Acknowledgements

Many people have contributed to the wealth of knowledge in the industrial rope access industry and particularly within the IRATA system. I would particularly like to acknowledge David Towse of Remote Access Technology for his input.

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Importance of Dedicated Training

Rope access methods have been used in recreational caving and climbing for over a century now and recreational cavers and climbers accept calculated risks as a part of their sport. Decisions are taken to reduce the level of equipment whilst replacing it with increased levels of strength, skill and technique. This lightweight, higher risk approach is considered to be an enjoyable and positive aspect of caving and climbing as a sport.

People employed in the industrial rope access industry use a very different methodology and employ techniques giving safety the highest priority and reducing risk. The two rope system employed by IRATA and other such organizations ensures that 100% redundancy is used at all times in the setup and execution of the working environments.

For general non rope access work at height, the Bureau of Labor Statistics (BLS) (2008) reported that fatal work injuries involving falls decreased 20% in 2008 after a sharp increase in 2007. The 847 fatal falls in 2007 was the series high. Fatal falls to a lower level, which accounted for 85% of all falls, were down 23% in 2008.

The US Department of Labor (DOL) lists falls as one of the leading causes of traumatic occupational deaths, accounting for 8% of all occupational fatalities from trauma. Any time a worker is at a height of four feet or more, the worker is at risk and needs to be protected. Fall protection must be provided at four feet in general industry, five feet in maritime and six feet in construction. However, regardless of the fall distance, fall protection must be provided when working above dangerous equipment and machinery.

Persons not using the correct personal protective equipment (PPE) or attempting to use it without proper and adequate training are a danger to themselves and others, and are committing an unlawful act that could lead to prosecution.

It is essential that rope access personnel have the appropriate personal protective equipment for the task and have adequate training in all aspects of its correct use, care and maintenance.

During your course you will be taught to use the various industrial rope access techniques and devices in a safe and controlled manner, always under the direct supervision of your instructor.

After the course, it is very important that you undergo refresher training at regular periods to ensure that skills are not forgotten.
About This Training Manual

This training manual has been designed to aid you with and supplement your Industrial Rope Access Trade Association (IRATA) industrial rope access training course.

Neither this nor any other training manual is a substitute for practical, professionally administered training and should be used in conjunction with the following documents;

- ‘IRATA International Code of Practice’
- ‘IRATA General Requirements for the Certification of Personnel Engaged in Industrial Rope Access Methods’

Candidates will be given guidance from their instructor on which sections of this manual are relevant to their training and assessment level.

Your instructor will be happy to explain any part of the manual that is not clearly understood.

IRATA

IRATA, the Industrial Rope Access Trade Association, was formed in the late 1980s, as the result of an initiative by a number of leading companies involved in industrial rope access techniques, to provide a safe working environment for the industry.

Safety is paramount in our industry. Since its formation, IRATA and its member companies have worked assiduously to:

- Improve safety in the industry
- Produce an industry standard set of guidelines and training requirements
- Provide a comprehensive assessment and registration process for operatives

Much of this work has been carried out in close liaison with the Health and Safety Executive (UK). This has created an effective framework within which, in the decade that IRATA has been collecting safety statistics, there has been only one recent fatality offshore, and none during onshore work amongst its members. The incident rate for members is consistently well below that of other industries during the same period. Rope access provides an effective, efficient and economic means of access. However, it must be carried out in a proficient and safe manner.

IRATA's main activities are to:

- Promote and maintain a high standard of industrial rope access activities in terms of safety and work quality.
• Provide guidance on training and certification of personnel involved in Industrial Rope Access.
• Produce publications and guidance on good working practice, training and other related topics.
• Prepare submission and provide informed opinion and advice to government departments and others on matters concerning health, safety and training.
• Assist working parties charged with commenting on and discussing existing and draft legislation and directives.
• Assist in the provision of appropriate educational training and certification opportunities for personnel employed in Industrial Rope Access.
• Provide a forum for the free and informal exchange of experience and opinion.

Controlling Hazards & Reducing Risk

There are three reasons why you need to maintain high standards of safety in rope access:

Moral: Western society places safety at work high on its moral agenda and will generally react against individuals or companies who place themselves and the public at risk.

Economic: Accidents lead to losses. Companies become bankrupt and individuals lose time off work or are unable to work again.

Legal: Not complying with the health and safety regulations can lead to criminal prosecution of directors and employees, with a penalty of hefty fines and/or imprisonment.

The IRATA rope access system is a safe method of working because technicians understand their health and safety duties to themselves, colleagues and members of the public. This section shows what you need to do to work safely and refers to the regulations to reinforce the importance of this subject in US and Canadian industrial law.
Documentation to be Kept On-Site

It is recommended that the following documentation should be kept on site:

• A copy of the employer’s employment liability insurance.

• A copy of a letter from the insurance company acknowledging that they will give third party cover for the method of work (i.e. rope access).

• An equipment log (or other suitable record) which lists all the equipment on site and which gives equipment identification numbers with cross reference to batch or individual test certificates, or certificates of conformity, and safe working load, where appropriate.

• Information about the use and care of any chemicals that may be used on site.

• A safety method statement (job plan) including typical work details and standard practices. (In many cases, where types of job are similar, the safety method statements may be identical and may, therefore, be in the form of a general document. Where the work includes the use of tools such as welding torches, flame cutters and abrasive wheels which can constitute a potential hazard to the operative and his/her access equipment, a more detailed safety method statement needs to be prepared prior to the commencement of work.

• Personal records or similar evidence of competence, to be carried by all persons who are working using rope access techniques.

Work At Height General Principles

1. AVOID the risk by not working at height – where it is reasonably practicable to carry out the work safely other than at height then you should do so.

2. PREVENT falls – where it is not reasonably practicable to avoid work at height, you should assess the risks and take measures to allow the work to be done whilst preventing so far as is reasonably practicable people or objects falling. This might include ensuring the work is carried out safely from an existing place of work, or choosing the correct work equipment to prevent falls.

3. MINIMISE the consequences of a fall – where the risk of people or objects falling still remains you should take steps to minimise the distance and consequences of such falls. This also involves the selection and use of work equipment.
• Assess the risk to help you decide how to work safely
• Follow the hierarchy for safe work at height – Avoid, Prevent, Minimise.

A standard hierarchy for the work at height techniques rope access technicians use would be:
  • Work restraint
  • Work positioning (rope access)
  • Fall arrest

Risk assessment may change this for a particular job or situation.

• Plan and organise your work properly taking account of weather conditions and the possibility of emergencies (e.g. worker suspended from a lanyard).
• Ensure those working at height are competent to do so.
• Make use of appropriate work equipment.
• Manage the risks from working on or around fragile surfaces and from falling objects.
• Inspect and maintain the work equipment to be used and inspect the place where the work will be carried out (including access and egress).
• Ensure the appropriate level of supervision is in place.
• Ensure set procedures are being followed.
Managing the Falling Hazard

Assess the risks to help you decide how to work safely

Is there a risk of a person falling a distance likely to cause injury?

Yes

No

Perform the task in a safe manner

Is it reasonably practicable to safely carry out the work other than at height?

Yes

No

Perform the task in a safe manner

Take suitable and sufficient steps to PREVENT the risk of a fall, including:

• Using an existing safe work place
• Selecting the most suitable work equipment to carry out the work.

Where the risk of a person or object falling still remains take suitable and sufficient measures to:

MINIMISE the distance and consequences of any fall. Steps should include the selection of suitable work equipment to achieve this.

When selecting work equipment give collective protection priority over personal protection.
Employers must produce risk assessments and method statements, take measures to eliminate or reduce risks to your health and safety, appoint competent people and provide you with the appropriate access system, information, instruction and training.

As an employee or contracted self-employed person you are required to comply with any health and safety training and instructions provided, inform your employers of any shortcomings to that provision and report to your employer any dangerous situations you find developing on site.

A risk assessment is a careful, systematic examination of the hazards in your place of work that could cause harm to people or damage plant or property. It is to be done before the work takes place and before the work and access equipment is selected.

- **A HAZARD** is something that has the potential to cause harm to any person, property or animal. In practical terms it is often associated with a condition or activity that if left uncontrolled can result in injury or illness.

- **A RISK** is the likelihood of that harm actually occurring.

It is important, when carrying out a risk assessment, to identify the significant hazards, evaluate the level of associated risk and indicate whether existing precautions are suitable to eliminate or minimise the risk.

Any judgement of the risk should take account of the total number of persons who could be harmed and the severity of that harm, should it occur.

**A Five-Point Plan for Producing a Risk Assessment**

1. **Identify the Hazards in the Work Place**
   - Consider the area in which the rope access team is expected to operate and identify any hazards that could reasonably be expected to cause harm to your team members.
   - Look at how anything you do may create a hazard that could cause harm to others. Prioritise the hazards that could result in major harm or affect several people.
   - Consider also what effects other people may have on your team members’ safety.

2. **Identify Who Could be Harmed and How**
   - Identify which team members and any others who are at risk from each hazard.
3. Evaluate the Risks and Decide whether Existing Precautions are Adequate. If Not, State Actions Required to Control Risk.

One method of evaluating the level of risk arising from each hazard is shown by the simple formula below.

\[
\text{RISK} = \text{Frequency} \times \text{Severity}
\]

The **Frequency** of an accident occurring has the values:

1. Highly improbable
2. Remotely possible but known to occur
3. Infrequent
4. Occasional
5. Frequent and regular

The **Severity** of the consequences has the values:

1. Minor injury, no time off
2. Injuries resulting in up to 3 days off work
3. Injury resulting in more than 3 days off work
4. Major disabling injury (e.g. loss of limb, eye etc.)
5. Fatality

Multiplying the numbers together produces a risk rating that can be categorised as follows:

- Critical Risks: 15 - 25
- Significant Risks: 8 - 12
- Minor Risks: 1 - 6

This method of evaluating risk is subjective, based on a broad judgement of the values attached to the frequency and severity. However, it is fast becoming the industry accepted method of prioritising or rating risks for attention.

If you find that further precautions are necessary, examine each hazard and apply the following Hierarchy of Control Measures:

1. Remove the hazard completely
2. Try a less hazardous material or option
3. Prevent access to the hazard
4. Organise work to reduce exposure to the hazard

5. Increase level of information, training and supervision

6. Issue PPE and provide welfare facilities (e.g. washing facilities)

**4. Record Your Findings and Inform Team Members & Others**

Write down the findings of your risk assessment and state how you are going to eliminate the hazard or control it down to an acceptable level of risk. The results of the risk assessment must be communicated to all team members.

They must understand and comply with the contents of the risk assessment and the measures put in place to reduce the level of risk.

If there are other people in or around your team’s work-site, inform them about any risks that your work could cause them and what precautions are being taken.

All the significant findings from the risk assessment should be recorded. A record should also be kept if the activity involves high levels of risk. This will include most rope access activities.

A risk assessment should include:

- A statement of the significant hazards identified.

- The control measures in place and the extent to which they control the risks and the options and methods available for workmate rescue (cross-referenced to other documents).

- The persons exposed to the risks.

Keep the risk assessment for future reference. It will help you should an inspector question your precautions or if you become involved in any action for civil liability. It will also remind you to address safety matters and help to show that you have done what the law requires.
5. Review Your Assessment and Revise it When Necessary

Review your risk assessment at regular intervals and revise it when the situation changes:

- Hazards may change in the same environment over time.
- New equipment, procedures or materials cause new hazards.
- Changing working environments may introduce significant new hazards of their own. Consider them in their own right and do whatever necessary to keep the level of risk low.
- Young or inexperienced workers joining the team may require further actions to be taken.

**Training Site Risk Assessment**

<table>
<thead>
<tr>
<th>HAZARD</th>
<th>WHO AFFECTED</th>
<th>HAZARD CONTROL</th>
<th>RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td>General safety</td>
<td>Trainees, instructors, other work personnel, public</td>
<td>Training site safety induction prior to commencement of training.</td>
<td>Low</td>
</tr>
<tr>
<td>Potential fall from a height</td>
<td>Trainees, instructors</td>
<td>IRATA trained &amp; certified personnel, company operational procedures, risk assessment and method statements. Working &amp; safety ropes, structural or tested anchors, harnesses and equipment as appropriate, self-rescue systems, helmets as appropriate. Team briefings and demonstrations of appropriate techniques and safety systems.</td>
<td>Low</td>
</tr>
<tr>
<td>Rope access &amp; fall arrest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive winds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladders &amp; platforms</td>
<td>Trainees, instructors</td>
<td>Monitoring adherence by supervisor and Level 3’s, dependent on situation, competence of employees and safety systems utilised. All scaffold structures and safety systems installed and inspected on a weekly basis by suitably competent persons.</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Risk of Injury.</td>
<td>Trainees, Instructors, Other Work Personnel, Public.</td>
<td>Qualified First Aiders and equipment on site. Appropriate PPE for working at height. Equipment inspection regime. Team briefing to workforce and visitors on trip and bump hazards. Access routes take into account the hazards to Rope Access Personnel. All personnel are medically fit for the situation.</td>
<td>Low</td>
</tr>
<tr>
<td>Manual Handling</td>
<td>Trainees, Instructors</td>
<td>Appropriate techniques used to lift, haul, lower and rescue loads.</td>
<td>Low</td>
</tr>
<tr>
<td>Sharp edges and abrasion points</td>
<td>Trainees, Instructors</td>
<td>Use edge mitigation deviations or re-belay as appropriate. Verified Protection as per safe work method statement</td>
<td>Low</td>
</tr>
<tr>
<td>Falling Objects</td>
<td>Trainees, Instructors, Other Work Personnel, Public</td>
<td>Use of buckets/bags for containment of debris and small tools. All small tools (less than 8kg) attached to harness via lanyard. All larger tools attached to independent rope system. All persons in work area to wear appropriate helmets.</td>
<td>Low</td>
</tr>
<tr>
<td>Category</td>
<td>Participants</td>
<td>Measures</td>
<td>Risk Level</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Rescue &amp; Evacuation</td>
<td>Trainees, Instructors, Rescue Services.</td>
<td>Communications to rescue services. Rescue contingencies developed prior to practical work. Competent rescue personnel on site. Rescue equipment on site.</td>
<td>Low</td>
</tr>
<tr>
<td>Fire</td>
<td>Trainees, instructors, other work personnel, public</td>
<td>No hot work. Fire procedure and location of fire extinguishers communicated to workforce.</td>
<td>Low</td>
</tr>
<tr>
<td>Working with electrical equipment</td>
<td>Trainees, instructors</td>
<td>Earth breakers must be used. Electrical cables to be suspended from ropes where necessary and routed away from all moving machinery or access equipment or third party activity.</td>
<td>Low</td>
</tr>
<tr>
<td>Mobile Elevating Work Platforms (MEWP)</td>
<td>Trainees, instructors, other work personnel, public</td>
<td>All movements controlled or supervised by appropriately trained and qualified operators.</td>
<td>Low</td>
</tr>
<tr>
<td>Suspension intolerance</td>
<td>Trainees, instructors</td>
<td>Maintain movement in lower limbs. Use dummies for long rescue exercises.</td>
<td>Low</td>
</tr>
<tr>
<td>Strenuous and unfamiliar exercise and movement</td>
<td>Trainees</td>
<td>Ensure trainees warm up appropriately, take appropriate rests and during all manoeuvres keep awareness of correct body positioning and techniques to decrease chance of arm and back strains</td>
<td>Low</td>
</tr>
</tbody>
</table>
Use of unfamiliar techniques | Trainees | Both the trainees and instructors need to be certain that the instructions are fully understood prior to start. | Low

Note: The items in the risk assessment on the previous pages cover a training site only. Other hazards may be present on your worksite. These will require your full attention and the recording of specific control measures in order for them to be understood and acted upon by supervisors and technicians.

