Universal Training Corp.

Fall Protection
Northwest Territories and Nunavut
OH&S Compliant

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First Edition
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Saga Universal Training Corp. is dedicated to reducing deaths caused by illness and injury. It is expected that an employer will take the fundamentals of this training and apply them to their specific equipment and workplace.

Readers should not assume that reviewing this manual alone constitutes complete training.
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Saga Universal Training Corp. wishes to acknowledge the efforts of all the people who contributed to the writing, editing, and layout of this manual.

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Disclaimer

- It is expected that an employer will take the fundamentals of this training and apply them to their specific workplace.
- Job and / or familiarization of workers in specific workplace environments are in addition to this training.
- Although every effort is made to ensure the accuracy, currency and completeness of the information.
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Course Description

Program Overview

- This course is designed to introduce the learner to the basic concepts, hazards, hazard control processes and safe work procedures associated with working at height.
- This manual follows the regulations, guidelines, principles and recommendations established by the Northwest Territories and Nunavut Safety Act, and Regulations.
- Due to the different policies and procedures and equipment utilized on different work sites certain statements in this program may not apply.
- The course is intended to supplement a company’s larger Health & Safety Management System.

Certification:

- At the end of each chapter there will be a multiple choice, open-book exam of which, at least 80% correct must be achieved.
- Certificates of training issued by Saga Universal Training Corp. must be recognized by the employer and are valid for 3 years from the date of completion.

Course Goals:

- The student should be aware of the various legislation, regulations, and standards that pertain to workplace health and safety.
- The student should be able to assess a situation involving fall hazards and determine the safest approach
- The student should understand the advantages, disadvantages, and limitations and hazards associated with various fall protection components and equipment used in fall protection.
- The student should understand how to reduce the risk of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.
- The student should have an awareness of why, when and how equipment inspections are to be completed.
- The student should have an awareness of the skills necessary to be able to assess an anchor's strength, stability and location.
- The student should have an awareness of various fall protection systems used for unique work areas and tasks.
- The student should have an understanding of the effect of a fall on the human body, and how to reduce the risk of injuries due to a fall.
- The student should have an understanding of emergency response procedures to be used at the work site.

Exposure to Harm

Falls are a hazard found in many work settings.

A fall can occur during walking, climbing a ladder, or falling very long distances.

All though most falls will be related to slips and trips, about 1/3 will be falls to a lower level.

Types of Fall Hazards
- Trips and slips
- Edge
- Excavation
- Hole
- Opening
- Equipment

Falls are one of the leading causes of injuries and deaths in the workplace.

Any fall could result in serious injuries or death.

The elimination of fall hazards and the reduction of risk through the application of various fall protection systems can substantially reduce injuries due to falls.

What is Fall Protection?

Fall protection is a planned system used to protect workers from death or potential injury in the event that they lose their balance while performing a task at height.

A “system” is a set of detailed methods, procedures, and routines created to carry out a specific activity, perform a duty, or solve a problem. If one part of a system fails – the entire system fails.

A great diversity of personal fall protection systems are used by workers who have to work at height to position the worker or to restrain his/her movements in order to prevent falls or to protect him/her in case of fall.

A fall arrest system is used where there is a risk of free fall from height.

Competent workers using appropriate procedures, equipment and training can reduce the risk of injuries due to falls.

Competency

“competent” means in respect of a function, task, or duty, possessing the knowledge, experience and training to perform the function, task or duty.

It is your employer’s responsibility to ensure you are trained in the use of all workplace policies, procedures, and equipment used at your work site.

Only your employer can assess your experience and determine your competency. However, the worker also has a responsibility to ensure they have the training and experience to work safely.

This course is designed to introduce the learner to the basic concepts, hazards, hazard control processes and safe work procedures associated with fall protection.

Chapter 1 Oversight:

There are many layers of oversight of safety requirements in the workplace that are often in a hierarchical form of priority. For example, federal laws and regulations normally supersede provincial and territorial authority, but in some instances the federal government has given authority to the provinces and territories.

An employer must ensure an employee is aware of all legislation that relates to fall protection, which includes parts of the Safety Act and Regulations.

Goal:
The student should be aware of the various legislation, regulations, and standards that pertain to workplace health and safety.

Objectives:

1. The student should understand the relationship between Legislation, Regulations, Standards, Due Diligence, and Best Practices.

2. The student should be aware of the key elements of a health and safety program.

3. The student should understand their rights and responsibilities with respect to working alone.

4. The student should be aware of the Parts of the Safety Act and Regulations that pertain to fall protection.

5. The student should be aware of the Fall Protection Personal Protective Equipment Codes of Practice.

6. The student should know where to find current Parts Safety Act and Regulations that relate to fall protection.

Students Notes

Legislation

Criminal Code of Canada Section 217.1

- One of the farthest-reaching mechanisms of oversight regarding health and safety is Section 217.1 of the Criminal Code of Canada, it is where “due diligence” is defined in law:

“Everyone who undertakes, or has the authority, to direct how another person does work or performs a task is under a legal duty to take reasonable steps to prevent bodily harm to that person, or any other person, arising from that work or task.”

Canada Labour Code Part ll

- In Canada OH&S is a provincial jurisdiction and every province has its own OH&S legislation, code, and regulations.
- However, some industries are federally regulated, which can bring OH&S for those industries under the Canadian Labor Code and under federal jurisdiction.
- The Canada Labour Code applies to employees of the Federal Government, the Post Office, airports, banks, canals, highway transport, pipelines, radio and television broadcasting, railways, shipping services, and many more.
- All Provinces and Territories must meet the minimum requirements of the Canada Labour Code and Regulations in their own legislation and are certainly encouraged to exceed them.
- Approximately 90% of the Canadian workforce falls under the OH&S legislation of the province or territory in which they work.

Legislation and Regulations

- This information is for awareness purposes only. You must familiarize yourself with specific regulations that pertain to you and your worksite.

- The Northwest Territories and Nunavut Safety Act and Regulations apply to every occupation, employment and business.

- Workplaces must meet the minimum requirements of regulations but are also encouraged to exceed them.

- Whether the workplace simply meets or chooses to exceed the minimum of the regulations, the employer should document their regulations into the company's safe work policies and procedures manual.

- The Northwest Territories and Nunavut Safety Act and Regulations apply to every occupation, employment and business.

Northwest Territories and Nunavut Safety Act,
Follow the link below and familiarize yourself with:
Part 4 Duty of employer
Part 5 Duty of worker
Part 13 (2) Right to refuse work
Part 22 Offence and punishment

https://www.justice.gov.nt.ca/en/files/legislation/safety/safety.a.pdf

Northwest Territories and Nunavut, Occupational Health and Safety Regulations
Follow the link below and familiarize yourself with:

Interpretation

Application

Part 1 (4) General Duties Not Limited

Part 3 General Duties;
(14) Young Persons,
(33) Working Alone or at Isolated Work Site,

https://www.justice.gov.nt.ca/en/files/legislation/safety/safety.r8.pdf

Standards

- Regulations often refer to standards where the regulation will require the worker to follow a specific standard or use equipment that has met the requirements of a specific standard.

- The standards organizations are not the government so they cannot implement regulations.

- However, the standards organizations are made up of experts in various disciplines.

- The standards organizations most frequently referenced in OH&S regulations are:

    - CSA Group, formerly the Canadian Standards *Association* (CSA) (CAN/CSA)
    - American National Standards Institute (ANSI)
    - European Committee for Standardization (CEN), or in French: (Comité Européen de Normalisation) Conformité Européenne (CE),

Others Include:

- American Society of Safety Engineers (ASSE),
- National Fire Protection Association (NFPA),
- Underwriters Laboratories (UL),
- Underwriters Laboratories of Canada (ULC),
- Safety Equipment Institute (SEI).

For compliance purposes, any equipment required to meet specific standards must bear the mark or label of a nationally accredited testing organization such as CSA, ANSI, or CE as evidence that the equipment has been approved to the requirements of the Standard.

Use caution when purchasing equipment required to meet the various standards. Manufacturers must meet stringent criteria to have their equipment tested to these standards. There have been cases of fraud where equipment has not been tested to the standards criteria and counterfeit marks are placed on the equipment. It is always best to purchase equipment from reputable and authorized dealers.

The Bottom Line

- When a regulation requires certain standards to be followed, they must be followed just as if they were written verbatim in the regulation.

Due Diligence

- Applied to occupational health and safety, due diligence means that employers shall take all reasonable precautions, under the particular circumstances, to prevent injuries or accidents in the workplace.

  Note: The wording is very similar in the Criminal Code of Canada Section 217.1.

Best Practices

- A best practice is a method or technique that has been generally accepted as superior to any alternatives because it produces results that are superior to those achieved by other means, or because it has become a standard way of doing things.

- Best practices are used to maintain quality as an alternative to mandatory legislated standards and can be based on self-assessment or benchmarking.

- A procedure that has been shown by research and experience to produce optimal results and that is established or proposed as a standard suitable for widespread adoption.

- There are some standards that are not required to be followed by any regulations, but individuals and groups follow them because they produce results.

Best Practice vs. Due Diligence

- If due diligence in health and safety means to take all reasonable precautions, and best practices are used to maintain quality as an alternative to mandatory legislated standards; then wouldn't following best practices be considered an example of due diligence?

- A standard not required through a regulation but has been generally accepted as superior could be considered a best practice and therefore should be followed to meet due diligence.

  Note: Can you think of an example of best practices and due diligence being followed at your worksite?

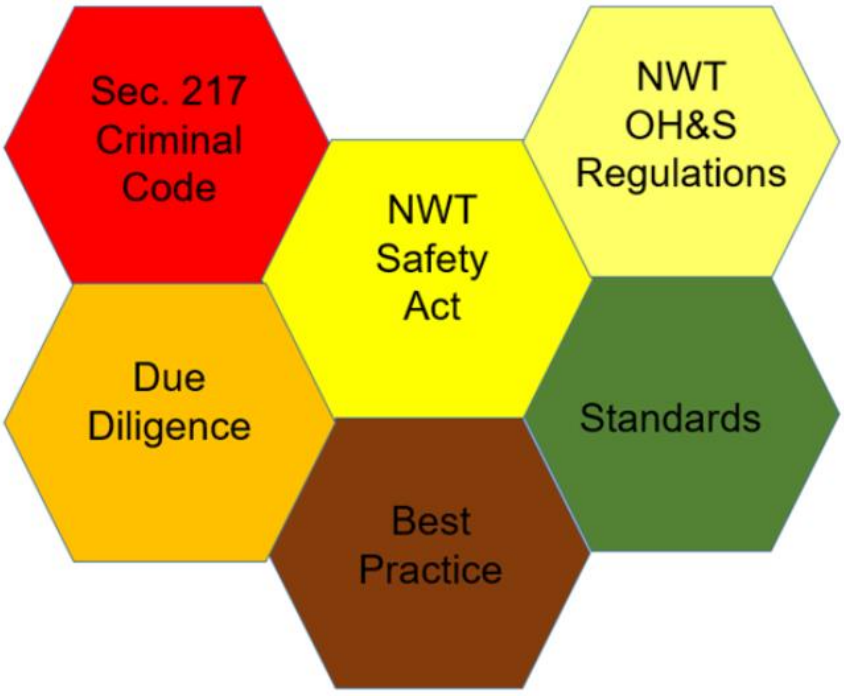
Reasonably Practicable

- In OHS the term “reasonably practicable” is frequently used.
- Reasonably practicable is a recognized term that is assessed using the reasonable person test.
- That is, what would a dozen of your peers consider reasonable in similar circumstances.
- Your peers would likely review what you did and compare it to what they do in their own operations.
- Some might do more, others less.

Requirement to Comply

Notwithstanding the requirement for competency (training and experience), appropriate equipment, and the right to refuse unsafe work:

- If legislation, regulations, or an adopted code imposes a duty on an employer, the employer must ensure that duty is met in accordance with the legislation, regulations, or the adopted code.
- If legislation, regulations, or an adopted code imposes a duty on a worker, the worker must perform that duty, and the employer must ensure the worker performs that duty in accordance with the legislation, regulations, or the adopted code.



Safety Regulations specific to Fall Protection.
Follow the link below and familiarize yourself with:

Part 7 Personal Protective Equipment;
- (103) Lifelines,
- (104) Personal Fall Arrest,
- (105) Full Body Harness,
- (106) Snap hooks on Personal Fall Arrest,
- (107) Lanyards
- (108) Workers' Responsibilities
- (109) Inspections

Part 9 Safeguards, Storage, Warning Signs, and Signals
- (118) Interpretation
- (119) Protection Against Falling
- (120) Fall Protection Plan
- (121) Control Zone
- (122) Anchor Points and Anchor Plates

https://www.justice.gov.nt.ca/en/files/legislation/safety/safety.r8.pdf

Code of Practice

A code of practice is not mandatory.

However, a Personal Protective Equipment Fall Protection Code of Practice has been produced by the Workers' Safety & Compensation Commission (WSCC).

In legal proceedings failure to observe a code of practice may be a consideration when determining whether a worker complies with the Safety Acts and related regulations.

Provides practical guidelines.

Needs to be adapted to the work site.

May be used as evidence.

A code of practice should be maintained and periodically reviewed.

Should be followed unless there's a better way.

A code of practice should be in writing and available to workers at the work site who are affected by it.

Workers affected by the code of practice must be familiar with it before work begins.

Workers should be consulted about the content of the code of practice as they often have the best understanding of the hazards involved in the work.

The help of safety professionals such as industrial or occupational hygienists or engineers may be necessary if the situation is particularly complex.

You can review the Fall Protection Personal Protective Equipment Codes of Practice by clicking the link below:

https://www.wscc.nt.ca/sites/default/files/documents/PPE_Fall%20Protection_Current_Code%20of%20Practice_%20NT%20and%20NU%20English.pdf

Chapter 1 Slide 48 – Video – CCTV footage of a worker falling from a ladder in a mall.

Summary

What was covered in Chapter 1?

- The relationship between Legislation, Regulations, Standards, Due Diligence, and Best Practices.
- The Parts of the Safety Act and Regulations that pertain to fall protection.
- The key elements of a health and safety program.
- The Regulations that pertain to fall protection.
- The Fall Protection Personal Protective Equipment Codes of Practice.
- Where to find current Regulations that relate to fall protection.

Chapter 2: Fall Protection Situational Awareness

Goal: The student should be able to assess a situation involving fall hazards and determine the safest approach.

Objectives:

1. The student should be able to identify training requirements for fall protection.

2. The student should be able to assess a situation where fall protection is required.

3. The student should be able to determine the most appropriate fall protection system to be used in different situations.

