Volume1

Industrial Rope Access

Level - 1

Canadian Rope Access Specialists inc.

CRAS

Rope Access Level 1

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0.3	27/02/2014	Improved Definition of WLL and SWL	G. Korpela
0.4	03/06/2015	Formatting and grammatical changes throughout. Changed "Rope Access Certifying bodies" to include more complete information on the background of SPRAT and IRATA. Added information about "Pro-Board" to the section on high-angle rescue certification. Changed the section on safety ratios and equipment strengths to reflect what is written in SPRAT and IRATA publications. Updated section on equipment standards to include actual quotes from organizations (CSA, ANSI etc) about who they are and what they do, and included specific standards relevant to work at height. Updated the lifespan of RA harnesses with actual manufacturer's information, and reference to refer to manufacturer's direction. Revised "Hazard Assessment/Risk Assessment" with information from the ICOP. Combined repeated/redundant L1, 2, 3 descriptions from RA principles and training method section. Renamed "Training Method" to "Rope Access Training" Changed section titled "Job Hazard Analysis, Standard Procedures" to "Rope Access Planning", modified sections under this heading to include quoted information from ICOP. Removed redundant entry for hauling and lowering from chapter 7, tweaked Chapter 9 on lowering and raising systems. Updated harness configuration names, remove IRATA A IRATA B	G. Korpela
0.5	March 1, 2016	Updated equipment information. Added Petzl Lock, Catch, Petzl P50 and CT Evo Chest Ascender, updated specific equipment standards, edited harness information, added manufacturer directions for inspection for multiple items. Formatting throughout. Removed Rack and Shunt.	G. Korpela

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Chapter 1

Introduction to Rope Access

Employers in many fields are finding that industrial rope access can prove to be faster, less expensive, more versatile, and safer than traditional access methods. The most common applications for modern rope access include inspection, maintenance, and construction of bridges, dams, wind turbines, towers, buildings, geologic slopes, and industrial plants. While inspection is the most common application, welding, cutting and heavy material handling can be accomplished by rope access professionals using specialized procedures.

Facility managers have found rope access to be exceptionally cost-effective compared to conventional methods of access like scaffolding. In many cases the inspection can be done more thoroughly and effectively without the obstructions commonly presented by scaffolding. Furthermore, properly trained and certified rope access technicians uphold an exceptional safety record compared to nearly all other industrial occupations.

Savings of fifty percent or more are not uncommon when a facility chooses to employ technicians trained in rope access instead of using conventional methods. Cost savings are attributed to shorter facility shut downs, fewer personnel required for a shorter duration, and lower equipment costs.

Purpose of This Manual

This book is designed as a student manual for Rope Access instruction. This manual is to be used as a reference to accompany a hands-on Rope Access course.

What is Rope Access

Industrial Rope Access is a proven method of achieving a safe work position at height, or in areas with difficult access. It was initially developed from techniques used in vertical caving and mountain climbing to answer the need for a simple, safe and adaptable means of access. The first large-scale use of these techniques was for the inspections of oil and gas platforms in the North Sea.

Since its inception, rope access has also developed onshore, where it is used for all manner of work. From high-rise window cleaning and general maintenance to repair, geotechnical and inspection work.

Rope Access has:

- An excellent safety record based on a commitment to thorough training and diligent operational procedures
- Complete access services that usually removes the need for the involvement of other access machinery or work equipment
- Minimal environmental footprint
- The ability to work without disrupting public access or other work nearby
- The capacity for rescues built in to the system

Where is Rope Access Used?

Rope access techniques are best used in areas where the work may be done relatively quickly, but the access is difficult.

There are eleven main areas of work undertaken by rope access companies:

- Inspection/Testing of Structures
- Various Maintenance and Repair including; Welding, Concrete Repair, Sealant Installation, and Glazing
- Cleaning and Painting
- Facilities Management Building Services
- General Window Cleaning
- Pest Control
- Coatings inspection and maintenance
- Banner and Sign Erection
- Geotechnical/Civil Engineering; Permanent Rock Anchorage, Concrete Spraying, Rockfall Prevention
- Tower erection
- Antenna and dish installation

Benefits of the System

Rope Access provides:

- Rapid set-up and dismantling, minimal disruption to building occupants, pedestrians and traffic flow
- No security risk on site with all equipment removed overnight and no structure that might allow criminal use or vandalism
- The assurance that comes from employing a well-trained and supervised work force operating to effective and proven guidelines
- Cost efficiency over swing stage and scaffold installation
- Flexibility to access areas where traditional approaches fail

Rope Access and other Industries

Rope access techniques and technicians form an industry of their own. These personnel are used for a wide variety of work. Rope access techniques are being adopted in traditional industries, where these techniques can increase the safety and flexibility in the work.

Fall Protection

Rope access incorporates its own fall protection techniques. Workers are trained to use traditional fall arrest techniques and specific rope access protocols.

The fall protection methods used in rope access are more flexible than traditional methods. These rope access specific methods demand higher levels of training and supervision.

Window Washing

Window washing traditionally uses a bosun's chair and fall arrest system. This system typically utilizes one way descent devices and traditional fall arrest techniques. The window washers system generally has no provision for the rescue of an injured worker.

Many window cleaning businesses are now training workers in Rope Access systems. These trained workers possess a higher level skill set and may be more flexible in their work. Theses rope access trained workers also possess the ability to perform rescues.

Tower Erection

Tower erection is traditionally done with lanyard/shock absorber access systems. Many tower erection companies have limited facility for the rescue of a fallen worker.

Rope access training increases the options for moving on complex structures. These techniques also allow workers to perform installations on buildings. Rope access trained workers provide rescue capabilities at the highest levels.

Regulation and Standards

Rope access is relatively new in the regulatory environment in North America. In Canada specific legislation has been adopted by Alberta, British Columbia and Nova Scotia. California and New York City have also recently drafted similar requirements. Several states and provinces are following suit. All of these laws either directly or indirectly reference industry consensus standards.

It should be noted that Rope Access methods of work at height may not be recognized by local regulatory bodies. In many states and provinces Rope Access workers may need to comply with regional fall arrest standards, or apply for a variance or acceptances to use an alternate standard (Rope Access).

Rope Access as an industry is becoming more prevalent and therefore is better known to regulatory bodies in North America than it once was. Rope Access backup devices have also become available that meet ANSI standards for fall arrest equipment. These devices often make the application of rope access compliant with health and safety regulations, even where specific rope access regulations have yet to be written. An increasing number of regulatory bodies are granting acceptances to use rope access techniques in the workplace.

Rope Access Certifying Bodies

IRATA, the Industrial Rope Access Trade Association, was formed in the UK in the late 1980's, to solve maintenance problems in the offshore oil and gas industry. IRATA has over 200 member companies and 40000 IRATA technicians registered in over fifty countries across every continent on earth. IRATA has created an industry-consensus standard for rope access work called the International Code of Practice

In North America, the Society of Professional Rope Access Technicians (SPRAT), based in Philadelphia has created industry-consensus standards called Safe Practices for Rope Access Work and Certification Requirements for Rope Access Work. SPRAT was established in the mid 90's to address the needs of a growing number of companies employing rope access techniques in North America. Since 2001, thousands of rope access technicians representing dozens of companies and government agencies have been certified to SPRAT standards.

The goals of these organizations are to create industry standards for rope access and serve as a resource for those engaged in rope access work

IRATA, International Code of Practice and General Requirements may be downloaded at:

http://irata.associationhouse.org.uk/default.php?cmd=213

SPRAT, Safe Practices for Rope Access Work and Certification Requirements for Rope Access Work may be downloaded at:

http://sprat.org/publications/standards/

All rope access personnel should be familiar with these documents. Those moving on to the higher levels must be well versed in the workings of their respective standards.

Specialized Skills within Rope Access

Rope Access is the vehicle to safely get in and out of difficult access areas. For general cleaning and maintenance work rope access trained personnel may be all that is required, however for other common rope access tasks trade skills may also be required.

There are many specialized skills that can often be utilized in conjunction with rope access

- Structural concrete repair
- Welding
- Electrical installation/repair
- Non-destructive testing (NDT)
- Engineering inspections
- Grinding/finishing
- Painting

These specialized trades require industry training and certifications. Specialized Rope Access techniques may also be necessary to protect the worker when using ropes for welding and grinding applications.

High Angle Rescue

The High Angle rescuer is trained in companion rescue as well as stretcher techniques and moderate angle techniques. This skill set provides the best patient care for these types of terrains.

These technicians are trained in limited forms of rope access and untrained in the use of guiding or single rope techniques.

There is no nationally or internationally recognized certifying bodies for high angle rescue. One of the more widely recognized bodies for high angle rescue certification is the Pro-Board. The purpose of the Pro-Board is to establish an internationally recognized means of acknowledging professional achievement in the fire service and related fields.

JIBC Rope Rescue Team Member and Leader Certifications are also widely recognized. The JIBC program trains high angle, but does not specialize in industrial tools and techniques. JIBC and Pro-Board training programs are standardized and have a reputable certifying body backing the process.

Many company based certifications are available. These certifications generally are not supported by certifying bodies and typically do not include an evaluation or testing process.

Confined Space Rescue

Many of the areas that technicians will enter for work are considered confined or enclosed spaces. Rope Access technicians need to be familiar with adaptations to their procedures which may be needed to work in confined spaces. At the most basic level a rope access technician must have confined space awareness training and competency with air monitoring devices and procedures.

Basic Confined space awareness programs are available online:

http://www.bistrainer.com

For work in high hazard environments, technicians should have a confined space rescue certification.

Like high angle rescue certification, confined space certifications are mainly company based. Most company based evaluations follow OSHA (USA) guidelines for certifying technician levels.

Chapter 2

SYSTEM OVERVIEW

System Overview

A rope access program must be built as an integrated system. The safety and efficiency of industrial rope access operations depend on an organization's commitment to successfully integrate four key components:

- Management systems
- Training systems
- Equipment management systems
- Qualified supervision

Rope Access Operations

The main features of most rope access systems are:

- Rope access technicians work on two ropes - a working rope and a back-up safety rope.
- Each rope has a separate anchorage point.
- In the event of working line damaged or failure the safety rope prevents a fall.
- To prevent accidental dropping, all tools of a suitable weight are attached to the technician, while heavier items are independently suspended.
- A minimum of two technicians are required for any job so as to enable monitoring and have facility for rescue within the system.
- All certified Rope Access technicians receive extensive training and independent assessment and are required to undergo re-assessment every three years.
- Rope Access training includes rescue procedures even though SPRAT/IRATA technicians have an unrivalled record of safe work.
- All equipment is regularly inspected and well maintained.
- All SPRAT/IRATA training and operational work is conducted in line with Association Guidelines, wherever in the world it is conducted.
- All work is performed under the guidance of a Rope Access Supervisor who designs the working methods, rescue plans, and performs a Job Hazard Analysis (JHA)

Training System

Industry-consensus standards give performance and training criteria for employees performing rope access work. The certification system is divided into three levels. A specified amount of rope access experience is required to progress to the next level, and candidates generally receive about 32-40 hours of training to meet the performance criteria prior to their evaluation at each level. Following this training candidates are evaluated through a written exam and a practical field evaluation.

Level I Technicians (Authorized Workers) are qualified to work under appropriate supervision and must be able to inspect their equipment and safety systems.

Level II Technicians (Lead Technicians) have documented work experience and are qualified to rig more complicated systems and trained to perform a wider range of rescue techniques.

Level III Technicians (Safety Supervisors) have more documented experience and training and are responsible for the safety management of the job.

Equipment Management System

An Equipment Manager is usually designated to maintain the equipment management system. Each piece of safety equipment should be given a unique identifier and inspected before being placed into service. This unique identifier allows the equipment to be traced back to its date in service and inspection record. While each technician inspects his or her own equipment on a daily basis, periodic inspections (usually twice annually) are conducted and documented by the Equipment Manager.

Each piece of equipment must be compatible with the other components of the system. Without specific testing, compatibility isn't always obvious. Testing has shown that some equipment is especially sensitive to variations in rope structure and diameter, for example. The best way to make sure that the equipment is compatible is to get advice from a knowledgeable dealer, and/or seek independent testing data.

Rope Access Supervision

Proper supervision is essential to the rope access safety management system. Ultimately, a properly qualified and certified Rope Access Supervisor, with the support of company management, should be able to identify and correct any gaps in the management systems, staff training, and equipment protocols to insure safe operations.

Job Planning

Once the rope access system is in place, every job requires a specific safety plan or job hazard analysis (JHA) and rescue plan that should be prepared before beginning the job. A thorough plan includes:

- Details and contacts related to the work site.
- Staff training and emergency contact information.
- Communication methods.
- Description of the work to be done, steps and tools needed, and the associated hazards.
- Environmental hazards and methods to mitigate those hazards.
- Detailed rescue plan, rescue equipment, and emergency services contact information.

The details of the safety and rescue plans are fine-tuned by the Rope Access Supervisor at the job-site. The Supervisors must conduct a safety meeting with all members of the team prior to beginning every job and usually on a daily basis thereafter. New employees are given a site safety orientation prior to beginning work. All members of the team must sign that they have been briefed on the safety plan. Because rope access technicians work in difficult access locations, certified rope access professionals are trained to rescue their work-mates and get them to an area where definitive medical attention is available.

Principles

Dual Rope System

The general rule which applies to all Rope Access is the idea of system redundancy. This means that each system has a backup. A rope access system actually consists of an **access** (sub) **system** and a **back-up** (sub) **system**, which are used together. The access system provides the primary support for access, egress and work positioning. The **access system** is comprised of a working line to which descending and ascending devices are attached, which are in turn connected to the rope access technician's harness. The **back-up system** provides additional security to that provided by the access system. The back-up system is comprised of a safety line and a back-up device, which is attached to the safety line and the rope access technician's harness. This means that there should be no time where if one aspect of a system fails, the entire system should fail. This parallel backup system also facilitates an efficient rescue response.

Safety Ratios

Safety ratio can be described as the minimum breaking strength (MBS) of a component divided by the expected load applied to that component. Within Rope Access this safety ratio takes in to account the added load of a rescuer.

The actual safety ratio used in rope access varies depending on the materials used, work situation and skill of the operator. Most rope access and rope rescue systems recommend a safety ratio of 10:1. This safety ratio accounts for the added forces that may occur if there was a failure of the primary (suspension) system. According to SPRAT Safe Practices 10.7.2 "In no case shall the safety factor for a rope access system be less than 5:1"

Generally speaking a 10:1 safety factor is recommended for all soft goods (ropes, slings and lanyards) and a minimum of a 5:1 safety factor is recommended for hardware (connectors, pulleys etc.). In no case should the safety factor be less than 5:1, and in most cases a higher safety factor is more desirable.

Simply put it is imperative that the weakest link in the system has a minimum rated breaking strength that is no less than 5 times that of the working load (i.e. the sum of the mass of the worker, potential rescuer and equipment). This means that the load represents a total of 200kg in mass or 2kN of force. The weakest link in the system should then have a rated breaking strength that is **at least** 5 times this amount.

Safety Ratios (IRATA)

The strength of main anchor points should be at least as strong as that of the ropes attached to them and not less than 15kN. To determine the minimum anchor strength requirement, IRATA's code of practice uses a safety factor of 2.5.

The maximum permissible impact force on the user in the event of a fall should not exceed 6kN; therefore, the static strength of all anchors should be at least 15kN. Deviation anchors and anchors placed simply to maintain the position of the anchor lines may have a lower static strength than this, but should be sufficient for the load that could be applied.

Equipment Strengths

"Manufacturers' specifications for the permissible loading of equipment should be taken as the starting point for the selection of equipment. Some equipment, e.g. descending devices; backup devices, may be supplied with maximum and/or minimum rated loads (RLMAX and RLMIN). Other equipment may be supplied with different types of load ratings, e.g. a safe working load (SWL); working load limit (WLL). These are sometimes in addition to the minimum static strength provided, e.g. connectors, and sometimes in place of it. Most personal fall protection equipment used in rope access work, such as low-stretch ropes, harnesses and ascending devices, is tested using the minimum static strength specified in the relevant standards." IRATA ICOP **2.7.1.4.1**

Manufacturers will generally mark their products with either a Minimum Break Strength (MBS) or Working Load Limit (WLL). The MBS is the minimum force required to break an item, whereas the WLL is the maximum weight that a worker may suspend on this equipment as decided by the manufacturer. The WLL is a percentage of the Minimum Breaking Strength (MBS) of the equipment. Different manufacturers utilize different safety ratios depending on the intended application.

Within Rope Access we generally use a minimum of a 5:1 safety ratio on primary materials, and in most cases a 10:1 safety ratio is preferred. Some devices may not satisfy this principle, but should always be designed for their intended use, and only used as recommended by the manufacturer.

Equipment designed for use

Rope access equipment should be used only for its designed and intended purpose as specified by the manufacturer. If equipment is to be used for other applications, confirmation should be obtained from the manufacturer that it is acceptable to do so and any caveats should be taken into account.

Equipment should always be used in accordance with the manufacturer's directions

Hazard Assessments / Risk Assessment

A hazard is something that has the potential to cause harm to any person, property or animal, whereas a risk is the likelihood of that harm actually occurring.

A risk assessment is a careful, systematic examination of the hazards in the place of work that could cause harm to people or damage to property. It should be done before the work takes place and before the work procedures and rope access equipment are selected. It is important, when carrying out a risk assessment, to identify the significant hazards, evaluate the level of associated risk and indicate whether existing and/or proposed precautions are suitable to eliminate or minimize the risk.

Rope Access professionals must have a sound understanding of the factors and principles applying to their craft. Risk assessment uses this understanding to critically look at each component of the Access system. What is the probability that this component may fail? What would be the consequence of this failure?

The objective of this risk assessment is to ensure that hazards are identified and risks are reduced to an acceptable level.

Facility for Rescue

The employer must conduct a risk assessment and develop written procedures in any workplace in which a need to rescue or evacuate workers may arise

Supervision

The Rope Access system is reliant on highly trained individuals and competent supervision. Rope access must be seen as an apprenticeship processes, were personnel are mentored and given hours and experience to be able to move to higher levels.

The work site must have a level 3 (Rope Access Supervisor) to oversee the project. This person is responsible for setting the project up, performing a hazard assessment, and overseeing the running of the work.

No Rope Access worker, regardless of qualification, is allowed to work at height alone. This would negate the facility for rescue, which is part of the system.

Rope Access Program Manager

An individual qualified and designated by the company to manage the Rope Access program including matters relating to safety, training, regulations, staffing, equipment selection and management, and other program responsibilities as outlined in this procedure.

This person is generally an experienced level 3 with practical knowledge of personnel management.

Rope Access Training

Rope Access training is done with a combination of training programs, independent assessment and apprenticeship time in the workplace.

At each level a training program is undertaken. This training is between 32 and 40 hours. An independent assessment is then performed. This assessment has a written, oral, and practical component. Most assessments will last one complete day.

The training is physically demanding and the assessments are mentally challenging. Candidates will need to work extremely hard to achieve a passing grade on exam day.

Level 1

Rope Access Technician: An individual with the appropriate training and certification for conducting standard Rope Access manoeuvres and limited rescue procedures. Level 1 technicians must work under the **direct supervision** of a Rope Access Supervisor. There are no pre-requisites for this level of training.

Level 2

Rope Access Lead Technician: An individual with the appropriate training, experience, and certification to perform all Rope Access work, rigging and standard rescue procedures. This person must work under the **direction** of a Rope Access Supervisor.

