Industrial rope access in New Zealand:

Best practice guidelines

Endorsed by the Industrial Rope Access Association of New Zealand (IRAANZ)

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Contents

Foreword

To be provided later…

1 Introduction

This document provides best practice guidelines for the use of rope access techniques when working at height in New Zealand.

It outlines the key elements of a safe system of work.

The guidelines have been prepared by the Industrial Rope Access Association of New Zealand (IRAANZ) to maintain and improve high standards within the industry, and to further the goals of the Health and Safety in Employment Act 1992.

Describing the essential principles of rope access techniques and equipment will encourage best practice throughout the industry in New Zealand and give management, staff and contractors confidence in rope access methods as a safe, proven and effective system of work.

The guidelines are not intended as an instruction manual for working at height. It is essential that all persons working at height first seek and obtain specialist training and qualifications in the correct use of the techniques and equipment described in this document.

The guidelines are divided into three sections:

1. References to relevant legislation, regulations, standards and OSH guidelines.
2. The best practice guidelines, which are based on the information contained in (1) above, as well as accepted best practice in the industry.
3. References to further information, set out in the appendices.

2 Scope

These best practice guidelines describe the use of rope access techniques in New Zealand when working at height and where rope access is used in a workplace as the main means of access, support and protection against a fall.

The guidelines are intended for use by employers, workers and self-employed people using rope access methods in New Zealand, as well as by those who contract or commission rope access work.

The guidelines are not intended to be applied in recreational situations or in emergency or rescue work.

3 Principles

Rope access provides a safe method to access, carry out and then leave work tasks at height or in other difficult-to-access situations. See AS/NZS 1891.4:2000, table 2.1, 'Characteristics of Various Restraint/Fall Situations' for situations in which rope access is a suitable method for working at height.

Key elements of a safe system of rope access include:

- planning and management
- selection, training and supervision of competent personnel
- selection, use and maintenance of appropriate equipment
- suitable working methods
- provision for emergency situations.

Before commencing any rope access work, an analysis should be carried out to confirm that rope access is a suitable method for the proposed work.

Appropriate planning and hazard analysis should be completed before commencing work.

Double protection is a fundamental principle of rope access. This usually means that a working line plus a safety line are used to prevent the worker from falling.

All operatives must be appropriately trained to carry out the specifics of a particular rope access project, and work in teams of at least two people.

4 Definitions

ACCEPTED INTERNATIONAL STANDARD

The main international standard-setting body is the International Organisation for Standardisation, widely known as ISO. Other international organisations with standards applicable to industrial rope access equipment and practice include the European Committee for Standardisation (CEN) and American National Standards Institute (ANSI). Advice should be sought before accepting any others.

ACCESS ADVISOR

A person who has, through a combination of training, education and experience, acquired knowledge and skills within the access industry to enable advice to be given on a range of height access options.

ANCHOR

A system or structure for the purpose of attaching a working line, safety line or people.

ANCHOR LINE

A flexible line, usually in the vertical position, secured to an anchor and providing fall arrest or work positioning protection to the operative by means of harness and attachment elements.

ANCHOR POINT

A point of attachment for the rope access operator's safety systems.

ANCHOR SYSTEM

A system of two or more interconnected anchor points, linked so as to provide a single secure anchor point.

ASCENDER

A type of rope grab, when attached to a rope, locks onto rope in one direction, and slides freely in

the other direction.

BACK-UP SYSTEM

Secondary system used as back-up in the event of a fall from a structure or, in a rope access system, in the event of working rope failure.

BELAYING

The practice of one worker controlling the safety line to another worker and able to provide a back-up in the event of a fall.

COMPETENT PERSON

Designated person suitably trained or qualified by theoretical knowledge and practical experience to enable the required task to be carried out properly.

DESCENDER

Device which attaches to a rope and, through applying friction, allows a person to descend the rope in a controlled manner and stop with hands off the rope.

DYNAMIC LOADING

A load introduced suddenly onto a system, as in the case of a fall.

DYNAMIC ROPE

Rope which absorbs energy when loaded, such as in a fall, by stretching.

ENERGY ABSORBER

Any part of a fall arrest system that is designed to absorb the force produced in a fall.

FACTOR OF SAFETY

The FOS is the relationship for any item between its Minimum Breaking Load (MBL) and its Safe Working Load (SWL) or Working Load Limit (WLL). The MBL is divided by the safety factor (expressed as a number) to arrive at the SWl/WLL; this provides a “safety buffer” between safe use

and failure. The FOS is expressed as a ratio, eg 5:1 (MBL + SWL = FOS).

FALL ARREST

System utilising Personal Protection Equipment, intended to stop a falling person hitting the ground or any obstructions, and which is designed to limit the force of arresting the fall and retain the user upright in the harness.

FALL ARREST HARNESS

An assembly of interconnected shoulder and leg straps, with or without a body belt, and used where there is likelihood of free or restrained fall. Also called a safety harness.

FALL FACTOR

Method of working out the proportional seriousness of a fall. It is the relationship between the length of the fall and the amount of media (usually rope) available to distribute the impact force of the fall.

FREE FALL

Any fall or part of a fall greater than 600mm where the person falling is under the unrestrained influence of gravity, either vertically or on a slope on which it is not possible to walk without the assistance of a handrail or line.

HAZARD

An activity, arrangement, circumstance, event, occurrence, phenomenon, process, situation, or substance (whether arising or caused within or outside a place of work) that is an actual or potential cause or source of harm and “hazardous:” has a corresponding meaning.

IRAANZ

Industrial Rope Access Association of New Zealand.

KARABINER

Type of connector, with a spring loaded gate. For rope access work the gate is always able to be

locked shut.

KILONEWTON

One kN is the force needed to accelerate 1000 kilograms by 1 metre per second per second ($1m/s^2$). As an approximation, 100kg hanging at rest on a line will exert a force of 1kN on that line.

