Part 41 Work Requiring Rope Access

Highlights

Occupational rope access work includes "industrial rope access work" that involves double rope technique in industrial settings. "Non-industrial rope access work" uses single rope technique in activities such as mountaineering, caving and sport climbing, and the requirements for this type of rope access work apply to the workers involved, not the clients.

- Section 808 requires an employer to develop a written occupational rope access safe work plan and section 809 describes its elements.
- Section 811 describes the elements to be included in the employer's safe work practices.
- Sections 821 and 822 deal with worker rescue and self-rescue.
- Section 823 recognizes industrial rope access practice guidelines used in the United Kingdom (IRATA), the U.S. (SPRAT) and Australia (ARAA). Employers are required to follow one of the listed guidelines.
- Section 826 requires industrial rope access workers to have the applicable skills and practical experience hours described in the certification guidelines published by IRATA, SPRAT, or the ARAA. Certification of Alberta workers by one or more of the organizations is not required.
- Section 827 requires industrial rope access workers to maintain a personal logbook of work hours and activities.
- Section 841 requires non-industrial rope access workers to have the applicable skills described in manuals and guidelines published by the Association of Canadian Mountain Guides (ACMG) or, in the case of caving activities, guidelines published by the Canadian Cave Conservancy and British Columbia Cave Rescue.
- This Part references many European standards for equipment.

Introduction

"Rope access" work involves rope-based techniques for gaining access to, or working at, work locations that are difficult or impossible to access by other means. For the purposes of the OHS Code, occupational rope access work is divided into two categories:

Occupational rope access

Industrial rope access work

- Generally at height
- Uses a working line and safety line in combination with a full body harness having a sternal or chest attachment point
- Mountaineering-type devices are used to ascend, descend, and traverse
- Suited to work on tall building, atria, bridges, roadside cliffs, shafts, towers, and odd-shaped structures such as steeples, domes and pyramids

Non-industrial rope access work

- Generally at height
- Uses a working line and sit harness or full body harness in combination with mountaineering devices
- Includes mountaineering, caving and canyoning i.e. travel vertically and horizontally on snow, ice or rock
- Includes rope access climbing on artificial structures such as climbing walls

Industrial rope access work

As a method of working at height, industrial rope access techniques can be used as an alternative to scaffolds, man lifts, and elevated work platforms. The techniques are best used for light to medium tasks such as

- inspection and testing – surveys, non-destructive testing,
- maintenance and repair – sealant installation, replacing cladding and glazing,
- cleaning and painting – jet spray, spray/roller/brush painting, and
- geotechnical work – surveying, rockfall prevention.

Industrial rope access systems are quick to assemble and disassemble, and require a small number of workers for a relatively brief period of time. Thus, the number of "man-risk" hours is kept to a minimum.

There is a small but growing industry in Alberta providing industrial rope access services. However, the traditional fall protection requirements of Part 9 of the OHS Code have limited or restricted the ability of workers in this industry to use the full range of rope access techniques and equipment used elsewhere in the world. Part 41 addresses the needs of this industry.

Non-industrial rope access work

Non-industrial rope access work includes the work activities of mountain guides, professionally certified mountain guides (Association of Canadian Mountain Guides – ACMG), guides involved in caving, workers involved in delivering outdoor education courses in rock and ice climbing and glacier travel, and workers who work at sport climbing walls and gyms.

The equipment and techniques these workers use, and their dependence on primarily natural terrain features for their safety, makes compliance with the fall protection requirements of Part 9 of the OHS Code impossible or dangerous. Part 41 addresses the needs of this industry.

General requirements

Exemptions

Section 805

The industrial-type fall protection requirements of Part 9 do not apply to workers involved in training for occupational rope access work or performing occupational rope access work. These workers may use equipment and practices other than those specified in Part 9 i.e. the equipment and practices described in Part 41.

Section 806

Workers involved in emergency rescue services or training for the purpose of emergency rescue are not bound by the requirements of the Part. This exemption allows rescue personnel to use equipment and practices other than those specified in this Part; it *does not* exempt rescue personnel from using fall protection equipment and practices. The equipment and practices used must provide an effective measure of worker safety and address the unique hazards that a rescue situation presents.

Section 807

In situations such as window washing, a worker can use a fall protection system that complies with Part 9, or can use an industrial rope access system that complies with Part 41 (including all its training requirements). It must be one or the other, not a combination of the requirements from the two Parts.

Self-progression is a key concept that differentiates and distinguishes occupational rope access work from work to which industrial fall protection techniques apply i.e. Part 9. Part 41 does not apply to systems that are used for descent purposes only, or to systems in which the worker is raised or lowered by others. In these cases, the industrial fall protection systems required by Part 9 should be used.

This section makes it clear that if a worker uses a traditional industrial-type fall protection system that meets the requirements of Part 9, then the requirements of Part 41 do not apply to that worker.

Rope access safe work plan

Section 808 3 metre fall height

An unusual possibility of injury exists if the injury may be worse than an injury from landing on a solid, flat surface. Examples include falling onto exposed rebar, a stairway, or the top of a fence.

Sections 809 and 810 Components of the plan

The purpose of the rope access safe work plan is to have the employer address a variety of issues that will help ensure the safety of workers involved in the rope access work. Section 8 of the *OHS Regulation* requires that the plan be in writing and available to affected workers. The plan must be available at the work site before work with a risk of falling begins.

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

Before occupational rope access work begins at a work site, a written hazard assessment as required by Part 2 must be completed. This helps to establish the appropriateness of using rope access techniques, identifies hazards, and should help the employer to determine how the hazards will be eliminated or controlled.

The rope access safe work plan needs to describe the rope access system that will be used. This helps ensure that workers use the correct equipment, that the correct equipment is on site, and that the system is set up correctly.

The procedures used to assemble, maintain, inspect, use, and disassemble the rope access system must be part of the rope access safe work plan. These procedures serve as a source of reference information when questions arise and they can help reinforce best practices.

Describing the duties of each member of the work team helps workers understand what they are responsible for, and what they are not. The duties assigned must be consistent with the workers' level of training and skills.

All personal protective equipment must be listed in the plan. This is not limited solely to rope access equipment. If respiratory protective equipment, protective eyewear, crampons, avalanche transceiver, etc. are required to perform the work safely, then this personal protective equipment needs to be specified in the plan. Listing this equipment in the plan serves as a check that each hazard identified in the hazard assessment has, to the extent necessary, been addressed by some type of personal protective equipment. The list can also serve as an equipment checklist to ensure that all the correct personal protective equipment has been taken to the work site.

The emergency response plan is an essential part of the overall plan. This plan deals not only with the direct hazards associated with working at height, but also all the other hazards identified in the hazard assessment. For example, what is the response plan in the event of extreme weather, a fire, a medical emergency, etc.?