The level 2 candidate is more highly trained in anchorage and rigging techniques than a L1 technician. Proceeding from level 1 to level 2 requires documented hours on rope and time as a certified technician.

SPRAT: 6 months and 500 hours minimum.

IRATA: 1 year and 1000 hours minimum.

Level 3

Rope Access Supervisor: An individual with the appropriate training, experience, and certification to be responsible for the entire Rope Access work site, manage other Rope Access personnel, and provide guidance and additional training as needed. The level 3 candidate is trained to perform rescues through any manoeuvre or obstacle within the Rope Access work site. This candidate is also trained to run more complex group work projects and tensioned line systems.

Proceeding from level 2 to level 3 requires documented hours on rope and time as a certified technician.

SPRAT: 6 months and 500 hours minimum.

IRATA: 1 year and 1000 hours minimum.

Medical Training

All rope access personnel are encouraged to seek certification in First Aid and Cardiopulmonary Resuscitation (CPR). Level 3 Rope Access Supervisors **must be certified in First Aid and Cardiopulmonary Resuscitation (CPR).** The First Responder level of training is recommended.

Annual Refresher Training

With most Rope Access work technicians do not practice the full range of their techniques. It is important that rope access technicians have an annual refresher where they can stay current with their level of training and practice rescue techniques.

Annual refresher training should be provided to all rope access personnel. The refresher training shall consist of a minimum of 8 hours (16 hours recommended) and include rescue training and a performance evaluation of a representative sample of the skills required for the technician's current level of certification.

This training should be documented in the technicians log book.

Re-certification

Rope Access personnel must re-evaluate every 3 years to maintain their certification. This evaluation will be the same format as their initial certification exam.

Lapses from work on rope

Any personnel who have not worked on or trained in Rope Access for 6 months must have an 8 hour refresher training prior to engaging in rope access activities.

Chapter 3

Rope Access Planning

The primary objective behind the planning and management of rope access projects is to create a work environment that maximizes safety and minimizes the risk of error, possible incidents and injury, i.e. to provide a safe system of work.

The planning process takes in to Account:

- Rope Access standards
- Local legislation for work at height
- Company procedures

Planning, the components of a Rope Access Work Plan:

- Site
- Purpose
- Pre-work analysis
- Rope Access Personnel
- Additional Personnel
- Emergency Contacts
- Communications
- Equipment
- Lockout/Tag out procedures
- Expected conditions
- Safety Method Statement
- Job Hazard Analysis
- Rescue Plan

Site

Paperwork should include a description of the worksite, including the physical location and type of structure, ex; dam face. This may also include Evacuation routes, Emergency muster points, fire suppression equipment, location of first aid equipment and attendants.

Purpose

Job planning should detail the reason for being on site, and the work tasks being undertaken.

Pre-work analysis

A pre-work analysis should be carried out before rope access work is undertaken on a project to confirm that rope access is a suitable method and to ensure control systems are in place to allow the work to be carried out safely. Examples of typical points to be covered are:

a) How the work area can be accessed and exited safely;

b) The ease and degree of safety with which a rope access technician will be able to use tools and equipment while suspended;

c) Whether there might be a risk of loose materials or equipment falling onto people below;

d) Whether the duration of the work in a location might put the rope access technician at risk, e.g. prolonged exposure to extremes of heat or cold;

e) Whether rope access technicians could be rescued quickly from any potential position in which they might find themselves.

Rope Access Personnel

The Rope Access Personnel needed for the work task, including their levels of rope access certification, responsibilities and any other qualifications should be documented on the work plan. The rope access plan should also include written confirmation that the rope access safety supervisor has the company's authority to act whenever necessary to ensure the safety of the rope access technicians, the public and the worksite. If rope access technicians from another company are working on the same team, a prior agreement of operating procedures should also be included in the rope access plan.

Additional Personnel

Any added workers must be documented with qualifications and emergency contacts.

Emergency Contacts

Outside emergency contacts must be part of the rope access plan, in addition to the contacts for workers. These are contacts for summoning outside assistance in the case of emergencies.

These may include:

- Police
- Fire services
- Ambulance and paramedics
- Helicopters and air ambulance

Communications

Communications procedures within the work site will include communication within the rope access team and with other workers. Any communication method must be understood within the team. Backup communications methods should also be considered.

Communications methods may include:

- Voice
- Radio
- Hand signals
- Whistles
- Air horns

Equipment

Rope Access, personal protective equipment, work tools, and emergency equipment should be documented prior to mobilization to the work site. This should also include up-to-date inspection records for all rope access and personal protective equipment.

Lockout/ Tag out Procedures

Specific procedures to deal with hazardous materials, machinery, fixtures and tools, and environmental hazards should be part of the work plan.

In many industrial settings there is work around energized or moving equipment. Lock out or tag out procedures are designed to keep moving or energized devices from impacting work in their vicinity. Most companies that have these situations will provide lockout training to contract workers onsite.

Expected Conditions

This describes weather and environmental conditions that may affect the work area.

Examples:

- Heat or cold
- Wind
- Rain or snow
- Noise
- Darkness
- Confined spaces

Safety Method Statement

Safety method statements are an effective way of producing an action plan for a safe system of work and are useful in bringing together the assessments of the various hazards that may arise on a job. The safety method statement should set out working procedures to be followed for each particular job. All safety method statements should include a specific rescue plan, e.g. rigging for rescue. In cases where types of jobs are similar, the safety method statements could be identical and may, therefore, be in the form of a general document. However, separate safety method statements may be necessary for each particular aspect of the job. Where the work includes the use of hazardous tools (e.g. welding torches, flame cutters, abrasive wheels), a more detailed safety method statement should be prepared. For advice on preparing a safety method statement, see IRATA ICOP **Part 3, Annex B**

Work Methods

This section describes the working methods that will be used to perform the work tasks.

These may include:

- Rope access methods ex: rebelay, aid climbing
- Anchoring methods
- Rope protection methods
- Work tools
- Specialized work methodologies (hot work, coatings, sandblasting, confined space, etc)

Job Hazards Analysis

Once it has been decided that rope access is a suitable method to carry out the intended task, employers should review carefully the procedures to be followed for carrying out the work. They should identify any hazards and examine how they can be removed or, if this is not possible, how the risk can be reduced to an acceptable level. This is determined by carrying out a risk assessment, which is also known as a job safety analysis (JSA).

For more information on risk assessment, see IRATA ICOP **Part 3, Annex A**.

The job planning process takes into account many components. This process is sometimes referred to as a JHA (Job Hazard Analysis) or JSA (Job Safety Analysis).

This section describes the hazards present on the work site, and with work procedures being performed. It will also describe the management tools to bring the hazards to an acceptable level for the work being done. Hazard identification should comprise identification of anything with the potential to cause harm.

Identify the hazards in the work place

a) The area in which the rope access team is expected to operate should be checked and any hazards that could reasonably be expected to cause harm to the rope access team members should be identified.

b) Any action that might be taken during the work that could create a hazard with the potential to cause harm to others should be identified. Hazards that could result in major harm or affect several people should be prioritised.

c) The effect of persons being in the vicinity of the rope access operations who are not part of

After the hazards have been identified, the risk assessment should continue with a careful study of all the hazards identified, to determine the level of risk posed by each. As a first step, wherever possible, hazards should be eliminated. If this is not possible, precautions should be taken to minimize the likelihood of persons being harmed. Thus, the chance of an incident occurring in the first place is reduced. In addition, the undesirable possibility of having to deal with an incident and its consequences is also reduced

Rescue Plan

Work done at height while hanging in harness has the potential to be high risk. Workers incapacitated while working at height need to have speedy transport to the horizontal where real first aid care can take place. In the vertical environment not much in the way of real first aid can take place. The best care generally is to move the casualty safely and speedily to the ground.

The rescue plan in a rope access site should be able to transport an incapacitated worker to the ground within 20 minutes. Complex work situations may have releasable components pre-rigged for rescue or pre-built rescue systems on standby.

Rescue Plans should include:

- Rescue procedures
- Rescue communication procedures
- Emergency contacts
- Rescue personnel
- Rescue kits and cache location

Common Rope Access Hazards

Falling From Height

Hazard: Workers falling from height

Management Tools:

- Dual rope systems (load and backup)
- Equipment inspection and documentation
- Buddy checks after donning of harness
- Proper training in rope access procedures
- Inspection of rope system to be used (ground check)
- Supervision

Dropped Equipment

Hazard: Dropped tools and equipment

Management Tools:

- Exclusion Zones
- Hardhats
- Tools on lanyards or loose items in captive bags
- Any tools off lanyards (ex. backup devices) with sure handed movements
- Avoid working under workers above, or if necessary inform the workers
- Keep platforms clear and tidy to avoid spilling materials on those below

Sharp Edges

Hazard: Sharp edges in contact with ropes, anchor or persons

Management Tools:

- Avoidance of hazards with rope access tools (rebelays, deviations etc.)
- Padding of edges with rope guards
- Wire anchor straps
- Awareness of hazard and the need to work in control
- PPE (personal protective equipment gloves etc.)

Hot Surfaces

Hazard: Hot surfaces in contact with ropes, anchor or persons

Management Tools:

- Avoidance of hazards with rope access tools (rebelays, deviations etc.)
- Awareness of hazard and the need to work in control
- PPE (personal protective equipment gloves etc.)

Pinch Points

Hazard: Hands and body parts being pinched

Management tools:

- Awareness of points
- Aid climbing care where grabbing points and slings
- Carabiners cross-loading when transferring to descent devices

Overuse Injuries

Hazard: Strains and overuse injuries

Management Tools:

- Proper warm-ups
- Stretching
- Changing work procedures (repetitive stress)
- Offseason fitness management
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Daily Toolbox Talks

The JHA should be understood by all workers on the rope access site prior to engaging in the work. The daily Toolbox (or Tailboard talk) is a running record of the job; the hazards, and their management.

Daily Toolbox should include:

- Running record of the job
- What we accomplished yesterday
- What we hope to get done today
- Observed hazards
- Anticipated hazards
- New tools
- New personnel
- Teams and assignments

Chapter 4

EQUIPMENT

Rope Access Equipment

Rope Access technicians must have a thorough understanding of their equipment and its proper use as well as its limitations.

The following equipment is some of the most commonly used in industrial rope access.

The specific equipment currently in use at the Canadian Rope Access Specialists training facility has been identified using our logo to the right of the item name.

Improper use of equipment could result in its failure and yours.

Equipment Standards

SA: Canadian Standards Association

CSA Group is a 'not-for-profit' membership-based association "serving business, industry, government and consumers" in Canada and the global marketplace. CSA creates a variety of safety and performance standards, including standards for Fall Arrest equipment. Workers covered under federal regulations, and in some provinces must use Fall Protection equipment meeting this standard to be compliant with health and regulations

ANSI: American National Standards Institute

The American National Standards Institute is a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. ANSI standards include standards for Fall Arrest equipment. Many provinces in Canada allow workers to use Fall Arrest equipment that meets this standard.

Standard Agency	Standard Number	Standard Title
ANSI	Z359.1	Safety Requirements for Personal Fall Arrest
CSA	Z259.10	Full Body Harnesses
CSA	Z259.11	Shock Absorbers for Personal Fall Arrest Systems
CSA	Z259.2.1	Fall Arresters, Vertical Lifelines, and Rails
CSA	Z259.2.2	Self-Retracting Devices for Personal Fall-Arrest Systems
CSA	Z259.12	Connecting Components for Personal Fall Arrest Systems (PFAS)

CE: Conformité Européenne, meaning "European Conformity"

The CE marking or formerly EC mark, is a mandatory conformity marking for products sold in the European Economic Area (EEA) since 1993. The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EC directives.

EN: European Standards

The CEN was founded in 1961. Its thirty national members work together to develop European Standards (ENs) in various sectors to build a European internal market for goods and services and to position Europe in the global economy.

EN 353-1: Personal protective equipment against falls from a height. Guided type fall arresters including a rigid anchor
EN 353-2: Personal protective equipment against falls from a height. Guided type fall arresters including a flexible anchor line
EN 354: Personal protective equipment against falls from a height. Lanyards
EN 355: Personal protective equipment against falls from a height. Energy absorbers
EN 358: Personal protective equipment for work positioning and prevention of falls from a height. Belts for work positioning and restraint and work positioning lanyards
EN 360: Personal protective equipment against falls from a height. Retractable type fall arresters
EN 361: Personal protective equipment against falls from a height. Full body harnesses
EN 362: Personal protective equipment against falls from a height. Connectors
EN 363: Personal protective equipment against falls from a height. Fall arrest systems
EN 567: Mountaineering equipment. Rope clamps. Safety requirements and test method|
EN 12841:2006 Type A - Safety Line Rope Adjustment, Rope Fall Arrester
EN 12841:2006 Type B – Rope Adjustment Device, Ascender
EN 12841:2006 Type B – Rope Adjustment Device, Descender

NFPA: National Fire Protection Agency

The mission of the international non-profit NFPA, established in 1896, is to reduce the worldwide burden of fire and other hazards on the quality of life by providing and advocating consensus codes and standards, research, training, and education.

The world's leading advocate of fire prevention and an authoritative source on public safety, NFPA develops, publishes, and disseminates more than 300 consensus codes and standards intended to minimize the possibility and effects of fire and other risks. The NFPA sets standards for Fire Rescue equipment, personnel and procedures. Most ropes made and sold in North American are certified to NFPA standards

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CI: Cordage Institute

The Cordage Institute is an American Organization that sets standard for rope and cordage. The Cordage Institute has an active Technical Committee, which is focused on the ongoing development of over 50 international standards, guidelines, test methods, and other technical documents for rope, cordage, and twine products.

UIAA: Union Internationale Des Associations D'Alpinisme

"We want to make it easier for you to choose the best when you go up into the mountains. Therefore we have developed different sets of UIAA standards for organizers and producers. This way you can make sure that your mountaineering equipment has passed safety tests and that a guidebook is easy to use. Or you can check that the company which arranges your expedition is environmentally friendly or the organizers of your climbing course are up to international standards. Look for the UIAA logos!" UIAA

Inspection

Equipment Inspection and Documentation of use is necessary to insure the integrity of rope access systems.

The following guidelines should be followed:

- Designate an equipment manager for the purpose of overseeing the care, storage, documentation, and replacement of equipment.
- Keep all manufacturer's instructions and lot identification tags.
- Mark equipment so that it can be uniquely identified, but does not compromise equipment operation or integrity.
- Record equipment usage with notes regarding extreme or abnormal conditions of use.
- Immediately remove from service any equipment with signs of deterioration or excessive wear, or if it has exceeded manufacturer's recommended work life.
- The worker will visually inspect equipment before each use (shift)
- An equipment manager or designate will thoroughly inspect the equipment periodically (project end or 6 months)

Care and Storage

Rope access equipment must be stored in a dry location away from possible chemical contamination or direct exposure to sunlight. Damp or wet equipment must be hung up to dry. Dry equipment can be stored in bags, boxes, or lockers. Whenever possible, equipment bags or cases should be used to transport the equipment to protect it from contamination by chemicals or exposure to excessive sunlight.

PPE

In addition to the specialized rope access equipment personnel must wear personal protective equipment (PPE) as warranted by the jobsite conditions or requirements.

This may include:

- Protective or high visibility clothing
- Footwear (steel toe or specialized climbing)
- Gloves
- Safety glasses
- Respiratory protection
- Ear protection
- Knee pads
- Helmets

Ropes

The most common ropes used in modern Rope Access are of kernmantle construction. In this type of rope the core (kern) has nylon strands running the full length of the rope, and a protective sheath (mantle) of braided nylon or polyester strands. The core of these ropes carries from 75 – 90% of the load and sheath acts primarily as a protective covering.

The most common materials for rope construction are nylon and polyester, due to its strength, abrasion resistance, and ability to ability to absorb shock loads. There are many other synthetic fibres used in rope manufacturing designed for specific (industrial and water based) applications.

Ropes may have dry coatings which will help prevent them from absorbing water. These coatings also make the ropes slick and backup devices may not reliably grab these ropes. Dry coated ropes are not generally used in Rope Access for this reason.

Fibers

Nylon

- 10% stronger than polyester (by weight)
- Good at absorbing forces (shock load)
- Resistant to many chemicals
- 10-15% weaker when wet
- Acid and bleaches can damage rope

Polyester

- Similar strength when wet or dry
- More acid resistant than nylon
- Low elongation (less shock absorption)
- Alkali degradation

Low Stretch

Low stretch ropes are designed for industrial and rescue applications. These ropes are sometimes mistakenly referred to as static ropes. Low Stretch ropes have an elongation of about 6% - 10% at 10% of their minimum breaking strength; by contrast "static ropes" have an elongation of less than 6% at 10% of their minimum breaking strength, and are not as commonly used for rope access applications.

Certifications: Most in North America are Cordage Institute or NFPA. CE EN1892 in Europe

Low Stretch ropes:

- Are stronger than their dynamic counterparts
- Have a thicker sheath and are more abrasion resistant than dynamic ropes
- Are not as elastic as dynamic ropes
- Will generally stretch 1-4% with a 90kg load
- Will generally stretch 6% - 10% at 10% of minimum breaking strength
- 11mm diameter ropes are most commonly used for Rope Access
- Have a minimum breaking strength of 28-32kn (11mm)
- Do not absorb shock adequately for use in lead climbing (climbing above anchor points)

Dynamic

Dynamic ropes are designed for use when climbing above anchor points. These ropes stretch under tension to act as a shock absorber in the event of a fall. They are designed primarily for lead climbing on snow, rock or ice. Dynamic rope is commonly used for lanyards where the stretch and shock absorption is of benefit. Dynamic ropes are not used for primary access ropes as their stretch would impede movement and their strength and durability are less than that of low stretch.

Certifications: CE EN, UIAA

Dynamic Ropes:

- Have thinner protective sheaths
- Will generally stretch 5-9% with a 90kg load
- Will stretch up to 40-50% under a dynamic load, such as a fall.
- Are most commonly used in 10-11mm diameters
- Have a breaking strength of 22-24kn (5000-5400lb)
- Are not designed to support multi person loads
- Can cause difficulties in rescue systems due to their inherent stretch

Dynamic rope generally comes in a variety of bright colours. It is difficult to distinguish between low-stretch and dynamic ropes unless tagged or marked.

Rope Care

- Protect rope from unnecessary abrasion.
- Inspect the rope after each use.
- Maintain a rope log.
- Wash and dry dirty ropes.
- Coil or bag rope after use.
- Store ropes where they will not be exposed to UV rays, high temperatures, chemicals or humidity.
- Avoid stepping on ropes. Grit can become embedded in the rope sheath and work its way to the core. Embedded dirt and grit will cut the nylon fibres and compromise the strength of the rope.
- Avoid prolonged exposure of ropes to sunlight. It has been demonstrated that ultraviolet radiation adversely affects the strength of ropes and webbing.
- A wet rope should never be left in a rope bag. Ropes should be dried in a ventilated area and not over a campfire or in a dryer. Excessive heat damages the nylon, making the rope weaker.
- Nylon on nylon connections should be avoided. Loaded moving rope running across stationary rope or webbing is extremely dangerous and can result in the cutting away or melting of the non-moving length of nylon. Do not run a moving loaded rope against a non-moving length of rope or webbing.

- Rope kinking can potentially result after several rappels, belays or coiling. Unchecked, kinking can turn a length of rope into a rescuer's nightmare. The use of in-line devices that do not twist the rope is recommended. Proper coiling and uncoiling methods are also of value in keeping twists out of the rope.