LANYARD

A line used to connect a fall arrest harness to a line or anchor. May be employed as part of a fall arrest lanyard assembly, which includes a personal energy absorber.

LEAD CLIMBING

Rope access technique that involves one person moving while supported by the structure, protected by a safety line that is anchored to the structure at intermediate points and controlled via a fall arrest device by a second person.

LIMITED FREE FALL

A fall not greater than 600mm generating a force no greater than 6kN.

LOG BOOK

Record of work experience.

MINIMUM BREAKING LOAD

The MBL is the minimum load at which an item of equipment can fall when it is new.

NOTIFIABLE WORK

Work which must be notified to the Department of Labour. (See Health and Safety in Employment Regulations 1995, especially regulations 2 and 26.)

PERSON WHO CONTROLS A PLACE OF WORK

In relation to a place of work, means a person who is the owner, lessee, sublease, occupier or person in possession, of the place or any part of it; or the owner, lessee, sublease or bailie, of any

plant in the place of work.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE is equipment designed to mitigate the effect on a user from one or more hazards in the working environment.

RESTRAINED FALL

Any fall where the person suffering the fall is under less than the full influence of gravity due to the action of a restraint device, or is sliding down a slope less than that described for a free fall, or a fall of less than 600mm.

ROPE ACCESS OPERATOR

A person trained and assessed as competent to use an industrial rope access system.

- Basic – Able to operate, under supervision, on various systems. (NZQA level 3)
- Intermediate – Able to setup and operate the various systems. (NZQA level 4)
- Advanced – Capable of designing (conceptual), supervising and operating at all levels of involvement of these systems. *(Still in planning)*

ROPE ACCESS SYSTEM

An access system relying primarily on ropes, which provide a primary system and a backup system. The system requires the use of a harness for the operator, who may also use a swing chair for comfort. Travel through the system is achieved by using ascenders and/or descenders on the primary rope.

ROPE PROTECTOR

Sleeve or other item that protects a rope from abrasion or cuts.

SAFE WORKING LOAD

The SWL is the maximum load that can be supported safely under normal working conditions as calculated in accordance with sound and accepted engineering practice. Typically equivalent to one person. See also working load limit.

SAFETY LINE

Rope used as a back up in the event of a fall from a structure or, in a rope access system, in the event of working rope failure. Also known as a back up rope or secondary rope.

SHALL

Verb indicating that the statement is mandatory under IRAANZ rules.

SHOULD

Verb indicating that the statement is a recommendation.

STATIC LOADING

The gradual introduction of load into a system.

TOTAL RESTRAINT

A working situation where a fall is not possible, usually due to anchor position and lanyard length.

ULTIMATE STRENGTH

The highest engineering stress developed in a material before rupture.

WORK POSITIONING

Techniques for supporting a person while working, by means of PPE in tension, in such a way as to prevent a fall.

WORK POSITIONING SYSTEM

A system designed to provide a primary means of support and restraint to allow work to be carried out in reasonable comfort.

WORKING LOAD LIMIT

The WWL is the maximum load (as determined by the manufacturer) that an item of equipment is designed to raise, lower or suspend. See also safe working load.

WORKING ROPE

Rope under load used primarily for work positioning and rope access including suspension, ascending and descending. Also known as the primary rope.

5 Documentation

5.1 Standards

5.1.1 New Zealand and Australian Standards

AS/NZS 1891.1–4: 2000	Industrial fall-arrest systems and devices
AS/NZS 4488.1–2: 1997	Industrial rope access systems
AS/NZS 1801: 1997	Occupational protective helmets
AS 2865: 2001	Safe working in a confined space
AS 4142.3: 1993	Fibre ropes; Man-made fibre rope for static life rescue lines

5.1.2 British Standards Institution

BS 8411: 2007	Code of practice for safety nets on construction sites
BS EN 1263.1: 2002	Safety nets; Safety requirements, test methods

5.1.3 European Committee for Standardization

EN 1891	PPE against falls from heights: Low stretch kernmantel ropes
EN 358	PPE against falls from heights: Work positioning systems
EN 361	PPE against falls from heights: Full body harness
EN 362	PPE against falls from heights: Connectors
EN 354	PPE against falls from heights: Lanyards
EN 355	PPE against falls from heights: Energy absorbers
EN 341	PPE against falls from heights: Descender devices
EN 795	PPE against falls from heights: Anchor devices – Requirements and testing

EN 813 PPE against falls from heights: Sit harnesses for rope access work

5.1.4 International Mountaineering and Climbing Federation

UIAA Label Standards, Chapter F: Helmets

5.2 Legislation

Health and Safety in Employment Act 1992

Health and Safety in Employment Regulations 1995

Building Act 1991

Electricity Act 1992 and Regulations 1997

5.3 OSH Publications

A Guide to Managing Health and Safety to Meet the Requirements of the Health and Safety in Employment Act 1992

Guidelines for the Prevention of Falls

Guidelines for the Provision of Facilities and General Safety and Health in the Construction Industry

Safe Working in Confined Spaces

5.4 Other publications

Department of Conservation (2008). 'Work at Height: Roped Tree Work'. Version 3.5.07

Department of Labour (2006). 'Health and Safety Position Paper: Working at Heights'. http://www.osh.govt.nz/order/catalogue/heightspositionpaper.shtml

Roofing Association of New Zealand. 'Guidelines for the Safe Working at Height for Residential and Light Commercial Roofing'.

Industrial Rope Access Association of New Zealand. 'Certification and Assessment Scheme and Operational Requirements'.

Industrial Rope Access Trade Association (2007). *General Requirements for Certification of Personnel Involved in Industrial Rope Access Methods*. United Kingdom: Industrial Rope Access Trade Association.

6 Management

6.1 Principles

The management of any rope access system requires a set of planning and decision-making processes that ensure appropriate equipment, appropriately trained personnel and suitable working methods are used.