4. The student should be able to identify when a fall protection plan is required.

5. The student should be able to list the specific information that is required in a fall protection plan.

Workers must be able to evaluate the elements of the environment they are working in, understand the situation, and be able to decide the best approach to ensure their safety while working in area with fall hazards.

Workers must be trained in the safe use of the fall protection system before allowing the worker to work in an area where a fall protection system must be used.

Workers also need to be able to determine under what circumstances fall protection is required and which fall protection system is most suitable for each situation.

Workers must know when a fall protection plan is required and be aware of the requirements of fall protection plans.

Fall protection must be in place before work with a fall hazard begins.

Instruction of Workers

An employer must ensure that a worker is trained in the safe use of the fall protection system before allowing the worker to work in an area where a fall protection system must be used.

The training should include the following:

(a) a review of current legislation pertaining to fall protection;

(b) an understanding of what a fall protection plan is;

(c) fall protection methods a worker is required to use at a work site;

(d) identification of fall hazards;

(e) assessment and selection of specific anchors that the worker may use;

(f) Instructions for the correct use of connecting hardware

(g) Information about the effect of a fall on the human body, including
- (i) maximum arresting force,
- (ii) the purpose of shock and energy absorbers,
- (iii) swing fall,
- (iv) free fall;

(h) pre-use inspection;

(I) emergency response procedures to be used at the work site, if necessary; and

(J) practice in

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

In addition, an employer must ensure that a worker is made aware of the fall hazards particular to that work site and the steps being taken to eliminate or control those hazards.

General Protection

Remember, that if the hazard can be eliminated that would always be the first choice. If the hazard cannot be eliminated it must be controlled. An example of eliminating the need to work at height would be to make equipment, lighting, controls, valves, etc., accessible from ground level or from a location where there is no hazard of falling.

When is Fall Protection Required?

A worker must use fall protection:

- if a worker may fall 3 metres (~10ft.) or more.
- where there is a risk of injury (i.e., into or onto a hazardous substance or object).
- if a worker may fall more than 1.2 metres (~4 ft.) at a permanent work area (i.e. loading docks and mezzanines).

While guardrails are the preferred method of preventing a worker fall, guardrails are not always practicable.

The employer's second choice is to protect workers by having them use a Fall Restraint system.

If a Fall Restraint system is not practicable, the employer must ensure that workers use an equally effective means that protects the workers from falling.

While a personal fall arrest system is an option, it will rarely be used in this height range of 1.2 (~4 ft.) to 3 metres (~10 ft.) because of lack of sufficient clearance distance to prevent worker contact with a lower surface in the event of a fall (not practicable).

Unusual Possibility of Injury

- Situations involving an “unusual possibility of injury” may include work performed above moving water, operating machinery, open vessels containing potentially harmful substances, extremely hot or cold surfaces, etc.

- An unusual possibility of injury refers to the potential for a worker to sustain injuries more serious than those likely to result from landing on a solid, flat surface.

- At fall heights of 1.2 (~4 ft.) metres or less, the OH&S Code does not require the use of a fall protection method unless there is an unusual possibility of injury.

Temporary or Permanent Work Area

- The words “temporary” and “permanent” describe the nature of the work being performed, not whether the work area is a temporary or permanent structure.

- Differentiating work areas on the basis of whether they are temporary or permanent links the likelihood of injury to the concepts of exposure to a hazard and frequency of exposure to that hazard.

- Applying the concepts tries to place practical requirements on where and how workers are to be protected from falling.

- For example, a flatbed trailer may have a deck height of 1.3 (~4 ft.) metres above grade. It may not be reasonable to expect all such flatbed trailers to be equipped with perimeter guardrails or some other fall protection option given how infrequently a worker is expected to be on the deck and exposed to a fall hazard.

In some situations, it may be very difficult to distinguish between a temporary work area and a permanent work area for the purposes of applying these regulations.

- Unfortunately, there is no way that a frequency of exposure can be stated for each and every possible situation involving worker exposure to a fall hazard between the fall heights of 1.2 metres (~4 ft.) and 3 metres (~10 ft.).

Refer to the examples on the following page

The following examples are intended to help readers assess their own work areas and determine if the area is a “temporary work area” or a “permanent work area”.

Example 1

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

Example 2

A worker at a chemical plant stands on an elevated platform at a height of 2.1 metres (~7 ft.) above grade, adjusting a valve once a month. The work area is a temporary work area because the work activity is done infrequently. If the valve is adjusted weekly or more frequently, then the work area should be considered to be a permanent work area.

Example 3

A worker does work while standing on the deck of a flatbed trailer that is 1.3 metres (~4 ft.) above grade. Normally, workers do not need to go onto the deck to adjust the load, straps, tarpaulins, etc. In the rare case that a worker must work while standing on the deck, then this should be considered to be a temporary work area.
If the worker is frequently on the deck, then the deck should be considered to be a permanent work area and subject to the fall protection requirements applicable to permanent work areas.

Example 4

A worker is working from a loading dock that is open on three sides and the height of the loading dock is 1.6 metres (~5 ft.) above grade. If the worker is frequently on the loading dock i.e. once every few days or more often, then the loading dock should be considered to be a permanent work area. The worker frequently accesses the loading dock as part of a routine work activity.

Example 5

A worker performs work from a highway billboard platform that is at a height of 2.1 metres (~7 ft.) above grade. The worker performs work from the platform once in every four to eight weeks, making the platform a temporary work area.

Determining Fall Distance

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

On a sloped roof, the 3 metre (~10 ft.) fall distance is measured in two ways:

(1) *if the worker is upslope from the eave and more than 2 metres (~6.5 ft.) away from a gable end*, the fall distance is measured from the top of the eave to a lower level. Lower levels include, but are not limited to, those areas or surfaces to which a worker can fall such as the ground, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment or structures. The vertical height that a worker may roll or slide down the sloped roof before he or she loses contact with the roof is not considered to be part of the “fall distance”;

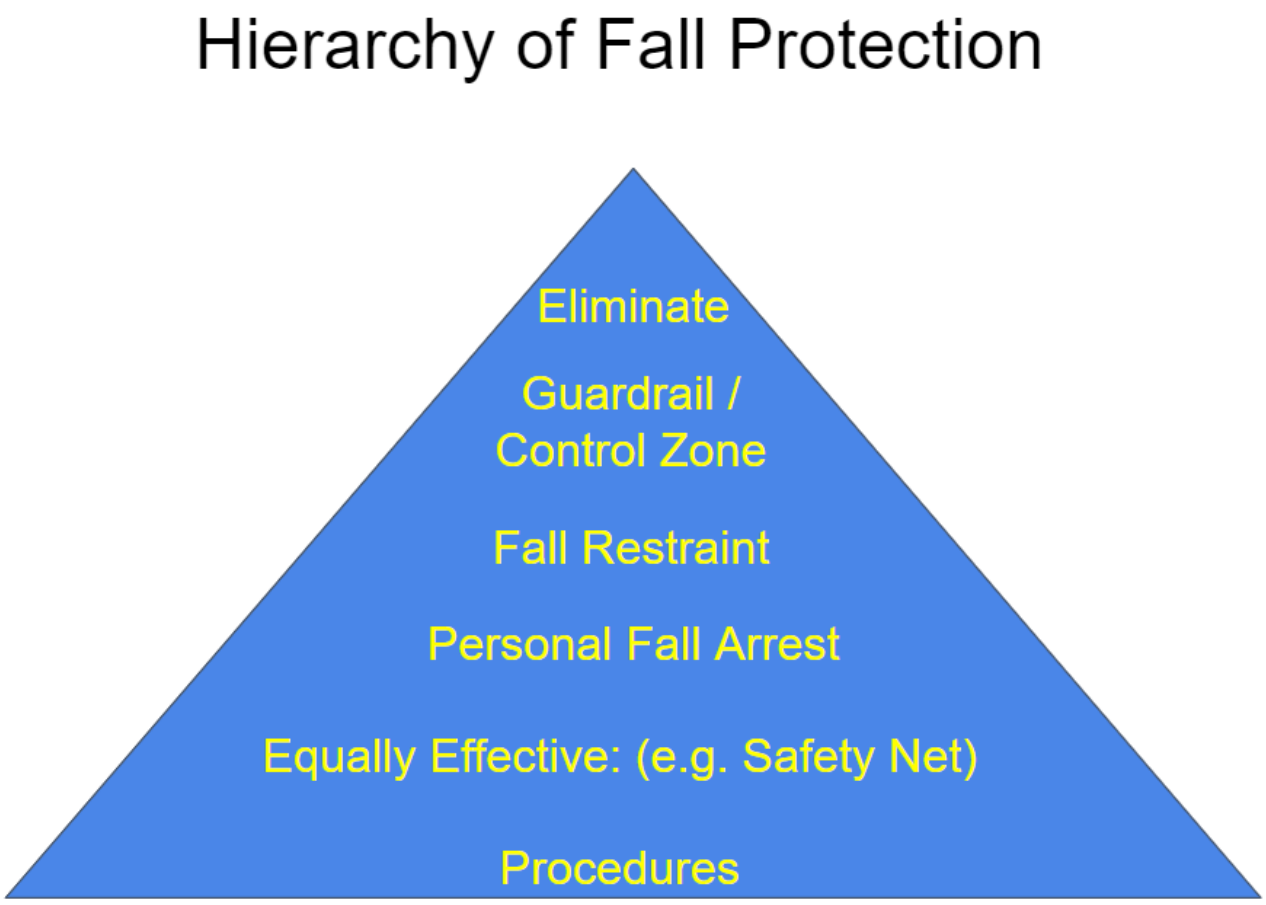
(2) if the worker is within 2 metres (~6.5 ft.) of a gable end at any point upslope of the eave, the fall distance is taken as the vertical distance from the worker’s feet to a lower level. The assumption here is that the fall hazard is the worker falling off the gable end – the worker is much less likely to roll or slide down to the eave and then lose contact with the roof.

In the case of multi-level sloped roofs, if a worker falls from one level to the next, a distance of 3 metres (~10 ft.) for example, and then continues to fall to the next level, an additional 2.5 metres (~8 ft.) for example, the need to provide fall protection is based on the overall fall distance of 5.5 metres (~18 ft.). The sloped roof onto which the worker falls is not considered to be a safe lower level i.e. one from which a further fall would be prevented.

Hierarchy of Fall Protection

Fall protection is of two major types:

- general fall arrest (or shared), such as covers, guardrails, control zones, and nets, and
- personal systems, such as lifelines, fall arrest, and fall restraint



The most common means of fall protection is the use of a guardrail.

- Guardrails are the preferred first choice for fall protection purposes.
- Guardrails become a permanent part of the installation, eliminating the need to equip workers with personal fall protection equipment and training those workers at periodic intervals.
- As such, guardrails are a type of passive fall protection system that is available at all times and does not require workers to do anything special.
- If a guardrail is used, it must meet the design requirements listed in section 315, i.e., position and location of horizontal and vertical members, strength of design, etc.
- Guardrails do not eliminate the fall hazard because like most engineered controls guardrails have administrative controls (procedures) that are not always followed.

Using the hierarchy of fall protection, if guardrails are not possible the second option is to protect workers by having them use a Travel Restraint system.

Travel Restraint

In travel restraint, the worker needs to correctly position the device on the life safety rope so that it is impossible to reach an unprotected edge.

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

Worker using work positioning system for travel restraint on a roof

Self Retracting Devices in Travel Restraint

- Self-retracting devices must not be used in a Travel Restraint system unless the length of the lifeline on the drum of the unit prevents the worker from reaching the edge from which he or she could fall.

- If a worker's movement cannot be adequately restricted by the Fall Restraint system, a personal fall arrest system must be used.

It is good practice and recommended that deceleration devices are also included in restraint systems, in case of misuse.

Personal Fall Arrest

The most common form of fall arrest in the workplace is the Personal Fall Arrest System, or PFAS ("lifeline").

Such a system should include 5 elements referred to as ABCDEs of Fall Arrest:

- A – Anchorage – a fixed structure or structural adaptation, often including an anchorage connector, to which the other components of the PFAS are rigged.
- B – Body Wear – a full body harness worn by the worker.
- C – Connector – a subsystem component connecting the harness to the anchorage – such as a lanyard.
- D – Deceleration Device – an essential subsystem component designed to dissipate the forces associated with a fall arrest event.
- E – Emergency Plan & Equipment – a clear and simple approach to rescue of a suspended worker following a fall arrest event. All workers should be familiar with the site-specific plan and competent to implement it. If a suspended worker is not recovered in good time, they may suffer the potentially serious effects of "suspension trauma".

Personal Fall Arrest Critical Components

- Harness Fit
- Anchor Strength
- Clearance
- Rescue

While a personal fall arrest system is the 3rd option it may not be practicable where there is a lack of clearance distance to prevent worker contact with a lower surface in the event of a fall.

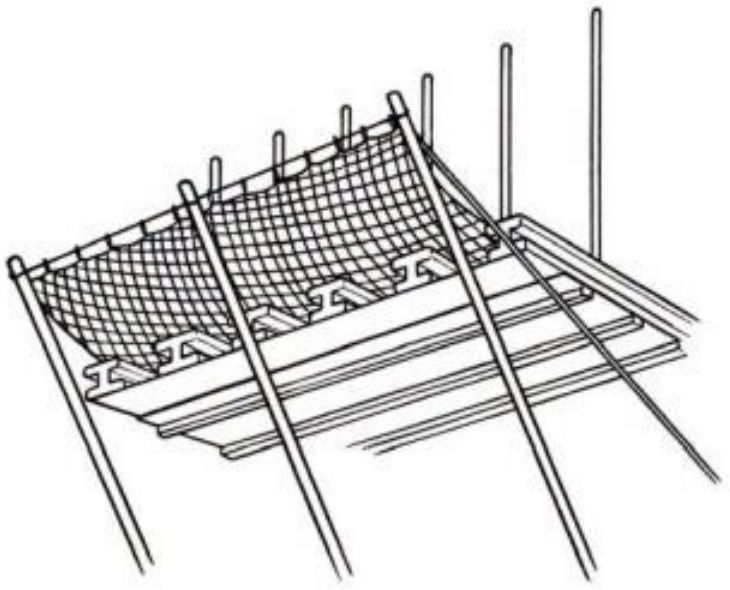
If personal fall arrest is not possible the next option is safety nets.

Safety Nets

An employer must ensure that a safety net meets all required regulations and standards.

A safety net must:

- Be manufactured from rope not less than 8 mm in diameter.
- Have equivalent in breaking strength to number one grade pure manila rope 9 mm in diameter.
- Have a mesh size not exceeding 150 mm by 150 mm.
- Have safety hooks or shackles of drop-forged steel that is 22.2 kN proof tested.
- Have joints between the net panels that are equal in strength to the net.
- Extend not less than 2.4 m beyond, and is not more than 6 m below, the work area.
- Be installed and maintained so that, at the maximum deflection of the net when arresting the fall of a worker, the net does not make contact with another surface.