Section 811 Safe work practices

The employer is responsible for developing and implementing safe work practices that ensure that the work is performed safely. The safe work practices must include each of the topics listed in this section.

Section 812 Instruction of workers

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

Workers must be competent to perform their work activities. Requirements specific to the training of workers in occupational rope access techniques are described in section 826 for industrial rope access work and section 841 for non-industrial rope access work.

Section 813 Tools and equipment

In many cases, the greatest danger of occupational rope access work is the dropping of tools on workers below the work area. To guard against this, small tools such as hammers and drills, weighing up to 8 kg, must be securely attached to the rope access worker's harness by lanyards. Alternatively, small items should be carried in a bucket or bag securely attached to the worker's harness.

Tools should only be carried like this if they are not of such weight that they could cause a significant reduction in the factor of safety of either the suspension system as a whole or any part of it. Where a tool needs to be pressed hard against the work face, or where the reaction from the tool could unbalance the worker, a light anchor should be pre-drilled or clamped on to the work face and the tool attached to it.

Equipment weighing more than 8 kg should be fitted with a separate suspension system secured to an independent anchor. Anchors and suspension ropes used for equipment should be clearly identified to avoid confusion with those used to support workers.

Section 814 Equipment compatibility

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

Section 815 Inspection and maintenance

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

Low stretch (static) and high stretch (dynamic) rope

Section 816 Same diameter of rope

Having rope of the same diameter allows for worker self-rescue because ascenders, descenders and other hardware are compatible with either rope. If the working and safety lines are inadvertently reversed, rope adjustment hardware will be unaffected and continue to function properly. While it is recognized that laid ropes are sometimes being used as the safety line in combination with standard industrial rope grabs, doing so limits or altogether prevents a worker from performing self-rescue. The ability to perform self-rescue is considered to be a key element of occupational rope access work.

Section 817 Standards for low stretch (static) rope

Efficiency in descending, ascending and, to some extent, working in one place for any length of time, depends on the elongation characteristics of the working line. Therefore, in most cases, the working line (and normally the safety line) should be a low stretch kernmantle rope. However, in situations where the possibility of a substantial dynamic load exists e.g. when using lead-climbing techniques, a dynamic rope should be used.

For compliance purposes, the rope must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the rope meets the requirements of at least one of the listed standards. Rope bearing a CE mark is considered acceptable for the purpose of this Code, as is rope bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the rope already bears a CE mark.

CEN Standard EN 1891

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

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

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

Type A rope has the following performance characteristics:
- elongation (stretch) must not exceed 5 percent under test conditions
- static strength without terminations – at least 22 kN
- static strength when terminated with a knot or other method – at least 15 kN
- fall arrest peak force must not exceed 6 kN under the test conditions.

NFPA Standard 1983

Chapter 5 of NFPA Standard 1983: 2006, *Standard on Fire Service Life Safety Rope, Harness and Hardware*, presents requirements for life safety rope. The rope must have the following performance characteristics:
- elongation must be at least 1 percent but not more than 10 percent at 10 percent of minimum breaking strength
- the breaking strength of light use rope must be at least 4500 lbs-force (20 kN)
- the breaking strength of general use rope must be at least 9000 lbs-force (40 kN)
- light use rope must have a diameter of not less than 3/8 in. (9.5 mm) and not more than ½ in. (13 mm)
- general use rope must have a diameter of not less than ½ in. (13 mm) and not more than 5/8 in. (16 mm)
- fibre used in rope must have a melting point of not less than 400^0 F (204^0 C)

UIAA Standard 107

UIAA Standard 107: 2004, *Mountaineering and Climbing Equipment – Low Stretch Ropes*, requires that the rope meet the requirements of CEN Standard EN 1891 plus several additional requirements. These additional requirements involve colour marking of the rope sheath.

Section 818 Standards for high stretch (dynamic) rope

For compliance purposes, the rope must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the rope meets the requirements of at least one of the listed standards. Rope bearing a CE mark is considered acceptable for the purpose of this Code, as is rope bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the rope already bears a CE mark.

CEN Standard EN 892

CEN Standard EN 892: 2004, *Mountaineering equipment. Dynamic mountaineering ropes. Safety requirements and test methods*, specifies safety requirements and test methods for dynamic rope (single, half and twin ropes) in kernmantle construction for use in mountaineering, including climbing. Dynamic mountaineering rope is defined by the Standard as rope that is capable of arresting the free fall of a person engaged in mountaineering or climbing with a limited peak force.

Dynamic rope has the following performance characteristics:

- static elongation must not exceed 10 percent in single ropes, 12 percent in half ropes, and 10 percent in twin ropes
- dynamic elongation cannot exceed 40 percent during the first drop of each test sample
- the peak force in the rope, during the first drop for each test sample, must not exceed 12 kN in single ropes, 8 kN in half ropes, and 12 kN in twin ropes
- under test, slippage between the sheath and core must not exceed 20 mm.

UIAA Standard 101

UIAA Standard 101: 2004, *Mountaineering and Climbing Equipment – Dynamic Ropes*, requires that the rope meet all the requirements of CEN Standard EN 892 plus an additional requirement for slippage.

Section 819 Cow’s tail

A cow’s tail is defined in the OHS Code as a short strap, lanyard or sling connected to the main attachment point of a harness. Cow’s tails are used to connect the worker’s harness to the safety line via a back-up device and to the working line via an ascender. Cow’s tails should be able to withstand any dynamic forces that may be imposed on them in case of a fall.

While manufactured cow's tails are available, and therefore subject to a manufacturer's testing and quality assurance programs, many rope access workers create their own from short lengths of rope. If a cow's tail is made of rope (some are made of webbing), it must be made of dynamic kernmantle rope. The rope must be approved to CEN Standard EN 892: 2004 or UIAA Standard 101: 2004. Readers are referred to the explanation for section 818 for information about these standards.

If a cow's tail is not made of dynamic rope, it must be approved to CEN Standard EN 354: 2002, *Personal protective equipment against falls from a height – Lanyards*. This Standard specifies the requirements, test methods, marking, and information to be supplied by the manufacturer for non-adjustable and adjustable lanyards. The Standard allows lanyards to be made of synthetic fibre rope, wire rope, webbing or chain and limits their overall length to 2 m. Lanyards made from synthetic fibre ropes or webbing must be able to sustain a force of at least 22 kN without separating, tearing or rupture of any lanyard element. The force applicable to lanyards made of metallic material is 15 kN.

Section 820 Removal from service

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

Sections 821 and 822 Worker rescue

Rescue procedures are a vital part of an employer's safe work practices. The survival of an injured worker often depends on the speed of rescue and the care given to the casualty during and after rescue. As a result, the work site should be regularly assessed to anticipate emergency situations and to plan how any resulting rescues would be carried out. Specific rescue equipment should always be at the worksite.