**Job Hazard Analysis**

Including the results of the detailed risk assessment produce a daily Job Hazard analysis (JHA), directly related to the tasks to be performed. It is a technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment. Ideally, after you identify uncontrolled hazards, you will take steps to eliminate or reduce them to an acceptable risk level.

**Appropriate jobs for JHA**
- Jobs with the highest injury or illness rates
- Jobs with the potential to cause severe or disabling injuries or illness, even if there is no history of previous accidents
- Jobs in which one simple human error could lead to a severe accident or injury
- Jobs that are new to your operation or have undergone changes in processes and procedures
- Jobs complex enough to require written instructions

**Safety Method Statement**

A Safety Method Statement is prepared from the results of the Risk Assessment. The Safety Method Statement states the sequence of events necessary for the safe execution of the task. It should be reasonably detailed, setting out the general principles and working procedures for each part of the task. The Safety Method Statement must be shown to, and fully understood by, all the members of the team, and made freely available to them for the duration of the work.

During operations, should you be required to gain access to a new area or use techniques not covered in the Safety Method Statement, appropriate documents should be added to highlight the changes. Any new documents must then be shown to, and understood by, all members of the team before the new work is carried out. Upon completion it should be filed away with the Risk Assessment.
Contents of a Safety Method Statement

When writing a Safety Method Statement consider the following and include under the relevant headings.

- Introduction, originator and date
- Copy of the relevant Risk Assessment
- Detailed sequence of events including hazard identification and risk control measures
- Scope of works
- Details of all personnel including; qualifications, levels of competency, training requirements and team structure. Names of the people who are responsible for coordinating and controlling safety arrangements
- Special equipment, plant and machinery requirements. This should include certification where applicable
- Arrangements for safeguarding personnel and third parties, including the general public. Exclusion of third parties from the work area. Details of areas outside the site boundaries that may need control during critical aspects of work
- Emergency considerations such as rescue, evacuation and fire procedures
- Locations and means of fixing the stability of any lifting equipment to be used
- Details of Personal Protective Equipment (PPE) and other risk control measures to be used
- Communications
- Welfare arrangements
- Permits to work/isolation of services
- Arrangements for temporary services required (e.g. toilets, electricity)
- Arrangements for the control of site transport
- Any environmental limitations that may apply; such as wind speed, rain and temperature
- Arrangements for the disposal of waste
- How hazardous substances will be controlled

Permits to Work

Remember, where the environment you are to enter contains hazards such as live electrical conductors, hot metal ducts or vents for steam and gases or entering into a confined space then a ‘Permit to Work’ system may be in operation. This will generally be obtained from the local issuing authority to ensure that such hazards are effectively isolated before work
Thorough & Periodic Examinations

Lifting equipment should be thoroughly examined:

1. Before first use (the declaration of conformity normally serves this purpose)
2. Upon receiving the item from a third party
3. Every six months, or at intervals specified in an examination scheme drawn up by a competent person and taking into account manufacturer’s recommendations and the work conditions

Lifting equipment should also be examined each time exceptional circumstances occur which could jeopardise the safe use of the equipment.

Remember lifting equipment shall also be subject to a pre-use check similar to that of PPE.

Records

A certificate of conformity indicating the standard to which the equipment conforms, and any strength requirements should be made available to the user. All components of the rope access system should be traceable to the certificates of conformity and examination reports. A coded marking system should be used.

Certificates of conformity should be kept for as long as the equipment remains in use. Thorough examination reports for the previous two years should be made available for inspection by the authorities.

Suitability of Work Equipment

All work equipment should be constructed or adapted as to be suitable for the purpose for which it is used or provided. The selection of work equipment must have regard to working conditions and any additional risks posed by the use of the work equipment. The equipment must be used only for operations, and under conditions for which it is suitable.

Maintenance

Employers, employees and others are to ensure that work equipment is maintained in an efficient state, in functional working order and in good repair. Where the machinery has a maintenance log, the log must be kept up to date. Any work equipment that becomes damaged or non-functional shall be quarantined and the either repaired by competent persons or scrapped.
Specific Risks

The use of equipment is restricted only to competent persons who are given the task of using it. Only suitably competent persons can maintain or repair equipment.

Information and Instructions

Users and supervisors of equipment must be given adequate health and safety information, and where appropriate, specific written instructions relating to the use of work equipment.

Training

All users and supervisors who use work equipment must receive adequate safety training including how to perform pre-use checks (e.g. cables checked and coiled wires unreeled), how the equipment may be adapted in use and any risks which may then arise and the precautions to be taken.

Use of Hazardous Substances

Using hazardous substances can put people’s health at risk. Exposures to hazardous and toxic substances are addressed in specific standards for the general industry, shipyard employment, and the construction industry.

1. Assess health risks to technicians and others.
2. Act to prevent or control exposure to substances.
3. Provide and maintain safety control measures.
4. Monitor and record measures and employees’ health.

Hazardous substances include any material, mixture or compound used or produced at work which are harmful to people’s health in the form in which they occur in the workplace. They are found in nearly all work places, for example; factories, bridges, oil platforms and office blocks.

Commercial chemicals and substances are supplied with a Materials Safety Data Sheet (MSDS) which will provide information about the types of hazards involved in handling, storing and transporting the material.

Generally the MSDS sheet will not show the effects chemicals have on ropes and harnesses. It will often be necessary to consult with both the chemical and equipment manufacturer to verify that the chemical will have no harmful effects on the equipment. It may also be necessary to carry out specific testing to verify this.

More information on this subject can be found in Annex J of the IRATA ICOP.
Manual Handling

Assess the risks associated with moving objects by hand or by bodily force with the aim of eliminating or minimising the risk of injury or long term health problems. All manual handling has to be within the capability of the technician. Manual handling risk assessments can be applied to assess tasks that could pose a risk of acute or chronic injury or condition. Consideration should be given to the effects of Manual Handling operations during hauling and counter-weighting exercises and also where lifting operations are carried out when your feet are not against a solid structure.

PPE Overview

When the use of personal protective equipment has been specified for hazardous work, its use will be mandatory as a condition of employment. Supervision, supervisors and Project Supervisors, will be held accountable for employees allowed to work without compliance. The accident statistics produced by IRATA have shown that the majority of reported accidents have been of a minor nature and have involved operatives not wearing the appropriate PPE, in particular suitable gloves and eye protection. In order for our industry to maintain its very high standards of safety, operatives are encouraged to wear the appropriate PPE for the full duration of the work activity creating the hazard.

There are 3 categories of PPE according to its level of complexity and the level of hazard against which it protects. These are:

- **Category 1** Simple  
  (gardening gloves, non-specialist coveralls)

- **Category 2** Intermediate  
  (helmets, protective footwear)

- **Category 3** Complex  
  (for protection against mortal danger)

Most rope access suspension equipment will fall into ‘Category 3’ and must undergo independent type testing, usually to European Performance (EN) standards.

The equipment must be supplied with appropriate technical and user instructions and must be manufactured under an independently verified quality system (e.g. ISO 9000) or be subject to periodic independent batch testing.

To counter the causes of degradation, the PPE Regulations require components to be examined at least every six months.
The UK HSE Specialist Inspector Report No. 59 ‘Issues surrounding the failure of an energy absorbing lanyard’ states that with regard to textile items, this period should be reduced to every six months. However, for use in ‘arduous environments’ this should be reduced to every three months or more frequently if the risk assessment shows special hazards. More information on this subject can be found in Annex J of the IRATA ICOP.

**Accidents and Incidents**

Employees are required to report all accidents to their supervisor as soon as practicable and possible.

You must notify your company-nominated person immediately (e.g. telephone) so that they can notify the enforcing authority without delay. You will need to record and provide details about the work situation, the injured parties and the accident. Take photographs, measurements and make detailed notes as soon as possible after the incident. A completed accident report must follow the initial notification.

Near misses should also be reported to your employer to assist in achieving the aim of continuous improvement of working methods.

Currently only IRATA compile accident returns for their members and the IRATA accident statistics and analysis is a free download from www.irata.org

**Selection of Equipment**

**Harnesses**

Suitable harnesses should be chosen for the task and be of a design that will support the user in the correct position. The harness should be comfortable, allowing adequate movement of the user and the unhindered operation of other devices within the system.

Harnesses should conform to the relevant standards for their particular application. Industrial sit harnesses are designed for Work Suspension (though may be used for Work Restraint purposes also) and should conform to appropriate CE EN 361, CE EN 358, CE EN 813 and CE EN 12841 type B European standards and to ANSI Z359.1, NFPA 1983 Class III, CSA Z259.10 North American standards.

Fall arrest situations require a full body harness conforming to EN 361. Some ‘combination’ sit harnesses also conform to the requirements of an EN 361 full body harness, making them a useful dual purpose harness. Some other sit harnesses can be adapted by adding the correct chest harness and a special EN 361 attachment to connect the two.
Mountaineering harnesses complying with EN 12277 are not sufficient for industrial rope access use.

**Connectors**

All connectors used in rope access, should be of the double closure type (e.g. screw gate) or screw link method of closure (e.g. Maillon Rapide) as these provide the required level of security from accidental detachment. Some self-locking connectors (e.g. twist lock) may lead to “rollout” and detachment and as such should only be used with special consideration.

Steel connectors should be chosen when making attachments to other metal anchors, for example, cables, eyebolts and hangers.

The connector should be of such a design and size that it is able to rotate freely on the anchor without hindrance and without loosening the anchor or putting incorrect loading on the connector.

Carabiners should only be loaded along the axis of their length (on a line close to the spine). Attaching carabiners to multiple items of equipment, having more than two carabiners connected to each other where a shock load could occur or attaching carabiners to items that are too large a diameter or an irregular shape (angular steelwork) may cause undue loading and promote failure.

To avoid loading against the gate, it may be more appropriate in some instances to use a carabiner with a captive eye to maintain a lanyard or component in the intended position.

‘Maillon Rapides’ of the appropriate shape may prove more suitable where permanent or semi-permanent attachments are required, or where multi-directional loading may occur.

Carabiner type connectors should conform to ANSI/ASSE Z359.1-2007: or EN 362 (B.L. 15kN / 3,300lbs) however, under IRATA standards they must be a minimum of 22kn.

**Descenders**

Descenders are devices, which attach the operative to the working rope and allow a controlled descent. They must give the user total control over the descending speed and not cause undue shock loading to the rope during braking. The descender should be of a type that will stop the descent if control is lost by the operative and cannot be accidentally detached from the rope once threaded.

The current standard for descender devices used in the rope access industry is often the CE EN 341 Class A also CE EN 12841 type C or NFPA 1983 L.
Ascenders

These devices are attached to and used to climb the working rope. They should be of a type that cannot be accidentally detached from the rope once engaged and cause the minimum amount of damage to the rope when in use. Dynamic loading to the ascender when attached to the rope must be avoided as this can cause serious damage to the sheath.

The current standard for rope adjustment devices often used is the European standard EN 567 or ANSI Z359.1

Back-up Devices

These devices are attached to the safety rope and used in addition to any other equipment engaged on the working rope. Should the operator lose control of a descent/ascent, or the working rope fail, the back-up device should lock onto the safety rope and help to absorb any shock loading that may have been generated without causing significant damage to the safety rope.

Some types of fall arrest device which conform to EN 353-2 might also be appropriate, provided that they can be positioned on the rope by the user.

The Petzl Shunt is used by many as a back-up device in the rope access industry, conforming to the standard, EN 567. The Shunt has no teeth to damage the rope and reduces the ‘Peak Impact Force’ (PIF) to approximately 3kN in a fall situation. Properly supervised training is essential for safe use however, and should not be used as a fall arrest device by itself or outside the IRATA scheme of Work. The shock load should be kept to as low as possible to conform to best practice and international standards.

Major precautions are required when using a ‘shunt’:

- Minimize contact with the body to avoid defeating the auto lock
- Do not put your hand on the rope above the shunt to avoid defeating the auto lock
- Use the ‘one for one technique’ at all times
- Ensure the casualty manages a separate shunt during rescue practice
- Never allow the Shunt to go below shoulder height and or below the level of the top of the descender
- For rescue ensure the lanyard length is restricted to 60 cm/2 ft
- Ensure the only ropes used are low stretch 10.4mm - 7/16th diameter and not less
Ropes

Polyamide or polyester ropes of a kernmantel construction are normally considered suitable for rope access applications, i.e. constructed with a load bearing core (kern) and an outer protective sheath (mantel) that provides resistance to both wear and the ingress of dirt and grit.

Low Stretch ropes conforming to EN 1891 (Type A) should be used for general rigging. This rope has undergone testing to ensure that it has a Minimum Breaking Load (MBL) of 2200kg and the maximum elongation does not exceed 5%. This latter test is carried out by first applying a pre-load of 50kg, which is then increased to 150kg. The % elongation is measured between the two loads.

Low stretch ropes are also tested by subjecting them to a series of Fall Factor 1 tests with a 100kg load, generally breaking after approx. 10 Fall Factor 1 falls. In practice, Low Stretch rope should not be subjected to Fall Factors in excess of FF 0.3 and should be retired after one fall. The Working Load Limit of Low Stretch rope is one tenth of its quoted minimum breaking load.

Dynamic ropes conforming to EN 892(UIAA (1)) (Full Rope, generally with a minimum recommended diameter of 10.4mm) will stretch as much as 15% with the same static loading as for Low Stretch rope, dependant on the manufacturer. In a shock-loading situation a dynamic rope can stretch as much as 50%. Instead of being subjected to FF1 falls, as with low stretch rope, dynamic rope is subjected to FF2 falls. Generally they will break after being subjected to approximately 10 FF2 falls.