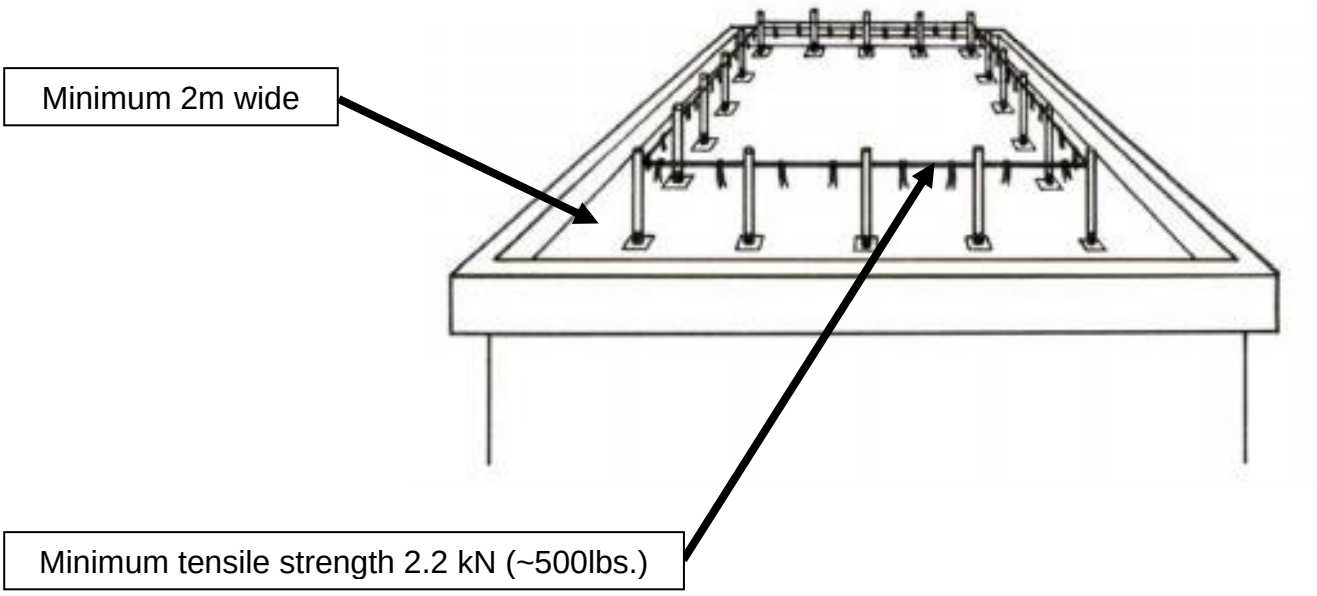


Control Zone

Under specific circumstances a control zone may be an alternative to guardrails.

- Guardrails are not possible.
- Virtually flat roof (< 4 degree slope).
- Minimum width of the control zone of 2 metres (~6.5ft.).
- Barrier has a minimum tensile strength of 2.2 kN (~500lbs.).

Example of control zone marked out on flat roof



The use of a control zone is an approach to fall protection that places special requirements on workers and work being performed on a nearly level working surface within 2 metres (~6.5 ft.) of an unguarded edge from which a worker could fall.

- Control zones can be used on surfaces having a slope of up to 4 degrees measured from the horizontal.

- If a worker works within 2 metres (~6.5 ft.) of the control zone, i.e., within 4 metres (~13 ft.) of the unguarded edge, a raised warning line or equally effective means is required.

- If a worker works within the control zone, then a Fall Restraint system must be used.

- A control zone cannot be used if the level working surface on which work is being performed is less than 4 metres (~13 ft.) wide, (i.e. a skeletal structure that is a work area). In such circumstances, one of the other methods of fall protection required must be used.

- If a worker will at all times remain further from the unguarded edge than the width of the control zone, no other fall protection system need be used.

- A worker is not required to use a fall protection system when crossing the control zone to enter or leave the work area.

- When crossing a control zone to get to or from the unguarded edge, a worker must follow the most direct route.

Line defining the control zone

- An employer must ensure that a control zone is clearly marked with an effective raised warning line, or another equally effective method if a worker is working within 2 metres of the control zone.

- The raised warning line or other equally effective means such as barricades must be placed at least 2 metres (~6.5 ft.) from the edge.

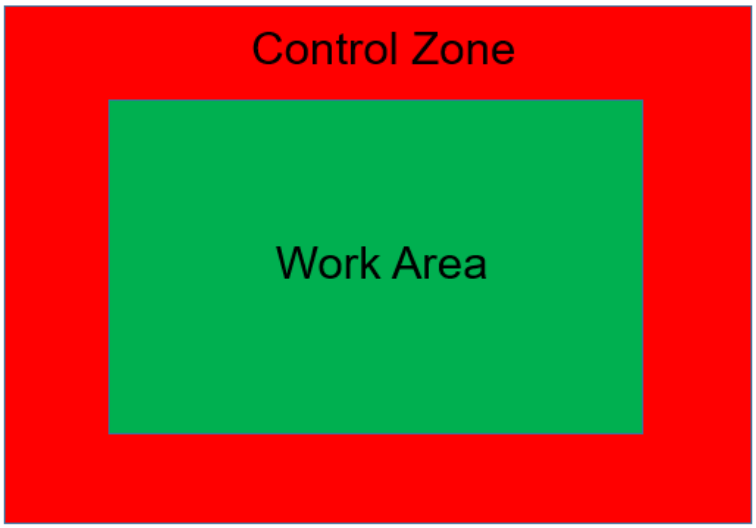
- The warning method provides a visual and physical reminder of the presence of the hazard.

Work within the control zone

- If a worker works within the control zone, then a Travel Restraint system or equally effective means that prevents the worker from getting to the unguarded edge must be used.

- A Travel Restraint system is always preferred but may not be appropriate or possible in all circumstances.

- A person who is not directly required for the work at hand must not be inside a control zone



- If a worker will at all times remain further from the unguarded edge than the width of the control zone, no other fall protection system need be used.

- A worker is not required to use a fall protection system when crossing the control zone to enter or leave the work area.

- When crossing a control zone to get to or from the unguarded edge, a worker must follow the most direct route.

Procedures in place of fall protection equipment

An employer may develop and use procedures in place of fall protection equipment, if it is not reasonably practicable to use one of the fall protection systems.

The following situations are examples of where procedures might be acceptable:

- the installation or removal of fall protection equipment.
- roof inspection.
- emergency repairs.
- at-height transfers between equipment and structures if allowed by the manufacturer’s specifications.
- situations in which a worker must work on top of a vehicle or load.
- work is limited to light duty tasks of limited duration.

A hierarchy of fall protection means the fall protection systems are in order of preference based upon risk. The system with the least risk that will allow the work to be done must be chosen first.

If a guardrail is possible it must be the first option,

Option 1: Guardrails

If the use of a guardrail or control zone is not reasonably practicable…

Option 2: Travel Restraint “Fall Restraint system” means a type of fall protection system, including guardrails or similar barriers that prevents a worker from travelling to the edge of a structure or to a work position from which the worker could fall.

If the use of a Fall Restraint system is not reasonably practicable…

Option 3: Personal Fall Arrest Personal Fall Arrest System means personal protective equipment that provides a means of safely arresting the fall of a worker and that, subsequent to the arrest of the fall, by itself does not permit the further release or lowering of the worker

If the use of a personal fall arrest system is not reasonably practicable…

Workers must use an equally effective fall protection system. Example: Safety Net, Control Zone

If no other fall protection system is available…

Procedures in place of fall protection equipment.

Fall Protection Plan

A fall protection plan is required if work is performed at a work site at which a fall of 3 metres (~10 ft.) or more may occur and guardrails do not protect workers.

The plan must be available at the work site before work with a risk of falling begins.

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

The fall protection plan must specify the following information:

- The fall hazards at the work site.
- The fall protection system to be used at the work site.
- The procedures used to assemble, maintain, inspect, use and disassemble the fall protection system, where applicable; and
- 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.

Summary

What was covered in Chapter 2?

- Training requirements for fall protection.
- Assessment of a situation where fall protection is required.
- How to determine the most appropriate fall protection system to be used in different situations.
- When a fall protection plan is required.
- Information that is required in a fall protection plan.

Chapter 3: Equipment

Goal: The student should understand the advantages, disadvantages, and limitations and hazards associated with various fall protection components and equipment used in fall protection.

Objectives:

1. The student should understand why a full body harness is the only acceptable type of harness used in industrial fall protection systems.

2. The student should be familiar with various lanyards used in fall protection systems.

3. The student should know the elements that contribute to arrest force, and how to limit the arrest forces experienced in a fall.

4. The student should be familiar with types of equipment used in fall protection systems

Body Holding Devices

This is a brief overview of the regulatory requirements regarding Body Holding Devices. The full body harness will be covered in detail in Chapter 8.

Full Body Harness

An employer must ensure the full body harness is approved to required standards.

A worker using a personal fall arrest system must wear and use a full body harness. Full body harnesses are the only type of harness allowed in personal fall arrest systems.

Full body harnesses have four main functions:

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

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

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

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

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

Body Belts

Some jurisdictions allow the use of Body Belts limiting their use to Travel Restraint and systems.

The use of body belts in a fall arrest system is prohibited due to the possibility of death or injury resulting from a worker falling out of the belt or abdominal injuries.

In jurisdictions where Body Belts are allowed in they have been banned on most sites.

Lanyard

An employer must ensure that a lanyard is approved to required standards.

A lanyard is a flexible line of webbing or synthetic or wire rope that is used to secure a full body harness or safety belt to a lifeline or anchor point.

There are different types of lanyards; Elastic, Twin Leg, Adjustable, and lanyards designed to be tied-back on itself (Chokered).

Lanyards can be made of various materials each with their own attributes making each one more desirable for use in different environments.

Non-Adjustable Lanyard
With Energy Absorber

Non-Adjustable Twin-Leg
Lanyard With Energy Absorber

NEW
In January 2017
CSA changed the name to
“Class Y Lanyard”.

Adjustable lanyard with
Energy Absorber

Use Keepers to Control Extra Webbing

When the lanyard is adjusted to a shorter length it is important to use the "keepers" (aka - "webbing stays") to control extra webbing.

Elastic Lanyard with
Energy Absorber

Rope Lanyard
With Energy Absorber

Rope Lanyard
Without Energy Absorber

Wire Rope Lanyards

When working in areas with hazards such as a tool or corrosive agent that could sever, abrade, or burn a lanyard the worker might choose a lanyard that is made of wire rope or other material appropriate to the is used in the work area.

However, if a worker works near an energized conductor or in a work area where a lanyard made of conductive material cannot be used safely, another type of lanyard or possibly a different fall protection system would have to be used.

A wire-rope lanyard should be used in any situation that involves welding, cutting with a torch or other similar operations.

Synthetic fibre lanyards can be cut, burned, melted or otherwise damaged during such operations.

In the event that a worker works near an energized conductor or in circumstances where a lanyard made of conductive material cannot be used, the worker must use another effective means of fall protection.

A system using a wire-rope lanyard must incorporate a shock absorber.

Chokering / Tie Back

Tying equipment back on itself (Chokering) affects the overall strength and must not be done unless the manufacturer specifically states that it is specifically designed for that type of use.

Lanyard Length

Daisy Chaining (Connecting two lanyards together)

Lanyards must not be “daisy-chained” to extend the distance that a worker can move.

The fall arrest system must be repositioned to extend or alter worker movement.

Daisy-chaining is unacceptable because it can greatly increase a worker’s fall distance, resulting in arrest forces capable of injuring the worker or allowing the worker to contact a lower level.

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

(a) WITHOUT a shock absorber; the free fall distance of 1.2 metres (~4 ft.)

(b) WITH a shock absorber; the maximum allowed free fall distance determined by the manufacturer, or 2 metres, whichever is less.

The only fall arrest system in which a shock absorber or shock absorbing lanyard is not desired is one in which the added fall distance (1.1 metres [3.5 feet] for North American shock absorbers, 1.75 metres [5.75 feet] for European shock absorbers) created by the shock absorber fully extending creates a greater risk of injury than if the shock absorber were not used.

A shock absorber should not be used where this added distance could result in worker injury. However, allowable arrest forces can not be exceeded.

A self-retracting device limits the fall distance and may be the best choice in situations with reduced clearance distance.

Arrest force is determined by:

- the weight of the worker,
- the distance of the free fall, and
- ability of the fall arrest system to absorb the energy associated with the fall.

You can reduce injuries by reducing the arrest force.

Maximum Arrest Force (MAF)

Maximum arresting force is the short-duration (milliseconds to tenths of a second), peak dynamic force acting on a worker's body as the worker's fall is arrested.

The Maximum Arresting Force (MAF) is 8 kN (1800 lb).

Energy Absorbers

To arrest a fall in a controlled manner, it is essential that there is sufficient energy absorption capacity in the system.

Without this designed energy absorption, the fall can only be arrested by applying large forces to the worker and to the anchorage, which can result in either or both being severely affected.

A shock absorber is a device intended to reduce the force on a worker when a personal fall arrest system is operating.

The shock absorber must always be attached to the D-Ring.

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

An employer must ensure that a personal fall arrest system consists of a full body harness and a lanyard equipped with a shock absorber or similar device.

CSA Standard creates two categories of shock absorber (re-named as energy absorber by CSA), known as E4 and E6. An E4 shock absorber is equivalent to the type of shock absorber that has been in use for many years.

An employer must ensure that if a shock absorber or shock absorbing lanyard is used as part of a personal fall arrest system, it is approved to the required standards.

In the case of a heavy worker, an E4 shock absorber may be unable to absorb all the energy of a big fall, causing the worker to "bottom out" and be jolted with the residual energy.

Heavier workers should be using an E6 shock absorber. In the case of a heavy worker who takes a long free fall, perhaps because the only anchor location was at the worker's feet, a European shock absorber may be a better choice. Because of its 1.75 metre (5.75 foot) elongation, it should be able to absorb all the energy of the fall.

CSA created the two ratings to better protect workers of different body weights.

Research studies have shown that the short duration forces that happen during fall arrest are unlikely to cause injury if they act vertically upwards through the buttocks and spine and are limited to no more than 9 kN (2000 lbs). The 6 kN (1350 lb) limit is therefore considered safe, but as was discovered during the studies, is subject to the following conditions:

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

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

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

The shock absorber / energy absorber is always attached closest to the body

A shock absorber or similar device is not required if the personal fall arrest system is used in accordance with section 151 which states:

If the shock absorber is removed from the personal fall protection system, then the worker's free fall distance must be limited to 1.2 metres (~4 ft.).