Inspection

There is no fool proof method to determine precisely how much damage has been done to a rope. However, there are indicators of rope damage. Inspection consists of checking the rope for these indicators and signs of damage.

This is best done when coiling and uncoiling the rope, by running the rope through the hands under slight tension to feel for any inconsistencies.

Signs of possible damage:

- Signs of possible impact by an object
- Flattening of any part of the rope
- The core feels unusually soft
- Herniation's, bumps or fat spots
- Cuts in the rope sheath (core showing through)
- Excessive sheath abrasion (more than 50% of surface fibres)
- Contamination (discolouration)

If there is ever any doubt regarding the safety of a rope during an inspection, bring it to the attention of the Rope Access Supervisor. If possible cut out the damaged section and remove it from circulation.

If the damage is detected during an operation, stop the operation and bring it to the attention of the Rope Access Supervisor.

Replacement of the suspect rope is the best course of action, if replacement is not possible damage can be isolated by tying a Butterfly knot with the damaged section in the loop of the knot. Because a butterfly knot could have many applications it is a good process to distinguish it as a damaged section by marking it with some established system. This is sometimes done by tying a figure 8 knot within the butterfly so that all personnel know that it is not just a butterfly left in place.

Washing & Storage

Working ropes get dirty with use and can be washed by hand, in a washing machine or with a rope washer, which attaches to a garden hose. To wash by hand, use warm water with a mild soap, rinse and air dry. To wash with a machine, use successive daisy chains in the rope and use a gentle cycle. Check often to ensure the rope does not get tangled in the agitator. Ropes should be hung to dry in a cool well-ventilated room in loose coils on large diameter pegs or drying racks.

The best way to store working ropes is in a rope bag. The bag protects the rope while keeping it ready for immediate use. The rope length, diameter, and number should be marked on the rope and bag for easy identification. Do not store wet ropes in bags due to the possibility of mildew.

Replacement

All nylon materials deteriorate with time, regardless of usage. Ropes should be replaced when significant damage or wear is observed or at maximum of 5 year intervals. Due to the potential legal ramifications of old ropes being misused, many manufacturers are now constructing ropes with an identifying colour coded strand in the core of the rope which identifies its construction date.

Rope Log

Every rope should have its own rope log to keep track of that rope's history. It is important to record any rope use or damage in the rope log.

Harnesses

The harness is a worker's link to his safety system. With some exceptions, harnesses suitable for industrial rope access must be a full-body design (or integrated chest and seat harness). The harness must meet CSA Z259.10, ANSI Z359.1 or other relevant standards for its intended use. A basic *fall arrest harness* is designed to be employed only in the event of a fall and is not comfortable or functional for work-positioning applications.

Multi-use harness

A *multi-purpose harness* designed for rope access should be comfortable when the worker is suspended and have additional attachment points to perform the intended work. A multi-use harness will often have a waist (central), sternal, dorsal, and lateral attachment points called D-rings.

Yates Rope Access Basic Standards: UL classified to meet NFPA 1983/2012 standards. ANSI/OSHA Z359.1-2007, CSA Z259.10-12

Petzl Navaho and AVAO Standards: ANSI Z359.11, CSA Z259.10, CE EN 361, CE EN 358, CE EN 813, CE EN 12841 type B

Lifespan: Always defer to the manufacturer's recommendations.

Petzl harnesses have a maximum 10 year life span from the date of manufacture. Yates suggests a five-year maximum lifespan for all continuous use webbing products once they are put into service or a ten year shelf life from the date of manufacture. Yates also states that if the product has documented periodic/quarterly inspection reports that the service life can be extended up to ten years from date of manufacture as long as the product is maintained in GOOD condition.

Gear Loops are the soft fabric loops at either hip, and they are intended to store accessories such as ascenders, rope clamps, carabiners and descenders, and are not load rated.

Central D-ring or Ventral Point is a continuous metal ring at the belt buckle location, and it is designed for use with a descender, or other work positioning devices.

Sternal D-ring or Sternal Point is generally used as a fall arrest point in rope access. The sternal attachment will keep the worker upright and in a position where they may be able to perform self-rescue. These attachments are usually rated for ladder safety systems and vertical lifelines.

Dorsal D-ring is the traditional fall arrest attachment for long energy absorbing fall arrest lanyards. This point provides the least potential for spinal injury during a long fall into free air. If the worker is working against a surface the dorsal point may cause the worker to Face-Plant in to the structure. The dorsal suspension is also very difficult to self-rescue from.

Two Lateral points are designed to be used in pairs for work positioning. A Grillon, working positioning belt or pole strap is used to span between the attachments around a tower or pole. These points may also be used to provide added friction in the case of rescues.

A harness must be adjusted snugly while not restricting full freedom of movement. Follow the manufacturer's instructions for wearing and securing the harness.

Inspection

- Inspect all webbing (frays, tears, discoloration, burns, chemical damage).
- Inspect all critical stitching which is commonly differentially coloured.
- Inspect all metal buckles (cracking, pitting, and corrosion) and test for function.
- Inspect all D rings (cracking, pitting, corrosion)

Dos and Don'ts of Use

Do:

- Put harness on correctly
- Perform a buddy check
- Position Dorsal D ring between the shoulder blades for fall arrest

Don't

- Expose to chemicals
- Expose to heat

Connectors

Connectors are the term used to describe a class of metal links used to connect components. Carabiners, screw-links, and snap hooks are the main types of connectors used in rope-access and fall protection systems. Connectors are fabricated from steel, aluminium, and various alloys.

Steel connectors are the most common in industry because of steel's durability, strength, and relative low cost. Aluminium is chosen for its high strength to weight ratio, making connectors that are lighter than steel.

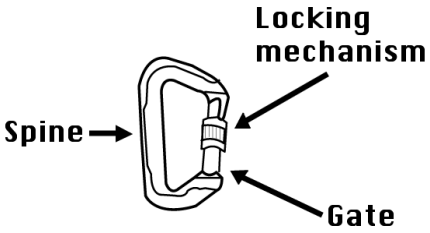
Connectors used for life safety applications must be designed and certified for this use.

Carabiners

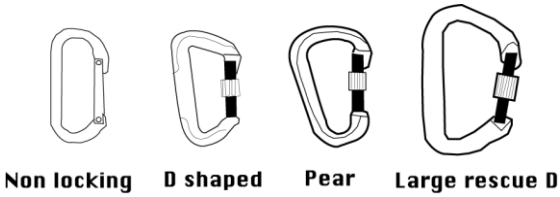
Carabiners used in rope-access systems must be outfitted with a positive locking mechanism and have a minimum breaking strength of not less than 5000 pounds (22.2kN) when tested in their functional orientation.

Non-locking carabiners can be used for any attachment outside of the life-safety system. (such as for attaching tools and accessory bags)

Parts



Shapes



D shaped carabiners are the strongest design, the shape helps focus the load on the spine of the carabiner.

Pear or HMS carabiners are used primarily for Italian hitch belays, the wide smooth curve on the end helps the Italian hitch rotate from belay to lower mode.

Large rescue carabiners are advantageous in some applications, particularly with some stretchers, or as Master points, and when large amounts of material need to be clipped to the same carabiner.

Locking Types

Locking carabiners are used in life safety applications due to their greater stability. Carabiners with their gates open have 30% of the strength of closed gate carabiners.

Locking mechanisms are described in terms of actions.

- A two-step action is 1. Unlocking the gate and 2. Opening the gate.
- A three-step action is 1. Pushing up on the lock mechanism (or release ball), 2. Twisting the lock open and 3. Opening the gate.

Most regulatory bodies stipulate that a carabiner for life safety applications must have at least a two-step mechanism.

Screw gate carabiners are the most common type. They are strong and provide a sure locking mechanism. The carabiner should be oriented so that the gate faces down and out. This will prevent system vibration from unlocking the carabiner.

Twist lock carabiners are commonly used in rope access. These carabiners are more expensive than screw gates. Twist lock carabiners may have a single, two-stage or three stage locking mechanisms. Many rope access technicians prefer a simple twist lock due to ease of handling with gloves and in all conditions.

Aluminum

These carabiners have the advantage of being lighter than steel, but will wear more quickly and are not as durable as steel. There are very few CSA or ANSI approved aluminium carabiners on the market because both of these standards require a 16 kN cross gate load strength and most aluminium carabiners do not meet this specification.

Steel

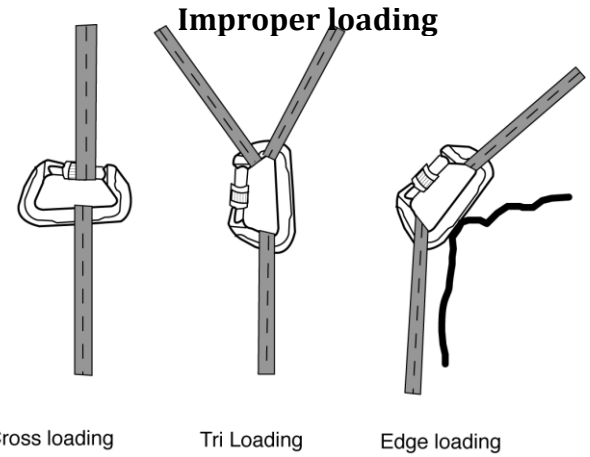
These carabiners have the advantage of being stronger and more durable than their aluminium counterparts however they generally weigh more and have higher cross load strengths than aluminium carabiners.

Certifications

CE EN, ANSI and CSA

Inspection

- Cracks Wear points
- Corrosion/pitting
- Gate action
- Locking mechanism action



Care and Usage

As with any hardware, carabiners must be treated with respect. They must be placed on the ground (**not dropped**) and passed to one another (**not tossed or thrown**). Carabiner gates should not be locked tightly while actively loaded. If carabiners cannot be unlocked, apply a constant force in line with the spine of the carabiner and attempt to unscrew the gate while loaded. If this does not work, use pliers.

A carabiner is designed so that it is to be loaded along its longitudinal axis. Improper loading occurs when the force, rather than being distributed along the spine, is transferred to weaker areas of the carabiner. This dramatically reduces the carabiner's strength.

Cross loading occurs when the load is placed on the spine and gate sides of the carabiner.

Tri-loading occurs when a carabiner is loaded in three directions.

Edge–loading occurs when a carabiner is loaded over a hard edge.

Mallions

Quick-links (maillons) close by screwing down the sleeve. Some quick-links are designed to take loads in multiple directions, making them more suitable than carabiners for specific applications. Quick-links are usually less expensive, stronger, more secure, and often more durable than carabiners. The quick-link closure is quite secure and can be even more secure when tightened with a wrench. The sleeve should also be screwed down completely when not in use to protect the threads.

Caution! Not all quick-links are suitable for life-safety applications. Standard hardware store quick-links are usually not designed for life-safety applications!

Descent Devices

Descent-control devices (or descenders) provide a means to descend at a controlled rate. Descenders can be operated by the user as a *travelling brake (rappel device)* or operated by a second person as a *fixed brake* attached to an anchor (lowering device).

Descenders used in industrial applications should have a self-braking capability, either built into the design of the device, or added afterwards by the user. The Petzl I'D, Stop and Rig all have auto-braking mechanisms.

Petzl ID

The Petzl ID is one of the three most common descent tools of the rope access technician.

Features:

- Self-braking
- Panic stop mechanism
- Wear indicator
- Low angle setting
- Useful as hauling clutch

The ID seems to be the tool of choice for the rope technician who may need to perform rescues. The ID may be used as a haul clutch and has a higher load limit for rescues than the Rig.

Primary Purpose: Descent device (sometimes used with a handled ascender for short distance ascent) Lowering and Belay device

Certifications: EN 341, EN 12841 C, NFPA Technical

Load ratings: 150Kg working load and a 250kg rescue load with added friction and proper training

For use on: 10-11.5mm ropes

Inspection: (structure, function)

Inspect the body of the device, wear areas (flange and wear indicator), toothed cam, gate closure, pivot pin and front plate engagement.

Load device, lock-off and test weight, check descent function, check panic lock.

Added Features: Panic lock, Reverse loading cam, Low angle/load button.

Dos and Don'ts

Do:

- Load correctly
- Have brake hand on while operating handle
- Load with correct size rope
- Store with handle towards carabiner

Don't:

- Use over with loads greater 150kg unless in an emergency
- Use for continuous descents over 200m (heating)

Petzl Rig

The Petzl RIG is another common descent tool in use by rope access technicians. Although this tool is similar to the ID, it does not have many of the same safety features, such as Anti-Panic.

Features:

- Self-braking
- Wear indicator
- Useful as hauling clutch
- Lower load rating (More difficult to use for heavier rescues and cross haul systems)

Primary Purpose: Same as ID

Certifications: EN 341 classe A, CE EN 12841 type C, NFPA 1983 Technical Use, EAC

Load ratings: 150kg and emergency load of 200kg

For use on: 10.5-11.5mm ropes

Petzl Stop

The Petzl STOP is an older, but still much used descent device with many rope access companies.

Features:

- Less expensive (worn parts may be replaceable)
- Does not twist ropes
- Self-braking (but may creep on many ropes)
- No panic stop mechanism
- More friction if used as a hauling clutch

Primary Purpose: Descent and Lowering device

Certifications: CE EN 341 class A

Load ratings: 150Kg working load and a 200kg rescue load with added friction and proper training

For use on: 9-12mm ropes

Inspection: (structure, function)

Inspect the body of the device, wear areas, gate closure, pivot pin and front plate engagement.

Load device, lock-off and test weight, and Check descent function.

Dos and Don'ts

Do:

- Load correctly
- Have brake hand on while operating handle
- Load with correct size rope

Don't:

- Use over 150kg unless emergency

Ascent Devices

Ascent devices used in rope access are normally toothed cam type devices. These work very well with most rope conditions such as on wet, or iced ropes. The downfall of devices with teeth is that they can damage the rope and strip off the sheath at a very low force. At forces as low as 4kN toothed ascenders can damage the rope. It is important in rope access to never shock load a toothed ascent device, or allow a situation to develop where it could be shock loaded.

Chest Ascender

Name: Petzl Croll (B16BAA)

Primary Purpose: Climbing up rope systems.

Certifications: EN 567:2013, EN 12841:2006-B

Load ratings: 100Kg or up to 140 with special considerations (see Petzl website)

For use on: 8-11mm ropes

Inspection: Verify that the product is free of cracks, deformation, marks, wear, corrosion, etc.

Check the condition of the frame, the connection holes, the cam and safety catch, the springs and the cam axle. It is important to regularly monitor the condition of the product and its connections to the other equipment in the system.

Name: Climbing Technologies, "Evo" Chest Ascender

Primary Purpose: Climbing up rope systems.

Certifications: EN 567:2013, EN 12841:2006-B

Load ratings: 100Kg

For use on: 8-13mm ropes

Inspection: Inspect the body for cracks and wear points, attachment to harness for fabric wear, burrs, and Mallion attachment. Check cams (teeth and burrs), spring tension, release mechanism. Place on rope, track upwards, move downwards (down-croll), weight test.

Dos and Don'ts

Do:

- Load correctly toward anchors
- Use only with compatible ropes

Don't:

- **Shock load device**
- Use as a single device for rope transfers
- Open cam while down-crolling

Handled Ascender

Name: Petzl Ascencion

Primary Purpose: Climbing up rope system

Certifications: CE EN 567, EN 12841:2006-B, UIAA and NFPA 1983 T for handled ascenders

Load ratings: 100Kg or up to 140Kg with special considerations (see Petzl website)

For use on: 10-13mm ropes

Inspection: Inspect the body for cracks, wear points. Check cams (teeth and burrs), spring tension, release mechanism Place on rope, track upwards, move downwards, weight test.

Dos and Don'ts

Do:

- Load correctly toward anchors
- Use with compatible ropes

Don't:

- **Shock load device**
- Use as a single device (must be paired with chest ascender or other)
- Open cam while down-Crolling

Backup Devices

Many North American regulatory bodies require that rope access technicians use an ANSI compliant backup device to qualify as fall arrest. Currently there are only a few such devices available, like the Kong Backup, the DMM Buddy and ISC Red. Some of these devices are not rated for two-person loads; therefor they should not be used as backup devices in rescue situations. The Petzl ASAP and ASAP Lock with the L-57 shock pack has been tested with a two-person load but it is not ANSI or CSA certified.

Petzl ASAP

Primary Purpose: Rope Access Backup Device

Certifications: EN 353-2, CE EN 12841 type A

Load ratings: single person, 2 people (rescue) with L-57 shock absorber

For use on: 10-13mm ropes

Inspection:

- Check the condition of the body, the connection holes, the protective cover, safety catch (cracks, marks, deformation, wear, and corrosion) and the spring of the arm.
- The safety catch should not rub against the frame.
- Rotate the locking wheel one full turn in each direction. It should rotate smoothly and easily in both directions.
- Verify that the teeth on the locking wheel are clean and not worn out.
- If any teeth are missing, do not use the ASAP.
- Inspect the OK TRIACT-LOCK connector (frame, gate hinge, locking sleeve).
- Open and release the gate to verify that it closes and locks properly. The Keylock slot must not be blocked by any foreign matter (dirt, pebble, etc.).

Dos and Don'ts

Do:

- Only use with L-57 for rescue
- Use for rescues on standing ropes
- Attach correct side up, and with carabiner engaging rope
- Keep as high as possible
- Have keeper cord at back of device (not riding in to cam)

Don't:

- Set aggressively
- Load device and shock pack (this can pre-tear the pack and cause malfunctions)
- Let device get low while rescuing close to ground

Petzl ASAP Lock

Primary Purpose: Rope Access Backup Device

Certifications: EN 353-2, CE EN 12841 type A

Load ratings: single person, 2 people with L-57 shock absorber (rescue)

For use on: 10-13mm ropes

Inspection:

- Verify that the absorber is correctly installed on the clevis, and that the latch is properly tightened.
- Verify that the arm pivots on the axle, and that the return spring works.
- Verify there are no cracks, nicks, deformation, wear, corrosion (on the frame, wheel, arm, clevis).
- Verify the condition of the safety catches, and that their return spring works.
- Verify that the locking wheel is clean and that the teeth are not worn out. Warning: if one or more teeth are missing, do not use the ASAP. Verify that the locking wheel rotates smoothly, through one complete revolution in both directions.
- Attach to rope, track up and down, test arrest function (set) and release.

Dos and Don'ts

Do:

- Only use with L-57 for rescue
- Use for rescues on standing ropes
- Attach correct side up
- Keep as high as possible
- Engage lock to park on rope when not moving.

Don't:

- Set aggressively
- Load device and shock pack (this can pre-tear the pack and cause malfunctions)
- Let device get low while rescuing close to ground
- Stop and work in rope transfer modes without putting the device into lock mode.

DMM Catch

Primary Purpose: The Catch is a towable rope access backup device. The towable release allows the user to tow the device while simultaneously descending.

Certifications: EN 12841:2006 Type A.

Load ratings: Single person, and two person rescue use.

Will slip on ropes at 4-5Kn

For use on: 11mm ropes.

Inspection: (structure, function)

Inspect the body for cracks, wear points. Check cams. Place on rope, track upwards, move downwards by tow handle, and perform a weight test.

Dos and Don'ts

Do:

- Load correctly toward anchors
- Handle with towable release handle or carabiner
- Handle with care (dropping potential)
- Keep positioned as high as possible (over the arm)

Don't:

- Grab body of device or above device

DMM Buddy

Primary Purpose: ANSI compliant Fall Arrest device (must be used with CSA/ANSI carabiners)

Must be used with short lanyards to reduce fall distance (under 13" including connectors)

Must be used with compatible ropes.

