a fall. 2. Are very light and many attach directly to a worker's dorsal D-ring. 3. Manufacturer's and Legislation requires a frequency of service on these SRLs to be recertified within 24 months after the date of manufacture and then annually after that.
___ Type 2 and 3	
___ Type 3 only	

4. What is best practice associated with the use of SRLs in the oil and gas industry?

- a. Leave your SRL extended and tied off.
- b. Lock off your SRL for work positioning.
- c. Allow the lifeline to retract as fast as possible when use is completed.
- d. Connect the SRL snap hook to a shock/energy absorber that attaches to the dorsal D-ring of a full body harness.

5. Identify which of the following statements are TRUE and which ones are False.

- a. Do not leave the climbing side of the derrick while using a SRL as this creates a risk of swing fall and cutting the line on an obstruction _____
- b. SRLs must be re-certified annually. _____
- c. Vertical systems such as rigid rail are found mounted on ladders and are used as a means of fall protection. _____
- d. Fall arresters are devices that slide freely along a horizontal lifeline. _____

ACTIVITY

- » Complete and review the Fall Protection Plan on the next page.
- » Climb and descend a ladder using a SRL.
 1. Access and transfer to the monkey board SRL.
 2. From monkey board SRL transfer to ladder SRL and then descend a ladder.
 3. Set-up, use and remove work positioning on the monkey board.

PLAN # 4 Company Name: Energy Safety Canada	Exercise: SRL systems for access and work positioning on monkeyboard
Work Site Address or Location: 1803 – 11 Street, Nisku, Alberta (east end of Nisku on south side of main road) Location on site or directions: Climbing (hands on training) device located in the shop area of the main building, see Instructor or office staff for directions.	
Describe work to be done: Climb to monkeyboard to position as required for tripping tubulars. Fall hazards to be protected against: <ul style="list-style-type: none"> » Fall while climbing » False connection of SRL snap hook » Damage to SRL lifeline from contact on obstructions in derrick during arrest of a fall » Fall while work positioned at monkeyboard 	
Fall protection system(s) used: Pre-attached fall arrest systems; ladder SRL (access system,) 2 monkeyboard SRL systems (for student and Instructor), work positioning lanyard, permanent cable system or SRL (used for descent). Anchor/Anchorage location(s): Located at top of access and descent ladders (on end of I-beam,) fixed anchorage I-beam above Monkeyboard, if permanent cable system is used for descent; pre-attached to straddle descent ladder rungs Full body harness: CSA approved class ALP (minimum) harness with positioning ring at mid back waist level (integral shock absorber recommended,) ensuring the formal inspections certify the harness for current use and it is the right size Connecting devices: 3 or 4 SRLs (20 ft minimum length,) personal shock absorber (if no integral on harness) permanent cable ladder system (brackets, turnbuckle, lifeline, manufacturer specified fall arrester and carabiner) and work positioning lanyard.	
Rescue plan: Have 1 student report the situation to the front office staff to activate internal emergency response and 911 for response from Nisku Fire Dept and Leduc EMS. Muster all other students to the classroom away from the climbing device. Have any other students at height immediately make their way safely to ground level and to the muster location. Instructor to use alternate access and fall protection system to reach the patient, then install rescue and fall protection systems for the patient (Rollgliss, type 3 SRL or pre-rigged Spencer system). If possible use SRL for the casualty's fall protection. If the SRL is not useable during rescue, install and attend a belay system with assistance from competent site personnel who must be on standby status during the climbing exercise.	
Worker(s) instruction required: *Function test of SRLs *Purpose of exercise *Hazards present *Fall protection system(s) and PPE required *Use of descent system (SRL or cable ladder system) *Method of attachment to connect the worker to the anchorage *Method of work positioning on the Monkeyboard *Method of peruse inspecting all gear	Clearance Calculations $FFD = L + B - C$ $FFD = L + B - C$ $TFD = FFD + DS + SAE$ $CR = TFD + B + SM$ Working height of monkey board is 10' above floor. Dorsal D ring 5' above feet, working level. Type 2 SRL's must arrest a fall within 1.4m (4.5') $FFD = 0 + 5 - 5 = 0$ $TFD = 0 + 1 + 4.5 = 5.5$ $CR = 5.5 + 5 + 2 = 12.5$ 12.5' Clearance required from anchor, 15' available.
Have all workers been trained in the safe use of the fall protection equipment? Yes ____ No ____	
Have all affected workers been made aware of this plan? Yes ____ No ____	
Instructor's signature: _____ Date: _____	