Keep in mind that even with this fixed distance, employers and workers need to be aware that, depending on the type of lanyard selected, the maximum arresting force of 6 kN stated in subsection 151(3) could be exceeded. And therefore employers and workers must ensure the maximum arresting force to which a worker can be exposed during fall arrest in Alberta does not exceed 6 kN (1350 lbs).

Know Your Equipment

- Only use equipment for the purpose for which it was designed.
- Always follow the manufacturers' instructions for the proper use of equipment.
- Unless stated otherwise in the manufacturers' instructions, assume the equipment is designed to be used by only one worker at a time.
- Ensure equipment components are compatible.
- Ensure equipment is compatible with the hazards and environment.
- Protect your equipment from hazards such as; sharp edges, corrosive material, rough edges, moving equipment, excessive heat, electrical hazards.

NEW

In January 2017 CSA eliminated Class E4 and E6 Energy absorber.

- Existing Class E4 and E6 Energy Absorbers may continue to be used until the end of their life.
- Energy Absorbers manufactured to meet the January 2017 CSA Standard will have a weight range, maximum free fall distance and maximum deployment, and enhanced labelling.
- Calculations will need to be made to predict the deployment distance.

Labelling for New CSA Energy Absorbers

For situations with free fall > 6 ft.

Maximum Free Fall Distance 3.6 m 12 ft.	Weight Range Including Tools 60-140 kg 130-310 lbs
Maximum Deployment 2.8 m 9.2 ft.	See user instructions to calculate deployment factor.

For situations with free fall up to 6 ft.

Maximum Free Fall Distance 1.8 m 6 ft.	Weight Range Including Tools 60-140 kg 130-310 lbs
Maximum Deployment 1.4 m 4.6 ft.	See user instructions to calculate deployment factor.

Deployment Distance and Clearance

Always include the deployment distance (deceleration distance) of your energy absorber when calculating clearance requirement.

E4 deploys 4ft. E6 Deploys 6ft.

A shock absorber is required with a fixed ladder fall arrest system only if it is required by the manufacturer of the system.

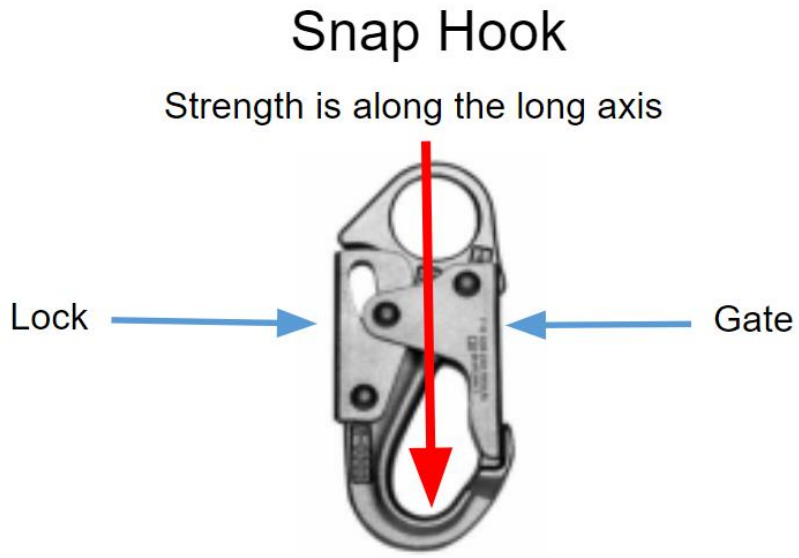
Chapter 3 - Slide 31 Video – Arrest Forces

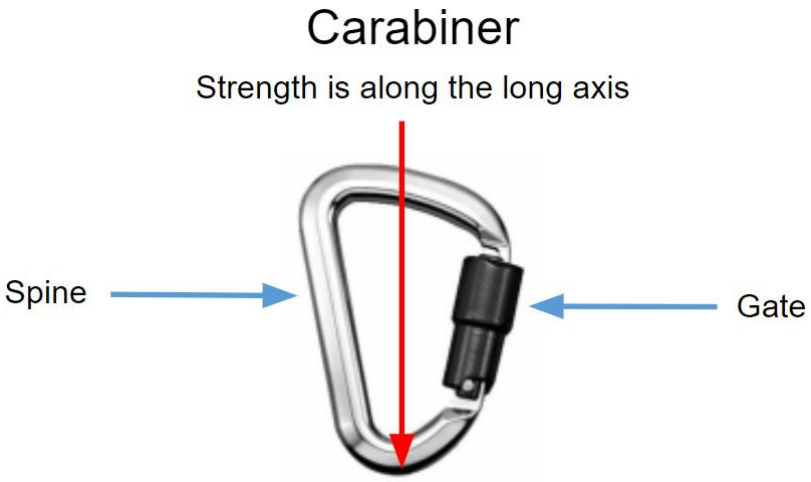
Carabiners and Snap-Hooks

- Must be self-closing and self-locking,
- May only be opened by at least two consecutive deliberate manual actions, and
- Must be marked with
    - its breaking strength in the major axis, and
    - the name or trademark of the manufacturer.

Equipment used to interconnect the components of a personal fall arrest system are subjected to the full maximum arresting force developed during a fall.

An employer must ensure that connecting components of a fall arrest system are approved, as applicable, to one of the required standards.





Hazards Associated with Connecting Equipment

Equipment compatibility

Compatible system components can be safely interconnected, e.g., carabiners and harness D-rings, ropes and ascenders, etc., without compromising equipment function or worker safety.

It is also important that components be compatible with the environment in which they are being used, i.e., high heat, corrosive, exposed to welding spatter, etc.

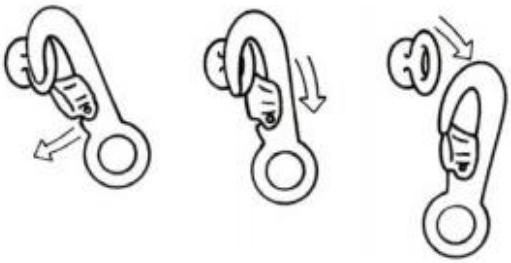
Roll-out & Forced Roll-out

When a force is applied on the top of a non-locking gate, the gate opens, releasing the mating hardware. The most typical roll-outs have been known to occur between snap hooks and D-rings. Although no manufacturer in North America or Europe uses non-locking snap hooks anymore, thousands of them may still be in service. Employers must remove this equipment from use and storage if it is used or could be used for fall protection.

Snap-hooks and Carabiners should never be positioned where arrest forces may be placed upon the gate.

Locking snap-hooks DO NOT "eliminate" forced roll-out

Example of accidental roll-out of a snap hook



Improper or Incomplete Connection (False Connection)

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

Gate cross-loading

Snap hooks and carabiners are designed to handle maximum loads in line with their long axes. However, because of their shape or circumstances of use, e.g., loops of webbing or rope coming to rest across the gate and then being placed under tension, snap hooks and carabiners can be subjected to gate cross-loading, resulting in much lower breaking strengths.

Connections between hardware components must be made carefully when using snap hooks and especially carabiners.

Controlling Hazards Associated with Connecting Equipment

- Ensure equipment meets required standards.
- Follow manufacturer's instructions for proper selection, use, maintenance, and inspections.
- Only use equipment that is compatible with other components.
- Only use equipment that is compatible with the hazards and environment it maybe exposed to.
- Ensure you are competent in the use of all equipment you use.

Fall Arresters

An employer must ensure that a fall arrestor manufactured on or after July 1, 2009 is approved to one of the required standards.

Fall arresters, commonly referred to as rope grabs or cable grabs, are used when workers need to move vertically, normally over substantial distances.

Example of a fall arrester in use

Example of a fall arrester in use on a vertical structure

Typical users include window washers suspended from swingstages and in growing numbers, workers climbing tall ladders

A fall arrester travels along a life safety rope or rail, following the worker's movements. The friction created between the device and the life safety rope or rail during a fall arrests the fall.

A sliding hitch knot or other system incorporating a knot is not a fall arrester.

For this reason, fall arresters must only be used on compatible ropes as described in the manufacturer's instructions.

Fall Arresters

- Must be compatible with the rope / cable.
- Must be properly oriented on the rope / cable.
- It is important to recognize that no fall arrester can safely be used on every life safety rope.

Manual & Automatic Fall Arresters

In general, there are two classes of fall arrester.

- Manual Fall Arresters are the simplest type. They are well suited to positioning systems on sloped roofs or Fall Restraint and may also be used for fall arrest systems.

- In positioning systems on sloped surfaces, the worker's weight may be supported some of the time.

- In Fall Restraint, the worker needs to correctly position the device on the life safety rope so that it is impossible to reach an unprotected edge.

Additional Fall Distance Using Fall Arresters

Manual fall arresters must be continually manually repositioned on the life safety rope as the worker moves. There is a danger that if a worker falls while manipulating the device, the worker may panic and squeeze the device—"Panic Grab"—holding it open and preventing it from locking onto the rope.

- To protect against "Panic Grab," it is recommended that manual fall arresters be selected that have integral panic hardware that prevents this from happening.

- Workers should be reminded to reposition their fall arrester frequently to eliminate unnecessary slack which increases fall distance, clearance requirements, and impact forces.

Automatic Fall Arresters trail up and down the life safety rope as workers move vertically providing "automatic" protection.

- Workers do not need to manipulate these devices while moving up and down, so there is a reduced danger that the worker will "Panic Grab" the device.

- The disadvantage of automatic fall arresters is that the free fall distance is increased.

- The standards permit the lock-off distance of the device to be up to 1 metre in the case of the referenced CSA standard and 1.4 metres (~4.5 ft.) for the referenced ANSI standard.

- In addition, when automatically trailing the worker's movements, the device will sometimes be a lanyard length below the worker at the start of the fall, creating a free fall of twice the lanyard length plus the lock off distance of the device.

Self-Retracting Device

A self-retracting device (SRD) is a fall arrest device that performs a tethering function while allowing vertical movement (below the device) to the maximum working length of the device, and are designed to arrest a fall while minimizing fall distance and impact force. For compliance purposes, the self-retracting device must bear the mark or label of a nationally accredited testing organization such as Canadian Standards Association (CSA Group), Underwriters Laboratories (UL), Safety Equipment Institute (SEI), etc. as evidence that it meets the requirements of the Standard.

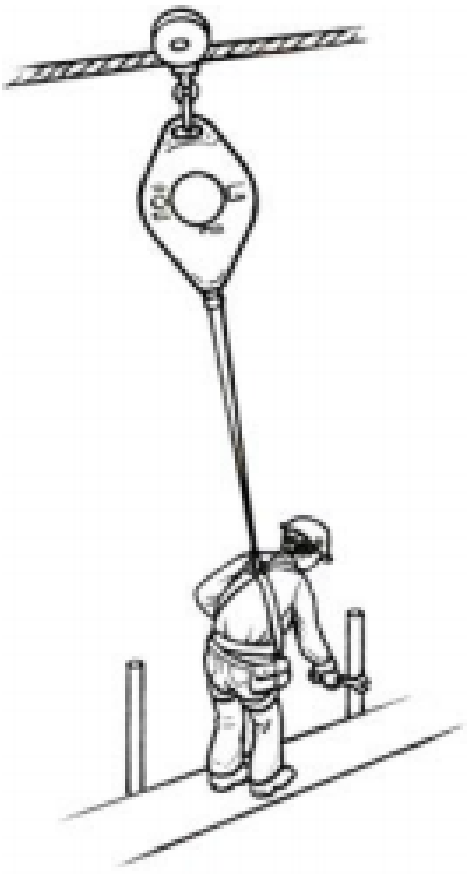
Because of their critical importance to the safety of workers using them, and the mechanical workings inside the housing, these units need to be inspected regularly according to the manufacturer's specifications.

Standards require that Type 2 and Type 3 SRDs be inspected two years after being placed into service, and annually thereafter. Because it is the only standard known to require such follow-up maintenance, it is the only standard listed in this section.

The self-retracting device must:

- Be anchored above the worker's head unless the manufacturer's specifications allow the use of a different anchor location.
- Be used in a manner that minimizes the hazards of swinging and limits the swing drop distance to 1.2 metres(~4 ft.) if a worker falls.

Although not required, Type 1 SRD should be used with a separate shock absorber if it is not already equipped with an integral shock absorber.



Self Retracting Devices and CSA classifications and Requirements

Type 1 Self-Retracting Device (SRD)

- This is a compact and lightweight SRD having a working length of 1.5 to 3.0 metres (~5 to ~10 ft.).
- Early versions of these devices resembled an automotive seatbelt mechanism and have a web-type lifeline.
- The internal locking mechanism of a Type 1 SRL is not capable of absorbing significant amounts of energy since it does not operate as a dynamic brake. The resulting deceleration distance is very short and the maximum arresting force will therefore be greater than if a Type 2 or Type 3 SRD were used.
- Employers using these devices should carefully read the manufacturer's specifications to confirm the conditions under which these devices can be used i.e. indoors versus outdoors, in dusty workplace settings.

Many of these devices have markings that state that the peak impact force will be below 4 kN, but this is only tested by the manufacturer with the device overhead.

> Therefore, it is recommended that Type 1 SRDs only be used where the device is anchored above the worker, unless otherwise stated in the manufacturer's instructions.

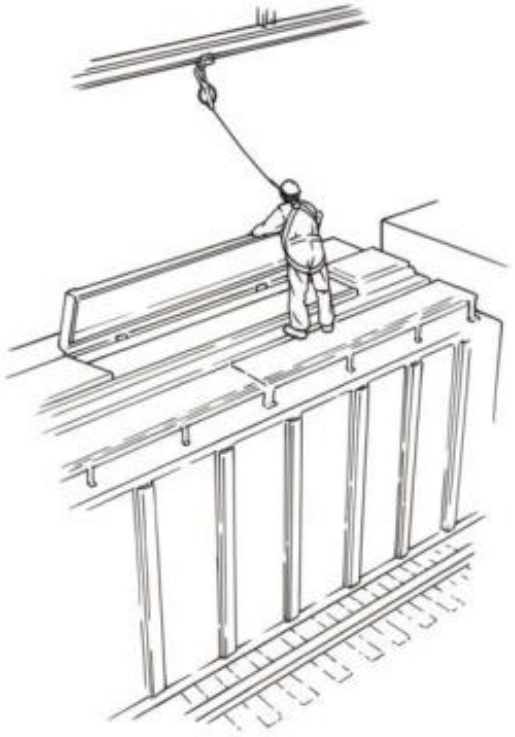
Type 2 Self-Retracting Device (SRD)

- This is a heavier SRD sometimes referred to as a self-retracting lifeline, generally having a working length of more than 3 metres (~10 ft.).
- It has an internal brake to minimize impact forces.
- The Type 2 SRD must have a visual load indicator that allows the worker intending to use the SRD to determine if it has arrested a fall.
- Type 2 SRDs are repairable after a fall incident and are subject to a manufacturer's service schedule.