Section 811 requires written procedures. After an arrested fall, the fallen worker remains suspended in mid-air from his or her full body harness, awaiting rescue. In most cases, the worker is not injured and can alter body position within the harness to be more comfortable.

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

Suspension trauma death is caused by orthostatic incompetence. A soldier standing almost motionless at attention for a long period of time and then fainting is an example of the problem. What happens with ortostatic incompetence is that the circulation of blood is reduced because the legs are immobile and the worker is in an upright position.

Gravity pulls the blood into the lower legs, which have a very large storage capacity. Enough blood eventually pools in the legs that return blood flow to the right side of the heart is reduced. This causes blood supply problems for both the heart and the brain. Normally the person faints at this point and falls to the ground. Now that the person is horizontal, blood from the legs flows back to the heart and on to the rest of the body.

While suspended in a harness however, the worker cannot fall into a horizontal position. Fall victims can slow the onset of suspension trauma by pushing down forcefully with the legs, by positioning their body in a horizontal or slightly leg-high position, or by standing up.

However, the design of the harness, the attachment points used, and the presence of fall injuries may prevent these actions. The suspended worker faces several problems:
(1) the worker is suspended in an upright posture with legs dangling;
(2) the safety harness straps exert pressure on leg veins, compressing them and reducing blood flow back to the heart; and
(3) the harness keeps the worker in an upright position, regardless of consciousness.

Rescue must happen quickly to minimize the dangers of suspension trauma. Time is of the essence because the suspended worker may lose consciousness in as few as five minutes.

If a worker is suspended long enough to lose consciousness, rescue personnel must be careful in handling such a person or the rescued worker may die anyway. This post-rescue death is apparently caused by the heart's inability to tolerate the abrupt increase in blood flow to the right side of the heart after removal from the harness. Current recommended procedures are to take from 30 to 40 minutes to move the victim from kneeling to a sitting to a laying down position. A physician should examine the rescued victim. Among other things, the reduction in blood flow while suspended can affect the kidneys and lead to permanent damage. For more information about suspension trauma, readers are referred to the sources listed below.

A motionless, suspended victim suggests serious injury and a rescue must be performed quickly. A non-breathing, motionless victim must be ventilated within four minutes of when they stop breathing in order to prevent irreversible brain damage. If a work platform or man basket is suspended from a crane or hoist, a fall protection plan must be in place for the rescue of the occupant(s) in the event that the crane or hoist is unable to lower the work platform or man basket.

For more information

www.hse.gov.uk/research/crr_htm/2002/crr02451.htm
Harness suspension: review and evaluation of existing information (A very comprehensive review of the topic, prepared for the Health and Safety Executive, United Kingdom)

www.cdc.gov/elcosh/docs/d0500/d000568/d000568.html
Will your safety harness kill you?

Industrial rope access work

Industrial rope access work is defined in the OHS Code as work activities at height which incorporate a working line, safety line and a full body harness in combination with other devices that allow a worker to ascend, descend and traverse to and from a work area under his or her own control.

The advantage of industrial rope access work is primarily the speed at which workers can get to or from difficult locations. In some cases, the cost or difficulty of using other means of access can be prohibitive. Rope access tends to be at its most efficient when used for inspection and similar light to medium duty tasks such as

- inspection and testing – surveys, non-destructive testing,
- maintenance and repair – sealant installation, replacing cladding and glazing,
- cleaning and painting – jet spray, spray/roller/brush painting, and
- geotechnical work – surveying, rockfall prevention.

An industrial rope access system as required by the OHS Code requires two independently anchored vertical lifelines. One lifeline provides a means of primary support to the suspended worker – the working line. The other line provides backup security to the suspended worker should the working line fail or there is an equipment malfunction – the safety line. Both lifelines are used in conjunction with a full body harness and other ascent and descent devices whereby the suspended worker, responsible for his or her own progression, can access a work area by means of ascent, descent or traversing the lifelines.

Safe work practices

Section 823 Recognized safe work practices

An employer is required to select and follow the safe work practices of one of the listed publications. An employer cannot blend together the safe work practices of two or more of the listed publications. The resulting practices might not be endorsed by any one of the referenced organizations and could create unsafe situations for workers.

While some employers may feel that this requirement places restrictions on what an employer can do in terms of safe work practices, the listed safe work practices constitute industry recognized best practices, have proven to be safe after many years of use, take the guesswork out of what an employer needs to follow, and create a defined minimum standard against which an employer’ operations can be assessed.

Section 824 Conflicting requirements

The requirements of some of the reference publications listed in section 823 may conflict with the requirements of the OHS Code. This section clarifies which requirement takes precedence.

Section 825 Two workers per team

Workers must work in teams of at least two, one of whom should be competent to supervise.

Section 826 Worker competency

Safe and competent rope access workers require a combination of both training and practical experience hours. Competent workers must be adequately qualified, suitably trained, and have sufficient experience to perform their work safely. Working a minimum number of hours at height helps ensure that workers meet the third component – sufficient experience – of the competency requirement. Documenting those hours in a logbook (see section 827) provides a record to employers of the practical experience hours a worker has gained while working at height.

Despite adopting the safe work practices of the Industrial Rope Access Trade Association (IRATA), the Society of Professional Rope Access Technicians (SPRAT) and the Australian Rope Access Association (ARAA,) and the technical skills and practical experience hours of these organizations, worker certification by these organizations remains optional at this time for industrial rope access workers in Alberta – it is not a mandatory requirement to be certified by one of these organizations. Requiring certification by these organizations would tie Alberta workers to having to become members of one or more of these associations, may limit worker access to training programs, and might prevent agencies presently involved in worker training from entering the industrial rope access training market.

Embracing the safe work practices, technical skill requirements, and practical experience hours of these organizations will help ensure the safety of workers engaged in work at height. By making worker certification by these organizations optional, employers can employ non-certified workers as long as the employer can assess a worker's competency against the stated requirements and the worker meets those requirements. This is the same worker competency model followed elsewhere in the OHS Code.

The employer is responsible for ensuring that workers performing industrial rope access work have the skills referred to in section 812, appropriate to the level of work assigned. The OHS Code considers a worker to be competent if the worker meets the following three conditions:

(1) adequately qualified – the worker has some type of qualification, usually earned through a formal education program, training course, etc., or a combination of education and practical experience. With certain exceptions such as professional designations e.g. professional engineer, nurse, physician, etc., or other legal requirement involving qualifications, the employer is responsible for evaluating and deciding if a worker is adequately qualified. The employer should be able to justify the basis on which a worker is considered to be "adequately qualified";

(2) suitably trained – the worker must have training that is appropriate to the tasks, equipment, etc., that will be performed or used. The employer is responsible for evaluating and deciding if a worker is suitably trained. The employer should be able to justify the basis on which a worker is considered to be "suitably trained"; and

(3) with sufficient experience to safely perform work without supervision or with only a minimal degree of supervision – determining whether a worker has sufficient experience to safely perform work is the employer's responsibility. A worker's qualifications, training and experience are no guarantee that work will be performed safely. The employer should be able to justify the basis on which a worker is considered to have "sufficient experience".