APPENDICES

GLOSSARY OF FALL PROTECTION TERMS

Anchorage

A structure, or part of a structure, that is capable of safely withstanding any potential forces applied by a fall protection system.

Anchor

An engineered component for coupling a fall protection or travel restraint system to an anchorage.

Anchor connector

The means by which a fall arrest or travel restraint system is secured to the anchorage. This can include steel cable sling, anchor strap, load-rated eye bolts, tripod davit arm, or any other devices designed to suspend human loads and capable of withstanding forces generated by a fall.

Anchor system

The term used to describe the combination of the anchorage, anchor or anchorage connector(s). The combination, and components of the combination, may be engineered or improvised. All equipment should be for the exclusive purpose of fall protection.

Approved

Deemed acceptable by a person or body having authority to establish regulations or standards.

Arresting Distance

The total vertical distance required to arrest a fall. Includes activation and deceleration distance. Does not include free fall distance.

Body Harness

Means of configuration of connected straps that are secured about the employee in a manner that will distribute the fall arresting forces over at least the upper thighs, waist, shoulders chest and pelvis with means for attaching a lanyard to other components or the personal fall arrest system.

Cable Grab

A fall arrest device that locks by either a cam lock (locking arm) or inertia when a free fall is sensed. It is attached to a worker directly or by a lanyard that slides up or down a fixed or vertical cable.

Carabiner

A connector component generally consisting of an oval and trapezoid shaped body with a closed gate or similar arrangement. The carabiner opens to permit the body to receive an object and, when released, automatically closes to retain the object. The steel auto-locking carabiner is most applicable for industrial purposes. (Only CSA approved self-locking carabiners are acceptable for use in the oil and gas industry).

Competent Person

A competent person is someone who has sufficient training and experience or knowledge and other qualities that allow them to assist you properly. The level of competence required will depend on the complexity of the situation and the particular help you need.

Connector

A device that is used to couple (connect) parts of the personal fall arrest system together. It may be an independent component of the system such as a carabiner or it may be an integral component or part of the system such as a buckle or D-ring sewn into a body harness, or a snap hook spliced or sewn to lanyard or self-retracting lanyard.

CSA

Canadian Standards Association

D-ring

A connector used in a harness or a positioning belt as an attachment element or fall arrest attachment. It is also used in lanyards, energy absorbers, lifelines and anchorage connectors as an integral connector. D-rings can be used for work position and fall restraint.

Egress

To exit from, or the route to exit from a work area. Opposite of access.

Engineered

Designed and/or approved by a Registered Professional Engineer.

Engineered Anchor

An anchor designed and approved by a qualified person.

Employer

A person who is self employed in an occupation, a person who employs one or more workers, a person designated by an employer as the employer's representative, or a director or officer of a corporation who oversees the occupational health and safety of the workers employed by the corporation.

Fall Arrest System

A combination of equipment and components connected together that are designed to stop a person from striking a lower level or an obstruction during a fall.

Fall Prevention

The elimination and minimization of potential fall hazard, lessening the chance of employee's exposure to a fall hazard for example guardrails, walls, floors and area isolation.

Fall Protection

Action and procedures to effectively protect the worker from fall hazards.

Fall Protection System

The system utilized to minimize the chance for injury during a fall. A fall protection system consists of an anchor point, connecting means and a body holding device (harness). A well-rounded fall protection program considers rescue and methods to extricate a fallen worker.

Fall Restraint System

A system designed to restrain a worker from reaching an exposed fall hazard. System include personal fall protection equipment, acceptable anchorage systems, trained worker and administrative procedures.