Type 3 Self-Retracting Device with Retrieval Capability (RSRD)

- Type 3 SRD's have all of the characteristics of a Type 2 device listed above.
- However, a Type 3 device incorporates a rescue winch that permits a single rescuer to raise or lower the victim to a safe level.

Self-Retracting Devices				
Type	**Length**	**Annual Inspection**	**Load Indicator / Arrest Indicator**	**Retrieval Function**
Type 1	1.5 – 3.0m (~5 ft. to ~10 ft.)	Not mandatory	Not Mandatory	No
Type 2	> 3.0m (~10ft)	Required	Required	No
Type 3	> 3.0m (~10ft)	Required	Required	Yes



Like a standard lanyard,
an SRD subjected to the force of a fall must be retired from service.

Read the Fine Print

Like equipment instructions, labels contain critical information for the proper use and possible hazards associated with the equipment.

Proper Use of Self Retracting Devices

- Workers should field test the locking feature of an SRD before using it by pulling down on the line quickly and forcefully.
- The visual load indicator on a Type 2 SRL or Type 3 RSRL should also be inspected.
- If the device does not lock or the visual load indicator has been activated, the SRD should be removed from service and returned to the manufacturer for re-certification.
- Only the manufacturer is capable of disassembling, refurbishing and re-certifying an SRD.
- To minimize free fall distance when using an SRD, the device must be anchored above the worker's work location and there should be no slack in the lifeline.
- The lifeline should not ride over any sharp edges - when under the tension of a fall, a lifeline in contact with the edge of an I-beam or hatchway opening can be damaged to the point of complete failure.
- The risk of damage and failure can be reduced by physically protecting the lifeline where it passes over an edge and using a shock absorber positioned between the worker's D-ring and the free end of the SRD.

Self-Retracting Devices and Fall Restraint systems

- Self-retracting devices must not be used in a Fall Restraint system unless the length of the lifeline on the drum of the unit prevents the worker from reaching the edge from which he or she could fall.

- If a worker approaches the edge and there is some lifeline still spooled on the drum, the worker could go past the edge and fall.

Know Your Equipment

- Equipment can have many variations.

- Workers must be familiar with the design purpose, limitations, and hazards associated with the equipment they are using.

NEW

In January 2017 CSA established a new classification system for self retracting devices (Self Retracting Lifeline).

- SRL: self-retracting lifeline is higher than the D-ring on the worker.
- SRL-R: self-retracting lifeline is higher than the D-ring on the worker and also has a rescue device.
- SRL-LE: self-retracting lifeline is lower than the D-ring on the worker or the self-retracting lifeline can lean against a sharp edge (LE if for Leading Edge).
- SRL-LE-R: the self-retracting lifeline meets the SRL-LE standards and also has a rescue device.
- Inspection requirements based on use rather than time.

Descent Control Device

For information only: This equipment requires specialized training NOT INCLUDED IN THIS COURSE

Descent control devices are designed and intended to be used and operated by one person for personal descent or to lower another person from an elevation.

A descent control device may be used for egress (exit), for work positioning, or both. Descent control devices can be either automatic or manual.

Once engaged, an automatic descent control device lowers the worker at a constant speed and the worker has no ability to stop or control the rate of descent.

A manual descent control device gives the user control over the rate of descent and the ability to stop the descent.

Lifelinethe ground level or another safe lower surface

The term lifeline is an alternative to the more familiar terms “vertical lifeline”, “life safety rope”, or “fall protection rope.”

- Lifelines must be free of knots or splices along their travel portion so that rope strength is not reduced and fall arresting devices such as fall arresters, i.e., rope grabs, can move freely.

  This requirement is not intended to prohibit the use of a knot at the upper end of the rope where the rope is secured to an anchor either directly or via a connecting device such as a carabiner. Ropes with a manufactured termination eliminate the need for workers to know how to tie a secure anchor knot, reducing the chances of the rope separating for the anchor. The stopper knot (AKA – “positive stop”) at the life safety rope’s lower termination serves to prevent the fall arrester from sliding off the rope.

- The lifeline must extend to the ground level or another safe lower surface.

- Must be protected to prevent abrasion by sharp or rough edges

  When under the tension of a fall, a life safety rope in contact with the edge of an I-beam or hatchway opening can be damaged to the point of complete failure

- Must be made of material appropriate to the hazard and able to withstand adverse effects.

- Must be installed and used in a manner that minimizes the hazards of swinging and should limit the swing drop distance to no more than 1.2 metres (~4 ft.) if a worker falls.

One Worker per Life Safety Rope

- You must assume that a rope (and most other equipment) is intended to be used by one worker at a time unless the manufacturer’s specifications or specifications certified by a professional engineer allow for the attachment of more than one worker.

The following types of equipment that are components of fall protection systems, and their installation, must conform to the manufacturer's specifications or are certified by a professional engineer:

- Permanent anchor points.
- Anchors with multiple attachment points.
- Permanent horizontal lifeline system.
- Support structures for safety nets.

Equipment, The Bottom Line

Workers must be familiar with the:

- Design purpose
- Inspection requirements
- Advantages and Disadvantages
- Limitations
- Hazards

Associated with the equipment they use.

Summary

What was covered in Chapter 3?

- Why a full body harness is the only acceptable type of harness used in industrial fall protection systems.
- Various lanyards used in fall protection systems.
- Elements that contribute to arrest force, and how to limit the arrest forces experienced in a fall.
- Types of equipment used in fall protection systems

Chapter 4: Special Hazards

Goal: The student should understand how to reduce the risk of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.

Objectives:

1. The student should be able to identify hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.

2. The student should be able to evaluate the risk of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.

3. The student should be able to reduce the risk of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.

Clearance Distance

A personal fall arrest system must be arranged so that a worker cannot:
hit the ground, an object which poses an unusual possibility of injury, or a level below the work area. There must be enough clearance distance including a safety factor.

Vertical Lifeline vs. Self Retracting Devices

In general, vertical lifeline require more clearance than self-retracting devices and should therefore only be used when large clearances are available.

The most important consideration when using vertical lifelines is knowing how much clearance is required.

Factors Contributing to Required Clearance Distance

- Lock-off distance of the fall arrester,
- Lanyard length,
- Stretch of the vertical life safety rope,
- Swing-fall / drop,
- Deployment of the shock absorber
- Type of harness the worker is wearing

Arrest Force

A personal fall arrest system must limit the maximum arresting force on a worker to 8 kN (1800 lb).

Factors Contributing to Arrest Force

- Free Fall Distance (length of lanyard and anchor location)
- Worker’s weight, (including tools and clothing)
- Ability of the fall arrest system to absorb the energy of the fall (type of connector).

“free fall distance” means the vertical distance between the point from which a worker falls to the point at which deceleration begins because of the action of a personal fall arrest system;

Free Fall

Determining Free Fall Distance

You must identify your allowable free fall distance as per the manufacturer specifications on your equipment.

- Free fall distance in a personal fall arrest system WITHOUT a shock absorber must not exceed 1.2 metres (~4 ft.).

- Free fall distance in a personal fall arrest system WITH a shock absorber is 2 metres or determined by the manufacturer of the shock absorber, whichever is less.

Then calculate the free fall and ensure the actual free fall distance does not exceed the allowable free fall as specified by the equipment manufacturer.

    - Free Fall Distance is equal to the length of your lanyard when the anchor is at the same height as your dorsal D-Ring.

    - If the anchor point is below your D-Ring add that distance to the length of your lanyard to calculate the free fall distance.

    - If the anchor point is above your D-Ring subtract that distance from the length of your lanyard to calculate your free fall distance.

You can reduce your free fall and total fall distance by:

- Shortening your lanyard.

- Raising your anchor point.

- Moving the anchor point further from the edge (use caution as this may introduce swing fall).

Limiting the Vertical Distance of a Fall

- Select the shortest length lanyard that will still permit unimpeded performance of the worker’s duties, and

- Securing the lanyard to an anchor no lower than the worker’s shoulder height.

    If the shoulder height anchor is not available, a worker must secure the lanyard to an anchor that is located as high as is reasonably practicable.

Low Anchor Points

If it is not reasonably practicable to attach to an anchor above the level of a worker's shoulder, the worker must ensure that they have sufficient clearance and they do not exceed allowable free fall or maximum arresting force requirements.

There are situations where using low anchor points can not be avoided, some workers have no alternative other than to anchor at their feet. Tying to an anchor at foot level is dangerous.

A shock absorber approved to the CSA Standard for shock absorbers will safely absorb energy based on a 2 metre (~6.5 ft.) fall of a 100- kilogram worker.

Tying a 1.8 metre (6 ft.) lanyard at foot level can subject the shock absorber to a 3.6-metre (~12 ft.) free fall. Unless specifically designed for this type of free fall, the shock absorber's webbing may fully extend without absorbing all the energy of the fall, resulting in a "bounce" at the bottom. The remaining energy (and there could be a great deal of it) goes into the worker, potentially causing serious injury.

Shock absorbers approved to CEN Standard EN 355: 2002 are currently available in the marketplace that will accommodate a 3.6 metre (~12 ft.) free fall and still limit the maximum arresting force on a 140-kilogram worker to 6 kN (1350). When using these products must take into account the extra clearance that these products require.

Low Anchor Point Problems

Insufficient Clearance
Exceed Allowable Free Fall
Exceed Maximum Arrest Force
Equipment Failure

Low Anchor Point Solutions

Horizontal Lifeline
Self Retracting Device
Hitching Post
Specialized Equipment

Horizontal Lifeline

Swing Fall / Drop

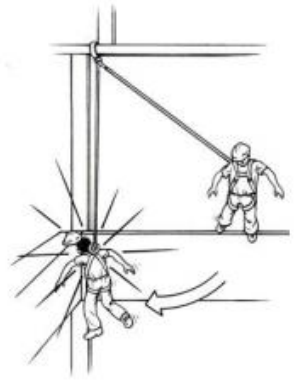
Anchor selection and routing of lifelines over and around structures must take into consideration Swing-Fall / Drop hazards.

Ideally, work should be performed directly below the anchor. The further away a worker is from this ideal position, the greater the potential for the worker to swing as a pendulum into objects if a worker falls.

Swing drop distance Must Not Exceed 4ft.

In situations where swinging cannot be avoided, but where several equally good anchor locations are available, the anchor selected should direct the swing fall away from objects rather than into them.

Where there is a choice among anchors, the one offering the least amount of swing should be selected.



The Bottom Line

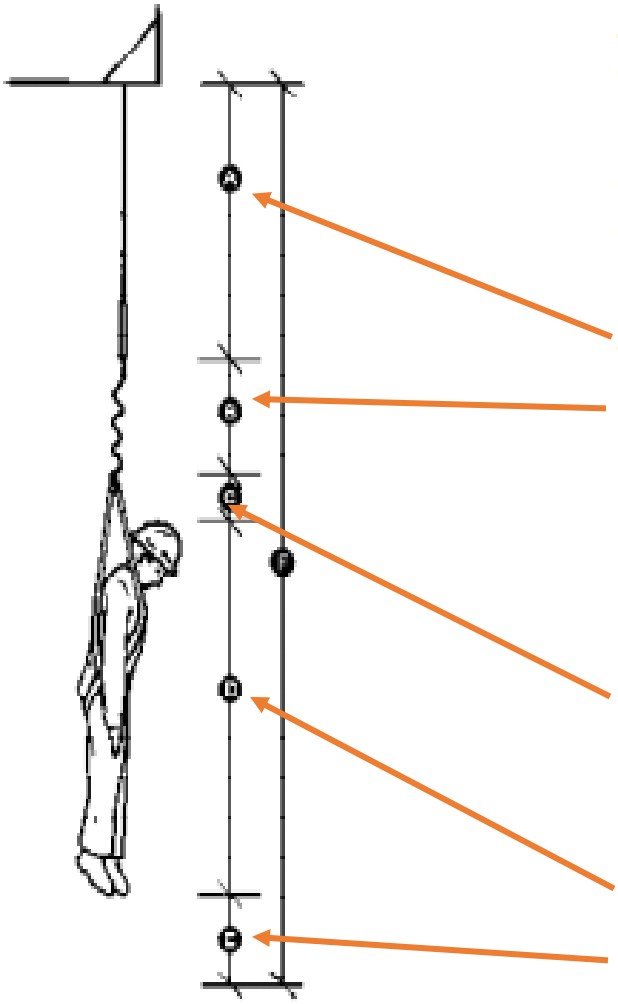
The anchor should be above the work position.
The length of the lanyard kept as short as possible (while still permitting the work to be performed safely) and the fall arrest system should almost always include a shock absorber.

Determining Clearance Requirement

LL + DD + H + SM = CR

- Lanyard Length (LL)
- Deceleration Distance (DD) is energy absorber extension, Self Retracting Device “arrest distance,” or combination of both
- Height of Worker (H) is how tall the worker is (avg.is 6ft.)
- Safety Margin (SM) is usually 2ft., but equipment manufacturer’s or employers may recommend a different safety margin.
- Clearance Requirement (CR)

Clearance Calculation



Assumptions:

The worker is 1.8 m (6 ft.) tall using a 1.8 m (6 ft.) long lanyard. The combined weight of the worker, clothing, and tool belt is at least 100 kg (220 lbs).

A Length of lanyard—1.8 m (6 ft.)

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

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

D Height of worker—1.8 m (6 ft.)

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

F A+B+C+D+E

Minimum clearance distance varies between 5.7 m (18.5 ft.) and 6.8 m (22.1 ft.) depending on the components used in the system.

Example:
Using an E4 shock absorber
LL + DD + H + SM = CR
6ft + 4ft + 6ft + 3ft = 19ft

Calculation Exercise #1

- Using a 1.8m / 6ft lanyard with an E4 Shock Absorber.
- The worker is 6ft tall.
- The anchor point is 20 ft above the ground.

Clearance Requirement
LL + DD + H + SM = CR

_____ + _____ + _____ + _____ = _____

Calculation Exercise #2

- Type 1 SRL extended 9 ft.
- The worker is 6ft tall.
- The anchor point is 18 ft. above the ground.