In cases where an employer is unable or unwilling to assess the competency of a worker planning to perform industrial rope access work against these criteria, a worker performing industrial rope access work would be considered to meet the requirements if the worker possessed a valid certificate from
(a) IRATA, appropriate to the level of work being performed,
(b) SPRAT, appropriate to the level of work being performed, or
(c) ARAA, appropriate to the level of work being performed.

An employer in the situation described could simply require that his or her workers be certified, eliminating the employer's need to assess the worker's competency.

Section 827 Worker's personal logbook

Worker logbooks are a mandatory requirement of industrial rope access workers. The logbook concept is an essential component of modern industrial rope access. A worker's logbook should be considered a tool that an employer or prospective employer can use to verify and quantify the work history of the rope access worker.

The logbook should clearly indicate the duration and nature of the work performed as well as the access techniques employed by the worker. Given the freelance nature of rope access workers, the logbook accompanies the worker and details the breadth and experience of the worker.

Personal logbooks are not a new type of requirement for the OHS Code. Part 31 of the OHS Code requires that commercial divers maintain a personal logbook of their dives. The logbook maintained by workers engaged in industrial rope access work must include the following entries:
(a) the date on which the work was performed;
(b) type of work, including access method – the nature of the task performed e.g. non-destructive testing (NDT), inspection, window cleaning or painting, as well as a brief description of the access method used e.g. vertical rope work, traversing, fall arrest climbing, equipment maintenance, etc.
(c) the type of structure worked on – e.g. flare stack 30 m tall, high rise building 100 m tall, etc., and

(d) hours worked – this includes only those hours worked using rope access techniques including rigging, equipment maintenance and inspection. Work using fall arrest methods is of relevance only if used in combination with rope access. The number of hours logged will not necessarily be the number of hours spent at the worksite or the time shown on time sheets.

The rope access supervisor or worksite manager must sign each logbook entry.

Although not required by this section, the logbook can also be used as a means of documenting the rope access and other training that an industrial rope access worker receives.

Section 828 Maximum arrest force, clearance

The behaviour of load components in the system, such as dynamic cow's tails, load-limiting back-up devices and the extension of the low-stretch rope, can help absorb any forces generated, should there be a limited fall. However, the system generally should be designed to avoid this i.e. it should function as a work positioning system.

Rather than stating a restrictive free fall distance, this section allows a worker to fall an unspecified distance as long as three conditions are met:

(a) *the maximum arresting force on the worker is limited to 6 kN* – maximum arresting force is the short-duration (milliseconds to tenths of a second), peak dynamic force acting on a worker's body as the worker's fall is arrested. The maximum arresting force to which a worker can be exposed during fall arrest in Alberta is limited to 6 kN (1800 pounds-force).

 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 pounds-force). The 6 kN limit is therefore considered safe but, as was discovered during the studies, is subject to the following conditions:
 (i) the maximum arresting force is applied upwards through the pelvic area;
 (ii) the worker's physical condition is sufficient to withstand such a jolt; and
 (iii) the duration of the maximum arresting force is limited to a fraction of a second;

(b) *the worker is prevented from striking a lower surface that could cause injury*, unless preventing this possibility exposes the worker to other greater hazards; and

(c) *the swing-fall hazard is minimized*.

Section 829 Anchorage strength

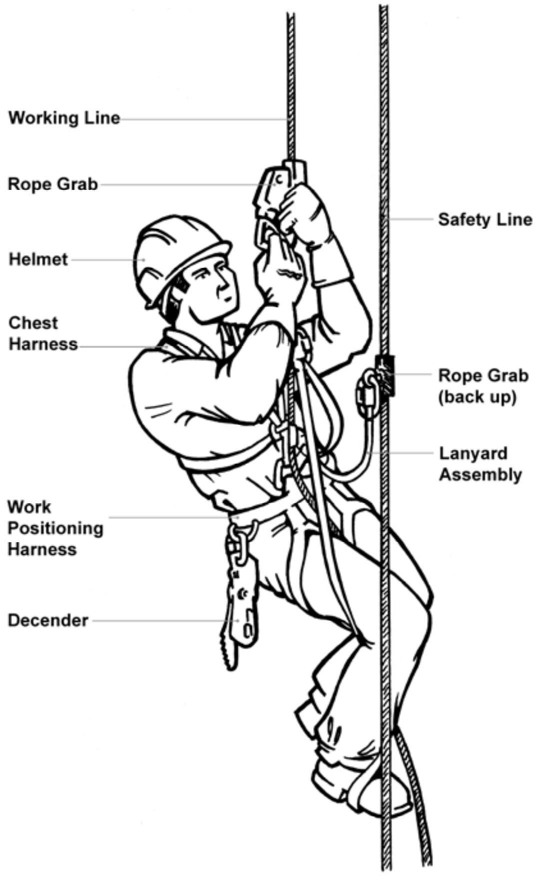
Anchors should be unquestionably reliable i.e. "bomber" or "bomb-proof". The strength of all anchors should be not less than 16 kN per worker attached. However, where this is not practicable, an anchor can be "de-rated" to have an ultimate load capacity of two times the estimated maximum arresting force created by a fall in the direction of the rope pull.

Section 830 Safety line

An industrial rope access system as required by the OHS Code requires two independently anchored vertical lifelines. One lifeline provides a means of primary support to the suspended worker – the working line. The other line provides backup security to the suspended worker should the working line fail or there is an equipment malfunction – the safety line. Both lifelines are used in conjunction with a full body harness and other ascent and descent devices whereby the suspended worker, responsible for his or her own progression, can access a work area by means of ascent, descent or traversing the lifelines.

As shown in Figure 41.1, it is appropriate for the worker's safety line to be connected to the sternal or frontal attachment point of the worker's full body harness. Unlike a full body harness used in industrial-type fall protection, a dorsal D-ring is not used.

Figure 41.1 Example of set-up used in industrial rope access work



Section 831 Head protection

Subsection 831(1) Headwear standards – lateral impact

If there is a foreseeable danger of injury to a worker's head during industrial rope access work, head protection must be worn. The type worn may vary based on whether a worker is likely to sustain a lateral impact to the head or not. For compliance purposes, industrial protective headwear intended for use where there is a significant possibility of lateral impact to the head must meet the requirements of one of the listed standards. Lateral impact occurs when an object strikes the headwear from any direction other than directly above. The headwear must be of the appropriate Class for the type of work being performed.