6.2 Systems

When planning and managing a rope access system, the aim is to ensure a safe workplace.

A documented system, including appropriate polices and procedures, must be in place.

All parties in the management chain have a responsibility to ensure that the techniques and equipment they are using are appropriate and fit for purpose.

6.3 Planning

To comply with the Health and Safety Act 1992, every employer should develop an appropriate health and safety policy.

The following issues should be considered when designing or planning a rope access project:

- Is the contract designed and being carried out in a manner that will minimise hazards?
- Can safety be improved by 'building in' features such as guardrails or safety mesh?
- Can future maintenance work be made safer by building in systems (for example fall arrest anchors)?
- Are there supervisory systems in place to monitor safety?
- Is enough known in order to carry out the work safely?
- Is there appropriate expertise to carry out the work safely?
- Have all potential hazards for others (such as other workers or the public) been taken into account?

In addition, the following should be considered when designing or planning any rope access

project:

- Lines of responsibility
- Safety procedures
- Insurance
- Risk assessment documentation
- Staff selection
- Communication
- Record keeping.

6.4 Preliminary analysis

Before any rope access work begins, an analysis should be carried out to ensure that it is suitable for the specific proposal and can be carried out safely.

6.5 Levels of operative skills

Personnel skill levels must be appropriate for the job to be carried out.

Competency requirements for rope access work exist at three levels:

- Basic
- Intermediate
- Advanced

6.6 Hazard identification and risk assessment

Before any rope access work is carried out, a risk assessment should be completed (see AS/NZS 1891.4 fig 1.1 'Control of risks').

The information gathered, together with the risks identified, are used to produce safe and efficient operating procedures.

See Appendix 4, for a risk assessment form designed to categorise a particular operation and identify the skill levels required to carry it out safely.

6.7 Hazards specific to rope access method or work task

All hazards should be identified that any person (including members of the public) could be

exposed to as the result of working at heights or falling objects. Once identified, they should be assessed in terms of their potential to cause harm.

To assess this risk, two factors should be considered:

- The likelihood that the situation will develop or the event will occur.
- The severity of harm that could result.

Once identified, hazards should be either eliminated, isolated or minimised to reduce the risk as far as practicable.

6.8 Height hazard assessment

Potential hazard areas for consideration include, but are not limited to, the following:

- access to and egress from the work area
- the ability of work platforms to support the required people, tools and other equipment
- size of and changes to the level, friction, slope and environment of work platforms
- restraints to stop people accidentally slipping or stepping off work platforms
- obstructions caused by materials, rubbish or fixed and protruding objects
- position of unprotected work platform edges or penetrations
- proximity of energy sources such as electricity and gas, etc.

6.9 Health and safety plan

A Health and Safety Plan should be prepared for each rope access project.

The plan should include:

- general aspects
- controlling public access
- rope access work
- rescue plan
- environment hazards.

6.10 Use of tools and equipment

Equipment that is of appropriate material and design suitable for the intended task should be used.

Compatibility of equipment should be checked.

All users must have received adequate levels of training in the correct use and examination of equipment supplied to them.

6.11 Communications

All team members must be able to maintain clear communication with each other. In particular, the supervisor should maintain contact with all other team members.

Particular conditions, such as noise or weather, need to be taken into account.

Provision for communication with outside groups (for example emergency services) needs to be part of any communications system.

6.12 Record keeping

Appropriate records of rope access projects, staff and equipment should be kept, and record keeping practices must meet all legislative requirements.

All relevant documentation should be available on site to personnel involved in the work.

7 Personnel

7.1 Selection

For each specific job, rope access team members must be chosen who possess the required attributes. Attributes to consider include:

- training
- aptitude and attitude
- physical fitness
- skill and experience

7.2 Competence

In New Zealand, rope access training is provided via the National Certificate in Industrial Rope Access. The certificate comprises three qualifications:

1. Elementary rope skills (level 3)
2. Working on ropes (level 4)
3. Manage rope operations (level 4)

Other qualifications may be acceptable but should be checked to ensure that they provide similar levels of skill and training.

7.3 Team size

Rope access teams must be supervised and self-supporting.

Teams should have a minimum of two members.

8 Equipment

8.1 General

All equipment should be carefully selected to ensure that it is suitable for its intended purpose.

Employers are responsible for the provision of personal protective equipment.

All employees and others should be trained in the use of personal protective equipment and made fully aware of the reasons for its use.

8.2 Limits of equipment use and compatibility

Manufacturers' data sheets are an invaluable resource when considering the purchase of equipment and in becoming acquainted with new or unfamiliar items of equipment.

Equipment must be able to safely withstand the loads or forces applied.

8.3 Standards and legal requirements

Only quality-assured equipment should be purchased.

Only equipment complying with relevant standards that apply to the intended purpose should be purchased.

Certificates that indicate compliance with relevant standards should be supplied on purchase. Standards may include AS/NZS 4488 and ASNZS 1891 or other accepted international standards (see also Documentation > Standards).

8.4 Specific criteria for the selection of rope access equipment

8.4.1 Ascenders

Ascenders are rope clamps designed to slide easily up the rope and lock in the opposite direction. Some are designed to be attached to a lanyard and foot loop system, allowing the climber to stand his weight on it, others are designed to be chest mounted.

Ascenders should only be used as protection for climbing a fixed line in the manner recommended by the manufacturer. Normally for this use they are attached directly to the harness.

Ascenders are not designed for descending fixed lines.

Ascenders must never be used as fall arrest devices.

8.4.2 Connectors

Locking mechanism

All connectors must be self closing and self or manual locking. They must be capable of being opened only by at least two consecutive deliberate manuals actions.

Examples

- Ball lock system (triple action)
- Screwgate (double action)
- Twistlock plus (triple action)
- Double lever lock (double action)

Single action snap-lock karabiners must never be used.