Certifications: EN353-2:2002 and ANSI Z359.1 (2007)

Load ratings: Single person only *** Not to be used for rescue***

Will slip on ropes at 4-5Kn

For use on: 11-13mm ropes see side plate

Inspection: (structure, function)

Inspect the body for cracks, wear points. Check cams. Place on rope, track upwards, move downwards, and weight test.

Dos and Don'ts

Do:

- Load correctly toward anchors
- Handle with carabiner only
- Handle with care (dropping potential)
- Keep positioned as high as possible (over the arm)

Don't:

- Grab body of device or above device
- Use with 2 person rescue load

Kong Backup

Primary Purpose: ANSI compliant Fall Arrest device (must be used with provided, or CSA/ANSI carabiners)

Must be used with short lanyard that comes with the device for sternal attachment to reduce fall distance.

Must be used with compatible ropes.

Certifications: ANSI Z359.1-2007, EN 353-2, EN 358, EN 567.

Load ratings: Single person, or two person rescue

Will slip on ropes at 4-5Kn

For use on: 11-13mm ropes see side plate

Inspection: (structure, function)

Inspect the body for cracks, wear points. Check the cams, spring tension and tow string.

Place on rope, track upwards, move downwards, and weight test.

Dos and Don'ts

Do:

- Load correctly toward anchors
- Handle with carabiner and tow-string only
- Handle with care (dropping potential)
- Keep positioned as high as possible (over the arm)

Don't:

- Grab body of device or above device
- Use with 2 person rescue loads

Helmets

Name: Petzl Vertex

Primary Purpose: Head protection from top impact (type 1) this helmet is not rated for protection from side impacts (type 2)

Certifications: ANSI z89.1, CSA Z94.1-05 Type 1 Class E
EN 397 and EN 12492 standards for protection against impact.
EN 397 and EN 50365 standards for electrical insulation.
EN 397 standard for molten metal splash, lateral deformation and use in low temperatures.

Inspection: 10 year maximum life span. Before each use, check the condition of the shell and the headband attachment system (verify there are no cracks or deformation on the outside or the inside...). Check the condition of the webbing and stitching. Verify that the headband adjustment system and chinstrap buckle are functioning properly. WARNING, a major impact to the helmet can significantly reduce its protective properties.

Dos and Don'ts

Do:

- Fasten chin strap while working at height
- Fit correctly

Don'ts:

- Expose to heat
- Put stickers on rib areas of helmet

Pulleys

Pulleys are used to reduce the friction of any rope running through it for example when building hauling systems, or when changing the direction of moving ropes. Pulleys may be fixed cheek or swing cheek. As a rough guide the larger the pulley wheel is then the more efficient it will be. Pulleys which include ball bearings can also reduce friction.

Name: Petzl Fixe

Certifications: EN 12278: Mountaineering equipment– Pulleys

Efficiency Rating: 71%

Load Ratings: 2.5kN/5kN

MBS: 11.5kN/23kN

Name: Petzl Rescue (P50A)

Certifications: CE EN 12278, NFPA 1983 General Use

Efficiency Rating: 95%

Load Ratings: 4kN/8kN.

MBS: 18kN/36kN

Inspection:

- Verify there are no cracks, deformation, corrosion, etc.
- Verify that the sheaves turn freely and that they are not worn out.
- Verify the play and deformation of the side plates. Verify that the sheaves do not rub against the side plates.

Dos and Don'ts:

Do:

- Ensure the pulley is inspected before each use.
- Ensure the pulley is compatible with other components in the system.

Don't:

- Drop it
- Overload it
- Use a swing cheek pulley with one cheek open

Webbing and Slings

A sling is essentially a strap of synthetic or wire rope forming a complete loop, or with loops at each end. Sewn slings are commonly used as quick, convenient means of setting anchors. Several different sizes and styles of synthetic and wire rope slings and straps are available. All slings used in rope access should be rated to at least 22kN or 5000lbs, and should have sewn, or swaged terminations.

Webbing Types

Synthetic slings are typically constructed of nylon or polyester. When using synthetic fibre slings it is important to protect them from abrasion, sharp edges, chemicals, and hot pipes. Knots may be placed in slings to shorten them, but keep in mind, as with any knot, this will reduce the breaking strength of the sling.

Sewn

Commercial webbing slings come in many different sizes and strengths. Most climbing style slings are rated with their minimum breaking strength while most industrial are rated with a WLL (working load limit). Webbing slings may be padded or protected to work around sharp or abrasive anchor points.

Cable

Wire slings are more forgiving in an industrial environment and will resist more damage. Wire slings should always have swages or ferrules in the end, allowing them to be used in basket or choke configuration.

Anchor Straps

Anchors straps are generally a length of webbing with D rings sewn into each end where a carabiner can be attached. Some anchor straps have heavy duty buckles that allow their length to be adjusted.

Chapter 5

Knots, Bends and Hitches

Knot Instruction

The web site below is animated and demonstrates most of the knots used within Rope Access.

http://www.animatedknots.com/

Terminology

Knot

A knot is a connection method used in flexible materials.

Bend

A knot that connects the ends of two ropes together.

Hitch

A knot that attaches a rope or webbing to another object in such a way that it would not exist without that object

Bight

A bight is an open loop formed when a rope is doubled back upon itself making a 180 degree turn but not crossing over itself.

Free End

The inactive section of rope during the process of tying a knot.

Main Line

The main section of rope away from the free end.

Dressed and Set

Dressed means the knot is neat with no added twists and is easy to check. Set refers to the process of weighting or pre-loading the knot.

Knots used in rope access should be tied neatly, weighted (dressed & set) and have 12-16 centimetres (11mm rope) or 6-8cm (8mm cord) of tail beyond the knot. This helps to ensure knot strength, stability and provides efficient checking of systems.

Knot Strengths

Knots invariably weaken the rope in which they are made. When knotted rope is strained to its breaking point, it almost always fails at the knot or close to it, unless it is defective or damaged elsewhere. The bending, crushing, and chafing forces that hold a knot in place also unevenly stress rope fibres and ultimately lead to a reduction in strength. The exact mechanisms that cause the weakening and failure are complex and are the subject of continuous study.

"Relative knot strength," also called knot efficiency, is the breaking strength of a knotted rope in proportion to the breaking strength of the rope without the knot. Determining this number is hard because many factors can affect a knot efficiency test: the type of fibre, the style of rope, the size of rope, whether it is wet or dry, how the knot is dressed before loading, how fast the knot is loaded, whether the knot is repeatedly loaded, and so on. Most common knots' efficiency ranges between forty and eighty percent.

While some rope splices can nearly maintain the rope's full strength, in most situations, when forming loops and bends conventional knots are far more practical. Thus the prudent knot user will always allow for a large safety margin in the strength

of rope chosen for a task due to the weakening effects of knots, ageing, damage, shock loading, etc. In general, the safety ratio of soft materials (rope, webbing) is 10:1.

Knot strengths will be given as a percentage range in this chapter, as different materials and diameter will give different efficiencies.

Knots

Figure 8's

This is one of the primary knot families used in Rope Access. These knots retain approximately 70% of the ropes strength. They are easy to recognise and check. This family of knots can be used to perform most of the functions in rope access.

Figure 8 Follow Through

This knot is used to tie a rope around an object or into a harness.

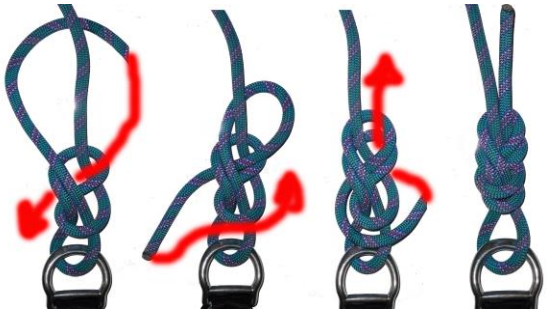


Figure 8 Bight

This knot is normally used to form a loop to clip into a carabiner or slip over an object. It can be tied in either the middle or end of a rope.

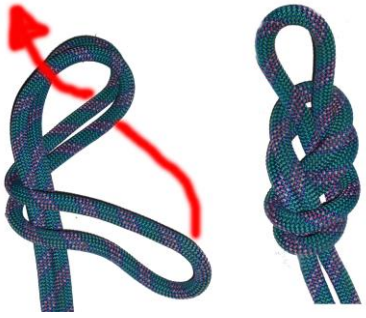


Figure 8 Bend

This knot is used to tie two rope ends together.

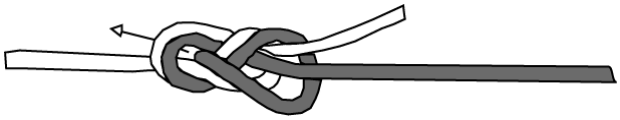
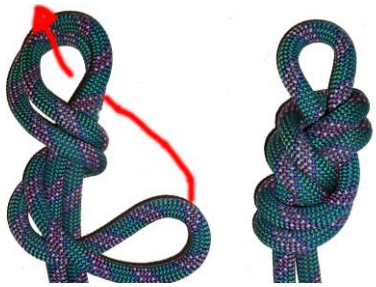


Figure 8 Bunny Ear

This knot is commonly used to equalize two anchor points that are a short distance apart. Expansion bolt anchors are commonly equalized in this way. This knot may also be used to attach to a single fixed point, as the knot will be easier to untie after loading.

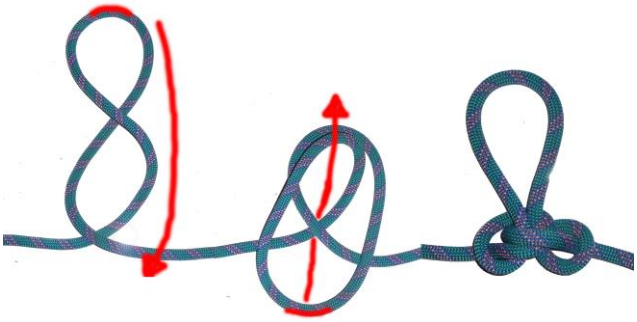
Figure 9



The figure 9 knot is primarily used to attach fixed ropes to an anchor point.

These knots retain approximately 72% of the ropes strength. The main benefit of this knot is that it is easier to untie once loaded.

Butterfly



The butterfly is a mid-line knot that may be loaded in three directions. This knot retains approximately 72% of the ropes strength. The butterfly may be used to:

- Isolate a damaged section of rope
- Create a clip in point
- Be used to equalize two anchor points (large y hang)

Barrel

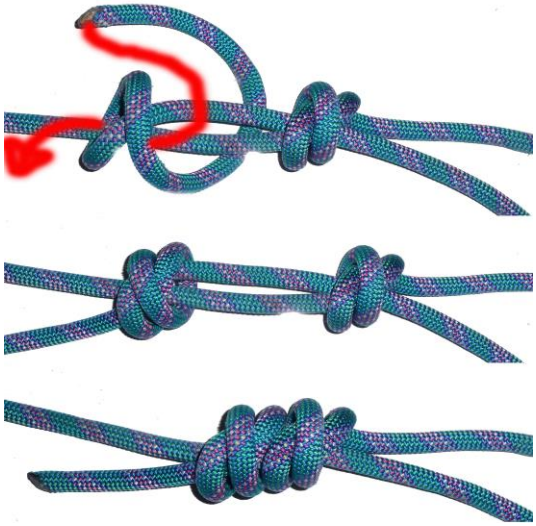
The Barrel or double overhand is used as a stopper knot. This is so that there is a knot at the end of the rope that will prevent the descent device or backup device from travelling off the end of the rope.

Barrel on a bight (Scaffold Knot)

This knot is used to attach to a carabiner or anchor point. It is most commonly used as a termination for a tied lanyard. The Barrel on a bight retains approximately 65% of the ropes strength. This knot will shock absorb more effectively than any of the other knots. This knot is also very low profile and may be of benefit where clearance is an issue.

When used in lanyards this knot may wear on the internal surfaces. It should be periodically taken apart and inspected.

Double Fisherman's



The Double Fisherman's is commonly used for connecting two ends of cord or rope together. The double fisherman's knot can be used with different diameter ropes. This knot retains approximately 75% of the ropes strength. This knot becomes difficult to untie when subjected to high loads.

Sewn Terminations

Sewn terminations are used for many commercially made lanyards and fall arrest ropes. These retain approximately 90% of rope strength. These terminations do not shock absorb as effectively as a knotted termination.

Chapter 6

HARNESS SET-UP

Harness Set-Up

The rope access technician should rig their harness so that they can perform all of their working tasks, and rescues. Rope access training courses train the candidates to do all the tasks with a sometimes, limited toolkit. There are many ways to rig a harness that are acceptable for us as technicians.

On many jobs the technician will carry different tools and set their harnesses up differently to better suit the work or rescue task.

Principles

Harness Setup Principles:

- Have all tools necessary for the job
- Have an organized system so that tools are quick to hand
- Have a clean setup
- 3 independent attachment points (for aid climbing)

Classic Set-ups

Sewn Terminations

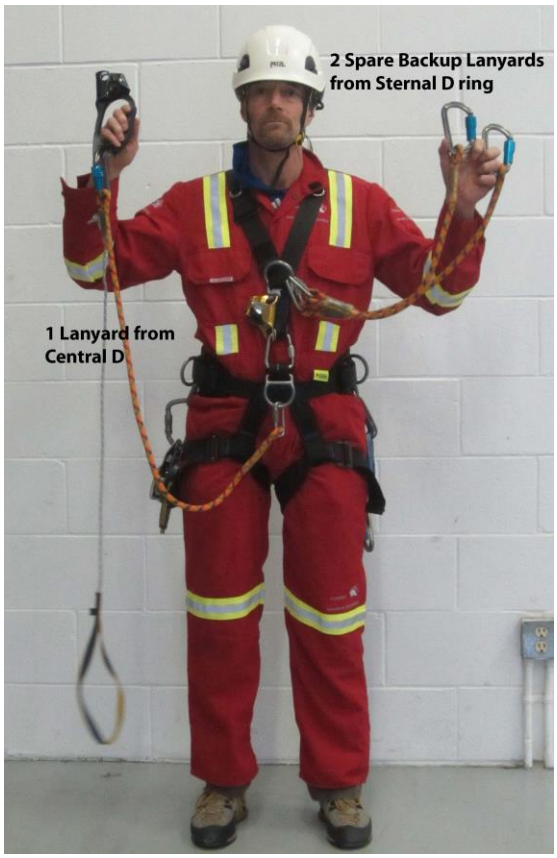
This setup involves one lanyard from the central D and two from the sternal D rings. Many of the companies who use this setup also use sewn lanyards as opposed to tied.

Pros

- More acceptable to regulators as the backup points (fall arrest) come from the sternal D, an A rated arrest point
- Clean with the sewn lanyards
- Fast to set up

Cons

- Lanyard lengths are fixed (too long or short for some)
- Lanyards put more force on the body in a fall
- Lanyards are more expensive



Tied Lanyards (Central)

This classic setup has three tied lanyards at the central D ring. Most rope access technicians who are rock climbers know that falling on to the waist area of a harness is not harmful when the technician is conscious. With the short falls expected in rope access environments it may be more comfortable as well.

Pros

- Lanyards are inexpensive
- Lanyards are custom lengthened
- Tied lanyards shock absorb better

Cons

- Lanyards are time consuming to tie (expense)
- Central D is very clogged

Tied Lanyards (Bullnose)

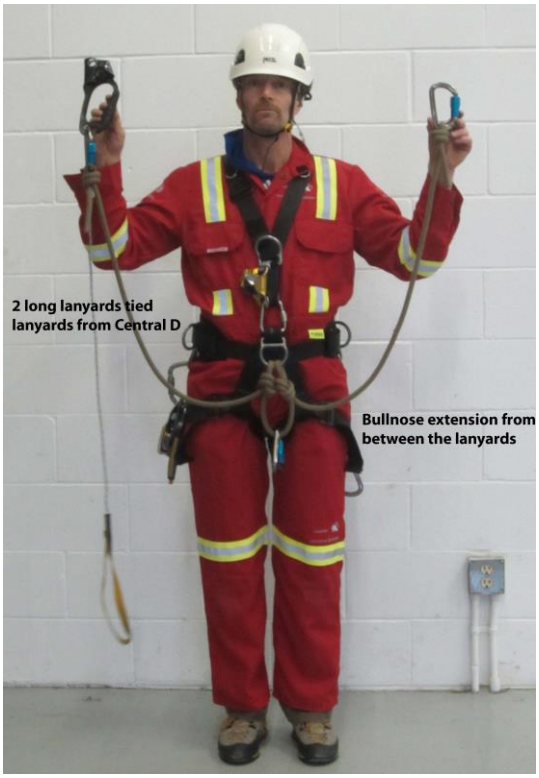
The second classic IRATA style of harness setup has two long lanyards and a short extension between them (the Bullnose). Again the lanyards are all tied.

Pros

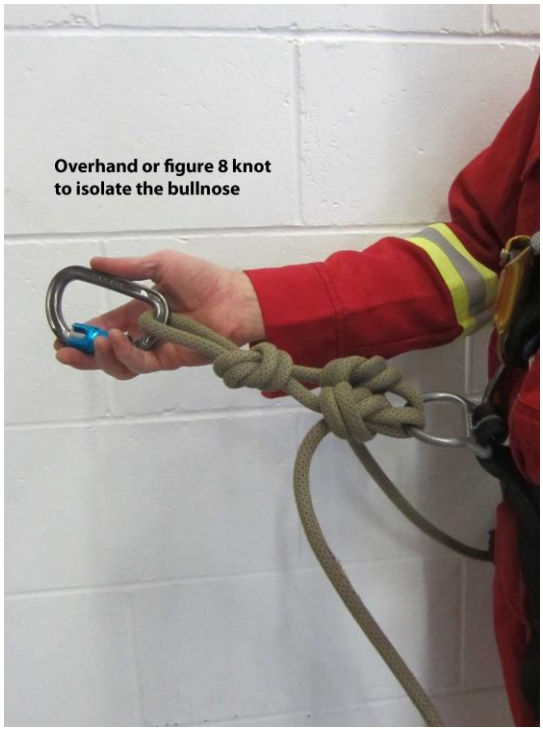
- Lanyards are inexpensive
- Lanyards are custom length
- Tied lanyards shock absorb better

Cons

- Will need another lanyard to use 2 backup devices
- Lanyards are time consuming to tie (expense)
- Bullnose is not an independent point unless overhand loop is added (going to 1 point aid climbing)
- Bullnose is not as adjustable in length for aid climbing as the other systems



Bullnose Isolation



Specialized Set-ups

The classic rope access harness setups work very well in a high angle environment. The chest ascender does not function well when used in a lower angle or terrain of changing angles. The system below with two separate handled ascenders and two foot loops that can be moved depending on the terrain works well in these circumstances.

Care needs to be taken with this setup. Excess length in the lanyards attached to the handled ascenders could result in shock loading the ascender. Improper technique could also result in potentially shock loading the ascender.

Chapter 7

ACCESS SYSTEMS

Access Systems

The goal of rope access is to get to and from the "at height" workplace in an efficient and safe manner. The rope access environment may be a very dangerous one, with sharp edges, heated pipes and other hazards. As part of the working method the supervisor needs to identify these hazards, and then design safe efficient means to get the workers to the needed areas.

Many times the level 2 and 3 technicians will use complicated or very time consuming methods to set up a simpler, easier access for the workers. These access systems are also used to redirect the rope system away from hazards. The access techniques will also take in to account ease of rescue, should that eventuality occur.