Clearance Requirement
LL + DD + H + SM = CR

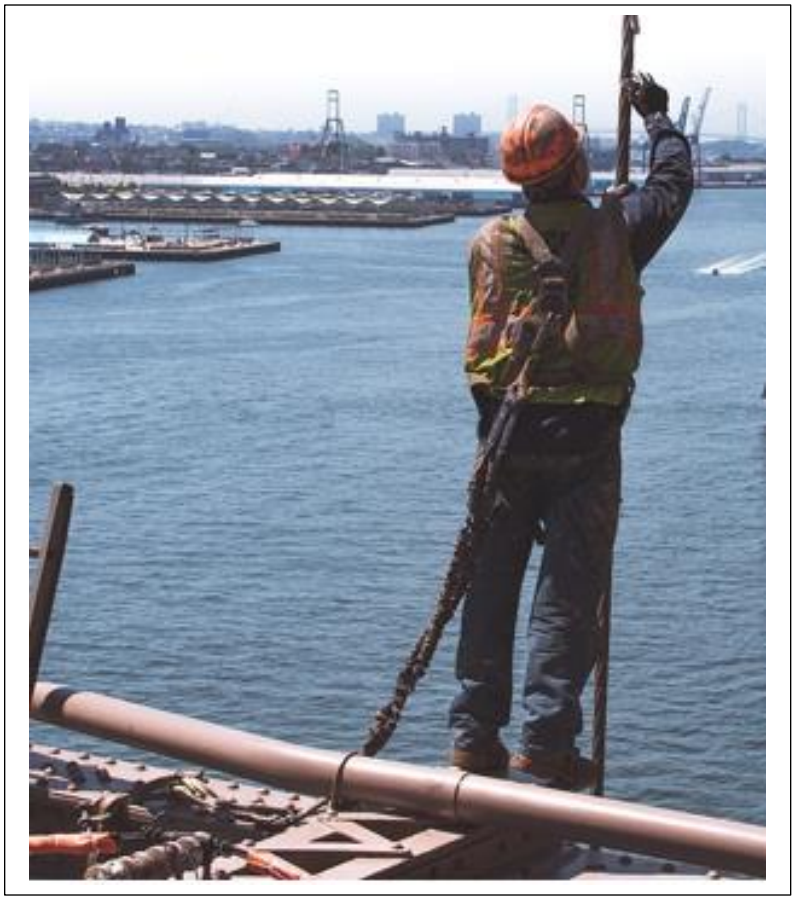
_____ + _____ + _____ + _____ = _____

Water Danger

If a worker is required or permitted to work at a place from which the worker could fall and drown, and the worker is not protected by a guardrail, the worker must use an appropriate fall protection system in combination with a life jacket or personal flotation device.

Rescue equipment must consist of a suitable boat equipped with a boat hook and a buoyant apparatus attached to a nylon rope that is not less than 9mm in diameter.

If the fall protection system prevents a fall into the water, then the life jacket or personal flotation device is not required. For example, if a worker uses a safety net or personal fall protection system that arrests the fall and prevents the worker from making contact with the water, then a life jacket or personal flotation device need not be worn.



Summary

What was covered in Chapter 4?

- Identification of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.
- Evaluating the risk of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.
- Reducing the risk of hazards associated with Clearance, Arrest force, Swing-fall, and water hazards.

Chapter 5: Inspection and Maintenance

Goal: The student should have an awareness of why, when and how equipment inspections are to be completed.

Objectives:

1. The student should understand the need to follow equipment manufacturers' instructions when conducting an inspection.

2. The student should understand the importance of preventing damage to their equipment.

3. The student should know how to identify obvious signs of damage, and the importance of manufacturers' inspections.

4. The student should know when equipment needs to be removed from service and what measures can be taken with equipment when it has been removed from service.

Equipment Inspection

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

It's called a visual inspection for a reason; you can't inspect what you can't see.

Equipment used as part of a fall protection system must be:

- Inspected by the worker as required by the manufacturer before it is used on each work shift,
- Kept free from substances and conditions that could contribute to deterioration of the equipment, and
- Re-certified as specified by the manufacturer.

How does equipment get damaged?

- Prevent damage to your equipment by understanding the hazards you may be working with, and how those hazards may damage your equipment.
- Nylon and polyester have different attributes that can make them suitable or unsuitable for exposure to greases and oils.
- Exposure to Ultra-Violet light (sun, lighting, welding arcs,) can cause damage that may be difficult to see but can be detected by touch.
- Keep your equipment away from, or protect it from damage by coming into contact with sharp edges and chemicals.
- Don't put your equipment away wet, mildew can damage webbing and rust can damage metal components.
- Put your equipment away dry and store it properly.

Always follow manufacturers' instructions for the proper inspection, use, and maintenance of your equipment

Manufacturer’s Inspection

In addition to the inspection required before each use the equipment must be inspected as required by the manufacturer. Most manufacturers require fall protection equipment to be inspected on a regular basis not to exceed one year, or more frequently, by a competent person (as defined by the equipment manufacturer), to verify that the equipment is safe for use.

Elements of a Visual Inspection (always follow the manufacturer’s instructions)

- Always follow the manufacturer’s instructions.
- Check the date of manufacture, if it meets the requirements of the manufacturer proceed with the remainder of the inspection.
- Check for missing or illegible tags.
- Check for missing webbing stays (keepers) or anything that might affect the equipment fit or function.
- Check all metal components for missing components (i.e. grommets, rivets), cracks, deformities, corrosion, chemical exposure, excessive heat, discoloration, or excessive wear.
- Check webbing and ropes for heat damage (burns, friction, welding arcs, sparks) fraying, un-splicing, kinks, knots, broken stitching, cuts, excessive abrasion, excessive oil or grease contamination, ultra-violet light, discoloration.
- Check all equipment for any alterations.
- Check for damage to, or improper function of, mechanical devices and connectors such as snap-hooks, or carabiners.

Removal from Service Protocol

Fall protection equipment that is damaged, fails an inspection, or shows signs of being used in a fall (signs of stretching, deployed arrest/fall indicator) must be removed from service.

Even without signs of a fall, if it is known that a fall protection system has stopped a fall the system must be removed from service.

It is important that there is a procedure in place for ensuring that defective or suspect equipment withdrawn from service does not get back into service without inspection and approval by a professional engineer or the manufacturer.

Once removed from service it must not be returned to service unless it has been repaired by an authorized and competent person (as defined by the equipment manufacturer).

Equipment that is no longer suitable for use that cannot be repaired, must be destroyed and made inoperable or unusable before it is discarded.

Summary

What was covered in Chapter 5?

- Importance of following equipment manufacturers' instructions when conducting an inspection.
- Importance of preventing damage to equipment.
- Identification of obvious signs of damage, and the importance of manufacturers' inspections.
- When equipment needs to be removed from service and what measures can be taken with equipment when it has been removed from service.

Chapter 6: Anchors

Goal: The student should have an awareness of the skills necessary to be able to assess an anchor’s strength, stability and location.

Objectives:

1. The student should understand the priorities in assessing the location of an anchor point.

2. The student should be able to differentiate the difference between a temporary, or improvised anchor point and an engineered anchor point.

3. The student should be able to relate swing-fall, free fall, arrest force, and clearance requirement to the location and strength of an anchor point.

Location and Strength of Anchors

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

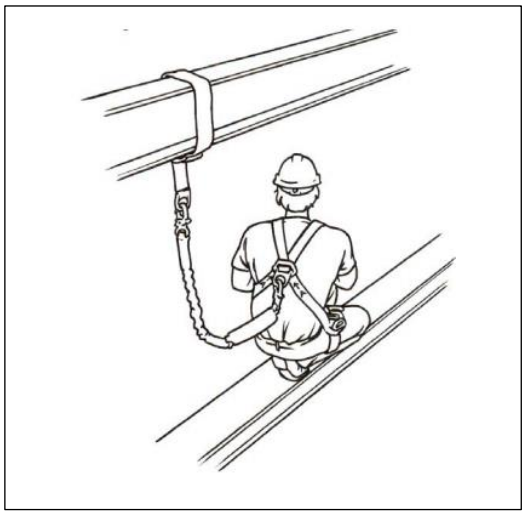
Factors to Consider are:

- Swing-fall / drop
- Free Fall
- Arrest Force
- Clearance Requirement.

Improvised Anchors

Parts of structures located in the vicinity of where a worker is working are often used as improvised anchors (as opposed to engineered anchors) for Fall Restraint and fall arrest systems.

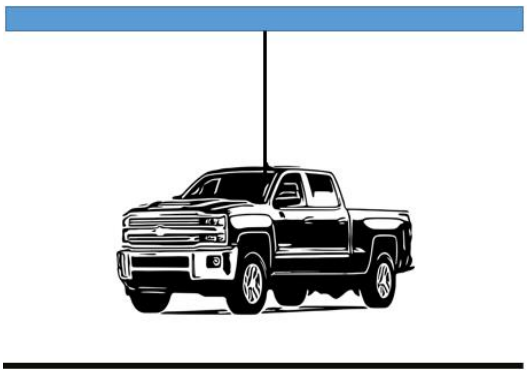
Improvised anchors are not manufactured to any technical standard. Improvised anchors may include a beam, struts of a communication tower, a concrete column, a sizeable tree, a locked out and chocked vehicle, or other similar, robust structures.



Assessing the Strength of Improvised Anchors

Workers may tug or reef on a potential anchor as a test to see if it will hold. This "test" is completely inadequate as the force generated during a tug rarely approaches even half the worker's body weight. Some manufacturers may recommend pulling on an anchor to check for swing fall or proper installation.

A better approach might be to imagine a passenger vehicle being supported from the anchor by a lanyard. If the vehicle, having a weight approaching 1600 kilograms (3600 pounds) can be held, then the anchor is a good one. The anchor must be "bomber" or "bomb-proof."



Stability

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

Strength

A temporary anchor point used in a travel restraint system must:

- Have an ultimate load capacity of not less than 3.5 kN (800 lbs.). per worker attached in any direction that a load could be applied.
- Be installed and used according to the manufacturer's specifications.
- Be permanently marked as being for travel restraint only.
- Be removed from use on the earlier of the date the work project for which it is intended is completed, and the time specified by the manufacturer.

A permanent anchor point used in a travel restraint system must:

- Have a breaking strength of not less than 22.2 kN (4,990 lbs.).
- Be installed and used according to the manufacturer's specifications.
- Be permanently marked as being for travel restraint only.

Anchor points to which the personal fall arrest system is attached must:

- Have a breaking strength of not less than 22.2 kN (4,990 lbs.).
- Have an *ultimate load capacity* of not less than 8.75 kN (1,967 lbs.) per worker attached in any direction that a load could be applied.

MACD

Cast In Place Concrete anchor

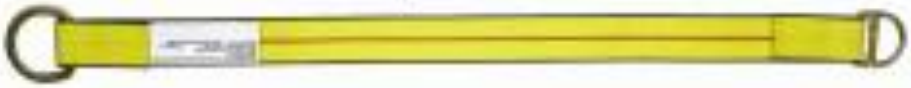
Attached sleeve protects the webbing from corrosion and abrasion

MALD

Single D Choker style

MADD

Double D Choker style



MATS

Double soft loop Choker style

BCTRAF075N

Reusable Bolt Anchor - for use where a temporary anchorage is required. Designed to be installed in concrete, it can be easily removed and reused.

Hybrid Anchor

BCTSWH100Y

Hybrid Swivel Anchor - for use where a temporary or permanent anchorage is required. Designed to be installed permanently in concrete, but it can be easily moved to another location. Its unique design allows it to rotate a full 360 degrees to follow the worker while maintaining 100% tie off.

Beam Clamp / Slider

BCTBWA014B

Sliding Flangebar with Quick Ratchet Locking System - for use where a temporary or permanent anchorage is required. Designed to attach to the top or bottom of horizontal beams, it fits beams 3.5" to 14" wide and 1.125" in thickness. Its unique design allows it to slide smothly along the flange of the beam to follow the worker while maintaining 100% tie off.

Roof Anchors

MRRA1

- Single use only - remove, bend or sheath over after using
- One person capacity
- Exceeds 5000lbs minimum breaking strength

Stainless steel permanent roof anchor -
One person capacity on each side -
Exceeds 5000lbs minimum breaking strength -

MSRA2

N5072F

- Reusable roof anchor
- One person capacity
- Exceeds 5000lbs minimum breaking strength

Truss Anchor

Duty To Use Anchors

To be effective, personal fall arrest and Fall Restraint systems must be safely secured to an anchor, i.e., lanyard or self-retracting device must be clipped in. Workplace Health and Safety is aware of many instances of workers being equipped with the appropriate fall protection equipment but failing, for whatever reason, to clip into an anchor.

The anchor must be securely fastened to its substrate and be free of any damage that could compromise its ability to function properly. If an anchor is damaged, the worker must not use it until the anchor is repaired, replaced or re-certified by the manufacturer or a professional engineer.

Some connectors will be more suitable than others for a given situation. Size, type and style of connector may need to be considered to avoid sizing mismatches and improve system ease of use.

- If a worker uses a personal fall arrest system or a Fall Restraint system, the worker must ensure that it is safely secured to an anchor that meets the requirements of the regulations.
- Prior to clipping in, a worker is required to visually inspect the anchor he or she is planning to use to make sure that the anchor is in sound condition and free of damage.
- Anchorage connectors such as carabiners, snap hooks, quick links, etc., must be appropriate for the work being undertaken.

Independence of Anchors

An anchor to which a personal fall arrest system is attached must not be part of an anchor used to support or suspend a platform.

Note that it is acceptable to use engineered anchors that have two or more loops on a single device that function independently of one another. A platform can be supported by one loop and a worker by another loop.

Wire Rope Sling As An Anchor

Many industries use wire rope slings to create fall protection anchors by wrapping the slings around substantial structural members and then clipping into one or both of the end terminations depending on how the sling is positioned around the structural member.

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

Never place a snap-hook directly through the thimble eyes of a wire rope. In the absence of an O Ring, a carabiner that is compatible with the snap-hook must be used.

Horizontal Lifeline

Flexible Horizontal Life-Line Systems

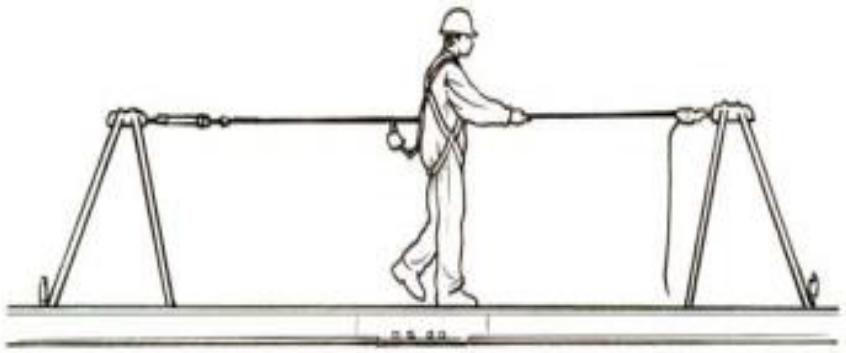
A horizontal lifeline (HLL) consists of a synthetic or wire rope rigged between two substantial anchors.