Materials

Connectors come in two main materials – steel and alloy.

Steel is the preferred choice as it is strong, reliable and less prone to unseen cracking.

Alloy karabiners have a better strength-to-weight ratio than those made of steel, however they are not as robust.

Shape

Oval

The simplest shape and a good general purpose karabiner. Particularly good for use with pulleys and rope adjustment devices because they sit centrally in the base of the oval and are not subject

to compression as in the acute corner of a D–shaped karabiner.

D-shape/offset D

The strongest shape because the load is kept close to the spine. Allows a relatively wide gate opening. The “O” shape is commonly used as the standard fall arrest karabiner.

Pear shape/HMS

Allows wide gate opening. The wide smooth profile results in good load distribution where several slings need to be loaded into one karabiner or where a broad knot, such as the Italian hitch, is used.

Captive eyes

Useful for attachment to lanyards as the direction is controlled and the karabiner cannot be side loaded during a fall.

Strength

15kN without distortion and 22kN without breaking (ASNZS 4488).

Maillon Rapides (quick link)

A Maillon is classified as a screwed closure connector.

Maillons come in a variety of shapes, so there is a range of possibilities for multi-directional loading configurations.

Maillons offer a good strength-to-size ratio and are useful when the connector must remain in a fixed position for an extended period.

Only some types of maillon qualify as PPE. They should be checked before use to ensure they are PPE and not general purpose.

It is essential that maillons are screwed up fully during use and storage, otherwise they are prone to damage.

8.4.3 Descenders

Descenders shall be designed and constructed to safely and effectively control the speed of descent.

This control should be exercised by means of an adjustable rope path through the device using a dead-man-type handle. The descender shall be capable of holding the operator with their hands free. It shall not be able to be removed from the rope while the rope is under tension.

8.4.4 Harnesses

The safety harness forms the ergonomic link or interface between the human body and the

attachment system. As such the harness is probably the most important item of a worker's PPE.

Harnesses should be selected to ensure that they are suitable for intended use. A well selected harness should have the following features:

- comfortable to wear when not in tension, eg walking about site
- provides adequate levels of comfort and support for working in
- able to catch a fall without injuring the wearer
- not overly complex to put on or adjust.

Poor choice of harness can mean the harness hampers rather than assists the worker in their task, and as a result they may be tempted not to use it.

Selection

The principal consideration will be whether the harness is required for work restraint, work positioning or fall arrest.

Depending on the nature of the task, and therefore the risk associated with it, careful consideration should be given to the position of attachment points. There are several common configurations:

Basic fall arrest harness

This type of harness is suitable for work restraint and fall arrest applications.

Multi-application harness

This type of harness can be used for work restraint, fall arrest and work positioning applications.

Sit/chest harness combination

The sit harness, incorporating a work positioning belt, can be used by itself for work restraint and work positioning. It can also be combined with an appropriate separate chest harness to make it suitable for fall arrest. This combination is particularly suitable for rope access; it is the best combination for hanging in and to minimise ill-effects if a fall occurs.

8.4.5 Helmets

Standards

Occupational protective helmets complying with AS/NZS 1801:1997 or other suitable approved head protection complying with a relevant standard, must be worn at all times on site where there is a risk of objects falling from above (see also NZS 2264:1970A2 Specification for industrial safety helmets (maximum protection).

Helmets should be replaced after dropping from a height or if signs of wear and tear are visible. Follow the manufacturer's instructions for replacement and check any expiry dates.

Climbing helmets

When working at height a climbing helmet complying with relevant standards should be selected. These have advantages over normal industrial helmets:

- more solid harness and chinstrap assembly, designed to retain the helmet on the head during a fall
- tested for side impacts that may occur during a fall
- no peak, allowing an operator to glance upward without exposing their whole face to any falling objects.

8.4.6 Lanyards and energy absorbers

Most lanyards are manufactured from nylon rope or webbing; some incorporate an energy absorbing element or adjustment device.

Careful and regular inspection is essential.

Lanyards

A lanyard is the flexible connection element between the harness and the attachment point.

The total length of any lanyard or lanyard assembly should not exceed 2m.

A lanyard can be constructed from a variety of materials and in a variety of configurations, depending on intended use.

The primary consideration is whether the lanyard will be used for fall arrest or work positioning. This dictates length and whether an energy absorbing element is incorporated.

For work positioning the lanyard is normally mounted to either the central or the lateral waistbelt attachment of the harness.

Because the maximum "fall" experienced should be 0.5m, an energy absorbing element is not required.

Work positioning lanyards may be either fixed or adjustable. An adjustable lanyard allows more precise positioning and therefore greater comfort as well as minimising potential falls.

For fall arrest the lanyard must be attached to a fall arrest harness either at the back (dorsal) attachment point or the chest (sternal) mounting point. The decision depends on the type of lanyard, climbing system, category of work and other equipment in use.

Work positioning lanyards must not be used in fall arrest systems.

Energy absorbers

Where the lanyard is used for fall arrest an energy absorbing element must be incorporated. In a

fall, the maximum permitted impact force (see AS/NZS 1891) is 6kN.

When using an energy absorber on a Y-lanyard, the leg not in use should be either left to hang free or clipped alongside its partner.

An energy absorber should not release below 2kN; this allows the lanyard to also be used for work positioning.

Typically, an energy absorber elongates to absorb the impact force; this must be taken into account when calculating clearance distances.

To minimise impact force (reduce fall factor) the lanyard should be clipped as high as possible.

8.4.7 Fall arrest devices

Fall arrest blocks

Includes inertia reels, retractable fall arresters and self-retracting lanyards.

Fall arrest blocks offer one of the simplest types of fall arrest protection. Connection elements, energy absorption and lanyard are incorporated in one unit. Thus the only additional protection required to give a complete fall arrest system is a full body harness with dorsal (back) attachment point.