In practice, in the rope access industry, dynamic rope should not be subjected to Fall Factors in excess of FF1 and should be retired after one fall. The Safe Working Load of a Dynamic rope is ‘one person’.

When choosing the type of rope for any particular application, the need for energy absorption should be balanced against the need to avoid excessive elongation or retraction of the rope.

Webbing

Webbing based equipment, including slings, harnesses and lanyards should be chosen so that any damage (through abrasion, cutting, excessive loading, heat, UV etc.) will become immediately visible before significant loss in strength occurs. Structural stitching will be of a contrasting colour to that of the webbing so as to aid inspection.
Anchor slings made from textiles should have sewn joints and have a minimum rated static strength of 22kN. Anchor slings should not be larks footed. The Working Load Limit of a webbing product is one tenth of its quoted minimum breaking load.

Webbing slings should conform to ANSI/ASSE Z359.1-2007: EN 566 or EN 795 B and lanyards to EN 354.

**Cow’s Tails**

Cow’s tails are used to connect the operative’s harness to the safety or working rope (via the appropriate knots and suitable attachment points). They should be able to withstand any dynamic forces they may be subjected to, including those that may occur as a result of a failure within the suspension system. Generally this would require them to be made from dynamic rope, conforming to EN 892 (UIAA (1)) (Full Rope, generally with a minimum recommended diameter of 10.4mm.)

The length of the cow’s tail should be kept as short as possible and limited to the limit of the operative’s reach when under tension and less than 1m/3ft.

The ideal length of the longest cow’s tail would be 0.6m/2ft with a maximum recommended Fall Factor not exceeding FF1. With no shock absorption being allowed for the maximum impact force generated with a 100kg/220lbs mass would be 6kN (600kg/1300lbs).

Where fall distances or fall factors are in excess of this then the use of energy absorbing lanyards should be considered. Lanyards used for safety backup in Rope Access shall be used in such a way such that any fall shall not exceed 4kn/900lbf force.

**Energy Absorbing Lanyards**

Energy absorbing lanyards are used to connect an operative’s fall arrest harness to a suitable attachment point on the structure. In the event of a fall the lanyard will limit the fall height and reduce impact forces on both the operative and the structure to below 6kn/1300lbs for the USA. The lanyards webbing or rope construction should have a minimum rated static strength of 22kn/4,800lbs. The longest length available is 2m/6ft; however, lanyards should be chosen which reduce the potential fall distance to an absolute minimum.

Single energy absorbing lanyards are used to protect a worker whilst entering a small hazardous area via a pre-installed safety harness eyebolt or temporary anchor strop. They are also used for connecting an operative to a permanent fall arrest system such as a continuous wire system.
Where progress around a structure is required then a double energy absorbing lanyard should be utilised thus ensuring continual attachment whilst progression is made. Two single lanyards should never be used as the force will be split between them and they will not deploy correctly.

**Helmets**

Rope access technicians should wear protective helmets that are suitable for the type of work being undertaken. It should have a fully adjustable head cradle and chinstrap for comfort and to prevent accidental loss of the helmet in the event of a fall. Some models conform to the industrial standard ANSI Z89.1 03 (EN 397) in respect of the shell, and the mountaineering standard (EN 12492) in respect of the 5kN chinstrap. These models, however, are hybrids and as such do not conform to any standard, industrial or otherwise. EN 397 helmets with a full cradle and chin strap assembly are generally deemed suitable as the risk of a large fall during rope access operations is low.

Helmets without a peak will prove beneficial when working in a vertical environment, in that vision will not be obscured whilst looking upwards. It would be an advantage if the helmet allowed for the installation of ear defenders and protective face shields. Helmets should always be used with the chin strap fastened.

**Equipment Strengths**

Breaking strengths may vary depending on particular product specifications from different manufacturers. The following items show the Minimum Breaking Loads (MBL) allowable for the particular Equipment Standard (EN Standard).

<table>
<thead>
<tr>
<th>Description</th>
<th>Breaking Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW STRETCH KERNMANTEL ROPE 11mm</td>
<td>34kN (3400kg/7650lbs)</td>
</tr>
<tr>
<td>STEEL SCREWGATE CARABINER 10mm</td>
<td>22kN (2200kg/5000lbs)</td>
</tr>
<tr>
<td>MAILLON RAPIDE 10mm</td>
<td>25kN (2500kg/5500lbs)</td>
</tr>
<tr>
<td>WEBBING SLING 25mm</td>
<td>25kN (2500kg/5500lbs)</td>
</tr>
<tr>
<td>WEBBING SLING 18mm</td>
<td>25kN (2500kg/5500lbs)</td>
</tr>
<tr>
<td>FIXED SIDE PULLEY</td>
<td>22kN (2200kg/5000lbs)</td>
</tr>
</tbody>
</table>
The following items of equipment are limited to lower performance specifications when used in conjunction with the rope. The figures shown are with a typical 10.5mm diameter Low Stretch Rope when new.

**DESCENDER:**
A Petzl STOP will begin to slip at loads circa 4.5kN (450kg/992lbs). Its Working Load Limit (WLL) is 150kg/330lbs. A Petzl ID has a working load limit of 200kg during two person rescue simultaneous descent or 250 kg for lowering by expert users.

**ASCENDER:**
ASCENDERS will generally begin to damage the rope at loads circa 6kN (600kg/1300lbs). This figure will generally reduce to as little as 4.5kN (450kg) due to age and wear of the rope. During testing to EN 567, an ascender should be capable of holding a 400kg/880lbs load for 3 minutes.

For normal operations the descender device should be used to hold the weight of one person only. In the event of an emergency and with appropriate training and experience this can be increased to a maximum of two persons with extra precautions.

When a force greater than 3.5kN (350kg/770lbs) is applied to a Petzl Shunt on a 11mm diameter rope the Shunt will begin to slip along the rope. Whilst slipping along the rope it will apply a braking force (dynamic braking) and lock off once more when the force is reduced to below 3.5kN.

- Potential energy in a fall situation = Mass x Gravity x Height Fallen (M x 9.81m/s/s x H); expressed in kilo Joules (kJ).
- Peak Impact Force (PIF) = Mass x Acceleration (M x 9.81m/s/s); expressed in Newtons (N).
- As an approximation 1kN (Force) is equal to 100kg (Mass).

**Working Load Limit (WLL)**

The maximum load (as determined by the manufacturer) that an item of lifting equipment is designed to raise, lower or suspend. The WLL does not account for particular service conditions that may affect the final rating of the equipment.

**Safe Working Load (SWL)**

The maximum load (as determined by a competent person) which an item of lifting equipment may raise, lower or suspend under particular service conditions. The SWL can be lower than the WLL.
The WLL (as determined by the manufacturer) or the SWL (as determined by a competent person) must NEVER be knowingly exceeded.

As a general rule in rope access all carabiners and ‘Maillon Rapides’ will have a SWL that is equal to 20% or 1/5th of their Minimum Breaking Load.

Textile items (webbing slings, lanyards and ropes) used under the IRATA scheme of work will have a WLL that is equal to 10% or 1/10th of their Minimum Breaking Load.

In cases where the item of personal protective equipment does not have a clearly definable Breaking Load (BL) e.g. ascenders and descenders, then the SWL should be regarded as being the equivalent of one person in normal use, and in the case of a rescue situation, 2 persons.

You should never exceed the SWL of the weakest link in the system.

CE Marking

Ensure that all Personal Protective Equipment carries a CE mark. For ‘Category 3’ PPE, CE marking indicates that the product has been independently type tested and meets the basic requirements of the ‘Personal Protective Equipment at Work Regulations 1992’.

The prime function of CE marking is to protect against barriers to trade within the European Union. It is not meant to be taken as a mark of quality, although ‘Category 3’ PPE is subjected to such rigorous controls that this point could be argued otherwise.

However, CE marking alone does not mean the item is fit for the intended application. When purchasing or choosing an item of PPE, ensure that it conforms to the appropriate European or North American standard for that particular item and its intended use.

Equipment Standards

A selection of relevant standards is listed below: (At the time of going to press a number of the following Standards were ‘Under revision’).

**ANSI/ASSE Z359.0-2007:**
Definitions and Nomenclature Used for Fall Protection and Fall Arrest: Establishes the definitions and nomenclature used for the Z359 Fall Protection Code.

**ANSI/ASSE Z359.1-2007:**
Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components: Establishes requirements for the performance, design, marking, qualification, instruction, training, inspection, use, maintenance and removal from service of connectors, full-body harnesses,
lanyards, energy absorbers, anchorage connectors, fall arresters, vertical lifelines and self-retracting lanyards comprising personal fall arrest systems for users within the capacity range of 130 to 310lbs (59 to 140 kg).

**ANSI/ASSE Z359.2-2007:**
Minimum Requirements for a Comprehensive Managed Fall Protection Program: Establishes guidelines and requirements for an employer’s managed fall protection program, including policies, duties and training, fall protection procedures, eliminating and controlling fall hazards, rescue procedures, incident investigations and evaluating program effectiveness.

**ANSI/ASSE Z359.3-2007:**
Safety Requirements for Positioning and Travel Restraint Systems Establishes requirements for the performance, design, marking, qualification, test methods and instructions of lanyards and harnesses comprising personal positioning and travel restraint systems for authorized persons within the capacity range of 130 to 310lbs (59kg to 140kg).

**ANSI/ASSE Z359.4-2007:**
Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and components: Establishes requirements for the performance, design, marking, qualification, instruction, training, use, maintenance and removal from service of connectors, harnesses, lanyards, anchorage connectors, winches/hoists, descent control devices, rope tackle blocks and self-retracting lanyards with integral rescue capability comprising rescue systems used in pre-planned self-rescue and assisted-rescue applications for 1-2 persons.

**ANSI A10.14, 1991:**

**ANSI Standard Z89.1-2003:**
American National Standard for Industrial Head Protection for Type I head protection, or ANSI Standard Z89.1-1997, American National Standard for Industrial Head Protection for Type I head protection.

**NFPA Standard 1983:**

**NFPA Standard 1983: 2001:**
Standard on Fire Service Life Safety Rope, Harness, and Hardware.

**CSA Standard Z259.12-01:**
Connecting Components for Personal Fall-Arrest Systems.
**CSA standards**
Z259.1-05 – Body Belts and Saddles for Work Positioning & Travel Restraint  
Z259.2.1-98 – Fall Arresters, Vertical Lifelines and Rails  
Z259.2.2-98 – Self-Retracting Devices  
Z259.2.3-99 – Descent Control Devices  
Z259.10-06 – Full Body Harnesses  
Z259.11-05 – Energy Absorbers and Lanyards  
Z259.12-01 – Connecting Components  
Z259.13-04 – Flexible Horizontal Lifelines  
Z259.14-01 – Fall Restrict Equipment for Wood Pole Climbing  
Z259.16-04 – Design of Active Fall Protection Systems

**CSA Standard Z94.1-92 (R1998):**  
Industrial Protective Headwear.

**EN 361: 1993:**  
Personal protective equipment against falls from a height – full body harnesses.

**EN 362: 1993:**  
Personal protective equipment against falls from a height. Connectors.

**EN 567: 1997:**  
Mountaineering equipment. Rope clamps. Safety requirements and test methods.

**EN 795: 1997:**  
Protection against falls from a height. Anchor devices. Requirements and testing.

**EN 813: 1997:**  
Personal protective equipment for the prevention of falls from a height. Sit harnesses.

**EN 892: 1997:**  
Mountaineering equipment. Dynamic mountaineering ropes. Safety requirements and test methods.

**EN 12841 type C:**  
Standard for rope access descent devices.

**EN 341:**  
Descender device for rescue purposes
**Equipment Certification**

All PPE must be CE marked to meet the requirements of the European PPE directive and the subsequent regulations, ‘Personal Protective Equipment at Work Regulations 1992’.

These regulations require the following:

- The product must undergo independent type testing to a particular standard
- The manufacturer must install a quality management and assurance standard such as ISO 9000, or;
- The manufacturer must subject the product to regular batch testing at an approved test house

When purchasing PPE, a certificate of conformity, stating that the product meets the requirements of the PPE directive and conforms to any standards it claims to meet, should be obtained.
Certificate of Conformity

Below is an example of a certificate of conformity.

Certificate of Conformance

Spelean Pty Ltd is the exclusive distributor in Australia for Petzl products. This is to certify that the following items of equipment, intended for life support purposes, satisfy the performance requirements of the standards indicated below.

Item - Karabiner
Brand - Petzl
Model – Oxan Screw-Lock D M72 SL/SLN and Oxan Triact-Lock D M72 TL
Standard:
- AS/NZ 4488.1:1997 Industrial rope access systems Part 1 : Specifications (Section 6.4 Attachment Hardware)
- AS/NZ 1891.1:2007 Industrial fall-arrest systems and devices
Part 1: Harnesses and ancillary equipment (Section 2.2 Attachment Hardware)
- CE EN 362:2004 Personal Protective Equipment against falls from heights – Connectors

Item - Karabiner
Brand - Petzl
Model – Vulcan Screw-Lock D M73 SL/SLN and Vulcan Triact-Lock D M73 TL
Standard:
- AS/NZ 4488.1:1997 Industrial rope access systems
Part 1: Specifications (Section 6.4 Attachment Hardware)
- AS/NZ 1891.1:2007 Industrial fall-arrest systems and devices
Part 1: Harnesses and ancillary equipment (Section 2.2 Attachment Hardware)
- CE EN 362:2004 Personal Protective Equipment against falls from heights – Connectors

Signed on behalf of Spelean Pty Ltd

Philip B Toomer BSc (Hons) Rigger (DG RA N-0065125/1) MRACI
10 Jun 2010
If the product is not classified as PPE, but is considered to be in the realms of safety equipment, suitable certificates that give confidence in the quality and suitability of the product should be obtained, for example a certificate of testing.

**Equipment Marking**

The marking of equipment will allow the origination, standard, inspection history and history of use to be established at any given time for any given single item.

If equipment is not marked and therefore not traceable, it should not be used.

One exception is for individual karabiners which IRATA recognize as a problem in maintaining markings. Karabiners should be traceable to its last inspection when issued from stores as part of a manifest and certificate of conformance if not individually marked. A company purchasing system should be in place to prevent compatibility issues and a system for preventing contamination.

A recommended system for marking equipment is to use a serial code comprising letters and numbers to uniquely identify each individual item. All Petzl equipment manufactured from 2006 is marked with both ‘batch’ and individual serial numbers in the factory.

- Provide two letters that identifies the type of item; for example, Chest Ascender: CA.
- Provide a number that identifies the item uniquely among other items of the same nature; for example, 001.

Therefore the serial code for this particular item would be CA 001.

When marking dynamic rope the type of item would be ‘DY’ for low stretch rope, ‘LS’.