These lifeline systems allow a worker to move horizontally while safely secured to a fall arrest system.

Synthetic rope HLLs should be considered temporary because they are usually subject to deterioration resulting from use, exposure to the elements, and exposure to other potentially damaging hazards.

Wire rope HLLs may be either temporary or permanent.

Example of wire rope used as horizontal lifeline



Horizontal Life-Line Systems Installation

Capacity 620lbs (Two Workers)

An employer must ensure that before a horizontal lifeline system is used, a professional engineer, a competent person authorized by the professional engineer, the manufacturer, or a competent person authorized by the manufacturer certifies that the system has been properly installed according to the manufacturer’s specifications or to specifications certified by a professional engineer.

Horizontal Lifeline Use

- Confirm there is enough clearance below the lifeline.
- Do not exceed the number of authorized users on the lifeline.
- Ensure the lifeline tension is maintained in accordance with the manufacturer's instructions, professional engineer, or a competent person authorized by the manufacturer or professional engineer.
- Always check for the manufacturers' or engineers' labels.
- Always check for date of recertification.

Rigid Horizontal Lifeline System

An employer must ensure that a rigid horizontal fall protection system is designed, installed and used in accordance with,

- the manufacturer's specifications, or
- specifications certified by a professional engineer.

- Never exceed the number of authorized users.
- Always check for the manufacturers' or engineers' labels.
- Always check recertification date.
- Always confirm available clearance.

Example of rigid rail

Summary

What was covered in Chapter 6?

- The priorities in assessing the location of an anchor point.
- The difference between a temporary, or improvised anchor point and an engineered anchor point.
- How swing-fall, free fall, arrest force, and clearance requirement relates to the location and strength of an anchor point.

Chapter 7: Special Situations

Goal: The student should have an awareness of various fall protection systems used for unique work areas and tasks.

Objectives:

1. The student understands that specialized equipment and procedures will require training specific to the equipment being used and must be done by a competent person.

2. The student should have an awareness of the following:
- Work positioning
- Adjustable lanyard for work positioning
- Prusik and similar knots
- Wood pole climbing
- Lineman’s body belt
- Fixed Ladders and Climbable Structures
- Fall protection on vehicles and loads
- Mobile Elevating Work Platforms (MEWP)
- MEWP without anchor points
- Leading edge fall protection system

Work Positioning

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

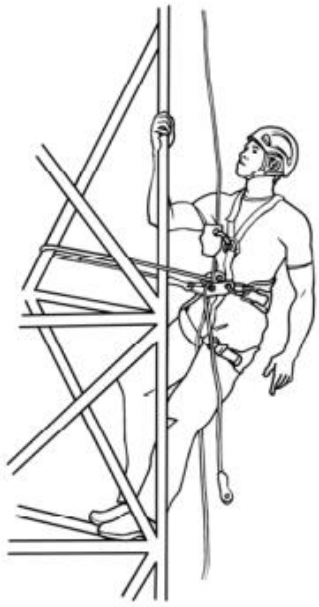
A work positioning system allows a worker to work at height supported in tension, part or all of the worker's mass being supported by the work positioning system and the remainder by the surface on which the worker is standing.

Work positioning can be used in occupational settings such as tree climbing, residential wood frame construction, residential roofing, high rise window cleaning, Christmas light installation, snow clearing on sloped roofs, etc. If a work positioning system is used as a means of holding a worker in position at the work location, the worker should select and use a fall protection system based on the work surface slope characteristics.

The free fall distance must not exceed 600 millimetres (~ 2ft.).

If the centre of gravity of a worker extends beyond an edge or if the work surface presents a slipping or tripping hazard,

A back-up personal fall arrest system must be used in combination with the work positioning system.



The worker relies on both the tension provided by the anchor and his or her feet to maintain the work position. The worker may use an adjustable work positioning lanyard to further secure his or her work position.

An employer must ensure that an adjustable lanyard, or energy absorber and lanyard meet the required standards.

- Once a worker moves to a preferred work location at height, an adjustable lanyard for work positioning is used to secure the worker to a structure to maintain a stable work position.

- Work positioning lanyards may be fixed length or adjustable and have connecting components at both ends to allow for connection to the side D-rings of a worker's full body harness.

- Adjustable work positioning lanyards allow a worker to cinch up or adjust the lanyard to optimize the worker's position.

Work positioning lanyards are usually made of rope and are designed to limit movement or to allow hands-free work while in position.

Rope Adjustment Device for Work Positioning

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

Prusik And Similar Knots

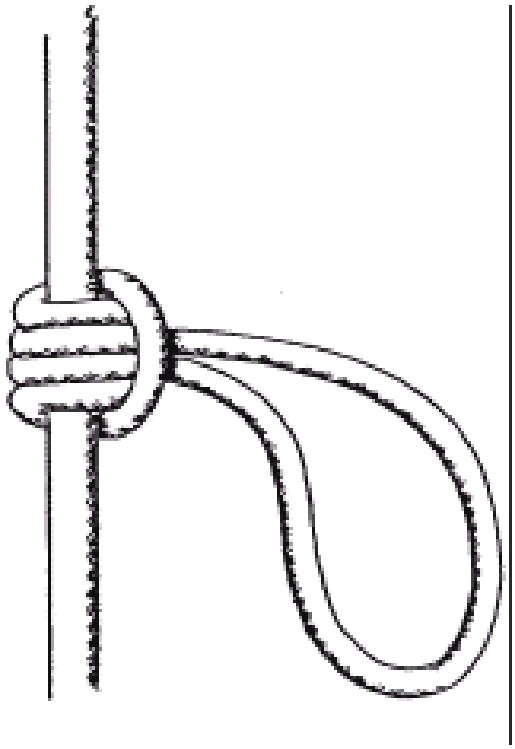
This information is being provided for awareness only.

Prusik or similar sliding hitch knot is used in place of a fall arrester only during emergency situations or during training for emergency situations and only by a competent worker.

Prusik and Similar Knots

Because its construction, effectiveness and safe use are so dependent on the user's knowledge and experience, the knots' use is restricted to competent rescue or emergency services personnel, or in an emergency situation to a worker trained in its use and limitations.

A fall arrester meeting the requirements of section 144 must be used.



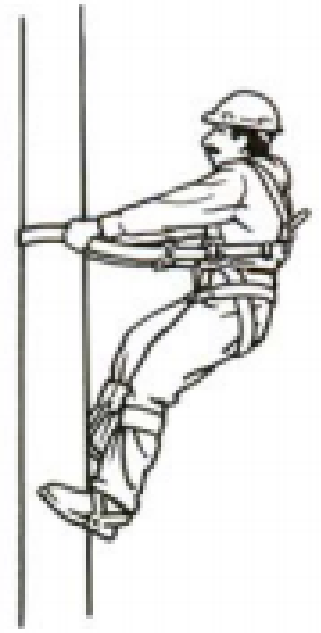
Wood Pole Climbing

This information is being provided for awareness only.

An employer must ensure that a worker working on or from a wood pole uses fall restrict equipment that is approved to the required standards. Or, a full body harness that complies with required standards of a full body harness

- This equipment is for use by a single worker exposed to the hazard of falling when ascending or descending, moving around and working on or from a wood pole.
- Fall restrict equipment is most commonly used by linepersons in the electrical/utility, telecommunications, and construction sectors.
- The CSA Standard recommends different types of fall restrict systems depending whether the pole is icy or not.

The main parts of a fall restrict system are a modified pole strap, rigid but articulated frame, and connecting hardware.



Fall restrict systems allow a worker to remain at his or her work position with both hands free. The system performs a limited fall arrest function when the worker loses contact between his or her spurs and the pole.

Fixed Ladders and Climbable Structures

- If a worker is working from or on a fixed ladder or climbable structure at a height of 3 metres (~ 10ft.) or more and is not protected by a guardrail, fall protection is required
- A worker ascending or descending a fixed ladder is not actually “working from or on a fixed ladder” and thus fall protection is not required.
- If a worker stops on the ladder to, for example take measurements, operate a valve, open a hatch, paint a surface, etc., and can fall a distance of 3 metres(~ 10ft.) or more, a fall protection system must be used.

Ladder Cage

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

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

Leading Edge Fall Protection System

Fall protection on leading edges can present unique hazards and challenges.

- Anchor points above are often not available, and anchoring at foot height is dangerous due to increased free fall distance.
- The edges are often sharp and jagged which can easily damage ropes and lanyards, special equipment designed to specific standards is necessary.
- When staying back from the edge at a safe distance is not an option there are options of portable anchors.
- A relatively new approach to providing fall protection at a leading edge is the use of fabric or netting panels specifically designed for this purpose.

At present, these panels usually cover a roof's secondary open steel structural members and offer leading edge fall protection while workers apply insulation and other roof coverings.

These panels are not safety nets and the requirements for safety nets do not apply to them. If an employer wishes to use a leading-edge fall protection consisting of fabric or netting panels, all of the required regulations and standards must be met conditions must be met.

An employer using a leading-edge fall protection system consisting of fabric or netting panels must ensure that all required regulations and standards are followed. All workers using the system must be trained in its use and limitations.

Due to the variety of structure climbing access techniques and the associated hazards, it is essential that a worker be given sufficient instruction to perform the required skills that are needed to safely access a structure and be compliant with the regulations.

Fall Protection on Vehicles and Loads

If a worker may have to climb onto a vehicle or its load at any location where it is not reasonably practicable to provide a fall protection system for the worker, an employer should:

- Take steps to eliminate or reduce the need for the worker to climb onto the vehicle or its load, and

- Ensure that the requirements of using procedures in place of fall protection equipment are met.

If the load is not secured against movement, a worker should not climb onto the load.

While working on a vehicle or load it is recognized that it is not always reasonably practicable for an employer to provide a “hard” fall protection system that uses guardrails, a harness-lanyard-anchor combination or some other approach.

- Despite the employer taking steps to eliminate or reduce the need for a worker to climb onto a vehicle or its load, a worker may still need to go up on a vehicle or load.

- In such cases, procedures in place of fall protection equipment should be used.

- The use of procedures in place of fall protection equipment is based on the employer determining that it is not reasonably practicable to provide a fall protection system for use by workers.

- The justification as to why it is not reasonably practicable, particularly when the employer’s work site has structures to which a fall protection system could be added or has the space to install a permanent or temporary system, should be noted.

Chapter 7 – Slide 19 – Video – Tie Off When Operating an Aerial Device

Mobile Elevating Work Platforms

- While in a lift workers must have fall protection in place, including a full body harness, lanyard and appropriate anchor point.
- The lanyard must be short enough to prevent the worker from being ejected or from falling out of the work platform or lift.
- If a worker is wearing a correctly selected and adjusted Fall Restraint system, there is less chance that he or she will be able to stand on the rails.
- As a rule of thumb, if a worker can stand on the mid-rail while using the Fall Restraint system, then he or she can fall off the platform.
- Remember once you are leaning over a guardrail it no longer provides fall protection
- Guardrails and Railings are NOT Anchor Points.
- Do not use guardrails or railings as anchor points unless they are approved by the manufacturer or professional engineer

Summary

What was covered in Chapter 7?

- Specialized equipment and procedures require training specific to the equipment being used and must be done by a competent person.

- An overview of; Work positioning, Adjustable lanyard for work positioning, Prusik knot, Wood pole climbing, Lineman’s body belt, Fixed Ladders and Climbable Structures, and Leading edge fall protection system.

- A review of fall protection on; vehicles and loads, Mobile Elevating Work Platforms (MEWP).

Chapter 8: Potential Injuries Due to Falls

Goal: The student should have an understanding of the effect of a fall on the human body, and how to reduce the risk of injuries due to a fall.

Objectives:

1. The student should have a basic understanding of mechanism of injury in falls.

2. The student should have a basic understanding of suspension trauma, and how to reduce the effects.

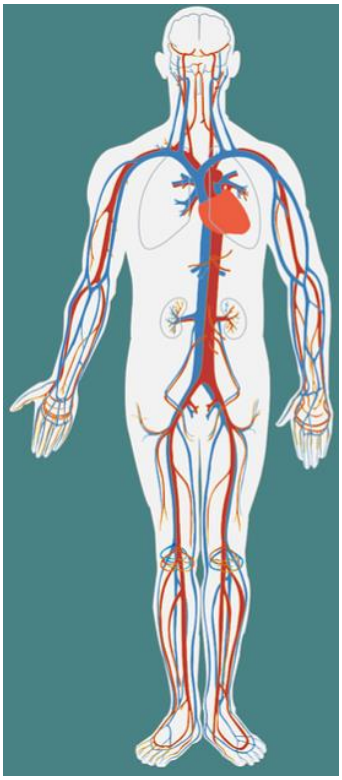
3. The student should have an understanding of the importance of selecting the correct harness, don a harness correctly, and understand how a properly fitted and adjusted harness can reduce the risk of injury.

4. The student should understand the safety procedures to be followed before and during the harness suspension.

Effect Of Falling On The Human Body

- Injuries due to a fall will vary depending on the distance a person falls, body weight, orientation of the body upon impact, and the nature of the surface impacted.
- The distance of the fall is the major determining factor.
- As a person falls the kinetic energy increases due to acceleration during the fall and is at maximum at the moment of impact.
- The kinetic energy is transferred into the body causing the injuries.
- A fall will almost always result in injury, from very minor scrapes, cuts, bruises and abrasions to moderate injuries such as fractures of long bones.
- More severe injuries including injuries up to and including death are possible.

- Arrest forces may result in heavy organs such as the heart, liver, kidneys, and spleen to tear away from blood vessels.
- Concussion and brain injuries are also possible.
- Blunt force trauma may result in internal and external hemorrhage as well as fractures to the skull, and other bones.
- Landing on objects may cause penetrating injuries.



Injury Prevention and Control

- The OH&S Code requires hazards to be eliminated when possible.
- Control trip and slipping hazards: Even a fall from standing height can result in a serious injury, a lot has to do with what you land on. There isn't a lot of friendly ground on most construction sites.
- Choose the least risky fall protection system: Even though elimination of hazards is your first obligation, some work will always be required to be done at height.
- Inspect your equipment before each use.
- Use equipment designed for the task.
- Keep your free fall as short as possible. The further you free fall, the faster you go, and the more serious the injuries can be.
- A Full Body Harness is the only acceptable means of stopping a falling workers body. Wear the right harness, adjust it properly, and use the correct D-Ring for the task.
- Use a Self-Retracting Device whenever possible.
- Use a shock absorber in all other circumstances.
- Always confirm you that you have sufficient clearance.
- Keep your eye on what is going on beneath where you are working in case your clearance changes
- Always work directly below your anchor. Swing fall can cause injuries when you crash into a structure or piece of equipment. Your shock absorber won't help in a swing fall.