CSA Standard Z94.1

CSA Standard Z94.1-05, *Industrial Protective Headwear*, applies to headwear intended to protect the heads of industrial workers. The Standard defines the areas of the head that are to be protected and includes basic performance requirements for impact protection, object penetration, stability and dielectric properties (the ability of a material to resist the passage of electric current).

The Standard divides protective headwear into three Classes according to its intended use:

(a) *Class G (General Use)* – this Class is intended to provide workers with protection against impact and penetration. This headwear is non-conducting and must pass a 2200 V dielectric-strength test. This protective headwear provides limited protection against electric shock.

(b) *Class E (Electrical Trades)* – this Class is intended to provide workers with protection against impact and penetration. This headwear is non-conducting and must pass a 20,000 V dielectric-strength test. This headwear provides improved protection against electric shock following accidental contact between the headwear and exposed energized electrical sources.

(c) *Class C (Conducting Headwear)* – this Class is intended to provide the user with protection against impact and penetration only.

Protective headwear meeting the CSA requirements may have a brim around the entire circumference of the shell or have a partial brim with a peak.

ANSI Standard Z89.1

Type II helmets that meet ANSI Standard Z89.1-2003, *American National Standard for Industrial Head Protection*, may also be used at the workplace. The ANSI Standard applies to protective helmets intended to provide limited protection for the head against impact, flying particles, electric shock or any combination of these hazards.

The Standard divides protective helmets into two types and three classes according to their intended use. Type I helmets are intended to reduce the force of impact resulting from a blow only to the top of the head. Type II helmets are intended to reduce the force of impact resulting from a blow that may be received off-centre or to the top of the head. The three classes are as follows:

(a) *Class G (General Use)* – this Class is intended to reduce the danger of contact exposure to low voltage conductors and must pass a 2200 V dielectric-strength test.

(b) *Class E (Electrical Trades)* – this Class is intended to reduce the danger of contact exposure to high voltage conductors and must pass a 20,000 V dielectric-strength test.
(c) *Class C (Conductive – no electrical protection)* – this Class is designed specifically for lightweight comfort and impact protection. This Class is usually manufactured from aluminum and offers no dielectric protection.

ANSI types and classes are combined to provide products classified as Type I, Class G or Type II, Class E, etc. Helmets meeting the ANSI requirements may have a brim around the entire circumference of the helmet shell or have a partial brim with a peak.

CEN Standard EN 12492

CEN Standard EN 12492: 2000, *Mountaineering equipment – Helmets for mountaineers – Safety requirements and test methods*, specifies safety requirements and test methods for safety helmets for use in mountaineering. Because they are intended for mountaineering, helmets meeting the requirements of this standard can only be used for industrial rope access work if the manufacturer's specifications allow the helmet to be used for industrial work at height.

The Standard requires a helmet

- to have a retention system with three separate points of attachment to the shell. The helmet must have a chin strap,
- to be ventilated, and
- to be able to withstand a specified impact force delivered to the top, sides and rear of the helmet. The force transmitted to the headform must not exceed 10 kN.

UIAA Standard 106

UIAA Standard 106: 2004, *Mountaineering and Climbing Equipment – Helmets*, requires that the helmet meet all the requirements of CEN Standard EN 12492 but that the value of impact force transmitted to the headform during testing be limited to 8 kN rather than the 10 kN specified in CEN Standard EN 12492. Because they are intended for mountaineering, helmets meeting the requirements of this standard can only be used for industrial rope access work if the manufacturer's specifications allow the helmet to be used for industrial work at height.

Subsection 831(2) Helmet standards – lateral impact unlikely

If the possibility of lateral impact to the head is unlikely, the headwear can meet the requirements of one of the standards listed in this subsection. Because helmets designed for lateral impact protection are subjected to impact tests to the crown, the majority of the standards listed in subsection 831(1) also appear here. Readers should refer to that subsection for information about each of those standards. The only standard not included in that subsection but which appears in this subsection is CEN Standard EN 397: 2006, *Industrial safety helmets*.

This Standard specifies physical and performance requirements, methods of test and marking requirements for industrial safety helmets. The mandatory requirements apply to helmets for general use in industry. This Standard requires the following of a helmet:

- ventilation holes in the helmet shell are optional
- the helmet must be able to withstand a specified impact force delivered to the top of the helmet. The force transmitted to the headform must not exceed 5 kN
- the chin strap must open when subjected to a force ranging between 150 and 250 N
- optional requirements include a low temperature test, very high temperature test, electrical resistance, lateral deformation, and molten metal splash.

Section 832 Headwear retention system

To ensure that the protective headwear remains on the worker's head despite his or her position or orientation while working, the protective headwear must have a retention system. The retention system must have at least three separate points of attachment to the helmet shell and must include a chin strap.

Section 833 Worker to secure headwear

The employer must ensure that workers secure their protective headwear according to the manufacturer's specifications.

Section 834 Full body harness

For compliance purposes, the full body harness must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the full body harness meets the requirements of at least one of the listed Standards. A full body harness bearing a CE mark is considered acceptable for the purposes of this Code, as is a full body harness bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the full body harness already bears a CE mark.

Each of the listed harness standards recognizes the use of a sternal attachment point for rope access work.

NFPA Standard 1983

NFPA Standard 1983: 2006, *Standard on Fire Service Life Safety Rope, Harness and Hardware,* as a Class III harness. A Class III life safety harness is one that fastens around the waist, around the thighs or under the buttocks and is designed for rescue where two-person loads may be encountered and inverting may occur. A Class III life safety harness must meet the following requirements:

- all webbing, stitching and riveting must withstand a tensile test of at least 6000 lbs-force without failure
- fibre used in the construction of the harness, including webbing, thread, and labels must have a melting point of at least 400^0F
- drop testing is done in accordance with ANSI Standard A10.14, using a 300-lb manikin

CEN Standard EN 361

CEN Standard EN 361: 2007, *Personal protective equipment against falls from a height – Full body harnesses*, specifies the requirements, test methods, marking, information supplies by the manufacturer and packaging for full body harnesses. Drop testing involves both feet first and head first drops of a 100 kg mass through a free fall distance of 4 m.

ANSI Standard Z359.1

ANSI Standard Z359.1-2007, *Safety requirements for personal fall arrest systems, subsystems and components*, establishes requirements for the performance, design, marking, qualification, instruction, training, inspection, use, maintenance, and removal from service of connectors, full body harnesses, lanyards, energy absorbers, anchorage connectors, fall arresters, vertical lifelines, and self-retracting lanyards comprising personal fall arrest systems for users within the capacity range of 130 to 310 pounds (59 to 140 kg).

Connecting components

Section 835 Standards

For compliance purposes, the connector must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the connector meets the requirements of at least one of the listed standards. A connector bearing a CE mark is considered acceptable for the purposes of this Code, as is a connector bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the connector already bears a CE mark.