Free Fall

The act of falling before a personal fall arrest system begins to apply force to arrest a fall.

Free Fall Distance

The distance a worker may fall before a fall arrest system engages and begins to slow the fall.

The vertical distance from the onset of a fall to a point where a fall arrest system is activated or engaged (this is the vertical displacement of the fall arrest attachment point on the employee's body harness between onset of the fall and just before the system begins to apply force to arrest the fall. The distance does NOT include deceleration distance and lifeline/ lanyard elongation but does include any deceleration device slide distance or self-retracting lifeline/lanyard extension before they operate and fall arrest forces occur)

Full Body Harness

A device made primarily out of straps for containment of the torso and pelvic area (and optionally the waist area) designed to support the user during and after the arrest of an accidental fall and/or during a rescue operation and/or during activities, depending on the group classification of the harness.

Gravity

A force of attraction between the earth and all bodies of mass near its surface that causes those bodies to move toward the earth at an acceleration of 9.8 metres (32 ft) per second per second.

Horizontal Lifeline

A fall arrest system that uses a line made from rope, wire rope or metal railing that spans horizontally between two end anchorages. The assembly includes the necessary connectors, turnbuckles, inline

energy absorbers, shackles Etc. and may include intermediate anchorage. This is a component of a fall protection system, which consists of a trained worker wearing appropriate fall protection equipment that enables them to safely traverse/work in the horizontal plane. The horizontal lifeline shall be designed, installed and used under the supervision of a qualified person.

Integral

Not removable from the component, system or subsystem without mutilating any element or without use of special tools.

Kilo Newton (kN)

The force which imparts to a mass of 102 kilograms an acceleration of 9.8 metres per second per second.

Kinetic energy

The energy of a body in motion. The kinetic energy of a body that is accelerating will increase as it accelerates its motion. The body in motion will tend to stay in motion unless acted upon by an outside force to the degree that an equal amount of energy is required to be applied in the opposite direction to stop the motion. If the body in motion is to be stopped immediately, the energy that is applied (opposite to the direction of motion) to decelerate (to a stop) the moving body must be very high for a very short time. If the energy is applied gradually to decelerate the motion, the energy level is much lower and will require a greater distance and time to decelerate and stop the motion.

Ladder Climbing Device

A device or climbing sleeve connected to the front D-ring on the climber's full body harness that slides up or down a rigid rail or cable. Should a fall occur while connected to the device, it is designed to lock by inertia or cam action and arrest the fall.

Lanyard

A flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the body harness to a deceleration device, lifeline or anchorage.

Lifeline

A component consisting of a flexible line for connection to an anchorage at one end, to hang vertically (vertical lifeline), or for connection to anchorage at both ends to stretch horizontally (horizontal lifeline) and which serves as a means for connecting other components of a personal fall arrest system to the anchorage.

Maximum Arresting Force

The peak force exerted on a body or test weight when a fall protection system stops a fall.

Newton

A metric unit of force which imparts to a mass of one kilogram an acceleration of 1 metre per second per second. (Forces must be applied to any mass to cause it to move as bodies at rest will remain at rest – no motion until a force is applied to cause them to move). In the case of a falling body, gravity supplies the force to cause the body to move toward the earth.)

Personal Fall Arrest System

A system used to arrest an employee in a fall from a working level. It consists of an anchorage system, connecting means and body support and may include a lanyard, deceleration device such as a shock absorber, lifeline or suitable combination of these.

Qualified Person

One who, by profession or a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.

Rope Grab

A deceleration device that travels on a lifeline and automatically, by friction, engages the lifeline and locks to arrest the fall of a worker. A rope grab usually employs the principle of inertial locking, cam/level locking or both.

Self Retracting Lifeline (SRL)

A deceleration device containing a drum-wound line which can be slowly extracted from, or retracted onto, the drum under slight tension during normal employee movement, and which, after onset of fall, automatically locks the drum and gradually arrests the fall.