Suspension Trauma

- AKA – harness hang syndrome (HHS), suspension syndrome, orthostatic intolerance, harness induced pathology, or orthostatic shock while suspended.

What Is Suspension Trauma?

- Suspension trauma is an effect which occurs when the human body is held upright without any movement for a period of time.
- If the person is strapped into a harness or tied to an upright object they will eventually faint.
- Fainting while remaining vertical increases the risk of death from lack of oxygen to the brain.

    (Since there is no evidence that these effects are specifically due to trauma, or caused by the harness itself, climbing medicine authorities have argued against the terminology of suspension trauma or harness hang syndrome and instead termed this simply "suspension syndrome").

What Causes Suspension Trauma?

- The most common cause is accidents in which the person remains motionless suspended in a harness for longer periods of time.
- Motionlessness may have several causes including fatigue, hypoglycemia, hypothermia or traumatic brain injury.

What Are the Symptoms of Suspension Trauma?

- Onset of symptoms may be after just a few minutes, but usually occurs after at least 20 minutes of free hanging.
- Typical symptoms are paleness, sweating, shortness of breath, blurred vision, dizziness, nausea, hypotension and numbness of the legs.
- Eventually it leads to fainting, which may result in death due to oxygen deprivation of the brain.

Reducing the Effects of Suspension Trauma

Breath, full deep respirations

If someone is stranded in a harness, but is not unconscious or injured, and has something to push against or stand on it is helpful for them to use their leg muscles by pushing against it every so often, to keep the blood pumping back to the torso.

If the person is stranded in mid-air then keeping the legs moving can be beneficial.

Use of suspension straps or simply a loop in a rope in which the person hanging can take some weight off the leg straps to help the blood to flow.

What Can You Do While Waiting To Be Rescued?

- Breath.
- Use Suspension Relief Straps.
- Move your legs.
- Bring your knees toward your chest.
- Get your foot up on a near by structure.

How important is a proper harness fit and adjustment?
How important is rescue?

Full Body Harness

"full-body harness" means a safety device that is capable of suspending a worker without causing the worker to bend at the waist, and consists of straps that pass over the worker’s shoulders and around the worker’s legs, an upper dorsal suspension assembly and integral hardware.

Full Body Harness Selection

The only acceptable style of harness for fall protection is a full body harness.

All metal parts of the full body harness and connecting linkage must be made of drop-forged steel 22 kN proof tested.

Standards

Verify your equipment meets all required standards.

Materials

Know your hazards and environment. Select equipment that is compatible with the environment and hazards you may be exposing them to.

Sizing

Like people, harnesses can be different. They look different and they feel different.

Some manufacturers use universal sizing (one size fits all). Others use weight range and height which will probably result in the safest and most comfortable fit.

You need to find a harness that is comfortable for you to wear when it is adjusted for safety.

Before buying a harness find out where the harness is made and verify that the harness meets all required standards.

Avoid harnesses with only use loop & hook (Velcro) to secure the straps. Also avoid harnesses without back straps.

Buy the right harness for the job. Harnesses come with a wide range of D-Ring locations, each used for different applications.

Always follow the manufacturer’s instructions for the proper selection, inspection, use and maintenance of your equipment.

The following information regarding classifications for full body harnesses is copyrighted by Safety Direct Inc. *and is used with their permission.*

Classifications of Full Body Harnesses

The Canadian Standards Association (CSA) establishes the classifications for full body harnesses. A harness can have more than one classification; however, all full body harnesses must meet the requirements for class A Fall Arrest.

Class A Fall Arrest

Class A harnesses are designed to protect workers when they are six feet or more above the ground. They support the body during and after a fall. Dorsal (back) D-rings are used for fall protection. They slide on impact, keeping the worker in an upright position.

Class AD Suspension and Controlled Descent

Class AD harnesses are used to support and hold a worker while being raised and lowered. There is one sternal (front) D-ring and one dorsal (back) D-ring. The sternal D-ring is used for attachment to a descent device.

Class AE Limited Access

Class AE harnesses are designed to raise or lower a worker through a confined area. Shoulder D-rings serve as anchorage points for attaching an extraction yoke or other rescue device. The D-rings slide on the shoulder strap for optimal positioning of the worker.

Class AL Ladder Climbing

Class AL harnesses are designed for use with a certified fall arrester that travels on a vertical lifeline or a rail. Sternal (front) D-rings are used for attachment to the vertical system.

Class AP Work Positioning

Class AP harnesses will hold and sustain a worker at a specific location, allowing full use of the hands, while limiting any free fall to two feet or less. Side D-rings at waist level are used for positioning and restraint.

Note:
Instructor Guided Full Body Harness Inspection

Prior to donning the harness for the harness suspension, the harness to be worn will be inspected by the student with guidance from the instructor.

Full Body Harness Donning

The strongest part of your body is located where the two biggest bones (Femur and Pelvis) are surrounded by the biggest muscles in your body.

To ensure that arrest forces are directed upward into the buttocks. It is important to follow this sequence of steps when donning your full body harness.

Step 1: Sub-Pelvic Strap.

Remember the goal is to ensure that arrest forces are directed upward through the sub-pelvic strap (“Butt Strap”) into the buttocks. Positioning of the sub-pelvic strap is critical for safety.

The sub-pelvic strap is raised or lowered by adjusting the length of your shoulder straps.

Ensure the sub-pelvic strap is just below the buttocks. If the sub-pelvic strap is too low it will not “grab” your buttocks during the fall and will allow the arrest force to impact the worker’s groin through the leg straps. If the sub-pelvic strap is too high the same result may occur.

After you have adjusted the sub-pelvic strap, ensure your shoulder straps are the same length and the ends are across from each other. That will ensure your sub-pelvic strap goes straight across just below your buttocks.

Be sure to control the extra webbing from your shoulder straps with the webbing-stays (keepers).

Step 2: Leg Straps

The purpose of your leg straps are to hold the sub-pelvic strap in place.

Once the sub-pelvic strap is in place, bring the leg straps through between your legs, make sure the leg straps are not crossed over or twisted.

The leg straps should be snug, but not too tight.

When properly adjusted you should be able to slide your flat hand through between your thigh and the leg strap, but not be able to bring your hand in a fist position back through between the strap and your leg.

Leg straps should be equally tensioned on each side.

Be sure to control the extra webbing from your leg straps with the webbing-stays (keepers).

Step 3: Chest Strap

The purpose of your chest strap is to keep you in the harness when you fall.

The chest strap needs to be positioned correctly and tensioned properly so that you cannot move your shoulder straps off your shoulders.

The chest strap needs to be on top of your chest, but no higher than your arm pit.

Test by pulling your shoulder straps outward toward your shoulders, you should not be able to get the shoulder straps off your shoulders.

Be sure to control the extra webbing from your chest strap with the webbing-stays (keepers).

Step 4: D-Ring Positioning

The D-Ring used for personal fall arrest or Fall Restraint is the dorsal D-ring.

It must be located in the centre of your back between your shoulder blades.

The height of the D-Ring can be adjusted by pulling up or down one side at a time.

The D-ring can be centred by lining up indicators on either side of the straps on your back.

Step 5: Partner Check

A partner check should be conducted to ensure all components are in the right position and straps are not crossed over or twisted.

Adjustment of the D-Ring is best done by a partner.

Your partner can check the D-Ring position by placing their hands on your back with their fingertips at the top of your shoulders and joining their thumbs. Where their thumbs join is where the bar on the D-Ring should be.

Your partner can line up indicators on the back straps and verify the D-Ring is in the centre of your back. If your partner has trouble centring the D-Ring they should check the shoulder straps and ensure they are adjusted symmetrically.

Full Body Harness Suspension

- Suspending in the harness is voluntary.
- Instructor must remind the students that safety violations are strictly prohibited (horseplay, swinging, pushing, etc.) and will result in an automatic fail of the course without a refund.
- Instructor has verified the system being used is safe.
- Instructor has verified there is no reason the student should not suspend in the harness.
- Instructor verifies the students harness is being worn properly.
- Student being suspended must be directly below the anchor.
- Student connects snap-hook to harness.
- Instructor reminds the student not to drop into the harness but sit down slowly.
- Student sits down gently in the harness and brings knees toward the chest.
- Maximum suspension time 1 minute

Summary

What was covered in Chapter 8?

- Mechanism of injury in falls.
- Suspension trauma, and how to reduce the effects.
- Criteria and importance in selecting the correct harness.
- Donning a harness correctly and understand how a properly fitted and adjusted harness can reduce the risk of injury.

Chapter 9: Emergency Preparedness and Response

Goal: The student should have an understanding of emergency response procedures to be used at the work site.

Objectives:

1. The student should be aware of the employer's and employee's responsibilities with respect to emergency response procedures.

2. The student should have an understanding of the steps taken in the initial response to a worker who has fallen.

Emergency Response Plan (ERP)

- An Emergency Response Plan (ERP) is a required element of a health and safety program for a worksite.
- The ERP must include the identification of internal and external resources, including personnel and equipment, that could be required to respond to an emergency.
- The ERP should be used to educate every person in the workplace about what they should do in case of an emergency.
- An emergency response plan must be established for responding to an emergency that may require rescue or evacuation.
- Affected workers must be involved in establishing the emergency response plan.
- The emergency response plan must be current.

The following are minimum requirements to be addressed in an emergency response plan.

- The identification of potential emergencies;
- Procedures for dealing with the identified emergencies;
- The identification of, location of and operational procedures for emergency equipment;
- The emergency response training requirements
- The location and use of emergency facilities
- The fire protection requirements;
- The alarm and emergency communication requirements;
- The first aid services required;
- Procedures for rescue and evacuation;
- The designated rescue and evacuation workers.

Emergency response items such as first aid and fire protection are common to all work sites.

It is essential that the emergency response plan be site specific. Individual work sites may need to add additional items that are specific to their operation.

Rescue and Evacuation of Workers

- The emergency response training must be appropriate to the work site and the potential emergencies identified in the emergency response plan.
- The training of designated rescue and emergency workers must include drill exercises that simulate the emergency response required.
- The workers who will provide rescue services and supervise evacuation procedures in an emergency must be designated.
- Designated rescue and emergency workers must be trained in emergency response appropriate to the work site and the potential emergencies identified in the emergency response plan.
- The training must include exercises appropriate to the work site that simulate the potential emergencies identified in the emergency response plan.
- The training exercises must be repeated at the intervals required to ensure that the designated rescue and evacuation workers are competent to carry out their duties.
- Workers who respond to an emergency must wear and use personal protective clothing and equipment appropriate to the work site and the emergency.
- A fall protection plan is required for every fall protection system except when the worker is protected by guardrails.
- A fall protection plan must specify 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.

Use of 911 For Emergencies

In some situations, an employer may use a “911” service as an acceptable means of providing emergency services at a worksite. Providing first aid and calling “911” may be the complete emergency response plan for this employer.

For the most part however, this approach will be limited to employers located in urban areas where the timeliness of the “911” service meets the intent of the requirement. Using a “911” service replaces some of the employer’s duties under this Part, but not all duties. For example, an employer must still identify potential emergencies, the procedures for dealing with the identified emergencies (which will include calling “911” for particular types of emergencies), fire protection requirements, workers who will supervise evacuation procedures in an emergency, etc.

> *Regardless of whether or not a “911” service is used, employers must meet the first aid equipment and service requirements of Part 11 of the OH&S Code. Using the “911” service does not replace the employer’s obligation to provide the required first aid equipment and services.*

- In the case of rescues involving workers suspended in the air after a fall, calling 911 alone and awaiting the arrival of rescue services personnel is considered to be an insufficient emergency response.

- The employer must have some basic level of on-site rescue capability in the event that rescue services personnel are delayed or unable to attend the scene (see section 140 for fall protection).

Verify Resources and Capabilities of Local Emergency Services

- In some situations, rescue services personnel may not have the equipment or skills to perform a rescue.

  e.g., a worker in a confined space deep below ground level in a horizontal tunnelling operation or a worker suspended 100 metres (~330 ft.) above ground level following the failure of a swingstage scaffold.

- In such cases, the employer’s on-site rescue capability must be such that the work site is virtually self-sufficient in returning a rescued worker to the surface or ground level.

Initial Response to a Worker Who Has Fallen

Speed is of the essence; this is truly a life-threatening emergency. But the actions taken must be purposeful and well thought out. A well-documented plan must be developed, shared with anyone who it may impact (management, workers, responders, etc.).

1. Warn others, ensure the safety of all workers.

2. Call for help, initiate the site emergency response plan (ERP) and Rescue Plan.

3. Assess the situation and resources available to respond.

- Maintain the safety of the emergency site where the incident has occurred by identifying and controlling any critical hazards.
- Have a worker meet emergency responders and show them a safe way in to access the emergency site.
- Allow a co-worker to maintain contact with the casualty to provide reassurance and remind the casualty what to do while waiting to be rescued.
- Do not allow co-workers who are not properly equipped or trained to perform the rescue.
- Do not experiment with equipment or procedures that have not been thoroughly thought out and with which training and drills have been carried out.
- Know the limitations of lifts and other equipment. Platform must accommodate a casualty laying down and have sufficient capacity for the casualty and rescuers.

4. When safe to do so, proceed with the rescue, or wait for emergency services to arrive.

- Workers involved in rescue must be competent and properly equipped.
- Once the rescue is complete, take the casualty to a safe location.

5. Persons qualified in first-aid should provide first-aid until arrival of emergency medical personnel. There is no first-aid treatment protocol specifically for a worker who has been suspended in a harness.

- If a spinal injury is suspected the first aider should maintain spinal motion restriction.
- Treat for shock by providing warmth.
- If conscious, place the patient in a position of comfort.
- If unconscious, place the patient in recovery position.
- Watch for vomiting, an unconscious patient is at risk of aspiration (vomit entering the airway). An unconscious patient who is vomiting should be rolled onto one side. Take extra care in rolling a patient with a suspected spinal injury.
- Constantly monitor the patient.

6. Ensure all appropriate authorities have been notified as per the ERP.

- Document, document, document
- Cooperate fully with police, and/or OH&S Investigators.

Follow-Up

- Ensure co-workers are debriefed and receive any assistance they may require.
- Police services may be able to offer assistance through victim services.
- Before allowing work to begin after an incident, replenish all first-aid and rescue supplies and equipment.
- When appropriate, review the incident and ensuing response, and make any revisions to the ERP or Rescue Plan that may be necessary.

Summary

What was covered in Chapter 9?

- The employer’s and employee’s responsibilities with respect to emergency response procedures.
- The steps taken in the initial response to a worker who has fallen.