The most common type of fall arrest block has a 6mm wire rope lanyard, supplied in a variety of lengths. This type of block can be obtained with or without a retrieval handle. Standard block/Type 2 fall arrest device & Type 3 fall arrest device.

The retrieval handle is deployed by removing the quick release pin and inserting it into the handle to form part of the winding mechanism.

A suitable anchor point must be selected prior to installing the block.

Ideally fall arrest blocks should be placed directly above the worker to avoid pendulum falls. The maximum recommended deviation of the wire from the vertical position is 40 degrees. This effectively means that the worker should always be working within a 80 degrees safety cone.

Workers should never work above the level of the fall arrest block or horizontally in line with it, (unless specifically designed for this purpose).

Care should be taken when working with fall arrest blocks that the wire does not become tangled with obstructions such as scaffolding, this will severely affect the operational performance of the block.

Fall arrest blocks should have a rated arrest distance. This is the distance it takes for the block to bring the falling body to a complete standstill (equilibrium after the arrest) from the initial starting position (onset of the free fall). This distance must be accounted for when calculating clearance

distances.

Several other types of fall arrest block are available which use webbing or rope for the lanyard. These tend to have a limited length and are often best for specific applications where a small portable unit is required. Also these types perform better in the horizontal position.

Mobile fall arresters

Always check that a particular device is compatible with the rope type, whether wire or nylon, and diameter.

A mobile fall arrester follows an operator up and down a rope automatically. In the event of a fall it engages on the rope. In a fall, hands should be kept clear of the device.

Always check that a fall arrester is installed the correct way up.

It should only be possible to remove the device from the rope with two consecutive actions.

The device should be able to be released under load for rescue purposes.

Some types of mobile fall arrester have a manual locking feature.

Always consult the manufacturer's guidelines before using a lanyard with any device.

Where the lanyard and connector assembly is greater than 0.25m (ie the potential vertical fall is greater than 0.5m), an energy absorber should be used. The maximum length of lanyard or lanyard assembly to be used is 1m.

Some mobile fall arresters can be used either with or without a lanyard. For use without a lanyard, on a rope, the fall arrester may be clipped directly to the rear or front fall arrest harness attachments. No further shock absorbency is required as falls will be minimal.

8.4.8 Ropes

Selection criteria

Knotability

- Resistance to wear chemicals and abrasion
- Performance in cold or wet conditions
- Compatible with all other devices in the system

Material

- Only ropes made from man-made synthetic fibres such as polyamide (nylon) or polyester are suitable as PPE.
- All ropes used should be kernmantle construction.

Strength

- 25kN is the minimum ultimate strength (ASNZS 4142.3).
- Euro standard is preferred and/or US (NFPA).
- Note that different standards apply for dynamic (EN 892) or low stretch (EN 1891).
- Figures vary depending on the rope type and manufacturer.

Type

Low stretch or semi-static

- Designed to give minimal stretch, typically up to 4.5 per cent over its length with 150kg applied.
- Suitable for fixed safety lines and rigging.
- Should not be used where high impact forces are possible.

Dynamic rope

- Stretches up to 12 per cent over its length with 150kg applied.
- Suitable where high impact forces are a possibility.
- Should not be used as main support or backup ropes.
- During a fall the elastic properties of this type of rope allow fall energy to be dissipated through the safety system. This means that no one item of the system has to bear the peak impact force generated by the fall, particularly the person falling.

Marking

All ropes should be marked to allow traceability back to the original reel and associated certification.

Ropes are normally marked by attaching labels to the ends with heat-shrink plastic.

Typical information that should appear on a rope label includes diameter, type, length, unique number and date put in service.

General care and maintenance

Ropes should be cut with a hot knife; this cuts and seals at the same time. Where this is not practical tape should be wrapped around the area to be cut; this can be cut through with a cold knife without the rope fraying and the ends can then be sealed with the flame from a lighter.

Certain manufacturers recommend pre-shrinking ropes in water to provide a more compact and harder-wearing sheath.

Ropes should be stored dry and clean, and hung up away from contaminants and direct sunlight.

The lifetime of a rope an vary greatly depending on type and intensity of use. A log should be kept,

indicating intensity and duration of use and noting any possible contact with contaminants and action taken. A rope should never be in service for more than 12 months.

8.4.9 Slings

Manmade fibre

Manmade fibre slings should be made from polyamide (nylon) or polyester webbing. Natural fibre slings are not suitable as PPE.

Slings should be sewn and never knotted.

Slings may be constructed in a variety of ways and are not limited to specific lengths.

Slings designed primarily for lifting purposes have an international colour coding and marking system to allow easy identification of working load limit.

Slings designed as PPE are not colour coded but must have a minimum breaking load of 22kN.

Variations in sling configuration and angles between slings drastically affects the SWL. Factors such as sharp edges, heat and chemical contamination will also significantly affect the strength of a fibre sling. Where sharp edges are present fibre slings must be suitably packed or a wire rope sling selected. In hot areas or in areas of suspected chemical contamination, wire rope slings should always be used in preference to fibre slings.

Avoid directly attaching 2 slings together as friction due to load can severely damage the material.

It is particularly dangerous to have two components running over each other repeatedly or at speed as the excessive head generated or severe abrasion an result in failure.

Avoid attaching man-made fibre slings, ropes, etc directly to each other as this severely weakens them due to friction between the two generating melting temperatures.

Wire rope slings (PPE)

In certain locations wire rope slings will be preferable to man-made fibre slings, for example on sharp edges or in hot or chemical areas.

The best configuration has a soft eye at each end, allowing the sling to be choked (note reduction of 25% in wire rope SWL). Wire rope slings should always be mechanically terminated with a ferrule. Tapered ferrules minimise cuts to fingers and hands in use.

A protective plastic sheath helps to ensure that the wire rope does not mark or damage the structure it is attached to.