CEN Standard EN 362

CEN Standard EN 362: 2004, *Personal protective equipment against falls from height. Connectors, s*pecifies the requirements, test methods, instructions for use and marking for connectors. Connectors according to this Standard are used in work positioning and fall arrest systems specified in EN Standard EN 358 and EN Standard 363 respectively. Lanyards with connectors as terminations are specified in EN Standard 354.

The Standard defines a connector as a connecting element or component of a system. Carabiners are one type of connector covered by the Standard. To reduce the probability of unexpected opening, connectors covered by the Standard must be self-closing and self- or manual locking. They must be capable of being opened only by at least two consecutive deliberate manual actions.

Connectors tested according to the Standard must be able to withstand a static strength test of at least 15 kN without tearing or rupture.

CEN Standard EN 12275

CEN Standard EN 12275: 1998, *Mountaineering equipment. Connectors. Safety requirements and test methods*, specifies safety requirements and test methods for connectors used in mountaineering including climbing. This Standard defines "connector" as a device that can be opened, allowing a mountaineer to link himself or herself directly or indirectly to an anchor. Connectors are classified as types B (basic connector), H (HMS connector), K (Klettersteig connector), A (specific anchor connector), D (directional connector, excluding anchor connectors), Q (screwed gate connector – Quicklink), and X (oval connector). Depending on the type of connector, the minimum static strength required along the major axis of the connector with the gate closed ranges from 20 kN to 25 kN, although type X connectors require a minimum strength of 18 kN.

UIAA Standard 121

UIAA Standard 121: 2004, *Mountaineering and Climbing Equipment – Connectors,* requires that the connector meet all the requirements of CEN Standard EN 12275 and for type K connectors, additional strength and dimensional requirements are imposed.

CSA Standard Z259.12

CSA Standard Z259.12-01 (R2006), *Connecting Components for Personal Fall-Arrest Systems*, sets out design and performance requirements, test methods, and requirements for marking and labelling individual connecting components used as part of a personal fall arrest system (PFAS). This Standard applies to components that are

(a) used in the interconnection of a complete unit referred to in other published Standards and/or projected Standards related to PFAS;
(b) intended to be used as the primary single link to a permanent anchorage connector; and
(c) intended to be used as a primary attachment point between two or more subsystems, as described and certified under other Standards related to PFAS.

According to the Standard, the term "connectors" refers to carabiners, D-rings, O-rings, oval rings, self-locking connectors and snap hooks used to interconnect the components of a personal fall arrest system. To comply with the CSA Standard, only snap hooks and carabiners that are self-closing and self-locking can be used as interconnecting hardware in fall arrest systems. For these connecting components to be acceptable for use, their gates require at least two consecutive, deliberate actions to open.

NFPA Standard 1983

Chapter 5 of NFPA Standard 1983: 2006, *Standard on Fire Service Life Safety Rope, Harness, and Hardware, s*pecifies design, labelling and performance requirements for connectors such as buckles, rings and snap-links. In terms of strength performance,

(a) load-bearing hardware must withstand not less than a 1200 lbs-force tensile test without permanent deformation,
(b) buckles must withstand a tensile test of not less than 5000 lbs-force without failure,
(c) rings must withstand a tensile test of not less than 5000 lbs-force without failure, and
(d) snap-links must withstand a tensile test of not less than 5000 lbs-force without failure when tested in manner of function.

Section 836 Acceptable styles of carabiners

Auto-locking and auto-closing carabiners reduce the likelihood of a carabiner being unintentionally left open, resulting in a potential worker injury or death. However, this type of carabiner may not be appropriate in all situations e.g. manipulating a screw-gate carabiner while wearing welding gloves or cold weather gloves/mittens can be much easier than trying to manipulate a self-locking, self-closing carabiner under the same conditions. As a result, screw-gate type carabiners that lock manually are acceptable for use in industrial rope access systems.

Non-locking carabiners are not allowed for use in industrial rope access systems.

Section 837 Ascenders

An ascender is a rope adjustment device which, when attached to an anchor line of appropriate type and diameter, locks under load in one direction and slides freely in the opposite direction. Ascenders are normally used to ascend the working line or position the worker on the working line.

Ascenders used in industrial rope access systems must be approved to one or more of the listed standards. Compliance with these standards reduces the likelihood that an ascender will accidentally detach from the line/rope and limits the risk of damage to the line/rope when in use.

Typically there are two types of ascenders used in a rope access system. The first is used to connect the worker directly to the working line; the other type is attached to a foot loop to aid climbing, and is also connected back to the harness to provide additional security. Ascenders should be of a type that cannot be accidentally detached from the line and should be chosen so that the risk of damage to the line is minimized during use. Any dynamic loading should be avoided, as damage could result to either the ascender or the line.

For compliance purposes, the ascender must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the ascender meets the requirements of at least one of the listed standards. An ascender bearing a CE mark is considered acceptable for the purposes of this Code, as is an ascender bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the ascender already bears a CE mark.

CEN Standard EN 567

CEN Standard EN 567: 1997, *Mountaineering equipment – Rope clamps – Safety requirements and test methods*, specifies safety requirements and test methods for rope clamps for use in mountaineering, including climbing. A rope clamp is a mechanical device which, when attached to a rope or an accessory cord of appropriate diameter, locks under load in one direction and slips freely in the opposite direction.

UIAA Standard 126

UIAA Standard 126: 2004, *Mountaineering and Climbing Equipment – Rope Clamps*, requires that the ascender meet all the requirements of CEN Standard EN 567 plus an additional safety requirement that applies to rope clamps used for self-belaying.

NFPA Standard 1983

Chapter 5 of NFPA Standard 1983: 2006, *Standard on Fire Service Life Safety Rope, Harness, and Hardware, s*pecifies design, labelling and performance requirements for ascent devices. Ascent devices must withstand a tensile test of not less than 1200 lbs-force without failure when tested in manner of function.

Section 838 Back-up devices

Back-up devices are used to attach the worker to the safety line. In the event of a failure of the working line or loss of control by the worker, back-up devices are intended to lock on to the safety line without causing catastrophic damage to the line and also to absorb the limited shock load that might occur. The device acts to prevent or restrict a fall. Back-up devices used in industrial rope access systems must be approved to one or more of the listed standards.

For compliance purposes, the back-up device must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the back-up device meets the requirements of at least one of the listed standards. A back-up device bearing a CE mark is considered acceptable for the purposes of this Code, as is a back-up device bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the back-up device already bears a CE mark.

CEN Standard EN 353-2

CEN Standard EN 353-2: 2002, *Personal protective equipment against falls from a height – Part 2: Guided type fall arresters including a flexible anchor line*, specifies the requirements, test methods, marking, information supplied by the manufacturer and packaging for guided type fall arresters including a flexible anchor line which can be secured to an upper anchor point. A "guided type fall arrester" travels along an anchor line, accompanies the user without requiring manual adjustment during upward or downward changes of position, and locks automatically on the anchor line when a fall occurs. A "flexible anchor line" may be a synthetic fibre rope or a wire rope and is to be secured to an upper anchor point.