Terminology

Anchors

Anchor is a general term for a fixed attachment point, or series of points, that supports the rope systems and other connections to personnel working at height.

Main anchors are those that directly support the life-safety system. Secondary anchors may be used to change the direction of the rope system.

All main anchors (full strength) or anchor systems must be 5000lbs (local legislation compliant) or 2.5 times maximum load 15Kn (IRATA compliance).

Rope Systems

This refers to the type of anchor configuration and path that the rope is designed to travel. This may range from a simple vertical anchor system to a much more complex tensioned rope access method.

Attachments

This refers to the knots and connectors that are used to attach the rope systems to the anchoring system.

Terminations

The termination refers to both ends of the rope. Both ends of the rope must have termination knots to keep the worker from descending, or being lowered off the ends of the ropes.

Zones

Hazard Zone

Any area where workers or public are at risk of injury from the actual work being performed (e.g. falling tools, etc.) These areas should be clearly marked as hazardous areas.

Access Zone

The access zone is an area in which people are at risk of falling, or dropping objects in to the hazard zone. This is very common when approaching a drop-off (edge) closer than 6 feet. Fall protection must be used when closer than 6feet (2M) from an unprotected edge.

Exclusion Zone

This refers to the area within the hazard zone that is flagged or roped, and marked as a hazardous area. This area should be under the control or the rope access supervisor. In areas where there are multiple trades at work a safety monitor is recommended to control traffic.

System Checks

Part of the rope access system is a series of checks that technicians perform each time that they get on rope.

Buddy Check

After the harness is donned the worker should do his own equipment check and then ask a fellow rope access worker to do a buddy check. This buddy check is a quick visual that consists of:

- Look at the helmet to check for fit and any damage
- Look at the harness to check for fit, proper attachment of carabiners and links and any damage
- A visual inspection of the workers equipment to see if it is all present, and in good condition
- Physically check that quick-links are more than finger tight.

Rope System Check

This is a pre use check of the rope system prior to going to work on it. This system check consists of:

- Looking for an end knot in the rope
- Checking the rope either tactile (preferably) or visually
- Look at the termination knots (top and bottom), connectors and anchor slings
- If the ropes and anchor systems cannot be seen from the starting point:
- Check with the level 3 that this is OK
- Weight test both ropes before leaving the ground
- Inspect the ropes as you climb them
- Inspect the anchors, connectors and terminations when you get to them

Vertical Ascent / Descent Systems

One of the simplest rope systems is a set of vertical ropes from two independent anchor systems on a wall. Many vertical rope systems start on a roof or platform of some type.

Considerations:

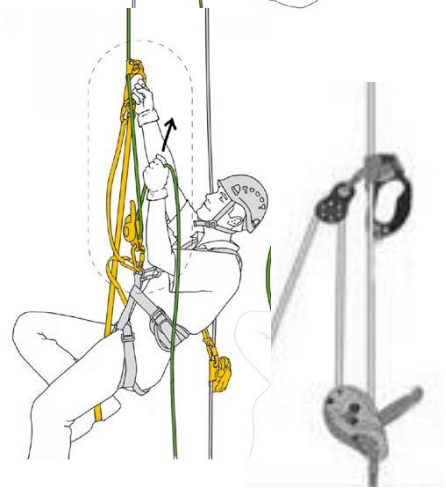
- Mark the access zone
- Ensure there is an exclusion zone below
- Make main anchors outside of the access zone
- Ensure that ropes reach work zone and have termination knots
- Any sharp edges are avoided or guarded
- Be aware of sharp edges and use of edge guards
- Avoid using toothed chest ascenders while coming on to platform

See manoeuvre notes 1.6

RAD or 2:1 Short haul

For short ascent/descent manoeuvres the 2:1 short haul or RAD method may be used. This skill is also applicable to some advanced rescues.

Rope Transfers



This is the transfer from one set of ropes on to a separate parallel set of ropes. This system is used where there is a need to transfer laterally but there are no problems with having long rope tails dragging. This system is commonly used to position a worker on the outside of a rounded column, and may be done more efficiently with two descenders.

Considerations:

- Attach ropes to be transferred to, onto equipment loop of harness
- Always control the swing fall hazard, maintain 4 points of contact until vertically under the second anchor system
- Attach to the initial ascent ropes if there is a need to get back the same way
- Ensure there is a method to be rescued

See manoeuvre notes 1.2

Knot Passes

Passing a set of knots may be done in a number of circumstances. This is most commonly two ropes attached together to create longer lengths of rope. This may also be the case of finding a section of rope that is damaged and using a butterfly to isolate the damage until it may be removed. This technique is also used in rescues where the rescuer needs to pass the casualty (either ascending or descending) to perform the rescue.

Considerations:

- The handled ascender may be moved around an obstacle without an added backup for the chest ascender
- The chest ascender must have an added backup (ID or butterfly knot) when moved around obstacle
- Ensure that moves are short and in control when moving around the knots (danger of falling on to handled ascender)

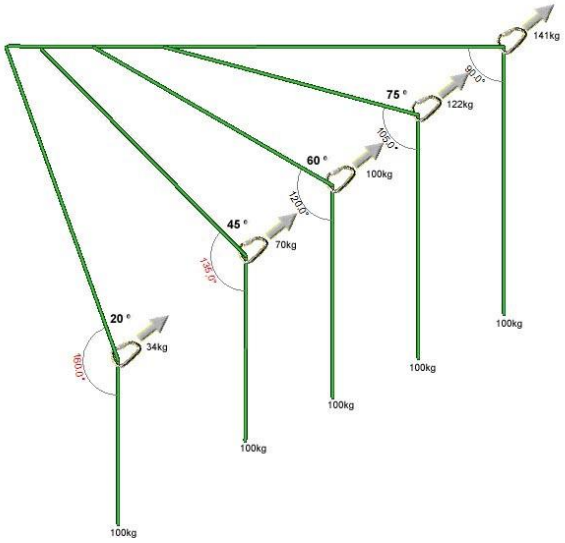
See manoeuvre notes 1.1

Deviations

A deviation redirects the path of the ropes from the anchor points to avoid abrasion, sharp edges, hot pipes or other hazards that could cause damage to the ropes, or to provide more accurate access for the worker.

A deviation may be a sling attached to a part of the structure, including items that would not be considered main anchor strength (cable trays, window suction cups etc). The ropes are attached using a karabiner pulling them to one side. Deviations should not pull the ropes such a distance that in the event of failure of the deviation anchor point a swing likely to cause personal injury, damage to property or abrasion could occur.

An example of the effect of the angle on the loading is given above. The loadings are based on a mass of 100kg (which equates to a force of approx. 1kN).



The angle of the deviation should not be above 20 degrees, more than this is difficult to pass, and may put too much force on the secondary anchor.

Considerations:

- Check that deviation carabiner is locked before and after passing
- Before passing the deviation ensure that a retrieval knot is in place
- Always control the rope tails to control swing hazard
- On return stop at 2/3rd height of deviation sling to pull in and reattach.
- The deviation anchor may not be a full strength anchor point and should not be weighted or used as such

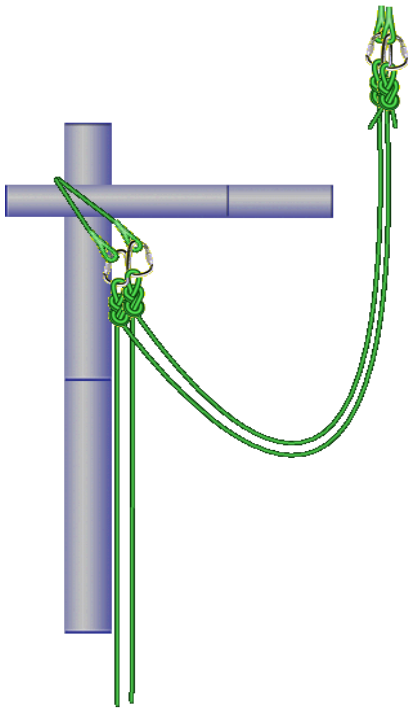
See manoeuvre notes 1.3

Rebelays

Applications

Rebelays can be used to avoid sharp edges, hot pipes etc., and to allow access underneath overhanging roofs/walkways. Where there is potentially a lot of rope stretch in the system, the ropes can be re-anchored at suitable intervals. It is important that the rebelay has a large 'loop' to allow for rescue.

Main and secondary anchors on rebelays must be full strength anchors. These anchors may be attached to, as a point of contact.



Short Rebelay

The short rebelay is defined by being less than 6 feet (2M) from anchor to anchor, and having no hazard in the swing fall zone.

Considerations:

- Treat as if this is a rope-to-rope transfer
- Do not use descending loop ropes (This gives more working rope and transfers better to rescue skills)
- Do not bottom out in the loop (this could load chest ascender dangerously)
- On return start to transfer to standing ropes at anchor connector height

See manoeuvre notes 1.4

Long Rebelay

This manoeuvre is performed when the anchor points are more than 6 feet (2M) apart or where there is a dangerous swing hazard within the shorter distance. This technique is also useful when there is a significant hazard beneath the loop ropes.

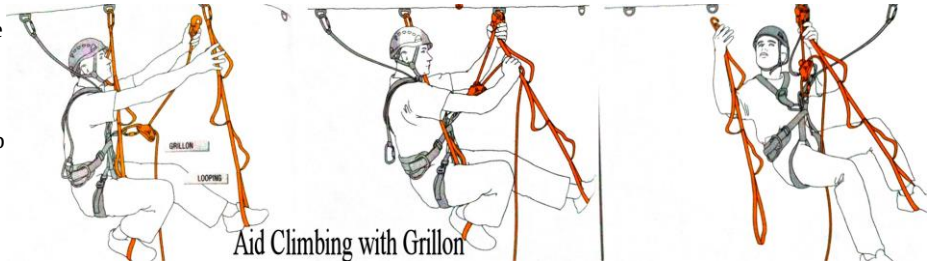
Considerations:

- Utilize the descending loop ropes to move out and back. This avoids putting the ropes in harm's way and leaves the standing line available for rescues
- Fully transfer to the descending loop ropes before attaching to the ascending loop ropes
- Do not bottom out in the loop (this will load chest ascender dangerously)
- Always control the swing fall hazard, maintain 4 points of contact until vertically under the second anchor system
- If working in the middle of this configuration position ASAPs (low velocity swing potential)
- On return start to transfer to standing ropes at anchor connector height

See manoeuvre notes 1.5

Aid Climbing

The use of aid climbing techniques enable rope access technicians to reach parts of a structure without the use of ropes, instead fixed anchors (bolts) or movable anchors (slings or beam clamps) may be used. The technician can climb vertically or horizontally in this fashion. An additional foot loop or etrier is often required for aid climbing



Aid Climbing with Grillon

The technician needs to have three lanyards (points of contact) so that at any time they maintain two independent points.

Considerations:

- It is best practice to have the positioning lanyard as a soft point to facilitate rescue
- When climbing do not climb above the height of connection (over factor1) on rope access lanyards
- On the ground pre-rig a second footloop on to the spare lanyard of the harness
- When rigging this do not attach with a spare carabiner (this may lead to confusion and going to one point of contact)
- When at the aid traverse clip the spare lanyard and footloop to the first aid point
- At the end of the traverse attach positioning lanyard to the first roped point
- Leave lanyard and footloop on the last aid point until rigged in the descent system

See manoeuvre notes 1.7

Structure Climbing

When there is a need to climb above the height of the climber's attachment points, specialized methods should be used. The traditional rope access lanyard systems would generate too much force on the body if a technician were to fall from above their anchor point. Two of the systems that work well while structure climbing are fall arrest lanyards and lead climbing techniques.

Climbing with fall arrest lanyards (Y lanyards) is a simpler way of dealing with most of these situations. A Y-lanyard with a shock absorber will limit the forces on the body in the event of a fall.

Lead climbing is more akin to what a rock climber would do to climb a cliff from the bottom to the anchor at the top. This is a very specialized form of climbing only to be undertaken by higher level, experienced technicians.

Chapter 10 Structure Climbing will deal with this subject at greater length.

Chapter 8

ANCHORING SYSTEMS

Rigging

Anyone using industrial rope access techniques (i.e. where the rope is used as the primary means of support or positioning) must be attached to two independently attached ropes. The main working rope will be used for primary support using a descender or ascenders, the other rope will be used as the safety or back-up rope. Each rope should have its own separate anchor system. Ropes should be rigged so that if one rope should fail, a shock load would not be passed on through the system.

Primary Anchor points

All anchor points used in rope access should be unquestionably reliable and capable of withstanding any potential loads to which they may be subjected.

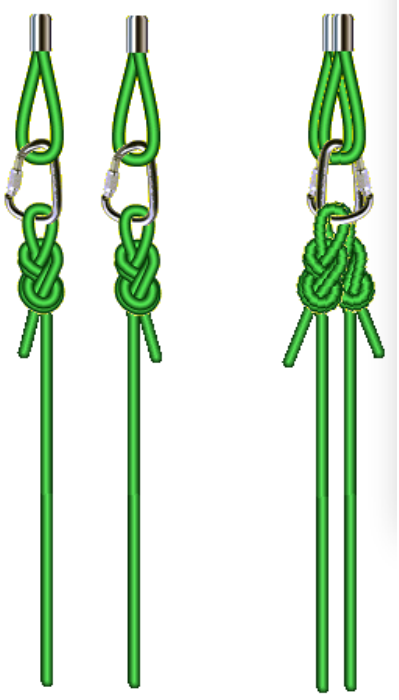
Examples of suitable anchor points could be structural steelwork, lift-shaft housings on tower blocks, suitably tested mechanical and chemical anchors, structural concrete features, deadweight anchors, substantial geological features and large trees. When attachment is made to a structure and it is apparent that the structure has more than adequate strength, it is still advised to attach each anchor line to separate anchors, e.g. via two anchor slings.

The strength of main anchor points should be at least as strong as that of the ropes attached to them. Throughout many parts of North America fall arrest anchors are required to be able to withstand a force of 22kN. The IRATA's code of practice uses a safety factor of 2.5 for anchor selection. Under the IRATA code of practice the maximum permissible impact force on the user in the event of a fall should not exceed 6 kN; therefore, the static strength of all anchors, should be at least 15 kN. Deviation anchors and anchors placed simply to maintain the position of the anchor lines may have a lower static strength than this, but should be sufficient for the load that could be applied.

Main Anchors

Anchors of the type that are fixed in masonry should only be installed and inspected by competent persons, who are aware of the numerous safety issues, e.g. minimum distance required between two fixed anchors, minimum distance from any edge, correct depth, solid or hollow masonry. Where possible, anchors should always be installed so that they are loaded in shear. In the case of eye bolts or other types of temporary anchors, where the strength of a single anchor may be inadequate, and the minimum required strength of may be obtained by linking and equally loading two anchors or more. In this case, it is essential that both anchor lines are attached to both anchors. This can be achieved, for example, by the use of a double figure-of-eight knot on the bight (bunny knot) or a combination of a figure-of-eight knot on the bight and an alpine butterfly knot.

The static strength of each anchor line including terminations (e.g. sewn and knotted) should be a minimum of 15 kN.)



Single Point (Basic)

The most common knots used here are the figure of eight on a bight and figure of nine on a bight.

Each anchor system is independent of each other.

Karabiners should be orientated so that screw gate is threaded downwards, this allows for any gravitational movement to screw gate closed.

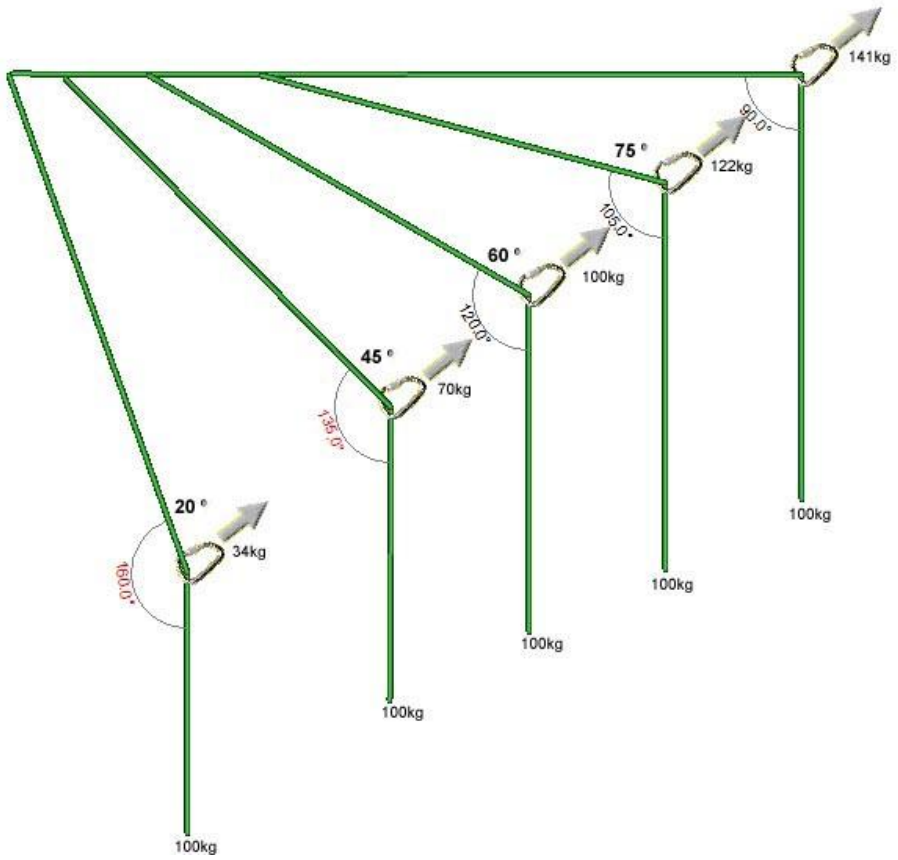
In some work environments such as hot works/blasting it may be worth considering rigging the backup rope slightly apart from the working rope.

If the anchor points are directly over the worksite then the bights of both knots can be attached into both karabiners for added security. Note how the karabiners are opposing each other (back to back), as the gates do not interfere with each other.

Deviation Anchors

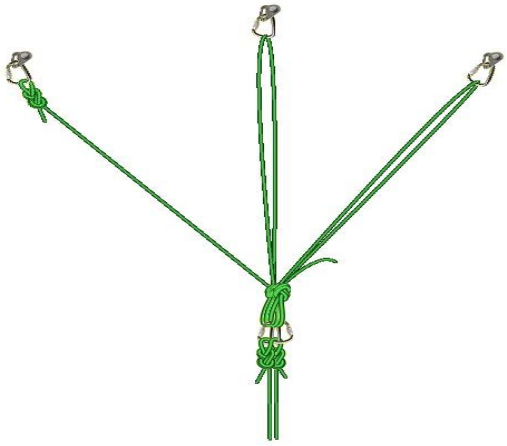
A deviation may be a sling attached to a part of the structure, including items that would not be considered anchor load bearings (cable trays, window suction cups etc). The ropes are attached using a carabiner pulling them to one side. Deviations should not pull the ropes such a distance that the failure of the deviation anchor is likely to cause a swing resulting in personal injury, damage to property or abrasion.

An example of the forces on the deviation anchor is given below. The loadings are based on a mass of 100kg (which equates to a force of approx. 1kN).