A suitable diameter of wire rope should be used so that the minimum breaking load of the sling is 22kN – a minimum diameter of 7mm. In practice, the most popular diameter of sling for use as a main anchor is 9mm

8.5 Equipment marking and traceability

Equipment should be thoroughly examined by a competent person before first use.

New equipment should be marked with a unique number linking it with its original certification. This is essential for traceability when it comes to examination.

8.6 Records of equipment usage

Equipment should be thoroughly examined at regular intervals by a competent person and a record kept of these examinations.

8.7 Inspection

The company should have an examination scheme in place.

Certification and examination records should be kept for the lifetime of the equipment.

Periods between thorough examinations should not exceed 6 months. However, for textile items, a three-month period is recommended by most manufacturers.

The user should perform a rigorous physical and visual check before and after each use, and continue to monitor the equipment during use. If there is any doubt as to the integrity of the equipment then it should be reported to a competent person s that appropriate action may be taken. If there is not a competent person available then the item should not be used until it has been confirmed as fit for use.

8.8 Care and storage

All equipment should be cleaned after use and stored by hanging in a clean and dry environment.

8.9 Retiring equipment

All equipment should be retired in accordance with the manufacturers' specifications – or earlier.

8.10 Records

The company must have a suitable equipment acquisition and management system in place; this should include the following features:

- Risk assessment and method statement should identify appropriate equipment for task.

- Commonly recurring faults should be identified and notified both to users and to the manufacturer to assist in future design improvements.

All users of the equipment should have sufficient training and experience to perform a pre-use check on the equipment that they are using in order to satisfy themselves that it is suitable for its intended use and is serviceable.

9 Working methods

9.1 General

Rope access methods involve a range of techniques that allow workers to travel up and down, climb horizontally underneath hard decks and work while suspended from ropes.

They are primarily a means of work positioning, but can also be configured as a fall arrest system.

All systems consist of a primary rope access system and a backup security system.

Work teams should be capable of carrying out independent rescue in emergency situations.

9.2 Rope access and fall arrest

Fall-arrest systems are designed to support and hold a person in the event of a fall. Rope access systems are designed to support a person while working.

An evaluation by a competent person of the particular situation is needed to make a practical and safe decision on whether to use a fall arrest or work positioning.

9.3 Safety

Rope access systems ensure the safety of workers by preventing them from falling.

Rope access systems rely on two independently attached ropes – a working rope and safety back up rope. In the event of any part of the primary support system failing, safety cover is provided by the secondary backup system.

All work teams should be self-supporting – that is, if any one member requires rescue, it should be able to be carried out by the other tams members. A work team therefore needs a minimum of two members.

Workers should be in regular visual contact with each other.

Workers must never be left alone.

In all situations, teams should assess potential hazards and have pre-planned responses ready to implement if necessary.

When setting up the rope access system, ensure that:

- the safe working loads of equipment are not exceeded
- fall distances and pendulums are minimised
- the backup system is able to arrest any fall within 600mm (excluding the effect of any energy absorber deployment) with a maximum arresting force of 6kN
- an exclusion zone is established at the base of the worksite if it may be accessible by other people.

Environmental factors, for example high winds, should be given consideration where they may result in serious hazard.

Ropes must be protected against sharp or abrasive edges.

9.4 Access system

The primary rope access system is always a work positioning system. Workers are attached with ascenders and/or a descender.

9.5 Backup system

The secondary system can either be a fall arrest system or a second work positioning system provided potential falls are always kept to a minimum.

A rope grab is used to attach the worker to the secondary rope.

9.6 Basic techniques

All operators should carry at all times, while within the rope access system, means of ascent and descent.

9.6.1 Descent

A self-braking descender is attached to the working rope. Speed must be able to be safely and effectively controlled. The descender must be able to hold the worker with their hands free.

9.6.2 Ascent

Ascent is carried out by using ascenders that grip the rope without damaging it when loaded in a downward direction.

9.6.3 Traversing

Generally means horizontal progression by means such as aid climbing, lead climbing, attachment via lanyards to a horizontal safety line, or pulley systems.

Passing re-anchors, knots, moving from one rope to another

A minimum of two points of attachment to the rope access system must be maintained at all times.

9.7 Advanced techniques

9.7.1 Cableways and highlines

A cableway is a rope system that facilitates horizontal movement in addition to the usual vertical progress, by means of either a guide line or a horizontal suspension line.

If a cableway system is used primarily for horizontal travel, it can be considered to be a highline.

Because of the high loads that these systems generate, other methods should be considered before deciding to use cableways or highlines.

These systems must be set up by a competent person (a person who has stage 2/level 4 qualification or equivalent) who is able to calculate the potential loads on the anchors.

Highlines should be backed up by another line, parallel to and above the first, so that the load can be shared equally.

Line tension is critical to any cableway, as this determines the force applied to the system anchors and sag in the line. Ease of progress along the cableway must be traded off against minimising the loads generated in the system.

It is vital that some sort of force limiting system, such as a descender, is used to connect the highline to its anchors to allow the rope to slip if excessive force is applied to the rope.

9.7.2 Lead climbing

Lead climbing is a versatile technique that allows a worker to move up, down or across a structure while supported by the structure rather than the ropes.

Maintaining good communication at all times is vitally important. Line of sight contact should be maintained wherever possible.

They are attached to a safety line (which must be a dynamic rope), which runs through intermediate anchors and is controlled through a belay device by a second person.

A backup system, whether a second safety line or lanyards to the structure, must be used.

Any fall can be arrested with only minimal force.

The lead climber ties the rope into the sternal attachment of his full body harness.

Careful consideration must be given to all factors, especially spacing of anchors, edges, potential fall paths and retrievals.

9.7.3 Aid climbing

Aid climbing is typically used to climb horizontally while suspended underneath structures.

As with lead climbing the worker may be belayed by another competent person. Or they may move by themselves using their lanyards.