It is important to mark each rope with its length. All these markings should be placed on both ends of the rope.

**Methods of Marking Equipment**

Marking should be carried out in a manner that will not affect the integrity of the equipment.

- **Helmet** Mark the serial code on the inside with an indelible pen that will not affect the integrity of the shell.

- **Metal Items** Engrave the equipment lightly with the serial code in an area that is clearly visible and in a manner that will not affect the function or load bearing properties of the item. The product manufacturer will give advice on the best location to carry out such marking.
Webbing  Mark the serial code on the information tag supplied with the item.

Harnesses  Mark the serial code on the information tag supplied with the harness or alternatively engrave the serial code on the metal attachment point if it has one.

Rope  Wrap suitable marking tape around the circumference of the rope at both ends. Write the details required on the tape with an indelible pen. Cover the tape with clear heat shrink sleeve. Another new method of marking the rope is via RFD chips and readers.

**Equipment Examination**

Equipment examinations play a central role in the IRATA scheme of work. They generally fall into three categories.

1. **Pre-Use Check** – before each use and continuously during use
2. **Periodic Examination**
3. **Thorough Examination**

Any item showing signs of defect or alteration without the approval of the manufacturer should be withdrawn from service immediately.

The manufacturer of any Personal Protective Equipment (PPE) should provide information on how to inspect their equipment together with further information on the use, care, lifespan and maintenance of the product. It is then the responsibility of the user to follow this information correctly.

All inspections of PPE must be carried out by personnel who are trained and competent to do so. Familiarity with all equipment is essential if deviations from the norm are to be detected. In addition, the following general advice should be noted:

Manufacturer’s recommendations on the obsolescence of equipment, i.e. competency of examiners and frequency of examinations should be strictly adhered to. In certain circumstances however, this maximum service life could be as little as a single use.

Listed below are some general points to look for.

**Textile Equipment**

Rope and webbing should be given a visual and tactile inspection, both before being placed into storage and before being issued back into service.
In the case of **kernmantel rope** a tactile inspection should be conducted by physically running the rope through the hands and feeling for any deformities to both the inner core (kern) and outer sheath (mantel), whilst visually checking the sheath for signs of cuts, abrasion and bulging etc.

**Webbing equipment** should be inspected for cuts, nicks, tears, abrasion, broken stitches, chemical contamination and distortion of the weave pattern (thus indicating that the product has been subjected to undue loading).

**Abrasion** is the most common cause of strength loss in textile equipment. This is usually caused by equipment rubbing against sharp or rough edges, or against it. Another significant cause of abrasion which is often overlooked is the ingress of dirt and/or grit working its way into the weave or inner core of the product and abrading the internal fibre. This will cause loss in strength but may not be easily detectable in its early stages.

**Cleaning & Maintenance**: In order to reduce the effect of abrasion by dirt, textiles may be washed in clean water at a maximum temperature of 40°C.

If the textile is especially dirty a suitable cleaning agent such as pure soap flakes or a mild detergent (within a pH range of 5.5 to 8.5) may be used. Textiles should then be rinsed thoroughly in cold, clean water after washing. If a washing machine is used it would be advisable to place equipment in a suitable bag to protect against mechanical damage. Do not use a high pressure hose. Dry any wet equipment naturally in a well-ventilated room away from direct heat or sunlight. Always refer to the manufacturer’s instructions on care and maintenance.

Textiles that have been in contact with rust should be washed. Textiles with permanent rust marks should be regarded as suspect and scrapped. Tests have indicated that rust has a weakening effect on polyamides.

**Mechanical damage** e.g. crushing from a falling rock will also have a detrimental effect on textile equipment, with the strength loss being directly proportional to the severity of damage.

**Overloading** and/or **shock loading** will have a weakening effect on ropes and webbing, this being proportional to the amount of load that the textile is subjected to. Ropes and webbing which have been subjected to a high load should be scrapped immediately and in such a way that they cannot be returned into service.

**Chemical damage** to textiles is often difficult to detect until the rope or webbing begins to disintegrate and can therefore be missed during an inspection. White powdery residues on the surface of the textile or a notable change in texture may be an indication of this.
Any textile that has been subjected to chemical contamination should be withdrawn from service immediately. Information on the effect that a particular chemical has on textiles may be obtained from the equipment manufacturer.

If in doubt, quarantine, destroy and dispose of the suspect equipment in such a way that it cannot be returned into service.

**Note:** Polyester has a better resistance than nylon to acids. Nylon has a better resistance than polyester to alkalis.

Textile equipment that has a **burnt** or **glazed** appearance may have been exposed to high temperatures, either by coming into contact with hot surfaces or suffering the effects of heat caused by friction from the descending device or the rubbing of textile against textile.

All of these causes of damage will have a detrimental effect on equipment strengths, ranging from minor strength loss to rope or webbing failure.

Care should be taken to protect ropes and webbing from high temperatures as most man-made textiles will begin to change in character and therefore performance at temperatures in excess of 50°C.

**Metal Equipment**

Metal items such as carabiners, ‘Maillon Rapides’, ascenders, descenders and harness buckles should be inspected to ensure that their mechanical function is not impaired in any way. Ensure that springs, hinges and threads work smoothly and that bolts and rivets are tight. Signs of deformation, wear, cracks or other deviations from the norm should be sought.

The action of equipment with moving parts should be checked to ensure that it is regular. Equipment should be kept clean and dry, with all moving parts (excluding those that may come into contact with textile equipment) being lubricated with silicon-based lubricants.

Any item proving to be defective should be taken out of service immediately.

Metal equipment can suffer internal damage which may be extensive though not visually detectable. This is often caused through the incorrect care of such equipment, e.g. dropping, overloading etc. and can result in catastrophic failure without any prior warning. It is therefore vital that metal equipment is afforded the correct care and maintenance.

**Cleaning & Maintenance:** Metal equipment can be cleaned by submerging in clean hot water (max. 100°C) and using a detergent or soap which must afterwards be thoroughly rinsed. An abrasive pad or scrubbing brush may assist. These should be constructed of a material other
than metal; for example, nylon. Always refer to the manufacturer’s instructions on care and maintenance.

**Helmets**

Check both inside and outside the shell for wear, cracks, burns, deformation and traces of chemical substances. Check the condition of the cradle for sound fixing, tears and loose stitching etc. Check that all adjustable parts are fully operational without slippage and not damaged or worn. Always refer to the manufacturer’s instructions on care and maintenance. Some manufacturers recommend a thorough examination of their helmets every three months.

**Cleaning & Maintenance:** Helmets should be washed with clean water at a maximum temperature of 30°C. Do not use a high pressure hose. Use a soap or powder suitable for delicate fabrics to wash the straps. Leave to dry in a cool, dark well ventilated place. To remove traces of adhesive (e.g. stickers) you may use methylated spirits.

**Eyebolts for Rope Access**

The IRATA International Code of Practise for the Use of Rope Access Methods for Industrial Purposes’, states that all eye bolt anchors used for the purpose of rope access should comply with ANSI Z359.2 or EN 795.

Eyebolts should be thoroughly examined by a competent person at least every 6 months (or at frequencies determined in a written examination scheme drawn up by a competent person). The competent person has the responsibility to determine whether the thorough examination should include testing. In addition, eyebolts should be inspected before each occasion of use.

**IRATA Technicians’ Responsibilities**

IRATA technicians have a number of responsibilities under ICOP for inspecting equipment, depending on their level of competence.

**Level 1 Technician:**

1. Be able to carry out a pre-use check of all their personal suspension equipment
2. Be able to identify defective or worn items of personal suspension equipment and describe the reasons for failure
3. Equipment should be identified and examined regularly
4. Understand the principles of certification and traceability
**Level 2 Technician:**

1. As Level 1
2. Identify proper maintenance measures
3. Be able to carry out periodic inspection of items (e.g. long term rigging)
4. Know how to complete records of periodic inspections (and understand the need for keeping those records)
5. Understand the consequences of not reporting defects or situations posing a risk to health and safety

**Level 3 Technician:**

1. As Level 2
2. Be able to produce an examination scheme for any given item of lifting equipment
3. Be aware of factors of safety for metal and textile items
4. Understand the Safe Working Loads for key items of rope access equipment
5. Explain the key requirements of the regulations relating to rope access equipment and operations
   
   - Application – Access/Egress of the worksite. Protection to others. Objective hazards
   - Equipment strengths
   - Positioning – especially in relation to other work tasks
   - Equipment marking – be able to identify proper position and method. Understanding of SWL of 1 person for PPE
   - Organising of operations – possess adequate theoretical and practical knowledge in relation to load attachment, work environment and hazards
   - Thorough examination and inspection of equipment
   - Reporting defects - the need for good record keeping

6. Understand the strength and properties required of anchorages suitable for use in Rope Access operations.
7. Be aware of the relationship of LOLER with other key legislation.
Equipment Handling & Storage

Equipment should be stored in a secure environment to which access is restricted to necessary, competent personnel only.

After the equipment has been cleaned, dried, serviced and inspected in accordance with the manufacturers ‘User Information’, it should be stored in a dry, well-ailed environment away from direct sunlight, other sources of excessive heat and away from any chemical contaminants. When on-site, ropes and other items should be stored loose in equipment tackle sacks in a safe, secure place to reduce the risk of chemical attack or mechanical damage.

Where ropes are required to be coiled, consideration should be given to the size and manageability of the coil as well as whether it needs to be coiled ‘double’ with the anchor point knots pre-tied to allow for easy installation during an aid climb for example.

It is preferable if the coiling method does not twist the rope or be prone to tangling during uncoiling. A standard 50m dynamic rope, pre-coiled and secured with straps by the manufacturer will require two operatives to uncoil it if tangles. Where rope is to be removed directly from the drum, it will first require securing and the rope should then be unrolled into a heap on a protective pad. Once cut and marked the rope can be coiled in the manner appropriate to the operations taking place.

Consideration should be given to the problems associated with tangled ropes, particularly during rescue operations when time is of the essence. A number of different rope coiling techniques will be demonstrated by your instructor.

Equipment Quarantine Procedures

A quarantine procedure is necessary to ensure that:

- New equipment does not enter service without first being inspected, marked and the details of such being entered into the relevant logs
- Defective or suspect equipment, which has been withdrawn from service, does not enter service again without the inspection or approval of a competent person
- Equipment awaiting disposal cannot re-enter service
- Equipment returned from operations does not re-enter service without first being inspected

This may be achieved by having a secure area marked ‘Quarantine’, where equipment in the above categories can be kept separately from other equipment that is ready for use. When an item enters the quarantine area it should be inspected by a competent person and a secure
label should be attached to it stating the reason; for example: Quarantine – Awaiting inspection, returned from site.

### Reporting Lost or Defective Equipment

The law requires that:

1. Employers make arrangements to ensure employees can report any lost or defective PPE.
2. Employees report any loss, damage or deficiency.

These arrangements should ensure that defective PPE is replaced before the employee concerned begins work again.

### Disposal of Defective Equipment

All equipment withdrawn from service should be disposed of by a suitably competent person, with the course of action being entered into all relevant logs.

In the case of textiles, these should have the serial codes removed and be cut up into unusable lengths before disposal.

Metal items should be made recognisably and mechanically dysfunctional before disposal.

Once it has been decided that an item of equipment is to be withdrawn from service, steps should be taken to ensure there is no possibility of that equipment being used from that point onwards.

### Principles of Safe Rigging

All persons using industrial rope access techniques (i.e. where rope is used as the primary means of support or positioning) must be attached to two independently attached ropes. These should be arranged so that in the event of a failure in one, the operative is protected by the remaining rope and cannot suffer a fall.

In practice, one of these ropes will be used as a primary suspension (working) rope and the other a safety (back-up) rope. Each rope should have its own separate anchor system. Ropes should be rigged so that if one should fail, a shock load would not be passed on through the system, for example; to the operative, the remaining rope or the anchor.

No potential fall should cause the operator to impact the ground. All practicable measures should be taken to avoid injurious impact with the structure or other obstructions.
The adverse effects of high winds should be removed by (e.g. only working on the lee side of a structure, fixing tensioned guide lines, installing deviations at regular intervals to keep the ropes in place or simply not working in such conditions).

‘Y’ Hangs

‘Y’ Hangs can be achieved by rigging both ropes in such a manner that each rope is attached to, and shares the load between, both anchor points. When the ropes are weighted, the load should be evenly distributed between both anchor points. This method of rigging is referred to as a ‘Y’ hang.

The crucial element in this rigging method is the angle of the ‘Y’.

At angles less than 90°, the load placed on each anchor point is significantly less than the load on the rope. At angles greater than 120°, the load placed on each of the anchor points is significantly greater than the load placed on the rope. It is essential therefore, that rigging angles should never exceed 120°, at which point the load placed on the rope is equal to the load placed on both anchor points. Ideally an angle not exceeding 90° should be achieved.

Where the anchor points for a ‘Y’ hang are located a reasonable distance apart then consideration should be given to the effects of the failure of one of the anchors (e.g. a swing likely to cause personal injury). This potential problem can be lessened by using 2 anchors for each half of the ‘Y’, thereby preventing a swing should any one element of the system fail.

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

<table>
<thead>
<tr>
<th>ANGLE OF ‘Y’ HANG</th>
<th>ANCHOR POINT LOAD (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>= 50</td>
</tr>
<tr>
<td>60°</td>
<td>= 57</td>
</tr>
<tr>
<td>90°</td>
<td>= 71</td>
</tr>
<tr>
<td>120°</td>
<td>= 100</td>
</tr>
<tr>
<td>140°</td>
<td>= 146</td>
</tr>
<tr>
<td>150°</td>
<td>= 193</td>
</tr>
<tr>
<td>160°</td>
<td>= 288</td>
</tr>
<tr>
<td>161°</td>
<td>= 303</td>
</tr>
<tr>
<td>177°</td>
<td>= 1915</td>
</tr>
<tr>
<td>178°</td>
<td>= 2873</td>
</tr>
<tr>
<td>179°</td>
<td>= 5747</td>
</tr>
</tbody>
</table>

Note: By exceeding 160° in a ‘Y’ hang, the WLL of a typical 10.5mm Low Stretch Rope would be exceeded when a load of 100kg is applied.
The formula for calculating the anchor point loading on ‘Y’ hangs is as follows:

\[
\text{Load at each anchor} = \frac{L + \cos \frac{1}{2} A}{2}
\]

If we take a ‘Y’ hang with an angle (A) of 120° and a load (L) of 100 kg the above formula can be worked out thus:

\[
\text{Anchor Load} = \frac{L + \cos \frac{1}{2} A}{2} = \frac{100 + \cos 60°}{2} = \frac{100 + 0.5}{2} = 200 = 100 \text{ kg}
\]
If we were to look at a worst case scenario with the angle of the ‘Y’ hang being 179° and the load being 100 kg the following anchor point loading would result. It is unlikely this would be possible with a rope but could easily be achieved with a ‘Tirfor’ type winch and cable.

\[
\text{Load} = \frac{(L \times \cos \left(\frac{\pi}{2} \times A\right))}{2} = \frac{(100 \times \cos 89.5°)}{2} = 5747 \text{ kg}
\]

The calculations below show how anchor point loads may be greatly reduced by altering the angle by only a small amount. In this example the angles are reduced from the 179° example described above down to 178°.

\[
\text{Load} = \frac{(L \times \cos \left(\frac{\pi}{2} \times A\right))}{2} = \frac{(100 \times \cos 89°)}{2} = 2873 \text{ kg}
\]
1. ‘Y’ Hang with Figure of 8 or 9 on the Bight and Alpine Butterfly

2. ‘Y’ Hang with a Bunnies Ears Knot (used only on anchors less than 2m/6ft apart)
Deviations

A deviation redirects the path of the ropes from the anchor points to avoid abrasion or other potential causes of damage to the ropes, or to provide more accurate access for the operative.