CEN Standard EN 567

CEN Standard EN 567: 1997, *Mountaineering equipment – Rope clamps – Safety requirements and test methods*, specifies safety requirements and test methods for rope clamps for use in mountaineering including climbing. A rope clamp is a mechanical device, which, when attached to a rope or an accessory cord of appropriate diameter, locks under load in one direction and slips freely in the opposite direction.

UIAA Standard 126

UIAA Standard 126: 2004, *Mountaineering and Climbing Equipment – Rope Clamps*, requires that the back-up device meets the requirements of CEN Standard EN 567 plus an additional safety requirement that applies to rope clamps used for self-belaying.

ANSI Standard Z359.1

ANSI Standard Z359.1-2007, *Safety requirements for personal fall arrest systems, subsystems and components*, establishes requirements for the performance, design, marking, qualification, instruction, training, inspection, use, maintenance, and removal from service of connectors, full body harnesses, lanyards, energy absorbers, anchorage connectors, fall arresters, vertical lifelines, and self-retracting lanyards comprising personal fall arrest systems for users within the capacity range of 130 to 310 pounds (59 to 140 kg).

Section 839 Descenders

Descenders are used to attach the worker to the working line and to control descent. Descenders should give the worker control over the speed of descent and should not cause undue shock loads to the working line when braking. If the worker loses control, the descender must stop the worker or allow only a slow, automatically controlled descent in the hands-off position. In addition, descenders should not cause significant abrasion of the rope sheath when suddenly clamped onto the working line. Descenders should be of a type that cannot be accidentally detached from the working line or become detached under any circumstances while supporting the worker’s weight.

For compliance purposes, the descender must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the descender meets the requirements of at least one of the listed standards. A descender bearing a CE mark is considered acceptable for the purposes of this Code. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives.

Standard EN 341

Standard EN 341: 1997, *Personal protective equipment against falls from height – Descender devices*, specifies requirements, test methods, marking and instructions for use for descender devices as rescue equipment to be used in conjunction with personal protective equipment against falls from a height e.g. full body harnesses, or rescue equipment, e.g. rescue harnesses. Descender devices are a means by which a worker can, at a limited velocity, descend from a higher to a lower position either on his or her own or assisted by a second person.

For a Class A descent device, the descent velocity must be maintained between 0.5 m/s and 2 m/s. In the case of hand operated devices, the velocity must not exceed 2 m/s after the control device is released. During the descent the descent velocity must be almost constant.

NFPA Standard 1983

Chapter 5 of the NFPA Standard 1983: 2006, *Standard on Fire Service Life Safety Rope, Harness, and Hardware,* specifies design labelling and performance requirements for descent devices. Descent devices must withstand a tensile test of not less than 1200 lbs-force without permanent distortion and not less than 5000 lbs-force without failure. Both tests must be performed in manner of function.

Non-industrial Rope Access Work

Non-industrial rope access work is defined in the OHS Code as work activities performed within a recreational or sport context that incorporates a working line and a sit harness or full body harness in combination with other devices during

(a) mountaineering, caving and canyoning activities requiring the use of rope access techniques, or

(b) climbing on artificial structures designed and built for the purpose of sport climbing.

Non-industrial rope access work includes the work activities of mountain guides, professionally certified mountain guides (Association of Canadian Mountain Guides – ACMG), guides involved in caving, workers involved in delivering outdoor education courses in rock and ice climbing and glacier travel, and workers who work at sport climbing walls and gyms.

Section 840 Safe work practices

Safe work practices used in non-industrial rope access work must be approved by a Director of Inspection. A Director of Inspection is a member of the staff of Alberta Employment and Immigration, appointed by the Minister under section 5 of the *OHS Act*.

At the time of publication of this Explanation Guide, the following publications were considered to present acceptable and appropriate safe work practices. Following the safe work practices does not mean that workers must be certified by one or more of the organizations that prepared the publications.

(a) Alberta Employment and Immigration recognizes the *Technical Handbook for Professional Mountain Guides* (June 1999), published by the Association of Canadian Mountain Guides (AMCG) as providing a set of safe work practices suitable for safeguarding workers during mountaineering and canyoning activities that involve the use of rope access techniques while climbing on snow, ice, and/or rock. The techniques and skills described in the *Handbook* are intended to assist guides in decision-making and provide a variety of tools by which to guide within reasonable limits of safety.

(b) Alberta Employment and Immigration recognizes the *Climbing Gym Instructor Technical Manual* (June 2003), published by the Association of Canadian Mountain Guides (AMCG) as providing a set of safe work practices suitable for safeguarding workers during rope access climbing on artificial structures such as climbing walls designed and built for the purposes of sport climbing. The *Manual* presents information that will help enhance the quality and safety of climbing at these facilities.

(c) Alberta Employment and Immigration recognizes the *Cave Guiding Standards for British Columbia and Alberta* (March 2003) published by the Canadian Cave Conservancy, and the *British Columbia Cave Rescue Companion Rescue Workshop* (2005) published by British Columbia Cave Rescue as providing a set of safe work practices suitable for safeguarding workers during caving activities involving rope access techniques. Jointly, these publications present clear and simple standards for workers guiding groups through caves.

Since the OHS Code concerns itself with worker safety and not safety of the client, only those portions of the referenced publications that deal with worker safe work practices are applicable.

The referenced publications present safe work practices that have been approved by a Director or Inspection as providing workers with an appropriate level of safety. Other practices may be equally acceptable but must be reviewed by a Director of Inspection and then approved in writing. The referenced publications set the benchmark against which other safe work practices will be judged for approval purposes.

This approach has the advantage of government being able to recognize the safety practices of other organizations if those practices are considered to be equivalent to or better, in terms of worker safety, to those recommended in the referenced publications. A second advantage is that the legislation need not be amended in order to include another organization's or employer's practices – accepting other practices becomes a policy and administrative matter.

Copies of the ACMG publications can be purchased by contacting:

The Association of Canadian Mountain Guides
Box 8341
Canmore, Alberta
Canada T1W 2V1
Phone: (403) 678-2885 Fax: (403) 609-0070
acmg@acmg.ca

The other reference publications are available from the organizations responsible for publishing them.