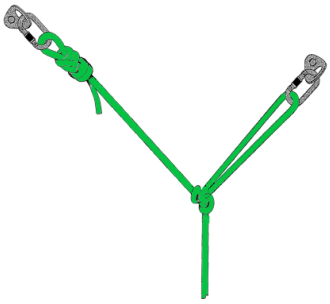
Equalized Anchors

For joining 3 or more anchors together. Locate all the anchors, attach slings and karabiners, and start by attaching a figure of 8 or 9 to furthest karabiner, the rope is then clipped into the remaining karabiners. The ropes between the karabiners are pulled down and equalised. A big overhand knot is tied.



Multi-point

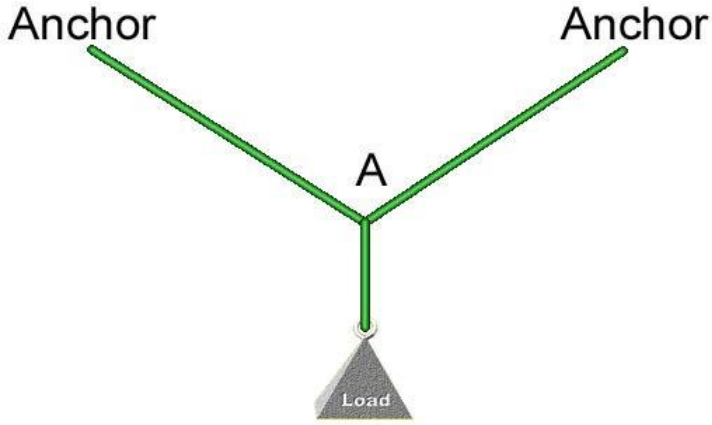
'Y' Hangs can be rigged where the anchor points are not directly over the worksite. The ropes are attached to both anchors and the load is shared evenly between both anchor points. The crucial element in this rigging method is the angle of the 'Y' (see factor forces below)



Multiplication of Forces (Vector Forces)

When an anchor point is pulled in more than one direction there is a multiplication of forces involved. The greater the angle the point is being pulled at, the greater the forces.

The physics of this work against us in anchoring and tensioned rope systems, but work for us in mechanical advantage haul systems.



Angles and Forces

The following angles of the 'Y Hang' will produce the resulting anchor point loading when a load of 100 kg is applied:

Angle 'A' of 'Y' Hang	0°	60°	90°	120°	140°	150°	160°	177°	179°
Anchor point load multiplier	.50	.60	.70	1.00	1.50	2.00	300	1915	5747

Note: By exceeding 160° in a 'Y' hang, the SWL of a typical 10.5mm Low Stretch Rope would be exceeded when a load of 100kg is applied.

General Anchor Principles

Security

Anchors should be placed in areas where they cannot be tampered with, by untrained persons. These anchors may also need to be signed or tagged in many locations

Zone Placement

Anchors should be placed outside of the hazard zone area, so that the technician can get on rope before going towards the edge.

Planning for hazard (edge/heat) avoidance

Anchors must be planned so that they take in to account the presence of sharp edges of heated areas. Avoidance of these areas is best, and as a secondary action they could be protected with padding, insulating materials, or wire slings. An edge of a sharper radius than the inside of a carabiner should be considered sharp and padded. Abrasive type edges must also be padded.

Edge Angles

The rope should run over the lip of the cliff edge at as close to a 90 degree angle as possible. This will reduce the potential of rope skidding sideways and abrading. Redirections may be used to help keep the rope at 90 degrees.

Edge Protection

When a rope system travels over an obstruction or the edge of a building that is sharp or abrasive edge guards must be used.

Minimize Leverage

Attach anchor points to the strongest areas of the main anchor. Reduce added forces such as leverage by attaching to the base of posts or beams.

Strongest sling configuration

Utilize the strongest practical sling configurations.

Proper loading of slings and connectors

Pay attention to the ways that slings and connectors are loaded. Carabiners gate direction, as well as cross-loading, edge-loading and tri-loading need to be considered during rigging.

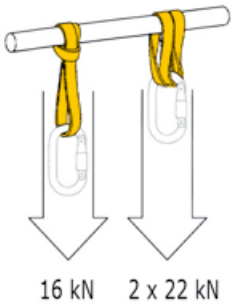
Simplicity

Try to maintain an anchor that is as simple as possible. This simple anchor will be easier to check and inspect with daily use, and will be familiar to all members of the team.

Slung Anchor Configurations

Basket Hitch

A basket hitch involves wrapping a sling around a beam or anchor point which effectively doubles its strength. Care must be taken that the anchor legs are not angled too much, since this can cross-load connectors and add forces to the sling.

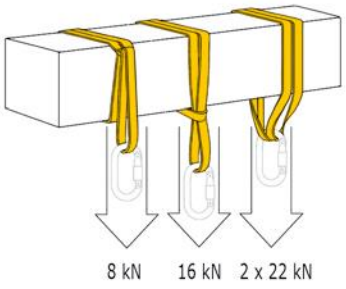


Wrap Basket Hitch

The basket hitch may be wrapped and attached in the same manner. This will shorten the anchor sling length and will provide some resistance to side sliding. This relation does not increase strength over the standard basket hitch.

Girth Hitch/Choker

This relation of using the sling will reduce the strength of the sling itself. In a standard girth hitch it will reduce the sling by approximately 40 percent. The Choker can reduce the sling by up to 60 percent



Anchor Equalization

Anchors may be equalized for a number of reasons. Equalizing two main "full strength" anchors will provide some redundancy to the system. Anchors may also be equalized to move or position an anchor point along the working area. Anchors that are not full strength may be equalized to create a full strength anchor point.

Slung

This may be done with webbing or rope slings and is excellent for equalizing many anchor points together that are not full strength. The focal point should be tied and fixed in place.

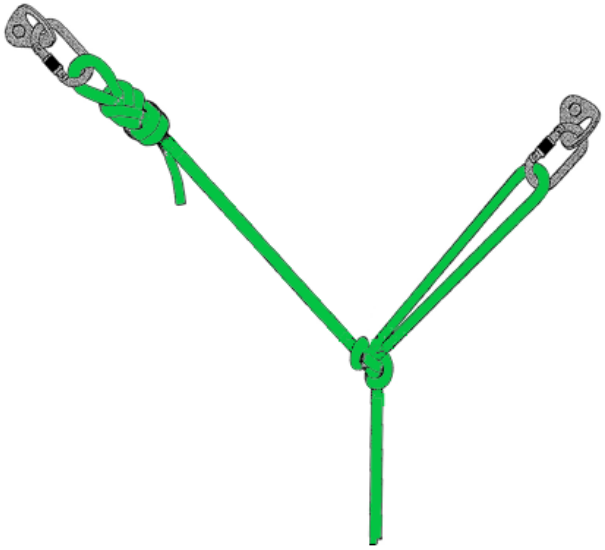
Narrow Y Hang

This is most commonly used to attach together two points that are relatively close together. This anchor becomes inefficient when the anchor points are more than 2M apart.

Wide Y Hang

The wide Y-hang is a better anchor configuration for more distant points. If the anchor points are more than 2M apart the main anchor slings and connectors must be doubled. This reduces the hazard of the ropes sliding and abrading should one sling fail.

'Y' Hang with Figure of 8 and Alpine Butterfly. Which is easy to adjust for lateral movement.



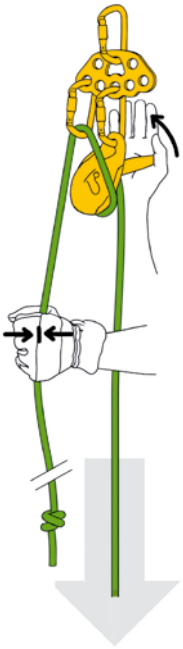
In-line 'Y' Hang equalizing the load between 2 vertical anchors.

'Y Hang with Double figure of 8 on a bight (Bunny Knot)

Chapter 9

LOWERING/RAISING SYSTEMS

Lowering Systems



Raising and lowering techniques are commonly used to move tools and materials, or they may also be used in specialized applications with live human loads.

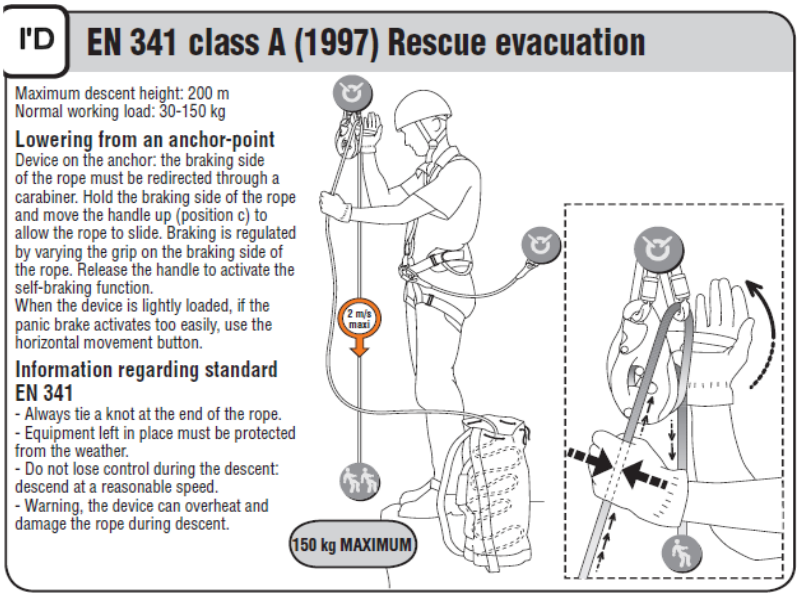
When lowering or raising material loads, with no potential to injure people below, a single rope system may be used. If the load is live (human) or there is the potential to drop the load on to a human, a second backup must be used. The backup system used in this configuration is called a belay.

Loads up to 150kg may be lowered with the Petzl ID under normal circumstances. This device may also be used to lower loads up to 250kg utilizing an additional Munter Hitch and specialized procedures. During lowering, the ID is rigged from an anchor and the rope is run across the flange beside the rope slot. This is made easier by redirecting the rope through an anchor plate or through a second carabiner.

Many other devices may be used to lower and raise loads. These devices involve specialized training. If loads are heavier than 150kg specialized load management tools and techniques should be considered.

Considerations:

- Ensure there are end knots in both sides of both ropes
- Always pull test both the lowering (ID) and backup devices (it is very easy to load them dangerously in this relation)
- Always direct the rope over the ID flange while lowering (a carabiner makes this more efficient)
- When lowering live loads communication is critical

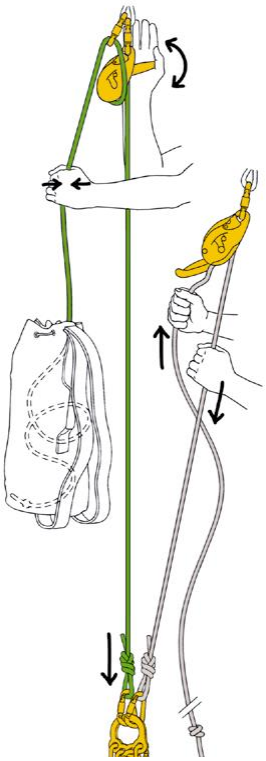


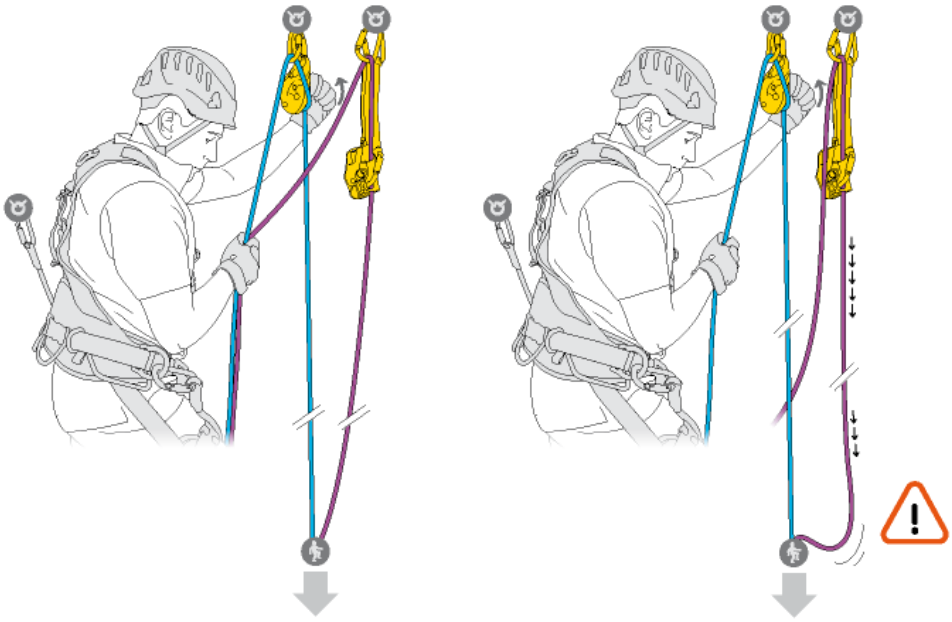
Backup Systems (Belay)

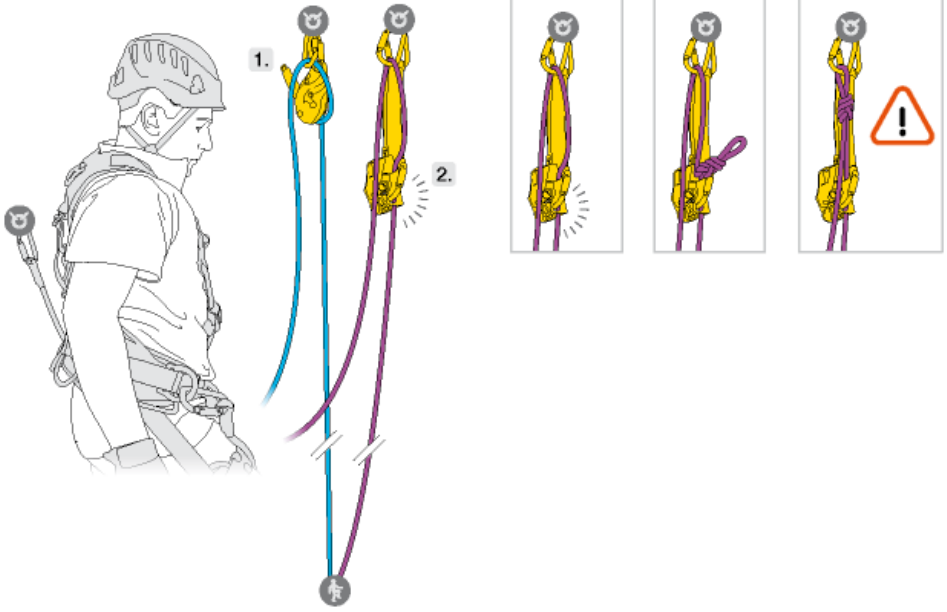
The purpose of a modern belay is to keep a person or load from falling should the primary working line or load line fail.

When moving live loads it's necessary to have a secondary rope system in place as a back-up, which is attached to its own independent anchor. The backup line, lifeline, or safety as it is sometimes called, will usually take the form an attended belay. An attended belay is usually operated from the same location as the hauling and lowering system.

Backup devices for hauling and lowering may be Shunts, Buddies, the ASAP or other Backups. Care must be taken in rigging these, as it is easy to rig them opposite the direction intended. The ID may also be used as a backup belay device and works very well when the anchors are very close together and the devices can be operated simultaneously







Communication Protocols:

While outdoor climbing signalling methods are used by many rope access technicians, when starting to build complex cross-haul or rescue systems it can become confusing. Rescue type communication protocols will work more effectively in these scenarios.

Climber starting at the bottom:

Climber: "Belay Ready, Main Ready?"

The climber is questioning if their main and backup systems are ready and checked.

Technician: "Belay Ready, Main Ready"

The technician is confirming that the rope systems are checked and ready for operation.

Climber: "Climbing", or "Raise" as appropriate

The climber is signalling that they are climbing or asking to be raised.

Technician: "Climb", or "Raising"

The technician confirming that they are managing the system.

At the top:

Climber: "Take", or "Tension"

Commanding the technician to take in any slack rope and ready the system for lowering.

Technician: "Got or Got-you"

Signalling to the climber that they may load the system.

Climber: "Lower"

Commanding the technician to lower out.

Technician: "Lowering"

Confirming the lower.

Climber: "Secure"

Letting the technician know that they are in a secure area where the load may be taken off the Main rope.

Climber: "Off Rope"

This means that the climber is safe, free of all ropes, with knots removed for retrieval.

Other Calls:

Climber: "Up Rope"

Letting the technician know that there is a loop forming in the rope and to take it in.

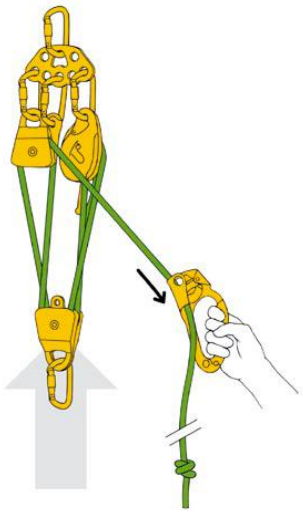
Climber: "Slack"

Letting the technician know that the climber needs some slack rope to move around.

Any Team Member: "Stop"

Signals for all rope movement to cease.

Raising/Hauling Systems



Loads may be raised utilizing simple haul systems. Backup belay systems are used with the same criteria as above with lowers.

The ID may be rigged from an anchor to perform as a progress capture. Since the ID is primarily intended as a lowering device, this system also facilitates quick transitions between lowering and hauling. Because the ID is not specifically designed as a progress capture pulley, it has higher friction than most other purpose built devices.

Hauling may be done redirected, from the ground or the top of a platform or it may be done from an anchor point. Hauling while standing on a flat surface is often easier since the operator has their feet on a hard surface and may use this to create force. A common method is to use a body haul for lighter loads. The operator runs the rope through the ID or redirect pulley and the attaches an ascender (handled or chest) on to the rope. The operator then lowers their body weight on to the rope and uses their body weight to lift the load. The operator may pull up on the rope to help with the raise.

Hauling while suspended from an overhead anchor point (pitch head hauling) is more difficult. The operator needs to be very organized so that the system does not get confused. It is usually easier to attach the operator to the anchor point nearest the loaded rope.

Pulley Systems and understanding Mechanical Advantage

Pulleys actually serve one of two purposes. They are either rigged to provide Mechanical advantage or simply to redirect and change direction of a rope.

Pulley's that are fixed provide no mechanical advantage whereas pulleys that travel with the load do provide mechanical advantage.