Shock/Energy Absorber

A component of a fall protection system that dissipates energy by deformation or extending the deceleration distance.

Snap Hooks

A connector comprised of a hook shaped body with a normally closed gate or similar arrangement, which may be opened to permit the hook to receive an object and when it is released, automatically closes to retain the object.

Supplier

A person who rents, leases, erects, installs or provides any tools, appliances or equipment or who sells or otherwise provides any designated substance or hazardous materials to be used by a worker in respect of any occupation, project or work site.

Swing Fall

A pendulum like motion that can result from moving horizontally away from, or toward, a fixed anchorage and falling. Swing fall generates the same amount of force when falling the same distance vertically. Swing fall has the hazards in both horizontal (swinging into an obstruction) and vertically (falling onto an obstruction or the ground) directions.

Total Fall Distance

The vertical distance between the anchorage location and connecting point on the body (harness D-ring) after the fall is arrested which includes the free fall and the deceleration distance.

Worker

A person engaged in an occupation (not including management who are designated by an employer as the employer's representative).

Worksite

A location where a worker is, or is likely to be, engaged in any occupation and includes any vehicle or mobile equipment used by a worker in an occupation.

Work Positioning System

This is a system of components attached to a vertical safety line and includes a full body harness, descent controllers and positioning lanyards used to support or suspend a worker in tension at a work position.

LIFE SAVING RULES



CONFINED SPACE

Obtain authorization before entering a confined space

- I confirm energy sources are isolated
- I confirm the atmosphere has been tested and is monitored
- I check and use my breathing apparatus when required
- I confirm there is an attendant standing by
- I confirm a rescue plan is in place
- I obtain authorization to enter



WORKING AT HEIGHT

Protect yourself against a fall when working at height

- I inspect my fall protection equipment before use
- I secure tools and work materials to prevent dropped objects
- I tie off 100% to approved anchor points while outside a protected area



WORK AUTHORIZATION

Work with a valid permit when required

- I have confirmed if a permit is required
- I am authorized to perform the work
- I understand the permit
- I have confirmed that hazards are controlled and it is safe to start
- I stop and reassess if conditions change



ENERGY ISOLATION

Verify isolation and zero energy before work begins

- I have identified all energy sources
- I confirm that hazardous energy sources have been isolated, locked, and tagged
- I have checked there is zero energy and tested for residual or stored energy



LINE OF FIRE

Keep yourself and others out of the line of fire

- I position myself to avoid:
 - Moving objects
 - Vehicles
 - Pressure releases
 - Dropped objects
- I establish and obey barriers and exclusion zones
- I take action to secure loose objects and report potential dropped objects



BYPASSING SAFETY CONTROLS

Obtain authorization before overriding or disabling safety controls

- I understand and use safety-critical equipment and procedures which apply to my task
- I obtain authorization before:
 - Disabling or overriding safety equipment
 - Deviating from procedures
 - Crossing a barrier



DRIVING

Follow safe driving rules

- I always wear a seatbelt
- I do not exceed the speed limit, and reduce my speed for road conditions
- I do not use phones or operate devices while driving
- I am fit, rested and fully alert while driving
- I follow journey management requirements



HOT WORK

Control flammables and ignition sources

- I identify and control ignition sources
- Before starting any hot work:
 - I confirm flammable material has been removed or isolated
 - I obtain authorization
- Before starting hot work in a hazardous area I confirm:
 - A gas test has been completed
 - Gas will be monitored continually



SAFE MECHANICAL LIFTING

Plan lifting operations and control the area

- I confirm that the equipment and load have been inspected and are fit for purpose
- I only operate equipment that I am qualified to use
- I establish and obey barriers and exclusion zones
- I never walk under a suspended load



FIT FOR DUTY

Be in a state to perform work safely

- I will be physically and mentally in a state to perform my assigned duties
- I commit to not being under the influence of alcohol or drugs
- I will inform a supervisor immediately if I or a co-worker may be unfit for work

customerservice@energysafetycanada.com
1 800 667 5557

EnergySafetyCanada.com