Section 841 Worker competency

The employer is responsible for ensuring that workers performing recreational rope access work have the skills referred to in section 812, appropriate to the level of work assigned. The OHS Code considers a worker to be competent if the worker meets the following three conditions:

(a) adequately qualified – the worker has some type of qualification, usually earned through a formal education program, training course, etc., or a combination of education and practical experience. With certain exceptions such as professional designations e.g. professional engineer, nurse, physician, etc., or other legal requirement involving qualifications, the employer is responsible for evaluating and deciding if a worker is adequately qualified. The employer should be able to justify the basis on which a worker is considered to be "adequately qualified";

(b) suitably trained – the worker must have training that is appropriate to the tasks, equipment, etc., that will be performed or used. The employer is responsible for evaluating and deciding if a worker is suitably trained. The employer should be able to justify the basis on which a worker is considered to be "suitably trained"; and

(c) with sufficient experience to safely perform work without supervision or with only a minimal degree of supervision – determining whether a worker has sufficient experience to safely perform work is the employer's responsibility. A worker's qualifications, training and experience are no guarantee that work will be performed safely. The employer should be able to justify the basis on which a worker is considered to have "sufficient experience".

An employer must ensure that a worker is trained in the applicable skills described in the referenced publications, appropriate to the activity being undertaken and the worker's level of responsibility. The publications are briefly described in the explanation to section 840.

Sections 842 and 843 Fall factor, clearance, anchorage strength

Forces are created primarily by a falling climber and, while lead climbers generate the greatest forces, second falls can also produce significant loads. Since measuring the actual load is a complex process affected by many variable, means for measuring the relative severity of a fall rather than actual loads or force have been devised. Fall Factor (FF) describes the relative severity of a fall.

Fall factor is a relationship between the forces generated in a fall and the shock absorbing qualities of the rope. Since climbing ropes are highly elastic they absorb tremendous amounts of energy as they stretch under load. Fall factor takes this stretch into account when calculating the severity of a fall. Fall factor is expressed as the relationship between the total length of a fall divided by the amount of rope available to absorb the energy.

Fall factor = length of fall/length of rope in service

Referring to EN Standard 892 and UIAA Standard 101 for dynamic ropes (see the explanation to section 818 for more information about these standards), the peak forces generated in the rope cannot exceed:

- 12 kN in single ropes (single strand of rope)
- 8 kN in half ropes (single strand of rope)
- 12 kN in twin ropes (double strand of rope)

These values are achieved with a rigid test apparatus. In real life situations, the rope system experiences slack and some degree of slippage and movement.

The dynamics of non-industrial rope access work and how an anchorage point may be used are far different from a worker using an anchor point for fall arrest. The anchor point(s) are under a constant and varying load depending upon the rope access technique being used. The maximum arresting force generated in a rope access environment can depend on many variables including, but not limited to, the length of rope in service, slack in the rope system, mass of the worker, type(s) of devices being used, slippage and movement of the rope in the system, and how secure the anchorage is against movement under load and the extent to which it might deform without failure. Combined, these factors make it extremely unlikely that the peak forces listed above would ever be experienced. A fall factor of 1.78 would, with the exception of lead falls, rarely be experienced.

Head Protection

Section 844 Headwear standards

Readers are referred to the explanation of section 831(1) for information regarding the referenced standards.

Section 845 Worker to secure headwear

The employer must ensure that workers secure their protective headwear according to the manufacturer’s specifications.

Section 846 Headwear remaining in service

Protective headwear in good condition and meeting an earlier edition of the standards listed in section 844 may remain in service. However, the headwear should be replaced at the replacement interval recommended by the manufacturer.

Section 847 Sit harness

For compliance purposes, the sit harness must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the sit harness meets the requirements of at least one of the listed standards. A sit harness bearing a CE mark is considered acceptable for the purposes of this Code as is a sit harness bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the sit harness already bears a CE mark.

CEN Standard EN 813

CEN Standard EN 12277: 1998, *Mountaineering equipment – Harnesses – Safety requirements and test methods*, specifies safety requirements and test methods for harnesses for use in mountaineering including climbing. It is applicable to full body harnesses, small body harnesses (intended for persons up to 40 kg), sit harnesses and chest harnesses.

UIAA Standard 105

UIAA Standard 105: 2004, *Mountaineering and Climbing Equipment – Harnesses* requires that the sit harness meet all the requirements of CEN Standard EN 12277 plus an additional requirement for contrasting thread.

Section 848 Full body harness

For compliance purposes, the full body harness must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the full body harness meets the requirements of at least one of the listed standards. A full body harness bearing a CE mark is considered acceptable for the purposes of this Code. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives.

CEN Standard EN 361

CEN Standard EN 361: 2007, *Personal protective equipment against falls from a height – Full body harness*, specifies the requirements, test methods, marking, information supplied by the manufacturer and packaging for full body harnesses. Drop testing involves both feet first and head first drops of a 100 kg mass through a free fall distance of 4 m.

ANSI Standard Z359.1

ANSI Standard Z359.1-2007, *Safety requirements for personal fall arresting systems, subsystems and components*, establishes requirements for the performance, design, marking, qualification, instruction, training, inspection, use, maintenance, and removal from service of connectors, full body harnesses, lanyards, energy absorbers, anchorage connectors, fall arresters, vertical lifelines, and self-retracting lanyards comprising personal fall arrest systems for users within the capacity range of 130 to 310 pounds (59 to 140 kg).

Section 849 Connecting components

In non-industrial rope access work, workers are allowed to use both locking and non-locking carabiners, appropriate for the working conditions. Non-locking carabiners are commonly used when connecting to protection during lead climbing and connecting slings to anchor systems. Locking carabiners can be self-locking and self-closing or use a locking screw-gate.

For compliance purposes, the connector must bear the mark or label of a nationally accredited testing organization such as CSA, UL, SEI, etc. as evidence that the connector meets the requirements of at least one of the listed standards. A connector bearing a CE mark is considered acceptable for the purposes of this Code as is a connector bearing the UIAA label. The CE mark – Conformite Europenne – indicates that the company manufacturing the product has met the requirements of one or more European directives. A UIAA label cannot be used unless the connector already bears a CE mark.

CEN Standard EN 12275

CEN Standard EN 12275: 1998, *Mountaineering equipment – Connectors. Safety requirements and test methods*, specifies safety requirements and test methods for connectors for use in mountaineering including climbing. The Standard defines "connector" as a device that can be opened, allowing a mountaineer to link himself or herself directly or indirectly to an anchor. Connectors are classified as type B (basic connector), H (HMS connector), K (Klettersteig connector), A (specific anchor connector), D (directional connector, excluding anchor connectors), Q (screwed gate connector – Quicklink), and X (oval connector). Depending on the type of connector, the minimum static strength required along the major axis of the connector with the gate closed ranges from 20 kN to 25 kN, although type X connectors require a minimum strength of 18 kN.

UIAA Standard 121

UIAA Standard 121: 2004, *Mountaineering and Climbing Equipment – Connectors,* requires that the connector meet all the requirements of CEN Standard EN 12275 and for type K connectors, additional strength and dimensional requirements are imposed.