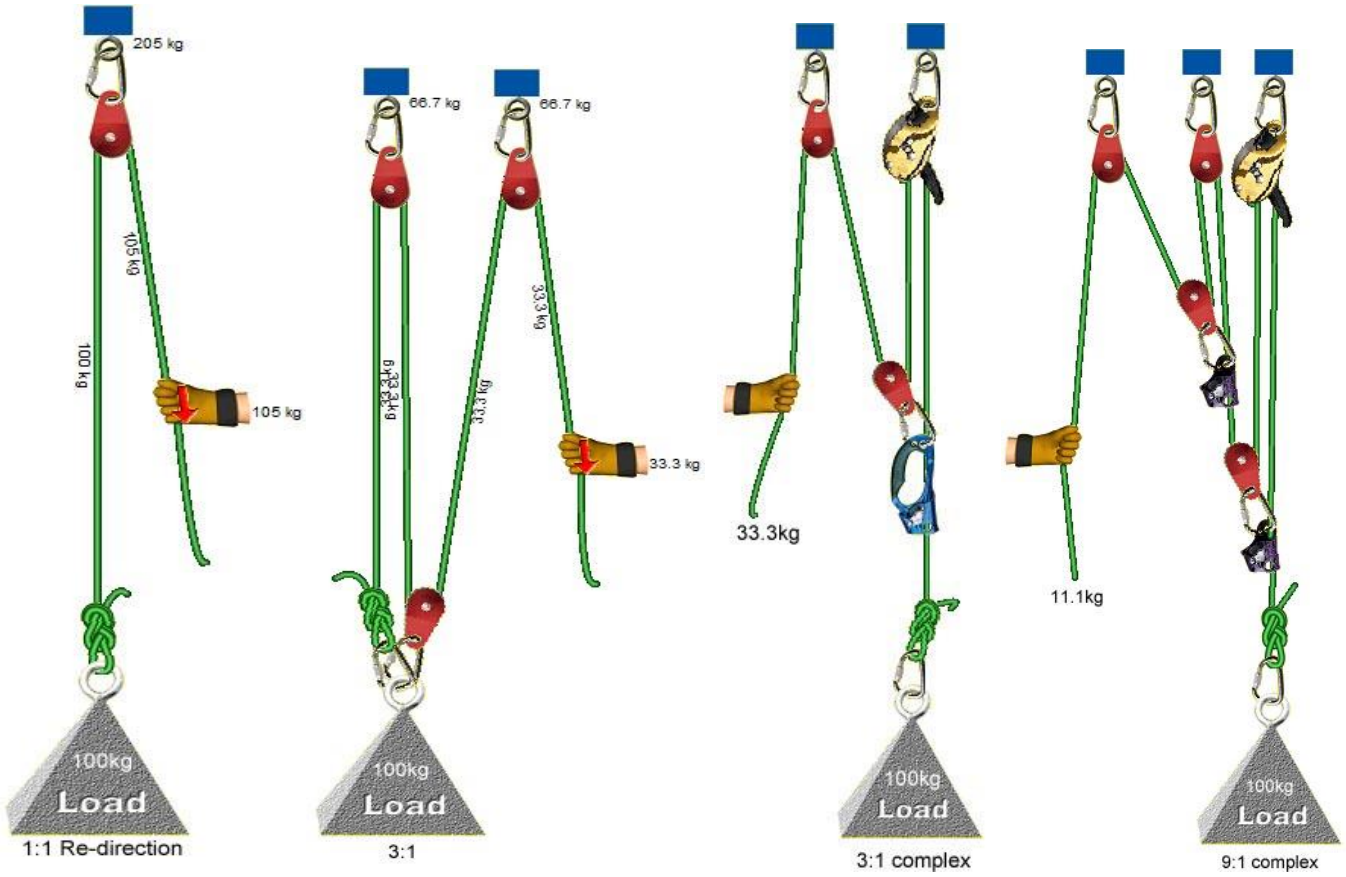
Pulley system ratios are relationships between the weight of the load and the required effort to move the load.

On a 2:1 system, each rope will be sharing the load, requiring less effort to move the load. Lifting a 100lb weight with a 2:1 mechanical advantage system would only require 50lbs of force; however the force would need to be applied over twice the distance.

Increasing mechanical ratios increases the power of the system, but also creates several drawbacks. In a 6:1 system, the rope must be pulled 6 feet in order for the casualty to be moved one foot (slower). More friction develops in mechanical advantage systems as the ratios are increased, since each pulley or bend introduced to the system adds additional friction.

Common Mechanical Advantage Systems

1:1 Based Systems



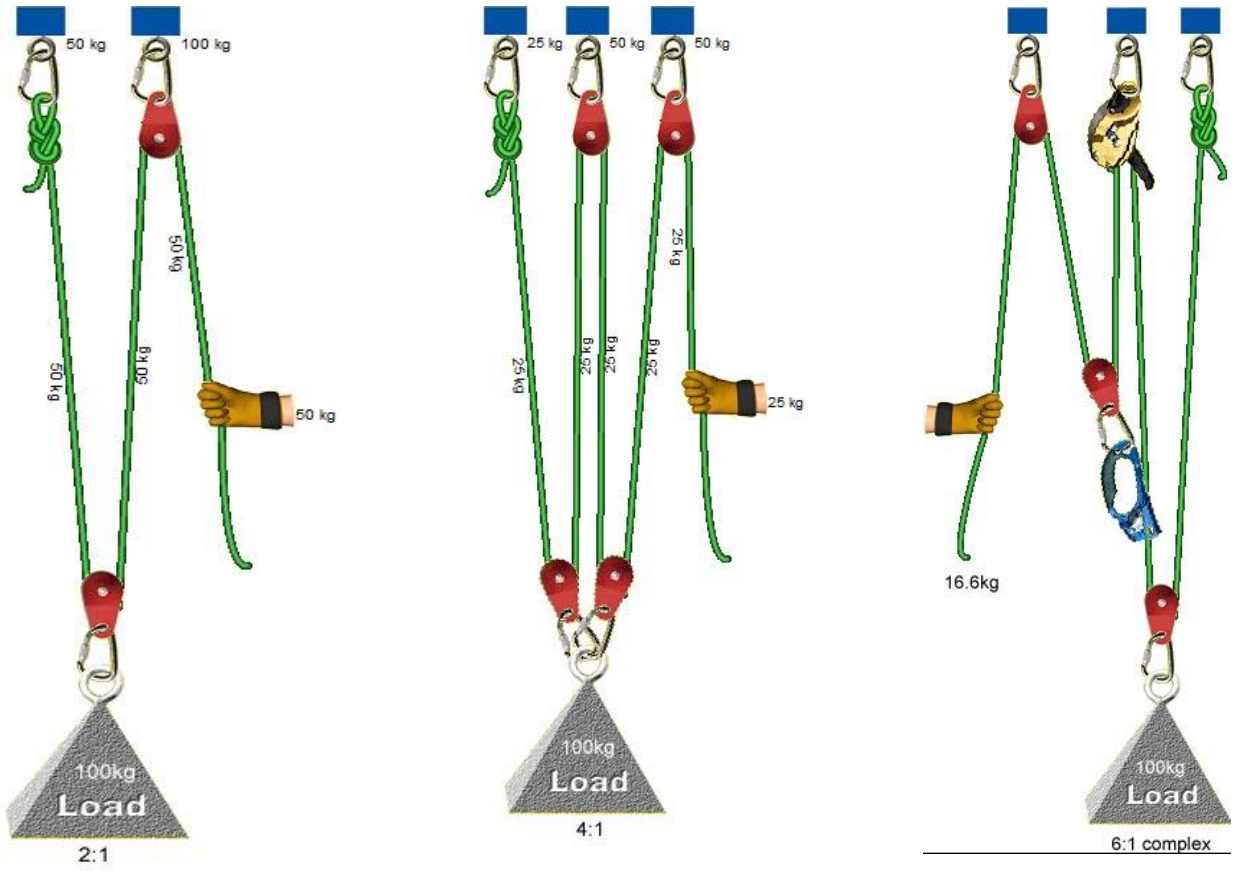
This system based on the 1:1 or counterbalance haul system is the most common used by rope access technicians.

1:1 The first is a straight counterbalance system; an ID may be put in the position of the top pulley to provide a progress capture. This will introduce some additional friction and lessen the actual output haul force.

3:1 The next two systems are 3:1 theoretical mechanical advantage. The first is mainly to illustrate the concept; the second is the most common way that the technician would set this up in the field. The last pulley in the chain is simply a redirection and does not add any mechanical advantage.

9:1 The 9:1 is a compounded system that attaches a 3:1 in to a 3:1 and this multiplies the haul force. This system is not commonly used; its main use being when a load needs to be raised over an edge with much friction. Care must be exercised in using higher mechanical advantage systems, if the load "hangs up" or there are too many technicians hauling, this system could damage ropes.

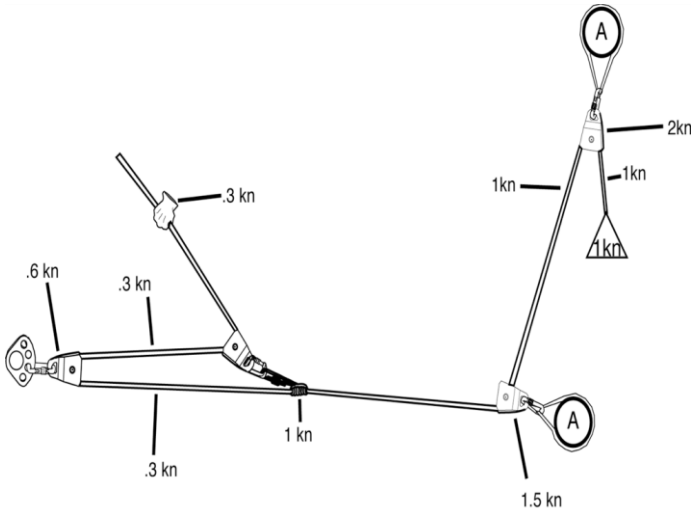
2:1 Based Systems



The 2:1 or drop loop based systems are more difficult to set up, but generally more efficient. The efficiency is gained because with the loads we generally raise a 2:1 is easy to operate and very quick. The efficiency is also gained in that the progress capture ID is in a position where it will give less real friction than the 1:1 based systems. See 6:1 above.

Forces within Rope Systems

When rope is directed around fixed points there is a multiplication of forces. It is important to see that when we redirect to an anchor overhead we double the forces upon this anchor and pulley. It can also be seen that the 90 degree redirection at the lower anchor point increases the forces to 1.5-ish times the original force.



Chapter 10

STRUCTURE CLIMBING

Falling

Falling is dangerous in any of the rope access manoeuvres but particularly in climbing structures because of the potential fall distances. In most rope access practices falls are shorter than the "traditional fall arrest worker" would take. These longer falls add forces to the system and increase the chances of hitting or swinging in to something.

Forces

When a fall is taken there are three factors that control how much force is put on the anchors, systems, and most importantly our bodies. These are fall distance, fall factor, and force dissipation.

Fall Distance

Bodies accelerate as they fall towards the earth. Acceleration due to gravity is 9.8m/s² (or 32ft/s²). That's equates to a speed increase of 35.28 kph every second. This following table outlines the distance you can fall in only a few seconds.

When a body falls, it continues to accelerate, and the velocity continues to increase rapidly. Every time the velocity doubles the resulting kinetic energy is increased by 4 times.

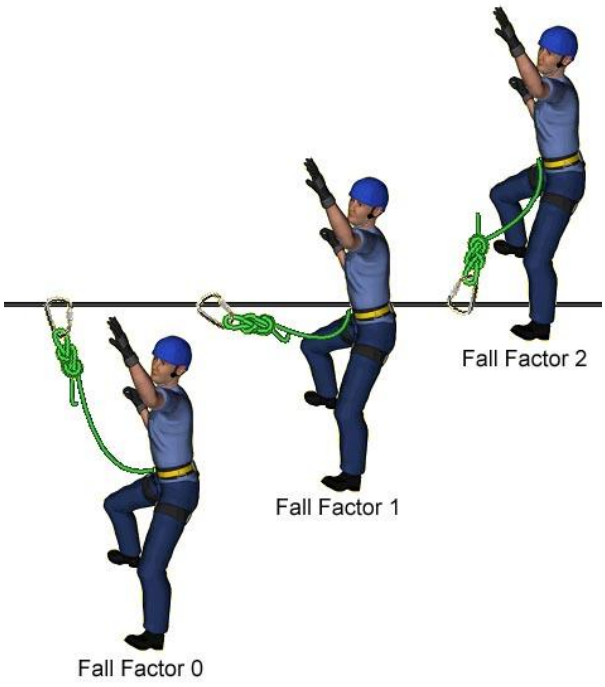
Time *(seconds)*	Distance *(metres)*	Distance *(feet)*
0.5	1.2	4
1	5	16
1.5	11	36
2	20	64
2.5	31	100
3	44	144
4	78	256

Fall Factors

The Fall Factor is calculated by dividing the length of fall by the length of rope holding the fall:

$$\text{FALL FACTOR (FF)} = \frac{\text{LENGTH OF FALL}}{\text{LENGTH OF ROPE}}$$

It is important to ensure that the Fall Factor (FF) is kept to a minimum. Dynamic rope is capable of withstanding a FF2 fall when new. It is best practice not to exceed Fall Factor 1 with dynamic ropes.



Force Dissipaters

The shorter the stopping distance the faster that energy is applied to the body, and the higher the arresting force. This is why it is important to utilize energy absorbing devices, dynamic lanyards and shock packs.

Force dissipaters spread force over time to lessen the peak force on our bodies.

There are many force dissipaters in our traditional rope access system:

- Dynamic rope lanyards
- Low-stretch rope (has some stretch to reduce shock loads)
- Knots (under fall force when tightening knots absorb force)
- Backup devices (many slip at 3-5Kn and dissipate force)
- Shock Packs

Climbable Structures

Towers

Most towers may be climbed with Y lanyards. The exception to this is if the cross-bracing is so distant that the technician cannot reach the next span. Diagonal cross-braces could also put the technician in to a position with a fall factor greater than 2.

Bridges

Bridges are usually climbed with a combination of aid climbing and Y-lanyards. As above when spans between bracing are too great lead climbing may need to be used.

Climbing Methods

Shock Absorbing Lanyards

Fall arrest climbing is a technique, which makes use of fall arrest tools and techniques to stop a falling person under safe conditions.

During the fall the user and their protection should not experience any force in excess of 6kN (approximately 1350lbs force). 6kN is a recognized threshold of injury under IRATA guidelines, and throughout most of the UK. By Contrast, under most Canadian Fall Protection regulations the maximum acceptable arrest force is 8kN

A suitable full body harness with sternal or dorsal attachment point is used in combination with an energy-absorbing lanyard. Under IRATA the harness should meet EN 361 , whereas under Canadian Fall protection regulations it should meet *CAN/CSA Z259.10* . Wherever possible all equipment should also meet local regulations. After a fall, the user must be retained in an upright person; this is the reason for having high attachment point.

When climbing the structure, hands and feet are the primary point of contact and the fall arrest lanyard is the secondary point (back up/safety).

The maximum length of a lanyard is 2m, but using the shortest practical length will limit fall distances.

The energy absorber will deploy after 2kN of force has been subjected upon it. On a 2m lanyard the energy absorber will extend by up to 1.75m in length, the lanyard above will extend by 0.70m.

NEVER add an extra length to a fall arrest lanyard, as this will increase the fall distance without adding energy absorption, which in the event of a fall, could exceed the 6kN maximum allowed in EN 355, as well as greater chance of hitting something.

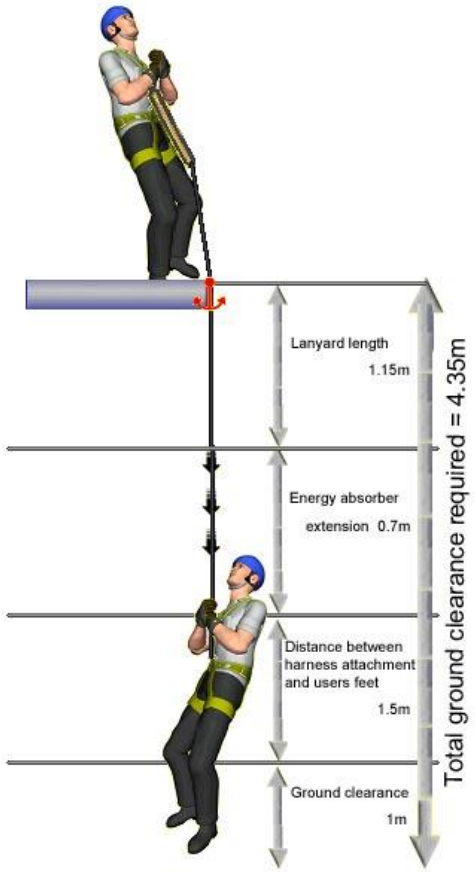
NEVER climb above anchor slings as this will effectively increases the length of the fall arrest lanyard as above, without adding energy absorption, and in the event of a fall could exceed the 6kN maximum allowed in EN 355.

NEVER use two single energy-absorbing lanyards. In the event of a fall onto both lanyards the maximum peak impact force applied to the body would be double the force that would be applied if a single energy absorber were used.

The clearance distance is the amount of free fall space between the anchor and an obstacle or the ground and should be sufficient to prevent the user hitting anything. Manufacturer's information will give the clearance distance for the product; it is made up of:

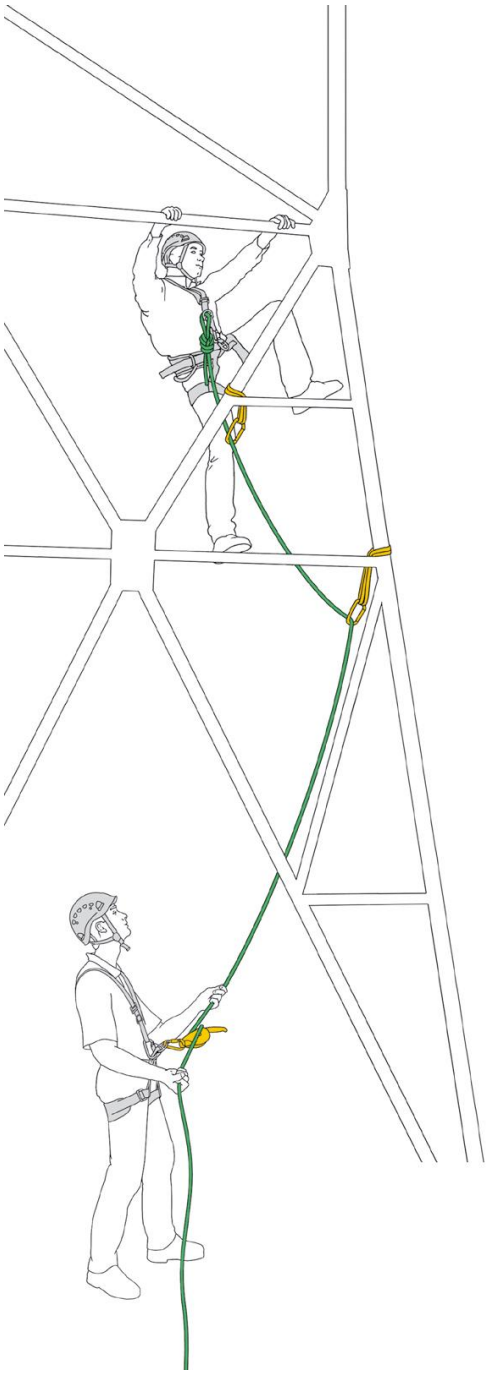
- Fall distance - possibly from above the anchor e.g. fall factor
- Energy absorbing lanyard
- Energy absorber extension
- Distance from the worker's harness attachment to worker's feet
- Distance below worker's feet – to prevent impact with ground or structure.

The length of the fall must always be minimised by attaching the lanyard as high as possible, preferably above head height [see fall factors], especially when working lower than the manufacturer's stated clearance distance. A minimal fall will cause minimal deployment of the energy absorber, reducing the likelihood of impact with a structure and force related injury.



Lead Climbing

Lead climbing is more like what a rock climber would do to climb a cliff bottom to anchor at the top. This is a very specialized form of climbing only to be undertaken by higher level, experienced technicians who have a traditional rock climbing background.