Two independent points of contact are maintained, using three separate lanyards (two attached and one moving).

Weight is transferred horizontally from lanyard to lanyard with the aid of etriers and/or other support devices.

Careful consideration must be given to all factors, especially spacing of anchors, edges, potential fall paths and retrievals.

9.7.4 Rigging and rope management

A person with Elementary Rope Skills (NZQA Level 3) can set up and use rope access systems, working in minimum team of two trained persons.

A person with Working on Ropes (NZQA Level 4) can do more advanced techniques, such as hauling systems, cableways and advanced recovery techniques.

Ropes must be protected from sharp or abrasive edges.

All rope access equipment must be protected from damage.

Rigging should enable immediate rescue retrieval if required.

There must be no slack in the safety line

Devices on the backup line should always be above the worker.

Don’t go off the end of the rope.

9.7.5 Knots

All knots should be neatly and correctly tied.

Knots should be chosen that are suitable for intended use, and consideration should be given to ease of tying and untying.

Knots weaken ropes, but making categoric statements about residual knot strengths is problematic.

Sewn slings should be used in preference to user-made knotted slings.

All operatives should be able to tie the following knots:

- Figure eight
- Figure nine
- Bowline
- Alpine butterfly
- Double fishermans
- Clove hitch
- Italian hitch
- Tape knot
- Prussic/klemheist

9.8 Anchor Points

9.8.1 Selection

Anchors may be permanent or temporary.

Selection of anchor points must be done by a competent person.

Permanent anchors include eye bolts, structural steel, natural geological features, steel or concrete structures (such as plant rooms).

Temporary anchors include beam clamps, ground anchors and needles.

Needles must only be used by appropriately qualified personel.

If the anchor has more than adequate strength (for example a lift housing), each line should still be separately attached by a connector and/or sling.

Ropes must be able to be attached to anchors, and operators attached to ropes, in a situation where there is no risk from falling.

9.8.2 Strength

Anchors must be capable of holding a minimum ultimate force of 12kN in all directions in which it might be loaded.

Except that, if slings are needed, they must be rigged for an ultimate load of at least 15kN.

All eyebolt anchors should be labelled with detailed installation, installer and maintenance information.

All permanent anchors should be regularly inspected and proof loaded.

9.8.3 Use

Each operative should use their own anchor system. The principle of double protection means two anchors should always be used for each person.

The angle between each anchor leg should be as small as possible: the preferred maximum is 90º, with a recommended maximum angle of 120º, unless allowance is made for the higher loads imposed by a greater angle.

10 Emergencies and rescue

10.1 General

This section applies only to rope access situations. It does not apply to recreational activities or emergency services.

All rope access operatives must receive training in dealing with emergency situations and maintain their competence through regular practice. Specific techniques for rescuing personnel working on ropes must be known and regularly practised.

For each project, a rescue plan must be developed that takes into account the potential risks and hazards present, necessary equipment, competent personnel, first aid and medical provision if necessary.

This then becomes part of the safety plan for the job.

In rescue situations, rope access systems will be often subject to higher than normal loads. This needs to be considered.

Clear instructions and procedures must be given for site-specific emergencies (for example, fire alarms or site evacuations).

Every worksite should have:

- specific rescue equipment that can carry out a rescue in any situation on the site
- first aid kit
- trained first aider.

10.2 Suspension trauma

Suspension trauma can occur when a person remains immobile while suspended. It can occur in as little as five minutes. It can lead to fainting, nausea, breathlessness and, if not quickly alleviated, unconsciousness and death.

It appears to be caused by the failure of the blood to return from the lower limbs to the heart, and that susceptibility is unrelated to fitness or other physical conditions.

To prevent suspension trauma from occurring, get out of a suspended position as soon as

possible. If this is not possible:

- move the legs regularly – like pedaling a bicycle
- raise the knees towards the chest

In rescue planning speed of rescue is important: death can occur in less than 10 minutes if the legs cannot be moved.

The casualty must not be put into a horizontal position too quickly. This can cause heart failure due to overstrain (rescue death). Immediate medical attention must be given.

Appendix 1

Summary of the Health and Safety in Employment Act 1992

1.1 The Objects of the Act

The overall object of the Health and Safety in Employment Act 1992 (HSE Act) is the prevention of harm to people as a result of work activities. Towards this, it defines harm and hazards in a comprehensive way, and promotes co-operation towards their systematic management in almost all places of work (section 5).

The Act imposes duties on employers, employees, the self-employed, principals, people who control places of work, and others. It is administered and enforced by the Occupational Safety and Health Service of the Department of Labour (OSH).

1.2 Regulations and Other Guidance Materials

The Act prescribes general duties and processes for the management of hazards in places of work. Further guidance on the steps to be taken in relation to particular hazards is provided by regulations, approved codes of practice or other guidelines.

Regulations may be made under section 21 of the Act. They describe steps which must be taken with respect to particular hazards or processes.

Approved codes of practice are provided for in section 20 of the Act. They are statements of preferred work practice or arrangements, and may include measures which could be taken into account when deciding on the practicable steps to be taken.

Compliance with approved codes of practice is not mandatory. However, an approved code may

be used in court as evidence of good practice.

Guidelines may be developed by agreement between industry groups and OSH. They set out preferred methods and standards and should be complied with unless other methods that result in the same standards are used. They may be used in court as evidence of good practice.

1.3 Employers' Duties

Employers have the most duties to perform to ensure the health and safety of employees at work. They also have duties to other workers who are deemed employees under the Act — including volunteers doing regular work, persons receiving on-the-job training or work experience and loaned employees (sections 3C-3F).

Employers have a general duty to take all practicable steps to ensure the safety of employees (section 6). In particular, they are required to take all practicable steps to:

- provide and maintain a safe working environment
- provide and maintain facilities for the safety and health of employees at work
- ensure that machinery and equipment is safe for employees
- ensure that working arrangements are not hazardous to employees
- provide procedures to deal with emergencies that may arise while employees are at work.