A deviation may be a sling or strop attached to a part of the structure, and then attached to the ropes via carabiners 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 assessment of the risks associated with the failure of a deviation should be carried out prior to the rigging and subsequent use of a deviation.

An example of the effect of the angle on the loading is given below. The loadings are based on a mass of 100kg (which equates to a force of approx. 1kN). Masses smaller or larger than this would give different loadings to those shown in the example below.
Deviation anchor loads in relation to angle of deflection from the vertical.

Rope Protectors

Rope protectors should only be used when it is not practicable to utilise another form of rope protection e.g. a re-belay or deviation. Commercially made rollers are the best type of rope protector when the rope has to run over a sharp edge. Rope protectors made from heavy-duty canvas with a ‘Velcro’ closure are also available. **DO NOT** use plastic materials for rope protectors as the friction generated will lead to the rope protector wearing through after only a short period.

Ideally, the attachment string should be tied to the structure. Failing this, it should be tied with a ‘Prusik’ knot or similar around the back-up rope only. This ensures that when the working rope is weighted, and therefore stretched, the rope protectors will remain in its desired position. **Both working and back-up ropes should have an individual rope protector on each.** Consideration should be given to the effects of the back-up rope stretching in the event of a failure of the working rope. This may require placing a number of rope protectors to allow for this.
Rope Security

All ropes, whether reaching ground level or not, should have a stopper knot tied at a suitable point to:

• Prevent the operative from accidentally descending off the end of the rope

• Bunch the sheath of the rope up against the knot in the event of serious shock loading with an ascender. This might prevent the operative falling all the way to the floor. It is important not to have excess rope coiled on the floor

Anchors – General

There are a variety of anchor strengths specified in various standards. IRATA have created Annex F of the ICOP covering anchors, refer to that document for further information.

All anchor points used in rope access should be capable of withstanding any foreseeable loads to which they may be subjected. Fall protection ANSI Certified tested points should be capable of standing twice any expected load and if uncertified capable of a minimum of 5,000lbs as per ANSI Z359.2-2007. ASTM standard E 488 – 96 may also be used.

IRATA ICOP specifies that it should be able to withstand 2.5 times the expected maximum permissible load on the user (6kN) i.e. 15 kN (1,500kg/3,300lbs), which is above the ANSI work positioning and rescue systems requirement but below that of fall arrest systems.

Anchor Requirements USA

**ANSI Z359.2.2007 Static Load Requirements**

Fall Arrest Systems:
Non-Certified = 5,000 lbs. (22.2kN)
Certified = 2 x maximum arresting force

Work Positioning Systems:
Non-Certified = 3,000 lbs. (13.3kN)
Certified = 2 x foreseeable force

Restraint & Travel Systems:
Non-Certified = 1,000 lbs. (4.5kN)
Certified = 2 x foreseeable force

Rescue Systems:
Non-Certified = 3,000 lbs. (13.3kN)
Certified = 5 x applied load

Horizontal Lifelines:
Must sustain at least two times the maximum tension developed in the lifeline during fall arrest in the direction applied by lifeline forces. Installed permanent anchorage connectors, such as expansion anchors or glue in anchors shall be pull tested to 600kg/1,350lbf (6kN) in all directions of potential loading to verify proper installation. Permanent anchors shall be tagged to indicate proper installation per these requirements. The tag shall include the pull test date and this standard’s number.

Examples of suitable anchor points are: structural steelwork, suitably tested mechanical and chemical anchors, concrete features, substantial geological features and large trees.

Process pipe work meeting certain criteria may be used if used according to your company’s code of practice and as agreed with the facility’s operators.

The strength of all anchor systems (except intermediate deviation anchors, which may be weaker) should be at least as great as that of the ropes attached to them and not less than 15kN.

When anchor lines are tensioned, for example; when creating a horizontal or diagonal tensioned line, the increase in the forces at the anchor points and other components in the system should be taken into account and calculated by a competent person.

**Mechanical & Chemical Bonded Anchor Bolts**

Various types of anchor bolt are available, for use in brick, stonework, rock and steel. There are also three main fixing types; mechanical, chemical and bolt through. Selection depends on the substrate the anchor is to be fixed to. For example, a resin type anchor should be used if it was considered the expanding action of a mechanical type anchor might fracture the host material.

Another important consideration is whether the bolt is to be removed after use. A sleeve type resin or expansion anchor can be left in the hole, the hanger plate removed and the hole capped. The anchor can then be subsequently re-used on return visits by uncapping the hole, replacing the hanger plate and re-testing to the required load.

The manufacturers’ installation instructions must be followed closely. Some general points of good practice are listed below:

- Anchor bolts for rope access must always be used as a minimum in pairs. 3 may be required to attain required strength
• The host substrate should be carefully checked for cracks and any other weaknesses
• The correct anchor type must be selected for the substrate material
• Pairs of bolts should be aligned correctly in relation to the intended load direction
• Holes should be drilled at 90° to the surface and to the correct depth using the depth gauge on the drill
• The hole diameter is dependent on the diameter of bolt and fixing type
• The minimum distance between bolts as outlined in the manufacturer’s instructions should be observed if full strength is to be retained. Contact the manufacturer for details
• Holes should be cleaned out to remove loose material using a suitable hole brush and then blown out using a suitable blower. This is especially important for chemical anchors
• Expansion bolts should be torqued to the required value as determined by the manufacturer
• Resin anchors should be given time to cure, curing time is dependent on temperature
• The bolt head or hanger should sit flush with the surface

Ground Anchors

It is appreciated that the operative may be required to operate in an area where no anchor points are readily available. In these cases, it may be possible to utilise suitable ground driven anchors or attach to suitable points on a motor vehicle (that has been effectively isolated and rendered immovable). Companies carrying out this type of work will have their own documented procedures for these types of anchorage.

Dead Weight Anchors

Occasionally there are no anchor points on the roof of the structure and it is preferable to use dead weight anchors.

Where dead-weight anchor systems are used, particular account should be taken of cantilever or frictional effects. Wet or icy conditions can significantly affect the frictional performance of anchor-weight systems. The frictional resistance of any anchor weight should be assured by checking that it does not move when subjected to a load of four times that which will be applied in a work positioning situation. A higher weight is required if a fall arrest situation is envisaged. Users should also consider the possibility of rescue, which might involve the weight of two persons. Always refer to the manufacturer’s instructions before using these anchor devices.

In some situations it may be possible to anchor ropes at ground level and direct them up and over a structure so that access to the opposite side may be gained. If this technique is to be
applied, action should be taken to prevent third parties entering the vicinity and tampering with the rigging.

The ‘stretch’ potential in the rope and unusual abrasion points should also be considered.

**Beam Clamps**

Beam clamps can provide a simple and portable attachment point for rope access purposes. They should not be used on any beam other than those designed, tested and marked as a runway beam (or lifting beam) with the exception that they may be used on a beam forming part of a structure where a specific design check for this purpose has been made.

For specific details on the correct use of beam clamps you should refer to the user information supplied with the product.

**Using Roof Buildings & Structures as Anchorages**

It is often possible to anchor ropes inside or around a sub-building situated on the roof of a building, with the ropes radiating out across the roof to the required points on the roof edge.

Care should be taken to ensure that all textiles used for rigging are suitably protected against abrasion and cutting. Where the anchor itself may cause damage to rope or textile slings it will be necessary to use canvas rope protectors or install wire slings.

The most common method of anchoring ropes around roof buildings is to utilise two 12mm steel cables. These should be protected at the corners of the roof building to ensure damage does not occur to either the cable itself or the roof building.

Operatives should also ensure that the ropes are adequately protected from any sharp edges or abrasion points that may be encountered across the roof and down the length of the drop.

At all stages of rigging, personnel should take into account the consequences should any part of the system fail. Steps should be taken to ensure that failure of any one part of the system does not affect the integrity of the rest.

**Rope Access Manoeuvres**

Before any work is carried out it is important to ensure that the level of supervision is appropriate to the work situation in terms of the numbers of operatives being supervised and the skill levels of the operatives being appropriate for the tasks.
The supervisor’s role is to ensure that all work is carried out in accordance with the method statement to ensure that there are no accidents, no wastage of materials and no defects in the work that is being carried out.

Any team members who have had a significant break from rope access work should undergo refresher training at the appropriate level prior to the commencement of the work. Newly qualified operatives should be subject to close supervision until such time that they are deemed competent to work under the supervision of an experienced operative.

Should the worksite have more than one distinct working area then it is important to ensure that all work areas have the appropriate level of supervision, in every case, the level of supervision should be appropriate to the particular work situation and the numbers and skills of the work team.

On larger sites where communication is a problem, consideration should be given to the provision of two way radios and their correct use. Permission should be sought from the site manager before radios are used.

Work teams must be no smaller than two operatives with one of these being a Level 3 who is competent to supervise.

**Pre-Use Equipment Check**

All suspension equipment needs to be checked prior to each use. Each Level 1 technician should have their equipment inspected by the Level 3 Safety Supervisor or his nominated person. **Before any rope manoeuvres are carried out, ensure that there is a security knot tied in the lower ends of both working and back-up ropes.**

**Safe Access To & From the Ropes**

- Where possible, the operative will either attach or detach from both safety and working ropes, 2m/6ft away from unprotected edges where there is no risk of falling

- If this cannot be achieved, cow’s tails, lanyards or other suitable equipment must be used to protect the operative whilst in the danger zone between safe ground and the ropes

- If there is a risk of falling a distance likely to cause personal injury, a fall arrest harness and energy absorbing lanyard should be used

**Descending Over an Edge**
• If safe access to the ropes is not available, protection needs to be maintained by other means until the operative is secured on both ropes (see above)

• At the edge, first attach the back-up device and then the descender to their respective ropes

• Attention must be paid to any large distance between the anchors and the point where you attach your descender. The rope may stretch once a load is placed on it. If sufficient measures have not been taken, the operative may drop, stressing the anchor points and placing the operative in a situation where they have no control

• Lock off the descender in such a position that when the working rope is under tension it will overcome the edge and sit within 0.3m/1ft below

• The correct procedure for locking off a descender will be shown by your instructor and found in the information leaflet supplied with the descender device

• Move the safety back-up device on the back-up rope to a position which minimises any falling distance

• Move over the edge in a controlled manner until your weight is transferred to the working rope. Your instructor will show you a variety of methods including the use of your hand ascender/foot loop

• Check that all equipment is loaded correctly and that your ropes are protected from the edge. When this is done it is safe to descend

• Unlock the descender device and descend. The right (controlling) hand should always maintain a firm grip on the rope below the descender throughout the descent.

• Do not tow your back-up device with you whilst descending but rather use the one to one method that your instructor has shown you

• In the case of some descenders, it is possible to depress the handle of the device fully, whilst maintaining control of the descent with a strong grip of the controlling hand; however, this requires considerable effort and is needless. Far better to find the correct balance between the depression of the handle and tension control of the rope

• The controlling arm should be tucked into the body and the controlling hand positioned on the working rope tail approx. 150mm below the descender device
• If you need to stop and use both hands for a work task, ensure your descender is first locked off

• Once the descender is locked off, position your back-up device high up on the back-up rope to minimise both the falling distance and the shock load to the system should the working rope fail

Note: If you lose control of the descent at any time, let go of all equipment. The descender device will then lock onto the working rope and/or the back-up device will lock onto the safety back-up rope.

• To release a back-up device that has become loaded onto the safety rope, first ensure that the descender device is securely locked off. Attach a handled ascender to the safety rope, a good distance below the back-up device, stand in the foot loop and the stretch in the back-up rope will generally allow you to de-weight the back-up device. If this is not possible you should follow the information regarding ‘De-Weighting a Loaded Safety Rope during a Rescue’

Ascending

• First attach the back-up device to the safety rope

• Attach the chest ascender to the working rope

• Attach the handled ascender and foot loop to the working rope above the chest ascender. (A cow’s tail should be attached to the handled ascender whenever it is removed from the working rope to ensure that it cannot be dropped and thus cause a hazard for people working below.)

• Stand in the foot loop so that the handled ascender is weighted and the working rope will ride through the chest ascender. If the rope drags through the chest ascender then hold the rope coming out of the bottom of the ascender in your hand or grip it between your feet. Sit back and rest on the chest ascender again. Your instructor will demonstrate a number of methods if you struggle with the one mentioned above

• Lift your feet and move the handled ascender further up the rope

• Repeat the process by standing up in the foot loop attached to the handled ascender

• The back-up device should be kept as high as possible (in all cases above shoulder height) on the safety rope throughout the ascent to help minimise the fall distance should the working rope fail. The technique used for moving the back-up device should not affect the operation of the device
Changing from Ascent to Descent

- Move the back-up device high up on the safety rope
- Attach the descender device onto the working rope, directly below the chest ascender
- Take in any slack rope through the descender until approximately 50mm remains between the descender and the chest ascender
- Lock off the descender
- Move the back-up device to a position level with your forehead
- Position the handled ascender at head height so that when standing in the foot loop, weight will just be taken from the chest ascender
- Stand up in the foot loop whilst disengaging the chest ascender and then sit back onto the descender, which will then become weighted
- Remove the handled ascender and foot loop from the working rope and begin to descend

Changing from Descent to Ascent

- Stop the descent. Lock off the descender and position the back-up device high up on the safety rope
- Attach the handled ascender to the working rope above the descender, leaving room between the two to allow attachment of the chest ascender
- Open the cam on the chest ascender and then in one movement stand up in the foot loop, place the working rope into the chest ascender, close the cam and sit back onto the chest ascender
- Remove the descender from the working rope and begin to ascend
Passing a 90° Edge (Ascent & Descent Mode)

Passing over an edge can pose real risk and potential damage to ropes; therefore it is essential that a rope protector be utilized to avoid a sharp edge from cutting through our ropes.