Chapter 11

RESCUE

Suspension Intolerance and the need for speed

Suspension intolerance is a condition in which a person suspended in a harness can experience restrictions of blood flow, which can lead to unconsciousness and eventual death. Persons likely to be affected are those who are suspended in an upright position and who are motionless, for example those who are seriously injured or unconscious, or fastened vertically in a stretcher. These conditions can occur and become critical in as little as 20 minutes. In some trials test subjects have fainted in as little as 3-5 minutes.

Traditional fall arrest harnesses with a dorsal arrest point are more likely to create this state. As rope access technicians we use a sternal arrest point and more padded harnesses, making us less prone to this condition.

Rescue Overview

A rescue plan should be in place for recovering any team member that becomes incapacitated while working at height and should be identified at the 'Risk Assessment' stage, before any work commences and should be fully described in the 'Method Statement'.

In any rescue the main principals are to always have a back-up, have the correct equipment to carry out the rescue and ensure that all rescue team members fully understand the techniques involved.

If the rescue scenario is particularly complicated then a practice rescue should be carried out to ensure the proposed rescue method could be successfully completed within an acceptable time span. Consider rigging for rescue, is it possible to lower the casualty to safety, or is a haul system in place to recover the casualty. The ropes you rig on site are ropes you have to rescue from. Keep potential rescues as simple as possible, starting with the rigging.

A rescue and recovery kit should accompany all rope access teams. This will include sufficient equipment to rescue a technician from any of the rope access situations in which they may be operating. Dedicated rescue equipment should not be used for anything other than a rescue. Ropes may have been damaged in the incident that lead to the need for rescue. It may be safer, and most times is simpler to rescue from a separate set of ropes.

Before commencing any rescue it is important that the cause of the casualty's accident is fully understood, so that these conditions do not affect the rescue team, for example if the casualty is unconscious through hazardous gas. Consider the position of casualty vs. the rescuer, in some scenarios it would be better casualty management for the rescuer to be beneath the casualty as this allows the rescuer to walk or push away from the structure with their legs.

Rescue Steps

- Assess the scene to determine if it is an incapacitated worker
- Assess for cause of accident and condition of the casualties rope system
- Stop all work in the area
- Contact the level 3 supervisor and report, location, incident nature, and condition of the casualty
- The level 3 will then determine who will carry out the rescue
- Call out procedures for higher levels of medical care will followed
- Rescue is then undertaken

Added considerations:

- Ensure the rescuers do not endanger themselves while carrying out the rescue
- Provide appropriate First Aid Treatment & Prevent further injury to the casualty
- Evacuate the casualty to a safe location where suitably qualified persons can administer effective treatment
- Casualty management must be constantly addressed throughout the rescue, with the rescuer taking sufficient steps so as not to worsen any injury sustained by the casualty
- The Level 3 Safety Supervisor should hold a current First Aid certificate appropriate for the location where the work is taking place

See manoeuvre notes 1.8

Chapter 12

EXAM PROCESS

Rope Access technicians commonly work in areas of high hazard. Rusting metal, sharp edges, heated pipes, weather, bystanders and property must always be considered. The training program is designed to train the technician to work in areas of high hazard and do so very safely.

The Assessor is looking to see that the candidate can work safely and in control in high hazard environments.

Examination Day Schedule

The examination day will be a full day. It begins with the written exam (SPRAT). Harnesses are then donned and a verbal test of the candidates understanding of job hazards and equipment is done. The practical exam is based upon the candidate performing the rope access manoeuvre that they have been trained in.

The level 1 will perform all manoeuvres that have been trained.

Written Exam

The IRATA written exam is open book and should be completed by noon on the 4th day of the course. This will allow the instructor time to mark the exam.

The SPRAT written exam is 40 multiple choice questions. These questions test the candidates understanding of the Safe Practices and Certification Requirements documents.

Verbal Exam

The verbal exam is to test the candidates understanding of workplace hazards and our management of them (JHA) and their knowledge of and inspection of the eight primary pieces of equipment. See equipment information sheets for preparation for this.

Talking Points:

- What it is called
- What its primary use is
- What certifications/load ratings does it carry
- How you would inspect it for function and wear
- Is it within the manufactures life span
- What are some of the dos and don’ts for handling/use
- What are any added safety features built in
- What would you do if you suspect it is damaged

Practical Exam

This examination tests the candidate's practical manoeuvres. Level 1's will be tested on all the skills learned through the week. At higher levels the skills are selected by the Assessor.

For the evaluation it is assumed that as soon as you leave the ground you are entering the access (fall) zone.

For the evaluation it is assumed that any swing is considered unsafe.

Candidates should show smooth controlled movements, demonstrating to the Assessor that they are competent to work in a high hazard environment.

Each level has different expectations:

- **Level I** technicians need to complete skills safely.
- **Level II** technicians need to complete skills safely and proficiently and demonstrate a good understanding of concepts, problem solving and leadership.
- **Level III** technicians need to complete skills safely, proficiently and quickly with a strong understanding of concepts and problem solving and be able to perform and organize complicated individual and team work and rescue scenarios.

Skills

SPRAT 1

Theory and Verbal exam components:

- An understanding of the responsibilities of a Level I Technician
- Demonstrate understanding of proper use, inspection, and care of all equipment required for the technical skills
- Demonstrate an understanding of the employer's safety management program, relevant policies, work permits, work zones, and job safety analysis. Candidate should also be aware of course site hazards and emergency procedures

Knots:

- Knot to join two ropes (e.g. Double Fisherman's, Flemish Bend)
- Middle knot (e.g. butterfly)
- Stopper knot to prevent descending off end of ropes (e.g. barrel knot)
- End Knot (Figure 8, and Double Figure 8)

Practical Manoeuvres:

- Demonstrate the use of an appropriate back-up device attached to a secondary safety rope in accordance with industry best practice.
- Use of Descenders
- Use of Ascenders
- Use of work seat
- Passing Knots
- Rope-to-Rope Transfers
- Deviation (redirect)
- Short Rebelay
- Long Rebelay
- Negotiate Edge
- Rope and Sling Protection
- General Anchor Inspection
- Climbing with Shock-absorbing Lanyards
- Belaying with Communication
- Lowering
- Pick-off Casualty on Descent
- Awareness of Simple Mechanical Advantage Systems

IRATA 1

The IRATA level 1 examination has only 2 differences to the SPRAT:

- Aid climbing, both fixed points and sliding are tested
- Belaying with communication is not an IRATA tested skill

Marking Criteria

The marking criteria consists of three potential outcomes to each exercise, a pass, a discrepancy or a fail. The candidate is allowed two discrepancies and the third would constitute a fail. Any fail mean that the examination is over for the candidate.

The marks are cumulative, and not confined to any one manoeuvre.

Written exams that are failed may be retaken at a later date at the discretion of the Assessor.

Discrepancies (minors)

- Poor understanding or improper use of equipment
- Unlocked carabiners
- Repeatedly low backup devices
- Backup devices to close to obstruction
- Consistently forgetting to lock or tie off a descending device
- No retrieval knots on deviation
- Negation of rescue (taking tails of rope up)
- Un-fastened helmet chin-strap
- Subjecting a rope or equipment to dangerous loading or abrasion
- Positioning a toothed ascender where it could be subjected to shock loading
- Rough handling of a rescue patient
- Patient coaching a rescuer
- Not using a n added friction carabiner where it is necessary
- Taking a long time to complete a skill.
- Giving a poor or incorrect answer when asked about a concept during a skill

Fails (majors)

- Going on to one anchor point
- Leaving a backup device behind so it is no longer effective
- No control of swing hazard
- Loading the ID backward and committing to it
- Being unable to complete a skill
- No helmet on a rope system
- Large uncontrolled swing
- No fall protection within 6’ of unprotected edge

Reexaminations

If the examination is not successful for any reason:

SPRAT

The candidate must wait 7 days until able to re-examine. The candidate will have 60 days period in which they will only need to re-examine the failed category (written, verbal, practical). After this point the whole exam must be undertaken again.

IRATA

The Assessor will write on the candidates assessment form their recommendations for further training. This must be completed and documented prior to re-examination. Students who fail their IRATA assessment have 60 days to re-examine. Students who do not re-examine within 60 days will be required to complete the course again in full.

Chapter 13

POST COURSE

Seeking Employment

Resume

One of the main first tools an individual needs to obtain employment in this work sector is a good, professional type resume. This should consist of:

- Cover Letter:
- Who you are
- Where you wish to go in this career path
- What experience you have in the industry
- Other relevant experiences

Resume:

- 1-2 pages maximum
- Word and other writing programs have very good templates

Companies hiring rope access techs

- Window cleaning/building maintenance companies
- NDT (Non-destructive testing companies)
- Glass Glazing
- Industrial Coatings
- Pest Control
- Banner and Sign Erection
- Geotechnical/Civil Engineering; Permanent Rock Anchorage, Concrete Spraying, Rockfall Prevention
- Tower erection
- Antenna and dish installation

Skills in addition to the rope access ticket

NDT

Level 1 Ultrasonic is the most used skill for on-rope NDT

Schools:

BCIT

http://www.bcit.ca/study/programs/5025nobcit

SAIT

http://www.sait.ca/about-sait/schools/school-of-manufacturing-and-automation/featured-programs/soma-fp-non-destructive-testing.php

NAIT

http://www.nait.ca/program_home_33656.htm

Wind Generation

Wind turbine maintenance and blade (composites) repair

Canadian Wind Energy Association

http://www.canwea.ca/wind-energy/education_e.php

Lethbridge College

http://www.lethbridgecollege.ca/externalapps/oldsite/iwea/index.php?option=com_content&task=view&id=528&Itemid=723

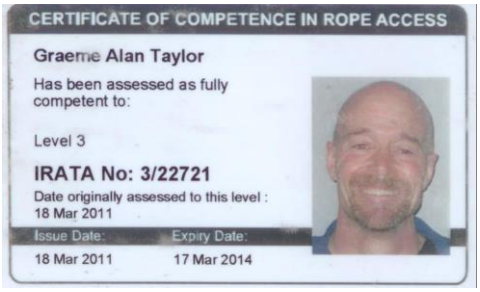
Other Sources of Information

http://www.rigg-access.com/rope-access-jobs.asp

http://www.rope-access-jobs.com

ID Cards

At the course end you should receive a copy of you technician evaluation form. This becomes your interim certification until the ID card and log books are received. These are now your primary rope access documentation and should be carried while on the job.


CERTIFICATE OF COMPETENCE IN ROPE ACCESS

Graeme Alan Taylor

Has been assessed as fully competent to:

Level 3

IRATA No: 3/22721

Date originally assessed to this level : 18 Mar 2011

Issue Date:	Expiry Date:
18 Mar 2011	17 Mar 2014

Log Books

Log books must be kept up to date and in order. When next training and examining the log book will be checked and the technician will not be allowed to test if the log is not in good order.

The final two pages give detailed instruction on the proper filling in of the log book.

The log book is also a running resume of the technicians experience and will be the first thing a new prospective employer will ask to see.

Proper Documentation

Dates:

- Fill in for every job
- On longer jobs in two week blocks or less

Details of Tasks:

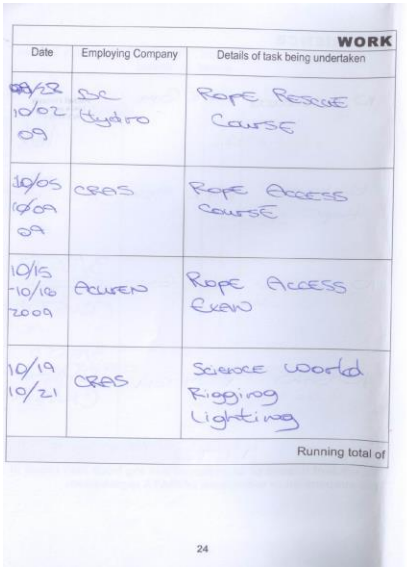
- Rope access Manoeuvres
- Anchoring and rigging methods

Location:

- Physical location (geographic)
- Type of structure worked upon

Hours:

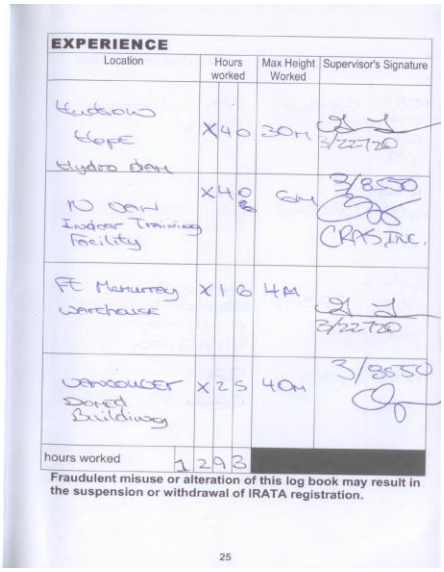
- Be sure to X out unused blocks
- Supervisor Signature:
- Signature and level 3 SPRAT or IRATA #


WORK

Date	Employing Company	Details of task being undertaken
10/02 09	Sc Hydro	Rope Rescue Course
10/05 - 10/09 09	CRAS	Rope Access Course
10/15 - 10/16 2009	Acuren	Rope Access Exam
10/19 - 10/21	CRAS	Science World Rigging Lighting

Running total of

24


EXPERIENCE

Location	Hours worked	Max Height Worked	Supervisor's Signature
Hudson Hope Hydro Dam	X 40	30M	3/22720
10 Day Indoor Training Facility	X 40	60M	3/8550 CRAS INC.
Ft Mcmurray warehouse	X 16	4M	3/22720
Vancouver Board Building	X 25	40M	3/8550
hours worked	129		

Fraudulent misuse or alteration of this log book may result in the suspension or withdrawal of IRATA registration.

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Seeking Higher Rope Access Levels

When preparing for higher levels of rope access programs, the more that can be learned prior to the course week will aid the candidate. Rope access companies with developed systems will most times take the promising candidate and have the level 3's train and mentor them in higher level skills.

Technicians should also seek out situations that will give them experience in as many of their trained manoeuvre as possible. The yearly refresher is also very valuable to help keep up skills not normally practiced while on the job.

Pre-Study

Prior to recertification, the rereading of your previous manual/s should be done. The Working practices and certification requirements documents that came on the thumb drive with this course should be thoroughly read and understood.

Log Book

Prior to your next course and exam submit 3-4 scanned pages of your log book to the training company. This will give the company representative time to see if it will pass muster from the Assessor and give the candidate time to correct any deficiencies.

Definitions and Terminology

Access Permit (aka Job Hazard Analysis; JHA): A written statement prepared by the employer describing how a particular job (or types of jobs where these will be essentially identical) should be undertaken to ensure any risks to health and safety of the workers, or others who may be affected, are minimized.

Access Zone: The area in which people are at risk of falling such measures such as verbal warnings, signs, barriers, safety lines, or other devices designed to prevent or arrest a fall.

Aid Climbing: is a method of accessing a structure or site where the rope access operative moves by attaching directly to anchor points with special foot-loops and support devices. The method allows workers to climb horizontally underneath the structure.

Anchor, Anchorage: A place, fixing or fixture that supports and to which the various ropes and rope systems are attached. A secure point of attachment for a lifeline or lanyard;

Ascender: A device that is designed to grip the rope for the purpose of ascending. The term ascender often applies to toothed, manual rope grabs that are used in pairs.

Belay: An active system operated by another employee for the purpose of arresting the fall of a rope access worker.

Carabiner: A type of connector, formed as a complete loop with a spring-loaded entry gate.

Carabiner, Locking: A carabiner with a mechanism that reduces the possibility of a gate being opened inadvertently. A locking mechanism requires at least two different consecutive manual actions to open the gate.

Competent Trainer: A person who, based on training, education, knowledge, and most importantly experience in rope access, can safely and effectively deliver a quantifiable educational program to others.

CSA: Canadian Standards Association

Descender: A device that acts as a friction brake on a rope. It is normally attached to the operator and enables the operator to control the rate of descent.

Fall Arrest System means a system that will stop a worker's fall before the worker hits the surface below;

Fall Factor: The fall factor is the ratio of the height a climber falls before his rope begins to stretch divided by the rope length.

Fall Protection System means a fall restraint system, a fall arrest system, or work procedures that are acceptable to the Board and minimize the risk of injury to a worker from a fall;

Fall Restraint System means a system to prevent a worker from falling from a work position, or from travelling to an unguarded edge from which the worker could fall;

Full Body Harness: means a body support device consisting of connected straps designed to distribute the force resulting from a fall over at least the thigh, shoulders and pelvis, with provision for attaching a lanyard, lifeline or other components;

Hazard Zone: Any area where a person may be at risk as a result of the work being performed.

IRATA: Industrial Rope Access Trade Association

Kernmantle Rope: Synthetic rope with a load-bearing core (kern) covered by a protective woven sheath (mantle)

Lanyard: means a flexible line of webbing, or synthetic or wire rope, that is used to secure a safety belt or full body harness to a lifeline or anchor;

Lifeline: means a synthetic or wire rope, rigged from one or more anchors, to which a worker's lanyard or other part of a personal fall protection system is attached

Main Line: The primary rope used for descending, ascending or positioning.

MBS - Minimum Breaking Strength: The lowest force that randomly sampled items from a production batch fail at.

On Line: The condition of being suspended from or attached to a rope.

Personal Fall Protection System means a worker’s fall restraint system or fall arrest system composed of a safety belt or full body harness, and a lanyard, lifeline and any other connecting equipment individual to the worker that is used to secure the worker to an individual point of anchorage or to a horizontal lifeline system;

Peek Impact Force: The maximum force exhibited on the body during a fall.

Proctor: Individual who oversees students for test taking purposes. Proctor must be approved by SPRAT and submit a signed affidavit.

Rescuer: An individual who is designated by the employer to perform rescue of rope access workers as a member of the rescue service.

Rescue Service: Organization determined by the employer to be capable of safe and effective rescue of rope access workers.

Retrieval System: The equipment (including a retrieval line, harness, lifting device, and anchor) used for rescue of rope access workers without placing a rescuer on-line. The safety line may be used as the retrieval line in a retrieval system.

Rope Access: Techniques by which access is gained to buildings, other structures (on or offshore), geological features (such as cliff faces), or manmade features (such as dams) by means of ropes.

It applies to all cases where ropes are used as:

a. the primary means of support.
b. as means of primary protection or positioning, and
c. where people descend or ascend on a rope or traverse along horizontal rope.

Rope Grab: A device used to grasp a rope for the purpose of supporting a load.

SPRAT: Society of Professional Rope Access Technicians

Safe Zone: Any area outside the Hazard Zone or the Access Zone.

Safety, Secondary, Belay or Backup Rope: Rope used to protect against falls if the user slips or the primary support, anchor or positioning mechanism fails.

Safe Working Load (SWL) The SWL is the maximum working load as determined by a ***competent person,*** by dividing the Minimum Breaking Strength of a piece of equipment by the desired safety factor, similar to WLL. SWL can best be thought of as being a derating of the WLL, by a competent person, following an assessment of the maximum load the item can sustain under the conditions in which the item is being used.

Working Load Limit (WLL) is the maximum working load designed or intended by the ***manufacturer***. The load represents a mass or force that is much less than that required to make the lifting equipment fail or break. The WWL is calculated by the manufacturer using a safety factor For example, 5:1 (5 to 1, or 1/5). An example of this would be a chain that has a MBS of 2000 lbs would have a WLL of 400 lbs if a safety factor of 5 (5 to 1) is used

Qualified: being knowledgeable of the work, the hazards involved and the means to control the hazards, by reason of education, training, experience or a combination thereof;