Taking "all practicable steps" means doing what is reasonably able to be done in the circumstances, taking into account:

- the severity of any injury or harm to health that may occur
- the degree of risk or probability of that injury or harm occurring
- how much is known about the hazard and the ways of eliminating, reducing or controlling it
- the availability, effectiveness and cost of possible safeguards.

An employer or other person is only required to take "all practicable steps" in relation to circumstances that they know, or ought reasonably to know about (section 2A).

1.4 Hazard Management (sections 7-10)

Employers must identify and regularly review hazards in the place of work, whether existing, new or potential, to determine whether they are significant hazards and require further action. This includes the recording and review of all accidents and incidents that involved or could have led to harm (section 7).

Employees must be given reasonable opportunities to take part in the hazard management process (part 2A).

Where any accidents or incidents occur, employers have recording and notification duties under the Act (see below).

“Significant hazard” means a hazard that is an actual or potential cause or source of:

- serious harm
- harm (being more than trivial) where the severity of effects on any person depends (entirely or among other things) on the extent or frequency of the person’s exposure to the hazard
- harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.

Where the hazard is significant, sections 8-10 set out the steps the employer must take:

- Where practicable, the hazard must be eliminated.
- If elimination is not practicable, the hazard must be isolated.
- If it is impracticable to eliminate or isolate the hazard, then employers must minimise the hazard to employees.

In addition, where a hazard is minimised, the employer must, where appropriate:

- provide protective clothing and equipment, make it accessible, and ensure that it is used
- monitor employees’ exposure to the hazard
- seek the consent of employees to monitor their health
- with their informed consent, monitor employees’ health.

1.5 Information for employees and health and safety representatives

Before employees begin work, they must be informed by their employer of:

- hazards they may be exposed to while at work
- hazards they may create which could harm other people
- how to minimise the likelihood of these hazards becoming a source of harm to themselves and others
- the location of safety equipment
- what to do in an emergency.

Employers are also required to inform employees of the results of any health and safety monitoring. In doing so, the privacy of individual employees must be protected.

Health and safety representatives in any workplace must be given ready access to sufficient information about health and safety systems and issues to enable them to perform their functions effectively (section 12).

1.6 Training and Supervision of Employees

Employers must ensure employees are either sufficiently experienced to do their work safely or are supervised by an experienced person.

In addition, employees must be adequately trained in the safe use of equipment in the place of work, including protective clothing (section 13).

1.7 Safety of People Who are Not Employees

Employers have a duty to ensure that no action or inaction of an employee causes harm to any other person (section 15).

1.8 Employee Participation

Employers must provide reasonable opportunities for employees to participate in ongoing processes for improvement of health and safety in the place of work. The Act is not prescriptive on the nature of employee participation, but contains default provisions where agreement cannot be reached within a place of work (part 2A and schedule 1A).

1.9 Employees and Self-Employed Persons

Employees and self-employed persons have a responsibility for their own health and safety while at work (sections 19 and 17 respectively). They must also ensure that their actions do not harm anyone else. An employee has the right to refuse to do work that they believe will cause them serious harm (section 28A).

These responsibilities do not detract from the employer's responsibilities. The self-employed also have duties to record and notify accidents (see below).

1.10 Principals to Contractors

Principals must take all practicable steps to ensure that no contractor, subcontractor, or employee of a contractor or subcontractor is harmed while doing any work (other than residential work) that the contractor was engaged to do (section 18).

1.11 Persons Who Control Places of Work

Persons who control places of work must take all practicable steps to ensure that persons in, or in the vicinity of the place of work are not harmed as a result of work activities (section 16).

Duties apply to the person in control of the place of work in relation to visitors.

1.12 Sellers and Suppliers of Plant for Use in a Place of Work

Any person who sells or supplies plant that can be used in a place of work has a duty to ensure that any plant used in a place of work is designed and made, and has been maintained, so that it is safe for its intended use (section 18A).

This applies to people who:

- hire, lease or loan to another, or
- otherwise sells or supplies plant that can be used in a place of work. Secondhand equipment that is sold "as is" is exempt.

1.13 Protection for Volunteers

Volunteers who do regular and ongoing work for an employer or self-employed person, and where the work is integral to the business, may be deemed "employees" with respect to many of the Act's duties (section 3C). This does not apply where the volunteer is:

- fundraising
- assisting with sports or recreation for a sports or recreation club or education institution
- assisting with activities for an education institution outside its premises, or
- providing care to another person in the volunteer's home.

In all cases of voluntary work, the person for whom the volunteer does the work must take all practicable steps to ensure the health and safety of the voluntary worker (section 3D).

1.14 Recording and Notifying Accidents and Serious Harm

Section 25 of the HSE Act requires employers, the self-employed, and principals who engage contractors to keep a register of work-related accidents, incidents, and other occurrences of serious harm in the prescribed form. This includes every accident that harmed (or might have harmed) someone. Employers are also required to investigate all these accidents to determine whether they were caused by a significant hazard (section 7(2)).

Those with recording duties are required to notify serious harm that occurs to employees and others that result from work activities to the Secretary of Labour, through the nearest OSH office as soon as possible. The accident must also be reported, using the prescribed form, within 7 days. (Suitable forms are available from OSH or from stationers.)

If a person suffers serious harm, the scene of the accident must not be disturbed unless to:

- save life or prevent suffering
- maintain public access for essential services (e.g. electricity, gas), or

- prevent serious damage or loss of property (section 26).

The OSH office will advise whether it wishes to investigate the accident and what action the employer, self-employed person or principal may take in the meantime.

NOTE: Trauma injuries and illnesses are listed in schedule 1. (Refer to the schedule for further information.) Any such occurrences of serious harm should be notified to OSH as soon as possible (section 25).