Ascent

• Ascend up to edge

• Change from ascent into descent (Stay high)

• Open rope protector and place back up above edge

• Place handled ascender above edge on working rope

• Walk up foot loop & move away from edge

Descent

• Place back up device on to the rope before you are within 2 meters of an unprotected edge

• Reach over the edge grab the working rope and thread into descender

• Place handled ascender above descender within reach of edge

• Walk down foot loop placing rope protection on edge

• Retrieve hand ascender and descend in a controlled manner

Rope to Rope Transfer

• Before attempting any rope to rope transfer, ensure you are in descent mode

• Lock off the descender and position the back-up device high up on the safety rope

• Take hold of the new working rope and attach both chest and hand ascenders to it, taking care to pull through all slack rope so that the chest ascender is in tension

• Place the back-up device on the new safety rope

• Descend the original ropes and ascend the new ropes as needed until the weight is transferred to the new ropes
• Remove the descender from the rope

• Remove original back up device from rope

• Four points of contact must be maintained throughout this maneuver

Passing Knots (Ascent & Descent Mode)

If the descent is particularly long, it may be necessary to join ropes together using a suitable knot. Whenever a joining knot is tied, a loop knot should accompany it to assist the operative in passing where the ropes are joined. The implications of tying a mid-rope knot in a rescue situation should be considered. Where a knot has been tied to remove a damaged section of rope then it will be necessary to tie an additional knot either above or below the damaged section in order to make a safe attachment during knot passing manoeuvres.

By utilising the casualty’s descender device during a ‘Snatch Rescue’ it is possible to switch ropes thus bypassing the knot with only the back-up device requiring removal.

Descent (Knot in both ropes)

• Descend until the knot is almost touching the descender and lock it off. Ensure the back-up device is high up on the safety rope

• Attach the handled ascender to the working rope above the descender, stand up in the foot loop and attach the chest ascender above the descender

• Remove the descender and replace it on the working rope below the knot. Lock off the descender

• Move downwards on the ascenders (Jimmying), moving the back-up device down as you descend, until the chest ascender is just above the knot

• Standing up in the foot loop, remove the chest ascender and sit back down on to the descender

• Remove the handled ascender and then take your second back-up device and place it below the knot on the safety rope. Remove the original back-up device from above the knot and descend as normal

Ascent (Knot in both ropes)

• Ascend the ropes until the back-up device can go no higher. Take your second back-up and place it above the knot and move high, then remove your original back-up from the rope
• Attach the descender device onto the working rope, directly below the chest ascender
• Remove the handled ascender and replace on the working rope above the knot
• In one movement, stand up in the foot loop, remove the chest ascender and replace it above the knot
• Remove the descender from the working rope and begin to ascend

Passing Deviations (Ascent & Descent Mode)

Where the direction of the ropes is required to be changed slightly, either to avoid abrasion or to afford the technician more efficient access, a deviation may be installed.

Ascent

• Ascend until level with the deviation anchor point
• Tie an overhand slip knot 2m/6ft below the deviation
• Place the ropes below your chest ascender and back-up device into the spare carabiner of the deviation. Once in place pull yourself into the deviation anchor point sufficiently enough to remove the original deviation carabiner and gently lower out using the trailing ropes below
• Continue with the ascent

Descent

• Carry out the above operation in reverse, removing the slip knot before descending

Passing Re-Anchors (Ascent & Descent Mode)

Where the direction of the ropes are required to be changed and it is not practicable to use a deviation either to avoid abrasion or to afford the operative more efficient access, a re-belay should be installed. A re-belay is a double anchor point part way down the drop into which the ropes are knotted and attached.

Ascent
• Ascend until directly below the re-belay
• Change from your ascender to your descender
• Attach spare back-up device high up on the new safety rope above the re-belay
• Attach handled ascender to the second rope above the re-belay
• Attach the chest ascender to the new working rope above the re-belay, ensuring all slack rope is pulled through
• Descend off of the old working rope until the descender goes slack and then remove it from the rope
• Remove the original back-up device from the rope
• Continue with the ascent

Descent

• Descend until level with the re-belay and lock off the descender
• Attach spare back-up device high up on the new safety rope below the re-belay
• Attach handled ascender to the second rope below the re-belay
• Attach the chest ascender to the new working rope below the re-belay, ensuring all slack rope is pulled through
• Descend on your descender until it goes slack on its rope and then remove it
• Remove the back-up device
• Change from your ascender to your descender
• Continue with the descent

Horizontal Aid Climbing
This technique is used to make horizontal progress whilst suspended from a structure or a series of suitable anchor points.

Three cow’s tails will be required, so as to maintain two independent points of attachment whilst re-positioning a third.
The following routine gives the example of moving onto a horizontal aid route from the top of a set of ropes.

- Ascend the ropes stopping just below the aid route
- Remove the hand ascender from the working rope and attach its cow’s tail carabiner directly into the anchor point. This will become your “back” cow’s tail
- Remove the back-up device and attach its cow’s tail carabiner to the first free anchor point carabiner. Attach an etrier to this cow’s tail. This will be your “front” cow’s tail
- Attach your third cow’s tail carabiner to the same anchor as your “front” cow’s tail. This is now your “middle” cow’s tail
- Stand in the foot loop and etrier, remove the chest ascender and attach it to the “middle” cow’s tail
- Remove the front cow’s tail and move it forward to the next free anchor point carabiner
- Remove the back cow’s tail and re-attach to the middle cow’s tail anchor point
- Stand in the foot loop and etrier and remove the middle cow’s tail, re-attaching it to the leading cow’s tail anchor point
- Repeating the procedure; systematically moving the cow’s tails in the direction of travel, removing and then relocating each cow’s tail in turn will allow you to make forward progress
- Aim to be suspended from the middle cow’s tail at all times unless involved in the process of moving it. This ensures that you remain close to the structure and that other cow’s tails can be relocated freely whilst not being placed under any load. You can adjust your height by ascending or descending with your chest ascender on the middle cow’s tail
- Once you are directly above or beside your new ropes attach either your ascending or descending device (depending on your intended direction of travel). Once this is done remove your “front” cow’s tail and attach it via your backup device to your safety rope. Step up in your foot loop and remove your “middle” cow’s tail and then finally remove your “back” cow’s tail. Ensure that at all time during this transfer to the rope that you stay on a minimum of two separate points and do not place any slack above a toothed ascender

The following routine gives the example of making horizontal progress along a structure by utilising three webbing or wire slings.
• Attach the front and back cow’s tails to the two outside slings and attach the middle cow’s tail to the central sling

• De-weight the central sling by standing in the foot loop and/or etrier and slide this sling in the direction of travel

• Re-weight the central sling and move the front and back slings in the same direction

• Repeat this process until a junction is encountered. Pass the obstruction by removing one sling and placing beyond the obstruction one at a time whilst maintaining two independent attachments

**Note:** Consult with your instructor for variations on the above techniques.
Vertical Aid Climbing

This technique is used to make vertical progress whilst suspended from a structure or a series of suitable anchor points.

Three cow’s tails will be required, so as to maintain two independent points of attachment whilst re-positioning a third. It is important to ensure that should an anchor point fail the operative’s fall height is reduced to as short a distance as is reasonably practicable.

The following routine gives the example of ascending a vertical aid route from ground level.

- Attach a cow’s tail to the first attachment point which will generally be at approx. 2m above ground level and attach to the cow’s tail carabiner a foot loop or etrier. This will be your “back” cow’s tail
- Stand in the foot loop or etrier and attach your “middle” cow’s tail carabiner to the same attachment point
- Attach a third cow’s tail to the next attachment point and attach to the cow’s tail carabiner a foot loop or etrier. This will be your front cow’s tail
- Stand in the upper foot loop or etrier, remove the middle cow’s tail and re-attach to the upper attachment point carabiner
- Repeating the procedure; systematically moving the front cow’s tails in the direction of travel, removing and then relocating each other cow’s tail in turn will allow you to make upward progress in much the same way as if progressing horizontally
- Aim to be suspended from the middle cow’s tail at all times unless involved in the process of moving it. This ensures that you remain close to the structure and that other cow’s tails can be relocated freely whilst not being placed under any load
Pull-Through

Descending & De-Rigging

This technique of retrieving ropes from a structure should be utilised only if there are no other means of carrying out the task.

- Both the working and back-up ropes should be passed around the structure ensuring both ends of each rope have a security knot and they reach the floor
- Tie a knot on one side of each rope (Alpine Butterfly or similar) just below the structure and connect carabiners to the loops created
- Clip these carabiners to the ropes hanging on the opposite side of the structure and pull tight
- First attach your back-up device and then your descender to the live ropes and descend
- Upon reaching ground level, remove all equipment and any knots. Pull the ropes down

Correct Attachment of a ‘Pull-Through’ System

Only one rope system has been shown for clarity.
Ascending & Rigging

This technique of temporarily rigging ropes to a structure should be utilised only if there are no other means of carrying out the task.

- Throw a thin line over the structure
- Attach the working and safety ropes to the line
- Tie the appropriate knots at the half-way point
- Attach carabiners in the manner shown below
- Pull the ropes until they are in the final position

It must be pointed out that the ‘Pull-Through’ method of rigging ropes has a higher level of risk attached due to possible abrasion problems on the hidden side of the structure and the possible mistake of attaching to the wrong side of the rope with disastrous consequences. It is therefore recommended that this method is restricted to competent and experienced technicians only, who will use it as a once-only method of access to or egress from the work-site and then immediately re-rigged in an appropriate manner.

Horizontal Tensioned Traverse Lines

- A horizontal tensioned traverse line will normally consist of two separate ropes running side by side in a horizontal plane, each rope being separately anchored at both ends
- The operative should make two attachments to the ropes and maintain them at all times during the traverse. This can be achieved by attaching a carabiner from your waist D ring to both ropes and then attaching another carabiner from your sternal D ring into both ropes

**Note:** When placed under load, the angle of the traverse rope around the load point may exceed 120° with a consequent increased loading on each anchor. The load applied to the anchors can be reduced by ensuring the load is applied to the two ropes in the system equally. The Level 3 Safety Supervisor will be responsible for the calculations involved in rigging such a system.

- All operatives should be aware that unnecessary dynamic movement whilst traversing will place additional peak loads to the anchor point that may exceed the designed Working Load Limit (WLL) or Safe Working Load (SWL)
• These systems may also be used to offer a ‘Work Restraint’ capability. It is important to ensure that the system does in fact prevent an operative from entering a falling hazard zone. Where such a system is in place ensure all operatives are familiar with the maximum length of cow’s tail/lanyard to be used on the system.

**Diagonal Tensioned Traverse Lines**

Diagonal tensioned traverse lines redirect the path of a descent or ascent from the vertical to a diagonal plane. They are used in addition to the operatives working and safety ropes, or the double rope systems used for hauling and lowering.

Diagonal lines are similar to horizontal lines in that they comprise two separate ropes running side by side, with each rope separately attached to independent anchor points at both ends. One end of the traverse ropes can be attached via suitable descender devices to enable the system to be tensioned or slackened as necessary. If the lines are to be tensioned, the angles created when loaded should be considered. Deflection will be small and a high load will be exerted on the anchors. A rule of thumb in the rope access industry when tensioning lines is to use a 3:1 system with one person pulling on it, this will stop excessive force being applied to the lines and anchors.

If lines are used to redirect the path of a descent or ascent from the vertical, the operative should descend or ascend their ropes in the normal way, whilst having two extra attachments to both traverse ropes. Rope can be taken in and out through the rope adjustment devices at any point during the ascent or descent enabling his/her position to be altered in both vertical and horizontal planes.

If the tensioned traverse lines are to be used for rescue purposes, the same system of double security should be employed in that the casualty should be lowered on two independent systems whilst maintaining two attachments to the tensioned traverse lines.

**Lead Climbing & Belaying Techniques**

Lead Climbing is a type of fall arrest technique allowed under the IRATA scheme of work. The technique is used to safeguard a climber whilst moving up or along a structure with hands and feet. Other team members protect the climber by ‘paying out’ or ‘taking in’ the ropes attached to the climber’s harness.

In the hierarchy of hazard management, this technique should be regarded as a last resort after safer methods have been considered.

Before an ascent is made, a competent person must produce a specific risk assessment which will identify:
1. Each of the hazards involved in the operation, with the aim of eliminating or minimising the associated risk.

2. The choice of equipment to be used.

3. The competent operatives who will manage each element of the task.

4. The safest and quickest method of rescue in the case of accident.

The technique used will vary according to the circumstances of each climbing task. However, the following principles must be incorporated in the plan and method:

1. The climber must wear a harness that complies with the Fall Arrest specification EN 361. The ropes should be tied directly to the fall arrest attachment point on the front of the harness.

2. Ideally, two different types of belay device should be used in the fall arrest system.

3. The maximum peak impact force on any operative in any potential fall should never be greater than 6kN.

4. The system used should ensure any fall distance is kept to an absolute minimum.

5. Two independent rope systems, attached to two anchorages, should be used.

6. The running belays placed must be capable of withstanding the maximum impact forces created in all foreseeable circumstances.

Note: A peak impact force of 6kN on the operative will place a force of approx. 12kN on the supporting running belay; exceeding the current strength requirements for EN 795 fall arrest anchors. Your system of work needs to minimise the falling distance to ensure running belays and any other equipment in the system are not overloaded.

7. Dynamic ropes conforming to EN 892 should be used. 11mm diameter ropes are recommended, however, the use of 11mm dynamic ropes on certain belaying devices may cause the maximum impact force on the operative in the event of a fall to exceed 6kN. Your safe system of work should be adjusted to ensure this does not occur.

The following is an example of a typical ‘ascent’ using basic techniques (to be used only after a site specific risk assessment has been carried out).

- A stance is prepared, consisting of two suitable and sufficient anchor points. Two suitable ‘auto lock’ belaying devices should be attached to these anchor points.
• Under no circumstances should the belay devices be attached indirectly to the anchor points via the belayer as, in the event of an accident, the belayer would not be able to walk away from the system to summon help if required.

• The climber attaches two suitable dynamic climbing ropes directly to the sternal attachment point on their full body harness with suitable knots. Do not use carabiners as there could be a possibility of abnormally loading them should a fall be arrested. The other ends of the climbing ropes should be attached to the belay devices.

• The climber then climbs the structure, placing running belays as often as is reasonably practicable in order to reduce the potential fall height to an absolute minimum until the objective is reached whereupon the climber should secure him/herself to the structure.

• The climber should place the ropes alternately through suitably strong running belays. These should enable the ropes to be redirected away from sharp edges or other potential causes of damage and ensure that in the event of a fall only one rope is loaded with the other acting as a back-up system.

• During the ascent, the ‘belayer’ protects the climber by operating the belay devices, constantly adjusting the rope length and maintaining a minimum amount of slack between the belay devices and the climber.

• It is the belayer’s responsibility to ensure the belay devices operate efficiently should the climber fall.
• As the climber retreats, removing the running belays as he/she does so, the ropes are ‘taken in’ by the belayer.

• Throughout the climb, constant, clear communications should be maintained between the climber and belayer. In noisy environments or on particularly tall structures this may be assisted by the use of two-way radios.

**Work Restraint / Travel Restraint**

One method of fall prevention is to restrict the operative’s travel so that he/she cannot enter the zone where a fall could occur. This can be fall arrest equipment or 2 work positioning rope access equipment lanyards (e.g. cow’s tails) of limited length so as to prevent the worker having any portion of their body over the edge.

The structure is never considered a point of contact for rope access.
Fall Arrest

If the planned method of work is such that, should the user lose controlled physical contact with the working surface there will be a free fall, it will be necessary to choose fall arrest equipment. This will include a full body harness that meets the requirements of EN 361 for fall arrest harnesses, an energy absorber conforming to EN 355 and a double lanyard system to allow forward progression without disconnecting from the structure. The lanyards should conform to EN 354.

Remember that following the hierarchy of hazard management this method of working should only be employed when it is deemed not reasonably practicable to use any other method of gaining access.

Always ensure there is sufficient clearance distance below the work area to allow for the length of the lanyard, deployment length and a suitable safety factor.

The clearance distance required for a 2m energy absorbing lanyard, measured from the lanyard anchor point is calculated thus:

\[
\text{Lanyard Length} + \text{Deployment Length} + \text{Safety Factor}
\]

\[
2m + 1.5m + 2.5m
\]

The clearance distance is therefore 6m.
NOTE: Always follow manufacturer’s information for calculating clearance distances.

When working at heights of less than 6m it is always good practice to attach a suitable length lanyard to a high point on the structure. In the event of a fall, the impact force with the ground or supporting structure would be considerably reduced.

• Always ensure fall arrest attachment points are kept as high as possible in order to reduce fall heights to a minimum.

• Never use an energy absorber that has been partially deployed. In the event of a fall, the Peak Impact Force could be in excess of the 6kN that a body can absorb.

• When using a double energy absorber, ensure that the lanyard not in use is NOT connected to any part of the harness as, in the event of a fall, the energy absorber would effectively be bypassed causing a possible failure of the lanyard webbing.

• Never use two single energy absorbing lanyards to make progress along a structure. 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.
• Never lengthen an energy absorbing lanyard by adding attachment slings that are too long for the supporting structure. Energy absorbers are designed to reduce Peak Impact Forces of a 100kg person who falls twice the length of the lanyard to below 6kN. Consideration should be given to operatives who are considerably lighter or heavier, as the Peak Impact Forces generated could be considerably greater.

• Never clip the connector on the end of an energy absorbing lanyard around the structure and then back onto the lanyard. In the event of a fall the connector could have a load applied across the gate which could be in excess of the minimum breaking load in this orientation.

• When using a mobile fall arrester on a flexible line, always ensure there is a stopper knot placed on the rope at the base of the route to ensure protection from falling ‘over the edge’.

Fall Factors

Fall Factors measure the relative severity of a fall in terms of the shock loads placed upon the equipment and user.

The Fall Factor (FF) is calculated by dividing the length of fall (m) by the length of rope holding the fall (m) or;

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

It is important to ensure that the FF is kept to a minimum. Whilst dynamic rope is capable of withstanding a Fall Factor 2 when new it is good practice not to exceed FF 1, and likewise it is good practice not to exceed FF 0.33 (one third) with a Low Stretch rope.
During lead climbing situations any potential fall should be mitigated by the use of appropriately spaced ‘Running Belays’ to reduce the fall height so far as is reasonably practicable and thus reduce the FF placed on the system.

In a lead climbing situation the higher a climber ascends a structure with sufficient running belay protection then the lower the resulting FF. However, as mentioned above, the overriding consideration is in reducing any potential fall height.

In some situations it is possible to generate Fall Factors which are in excess of FF2. If you were clipped to the handrails on a bridge suspension cable and you fell, the fall height would be calculated from the height at which you fell to the height at which your fall was arrested. On the Humber Suspension Bridge in the UK this height could in some cases be as much as 4m. With a 1m cow’s tail the fall factor would be FF4. This does not allow for the friction between the handrail and the cow’s tail carabiner slowing down the fall but highlights the potential for very high Fall Factors. Some equipment manufacturers produce energy absorbers specifically for high Fall Factor situations.
Knots used in Rope Access

**Figure of 8 on the Bight Knot**

1. ![Diagram](image1.png)
2. ![Diagram](image2.png)
3. ![Diagram](image3.png)

To form a loop in the end of a rope so it can be connected as a main anchor point. Always ensure knots are correctly dressed and set before use. Approximately 30% - 35% loss in strength.

**Figure of 9 on the Bight Knot**

1. ![Diagram](image4.png)
2. ![Diagram](image5.png)
3. ![Diagram](image6.png)

To form a loop in the end of a rope so it can be connected as a main anchor point. It is easier to untie than a Figure of Eight on the Bight after loading. Always ensure knots are correctly dressed and set before use. Approximately 30% - 35% loss in strength.
Re-Threaded Figure of 8 Knot

For tying directly into the harness in a lead climbing situation or around tubular steelwork. Always ensure knots are correctly dressed and set before use. Approximately 30% - 35% loss in strength.
Bunnies Ears Knot

1. 
2. 
3. 
4. 
5. 

To link and equalise two anchors. Always ensure knots are correctly dressed and set before use. Approximately 30% - 35% loss in strength.
Alpine Butterfly Knot

1. 

2. 

3. 

4. 

A mid-rope knot suitable for multi-directional loading. Ideal for long ‘Y’ hangs and as a temporary mid-rope knot. Always ensure knots are correctly dressed and set before use. Approximately 30% - 35% loss in strength.
Barrel Knot (1/2 Double Fisherman Bend Knot)

Used as a stopper knot in the end of a rope or when tied with a loop it forms the best cow’s tail knot in terms of reducing Peak Impact Force (PIF). Always ensure knots are correctly dressed and set before use.
Approximately 30% - 35% loss in strength.
Double Fisherman Bend Knot

1.

2.

3.

4.

5.

6.

It is used to join two ropes of equal diameter. Always ensure knots are correctly dressed and set before use. Approximately 30% - 35% loss in strength.
Suspension Intolerance
(Toxic Shock) (Orthostatic Intolerance)

Anecdotal evidence suggests that an immobilised person suspended in a harness will begin to deteriorate in a few minutes leading to coma and possibly death.

Suspension Trauma is a condition in which a person suspended in a harness can experience pallor, cold sweats, nausea, ringing in the ears, blurred vision, dizziness, feeling faint, loss of consciousness and eventual death. The condition appears only to have a serious effect on persons suspended in a harness with a dorsal attachment without moving, for example, when unconscious.

Muscular action in moving the limbs normally assists the return against gravity of blood in the veins back to the heart. If the legs are completely immobile, these ‘muscle pumps’ do not operate and an excess of blood accumulates in the veins, which are capable of considerable expansion and, therefore, have considerable capacity. The excess of blood in the veins is known as venous pooling.

Other organs critically dependent on a good blood supply, such as kidneys, can also suffer serious damage, with fatal consequences. The movement of a person with venous pooling (e.g. in a rescue) into a horizontal position can cause a massive flow in venous blood to the heart, which cannot cope, and this can cause potentially fatal cardiac abnormalities.

In several clinical trials where the test subjects were told not to move, most experienced many of the symptoms of suspension trauma, some including loss of consciousness, in just a few minutes. Others managed for longer before reporting symptoms.

It seems that steps can be taken to minimise the risk of rope access operatives experiencing the condition. Frequent ‘pumping’ of the legs, preferably against a firm surface, will activate the muscles and should reduce the risk of venous pooling. Harness leg loops should be well-padded and as wide as possible to spread the load and reduce any restrictions. The use of a ‘Work Seat’ might be advisable if work in one position is to be sustained for an extended period. It should be pointed out that there have been no reported cases of suspension trauma from in excess of 25 million ‘Logged Man Hours’ by IRATA members. An effective, speedy rescue plan is still a requirement.

Your instructor will demonstrate a variety of work seats currently in use. Work seats are not PPE and should be attached in such a way that double rope security is not compromised should there be a failure in the work seat.

Note: During a rescue it would be advisable for the casualty to be sat-up with the knees elevated slightly. This can be achieved by suspending the casualty from the sternal attachment point and, if possible, positioning the harness leg loops under the knees thus elevating them.
and avoiding a rapid return of venous blood to the heart. Medical advice should always be sought.

**Technical Rope Rescue**

The requirement for rescuing any team member that becomes incapacitated whilst working at height should be identified at the ‘Risk Assessment’ stage, before any work commences and should be fully described in the ‘Method Statement/Job Plan’ and include the following:

- The safety of the persons carrying out or assisting with the rescue
- The anchor points to be used for the rescue equipment
- The suitability/integrity of equipment (anchors, harnesses, attachments and connectors) that has already arrested the fall of the casualty for use during the rescue
- The method that will be used to attach the casualty to the rescue system
- The direction that the casualty needs to be moved to get them to the point of safety (raising, lowering or lateral) the first aid needs the casualty may have with respect to injury or the effects of suspension
- The possible needs of the casualty following the rescue

The loads placed on some items of equipment during a rescue may be higher than they have been originally designed for. If equipment is used for rescue either individually or in systems, the supplier should verify that it has suitable performance and loading characteristics in that specific configuration. This applies to all parts of the system including the anchors. The anticipated loads during the rescue situation should be within the loadings specified in the manufacturer’s user instructions.

There are four options for dealing with an emergency which requires an injured or incapacitated person to be recovered to safety, presented here in order of preference (bearing in mind the immediate aim is to recover the casualty to the nearest point of safety):

1. Lowering a remote casualty
2. Raising a remote casualty
3. Self-evacuation by descent
4. Rescuing another in descent

After ensuring the casualty’s condition is not worsening, the main principles in any rescue is 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 can be successfully completed within an acceptable time span.
Rescue equipment, including a suitable first aid kit, should accompany all operational 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.

It is essential to ensure that enough competent team members are at the location to implement a rescue if required. If the risk assessment shows that the casualty’s position cannot be reached by the rescuer, or that the time required to set up and implement a rescue would prove too lengthy, then a rescue system should be pre-rigged before work commences. If deemed necessary, this may be pre-attached to the operative throughout the work task.

Before any rescue is implemented it is important that the IRATA Level 3 Safety Supervisor assesses the situation, attempts to communicate with the assumed casualty to ascertain his/her condition and determines whether or not a rescue is necessary.

The rescue team’s order of priorities is to:

1. Ensure the rescuers are not in immediate danger and do not endanger themselves whilst carrying out the rescue.
2. Raise the alarm
3. Assess the needs of the casualty; you may have to deploy a technician immediately to provide appropriate First Aid Treatment & Prevent further injury to the casualty.
4. 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, as a minimum, a current first aid and CPR certificate. Where the location of the work is deemed to be an extreme location, where the evacuation of a casualty could take hours instead of minutes then additional first aid training or emergency cover may be required.

**Snatch Rescue (Casualty in Descent Mode)**

**Rescue Carried Out from Above**

Before implementing a rescue, confirm that one is necessary by first attempting to communicate with the assumed casualty.

If it is deemed necessary, the Level 3 Safety Supervisor should first arrange for the emergency services to be notified to ensure they will be on site to receive the casualty upon completion of the rescue.
• Descend the casualty’s safety rope with your back-up device attached to the casualty’s working rope. If the safety rope is loaded, ‘jimmy’ down the rope.

• Upon reaching the casualty, lock off your descender device and place the casualty in as near an upright position as possible without endangering the casualty further. This may be achieved by temporarily placing a loop from one side of the chest harness over the top of the descender device. The rescuer should consider the ABC of first aid (Airway, Breathing, and Circulation), and deal with the casualty’s condition in the strict order of: Breathing, Bleeding, and Bones.

• Make an attachment from your descender carabiner to the casualty’s sternal attachment on the harness with a carabiner which will eventually support the casualty in a near upright position.

• Remove the casualty’s back-up device from your working rope and place it below your backup device on your safety rope. Use a cow’s tail to make a second attachment to the main attachment point on your harness.

• Operate the casualty’s descender to lower them onto the carabiner connecting their sternal point to your descender carabiner. Once it goes slack remove their descender device from the rope.

• Before unlocking your descender, employ a braking carabiner to create additional friction. Descend slowly in a controlled manner employing the braking carabiner and avoiding any jerky movements that could shock load the system and employing good casualty management. Your instructor will demonstrate a number of methods of carrying out the above manoeuvres dependent on the type of harness and descender device being used.

• Maintain both the casualty’s and your own back-up devices as you descend using the one to one method.

**Rescue Carried Out from Below**

• Ascend the casualty’s safety rope with your back-up device on the casualty’s working rope.

• Move your back-up until it is obstructed by the casualty’s descender. Place your second back-up device above their descender and remove your original from the rope. Attach this cow’s tail to the casualty’s main D ring, this attachment may remain in place acting as the secondary attachment point to the casualty.
• Upon reaching the casualty bring the casualty into as near an upright position as possible. The rescuer should consider the ABC of first aid (Airway, Breathing, and Circulation), and deal with the casualty’s condition in the strict order of: Breathing, Bleeding, and Bones

• Continue to ascend approx. 0.5m above the casualty and then change to descent mode, this ensures you will be level with the casualty before the next stage of the rescue

• Make an attachment from your descender carabiner to the casualty's sternal attachment on the harness with a carabiner which will eventually support the casualty in a near upright position

• Remove the casualty’s back-up device from your working rope and place it below your backup device on your safety rope. You will maintain both back up devices on the descent

• Operate the casualty’s descender to lower them onto the carabiner connecting their sternal point to your descender carabiner. Once it goes slack remove their descender device from the rope

• Before unlocking your descender, employ a braking carabiner to create additional friction. Descend slowly in a controlled manner employing the braking carabiner and avoiding any jerky movements that could shock load the system and employing good casualty management. Your instructor will demonstrate a number of methods of carrying out the above manoeuvres dependent on the type of harness and descender device being used

• Maintain both the casualty’s and your own back-up devices as you descend using the one to one method

De-Weighting a Loaded Safety Rope During a Rescue.

If the back-up device has become loaded with the weight of 2 persons during a rescue, and cannot be de-weighted by using the techniques previously taught it will be necessary to turn your descender into a make-shift ascender. By placing a hand ascender on the working rope above the descender and placing the trailing rope from the descender through a carabiner on the ascender (a pulley would be an advantage for this connection if available), and by pulling down on the trailing rope a mechanical advantage of 2:1 can be achieved (not allowing for the effects of friction within the system). By placing a second hand ascender and foot loop to the trailing rope and standing in the loop the combined load of rescuer and casualty are easily lifted and the back-up device can be released.
This same technique can be utilised to recover a casualty who has descended into a re-belay loop and is incapacitated.

**Snatch Rescue (Casualty in Ascent Mode)**

**Rescue Carried Out from Above**

Before implementing a rescue, confirm that one is necessary by first attempting to communicate with the assumed casualty.

If it is deemed necessary, the Level 3 Safety Supervisor should first arrange for the emergency services to be notified to ensure they will be on site to receive the casualty upon completion of the rescue.

- Descend down the casualty’s safety rope with your back-up device attached to the casualty’s working rope
- Upon reaching the casualty, lock-off your descender device. It should not be necessary to get the casualty upright, as they will be hanging from their chest ascender and already in as near an upright position as possible.
- Make your attachments to the casualty in the same manner as with a casualty in descent mode
- Attach your 2:1 pulley system from the Maillon below the chest ascender on the casualty to your back-up device carabiner which is connected to their working rope. Connect a hand ascender and foot loop to the pulley system
- Stand in the foot loop and pull upwards on the casualty’s harness. This will lift the casualty enough to enable their chest ascender to be disconnected from the rope. Lower the casualty until they are suspended on their sternal attachment from your descender. This same technique can be used in an ‘Aid Climb’ rescue situation
- Remove the casualty's back-up device from your working rope and place it below your backup device on your safety rope
- Before descending with the casualty an additional braking carabiner should be introduced to the descent system and the rescuer should descend slowly in a controlled manner, paying particular attention to casualty management
- Maintain both the casualty’s and your own back-up devices as you descend using the one to one method
**Rescue Carried Out from Below**

- Ascend the casualty’s safety rope with your back-up device on the casualty’s working rope using the same technique as in the descent rescue

- The casualty should already be in a near upright position via his/her chest ascender attachment.

- Ascend to approx. 0.5m above the casualty and change into descent mode

- Make your attachments to the casualty in the same manner as with a casualty in descent mode

- Attach your 2:1 pulley system from the Maillon below the chest ascender on the casualty to your back-up device carabiner which is connected to their working rope. Connect a hand ascender and foot loop to the pulley system

- Stand in the foot loop and pull upwards on the casualty’s harness. This will lift the casualty enough to enable their chest ascender to be disconnected from the rope. Lower the casualty until they are suspended on their sternal attachment from your descender. This same technique can be used in an ‘Aid Climb’ rescue situation

- Remove the casualty’s back-up device from your working rope and place it below your backup device on your safety rope

- Before descending with the casualty, an additional braking carabiner should be introduced to the descent system and the rescuer should descend slowly in a controlled manner, paying particular attention to casualty management

- Maintain both the casualty’s and your own back-up devices as you descend using the one to one method

**Hauling & Lowering Rescues**

By using a combination of pulleys, descenders, ascenders and carabiners it is possible to set up elaborate hauling and lowering systems, employing the same double rope security, allowing the speedy evacuation of an injured operative from the most difficult of locations. Typically 2:1, 3:1, 6:1 and 9:1 mechanical advantages (theoretical) and counterweight systems are in operation during the hauling element and these are subsequently disengaged allowing the casualty to be lowered to a new position.

Remember to always make your pulley systems as simple as possible and maintain good rope management to avoid entanglement.
Consideration should be given to the effects of the lowering element of the rescue being at a different angle to the hauling element and the subsequent sliding potential of the rigging slings. A suitable method of paying out the back-up rope should be adopted with special consideration being given to any effect should there be a failure of the main lowering rope.

**Pulley Systems**
(Showing Mechanical Advantages)

By viewing the above 18:1 system as if ‘inverted’ it may be more easily understood.
In the diagram above, an ascender has been incorporated with a pulley at the main anchor point to stop the rope sliding back over the pulley. This is the most efficient type of hauling system as it produces the least friction. It is limited by the fact that a load cannot be lowered without introducing a lowering system. The hauling system shown gives a 3:1 mechanical advantage. By replacing the main anchor point ascender and pulley with a suitable descender device will offer the most efficient hauling and lowering system with increased mechanical advantage being easily implemented.

In cases where hauling or lowering is taking place, a secondary back-up system should be incorporated to ensure that, in the event of a failure of the main system, the casualty would not suffer a fall likely to cause personal injury or damage to property.
In the diagram above more friction has been introduced to the system by the addition of a descender as the locking device. This system is more versatile as it can be converted easily to a lowering system. However, because the system is based around a 2:1 mechanical advantage a rope which is double the length of the lowering distance is required. The hauling system shown gives a 6:1 mechanical advantage.

In cases where hauling or lowering is taking place a secondary back-up system should be incorporated to ensure that in the event of a failure of the main system the casualty would not suffer a fall likely to cause personal injury or damage to property.
Glossary of Terms

Anchor, Anchorage: A place, fixing or fixture to which an anchor line is connected.

Anchor Line, Anchorage Line: A flexible line connected at least at one end to a reliable anchor to provide a means of support, restraint or other safeguard for a person wearing a harness in conjunction with other devices. An anchor line may be a working or safety line.

ANSI: American National Standard Institute

Ascender: A rope adjustment device which, when attached to a rope of appropriate type and diameter, will lock under load in one direction and slip freely in the opposite direction.

ARAA: Australian Rope Access Association.

Back-up Device: A rope adjustment device for a safety line of appropriate type and diameter, which accompanies the user during changes of position or allows adjustment of the length of the safety line, and which locks automatically to the rope, or only allows limited movement along it, when a sudden load is applied.

Belay: A place where either anchor lines or people may be anchored or secured.

Belay Device: A device used to adjust the ropes during lead climbing or rescue operations.

Belayer: The person controlling the belay device during lead climbing or rescue operations.

Body Support: A belt or harness.

Breaking Load (BL): See also Failure Load (FL), Minimum Breaking Load (MBL). The minimum breaking load of an item of equipment when it is new.

Carabiner: A type of connector, formed as a complete loop, with a spring loaded entry gate which should be safeguarded in the closed position by a screwed ring (screw gate), automatic locking device (twist lock) or similar. Often spelt karabiner.

CE: For rope access equipment, it provides confirmation that a product meets the minimum requirements of the European Directive on Health and Safety: ‘Personal protective equipment at work regulations 1992’.

CITB: Construction Industry Training Board.

Competent Person: A designated person suitably trained or qualified by knowledge and practical experience to enable the required task or tasks to be carried out properly.
**Conformity Certificate:** A certificate issued by the manufacturer or equipment supplier confirming that the item of equipment meets the requirements of the PPE Directive and conforms to any standard that it claims to meet.

**Connector:** A device that can be opened used to connect components, which enables a person to link him or herself directly or indirectly to an anchor. It should as a minimum be of the double closure type, e.g. Screw gate, Twist lock or similar.

**Cow’s tail:** A short length of dynamic rope connected to the main attachment point of the harness.

**Descender:** A manually operated, friction inducing, rope adjustment device, which allows the user to achieve a controlled descent and a stop with hands off anywhere on the anchor line.

**Dynamic Rope:** A rope specifically designed to absorb energy in a fall by extending in length, thereby minimising the impact force.

**EN:** European Norm (or Standard).

**Energy Absorber; Shock Absorber:** Component or components in a fall arrest system, designed to minimise the impact force generated by a fall.

**Exclusion Zone:** Zone designated to exclude the public from a hazardous area and from rope access equipment, or to exclude the operatives from a hazardous area, unless suitably protected.

**Factor of Safety (FOS):** The MBL is divided by a factor to arrive at the SWL or WLL. This provides a ‘safety buffer’ between safe use and failure. The FOS is expressed as a ratio, e.g. 10:1.

**Failure Load (FL):** The minimum breaking load of an item of equipment when it is new. See also Minimum Breaking Load (MBL), Breaking Load (BL).

**Fall Arrest System:** Personal fall protection system intended to prevent a falling person from hitting the ground or obstructions, and designed to limit the impact force of the fall and retain the user in a near upright position in the harness.

**Fall Factor (FF):** The measure of the severity of a fall. The maximum height a person could fall if held by the rope/lanyard, divided by the length of the rope/lanyard, measured from the person to the anchor point.

**FASET:** Fall Arrest Safety Equipment Training. The body set up in 2000 for regulating the Fall Arrest Safety Net industry.
**FISAT**: Technical & Representative Association For Industrial Rope Access Working Methods. (German Rope Access Body).

**HASG**: The Height & Access Safety Group. Advisory group made up of ‘Work at Height’ PPE equipment manufacturers.

**IRATA**: Industrial Rope Access Trade Association.

**Kernmantel Rope**: A textile rope consisting of a core (kern) enclosed by a sheath (mantel).

**Kg**: Kilogram. 1000 Grams. SI unit of Mass.

**kN**: Kilonewtons. 1000 Newtons. SI unit of Force. (See N. Newton)

**Lifting Equipment**: Equipment for lifting, supporting or lowering loads and persons (LOLER), including its attachments used for anchoring, fixing or supporting it. For example, chain or rope sling or similar, ring, link, hook, plate clamp, shackle, swivel, eyebolt, carabiner, Maillon Rapide or webbing.

**Lifting Plan**: Detailed description of the equipment to be used and its SWL for a lifting operation.

**Low Stretch Rope**: A textile rope with lower elongation and, therefore, less energy absorbing capacity than a dynamic rope. See also Semi-Static Rope.

**Maillon Rapide, Quick link**: A type of connector formed as an open loop, which is closed by a threaded sleeve.

**Minimum Breaking Load (MBL)**: See also Failure Load (FL), Breaking Load (BL). The minimum breaking load of an item of equipment when it is tested, new under specific conditions.

**N**: Newton. This is the SI unit of force. 9.81 N is the force required to suspend a mass of 1kg under the force of gravity. It is commonly approximated to 10 N. (In common parlance 1kg = 10N).

**Peak Impact Force (PIF)**: The force applied to the body, PPE and the anchor point when a fall is arrested. The PIF is calculated by multiplying the Mass of an object by Acceleration over the distance fallen and is expressed in Newtons. All Fall Arrest systems should reduce the PIF to a maximum of 6kN.

**PPE**: Personal Protective Equipment.
**prEN**: A provisional, or preparatory, EN, yet to be finalised. Levels of revision are dated.

**Proof Load**: A test load applied to verify that an item of equipment would not exhibit permanent deformation under that load, at that particular time. This result can then be theoretically related to the performance of the test piece under its expected conditions of service.

**PSMA**: Personal Safety Manufacturers Association.

**Pull-Through**: A method of installing or retrieving ropes from a position where safe access to the belay point is not possible.

**Risk Assessment**: A careful, systematic examination of the hazards in your place of work that could cause harm to people or damage plant or property.

**Rope Access**: A technique normally incorporating two separately secured rope systems, a harness and other devices, for getting to and from the place of work and for work positioning.

**Rope Adjustment Device**: A device which, when fitted to an anchor line, will enable the user to vary their position along it.

**Running Belay**: A method of reducing the Fall Factor and, more importantly, the Fall Height whilst lead climbing a structure using Dynamic Belaying techniques. The Dynamic climbing rope is clipped into carabiners attached to the structure at regular intervals as the operative physically climbs up the structure.

**Safety Line, Safety Rope, Secondary Rope, Back-up Rope**: An anchor line provided as a safeguard to protect against falls if the rope access worker slips or if the primary means of support (e.g. the working line), anchor or positioning mechanism fails.

**Safety Method Statement**: A document prepared by the employer describing how a particular job (or types of job where these will be essentially identical) should be undertaken to ensure that any risks to the health and safety of the workers, or others who may be affected, are minimised.

**Safe Working Load (SWL)**: The maximum load (as certified by a competent person) which of an item of equipment may raise, lower or suspend **under particular service conditions**.


**Semi-Static Rope**: Old term for a Low Stretch rope.
**Sentry:** A person responsible for keeping watch to safeguard the anchorage areas and/or the area of ground below the workers. Such a person should be a full member of the work team and competent for the task but need not be trained in rope access.

**Slug (SL):** is an imperial unit of mass that accelerates by one foot (per second) (per second) (1 ft/sec²) upon force of one pound-force (1 lbf)

**SPRAT:** Society of Professional Rope Access Technicians (USA).

**Static Rope:** An old term for rope with lower elongation characteristics than dynamic rope, superseded by the term ‘low stretch rope’. Static Rope now only applies to ropes with negligible stretch, e.g. wire or ‘Kevlar’, which shows little extension at failure and hence having little ability to absorb shock loads.

**Suspended Scaffold:** Scaffold suspended by means of ropes or chains and capable of being raised or lowered by such means.

**Suspension Intolerance:** A condition in which a person suspended in a harness can experience pallor, cold sweats, nausea, ringing in the ears, blurred vision, dizziness, feeling faint, loss of consciousness and eventual death.

**Tensile Strength:** The load at which the product no longer has resistance to breakage.

**UIAA:** Union Internationale Des Associations D’Alpinisme. (International Mountaineering & Climbing Federation)

**UKOOA:** United Kingdom Offshore Operators Association.

**Via-ferrata:** Traditionally a cable-way set up both horizontally and vertically in the Italian Dolomites. By attaching a suitable double lanyard the climber is protected whilst traversing exposed edges or climbs. There can be very high Fall Factors generated in certain circumstances. Some equipment manufacturers have developed energy absorbing lanyards capable of withstanding these Fall Factors and reducing impact forces on the body to acceptable levels within the Mountaineering standards. In some circumstances it may be advisable to use such equipment if the Risk Assessment showed there to be an added element of personal protection to the user.

**WAHR:** The Work at Height Regulations 2005.

**Working Line, Working Rope:** An anchor line used primarily for suspension, work positioning, work restraint including descending and ascending.
**Working Load Limit (WLL):** The maximum load (as determined by the manufacturer) that an item of lifting equipment is designed to raise, lower or suspend. The WLL does not account for particular service conditions that may affect the final rating of the equipment.

**Work Positioning:** A technique that enables a person to work supported in tension or suspension by Personal Protective Equipment (PPE), in such a way that a fall is prevented.

**Work Restraint:** Techniques utilising PPE to prevent a person entering an area where a risk of a fall from a height exists.

**Work Seat:** A comfort seat for prolonged periods of suspension with the harness remaining as the primary means of attachment to the anchor lines.

**Zero Targeting:** The establishment of a system of working which aims to achieve zero accidents, zero waste and zero defects.