URBAN ABSEILER

INDUSTRIAL ROPE ACCESS TRAINING

MELBOURNE AUSTRALIA

TRAINING MANUAL

Manual for Industrial Rope Access & Safe Working at Height

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About Your Manual

First published in 2001 as an informative supplement to a formal IRATA training course, this 2018 revision brings together current recommendations on safe working at height equipment, techniques, legislation and industry best practice.

Used by Level 3 Safety Supervisors around the world, the manual has become one of the most widely referenced work at height documents of its kind.

It is not a substitute for formal practical training and should be used in conjunction with a range of documents which the training provider should make available during any training event:

IRATA, 'International Code of Practice for industrial rope access' (ICOP);

IRATA, 'Training, Assessment & Certification Scheme' (TACS);

BS/ISO22846-2, Personal equipment for protection against falls – Rope access systems – Part 2: Code of practice (International rope access standard);

BS7985, Code of practice for the use of rope access methods for industrial purposes. Recommendations and guidance supplementary to BS/ISO22846.

BS8454, Code of practice for delivery of training and education for work at height and rescue.

AS NZS 1891.4-2009 Industrial fall-arrest systems and devices – Selection use and maintenance.

AS NZS 4488.2-1997 Industrial rope access systems – Selection, use and maintenance.

ARAA Industry Code, Industrial Rope Access Method, September 2005.

Importance of Training

Rope access techniques have been used extensively in industry since the mid 1980's. Before this time the techniques had only ever been used in the sports of caving and climbing.

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.

The approach taken by the rope access operative is quite different because safety must be the prime consideration in the industrial environment. Nothing is ever left to chance and access is achieved with appropriate equipment and a 100% redundant back up system.

Approximately 60% of all fatalities in the construction industry are as a result of a fall, and a fall of less than 2m. Many of these fatalities could have been avoided, had the individual been using appropriate Personal Protective Equipment (PPE) and received proper and adequate training in its safe use.

Persons not using appropriate 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 and other work at height personnel have the appropriate PPE for the task and have adequate training in all aspects of its correct and safe use, care and maintenance.

All training should be carried out in accordance with the recommendations of BS8454, Code of practice for delivery of training and education for work at height and rescue.

Whilst the respected IRATA qualification scheme is the most widely known and used around the world other, more job specific, rope access qualifications may be more appropriate.

Such courses would likely follow the rope access management and operations recommendations given in BS/ISO22846-2.

Typically, these courses would cover only the elements of the IRATA Level 1, 2 and 3 syllabi that were relevant to the actual work being carried out. Such courses are often delivered at the worksite or similar training site and assessed by a different, impartial Instructor.

Such qualifications may follow a similar 3 tiered system or a 2 tier system which combines the traditional Levels 1 & 2.

It is important that regular refresher training is carried out after the course to ensure skills are not forgotten.

Note: *Prior to the commencement of any practical work or training, technicians should carry out suitable stretching exercises to counter the onset of cramp.*

***Safety** should always be of paramount importance.*

Industrial Rope Access Trade Association IRATA

The role of the Industrial Rope Access Trade Association (IRATA) is to ensure any work carried out by its members is done in a safe and high-quality manner.

The Association was established in 1989 following an initiative by leading rope access companies.

The initiative followed the 1988 North Sea Piper Alpha oil platform disaster and subsequent public enquiry and report overseen by Lord William Cullen and known as the Cullen Report.

Lord Cullen went on to lead the public enquiries into the massacre at Dunblane primary school and the Ladbroke Grove rail enquiry.

The formation of IRATA was fully supported by the UK HSE.

IRATA's mission is:

- To aim for zero errors and accidents in Safety and Work Quality;
- To provide Association representatives able to give informed opinion and advice to external bodies such as CEN and BSI;
- To prepare submission to government departments on matters such as health and safety and training, e.g. Health & Safety Executive;
- To comment on and discuss existing and draft legislation directives;
- To indicate areas of research and development where initiatives are required to solve problems facing the industry;
- To assist in the provision of appropriate educational training and certification opportunities for personal employment in Industrial Rope Access;
- To provide a forum for the free and informal exchange of opinion;
- To provide guidance on training and certification of personnel involved in Industrial Rope Access and guidance on good working practice.

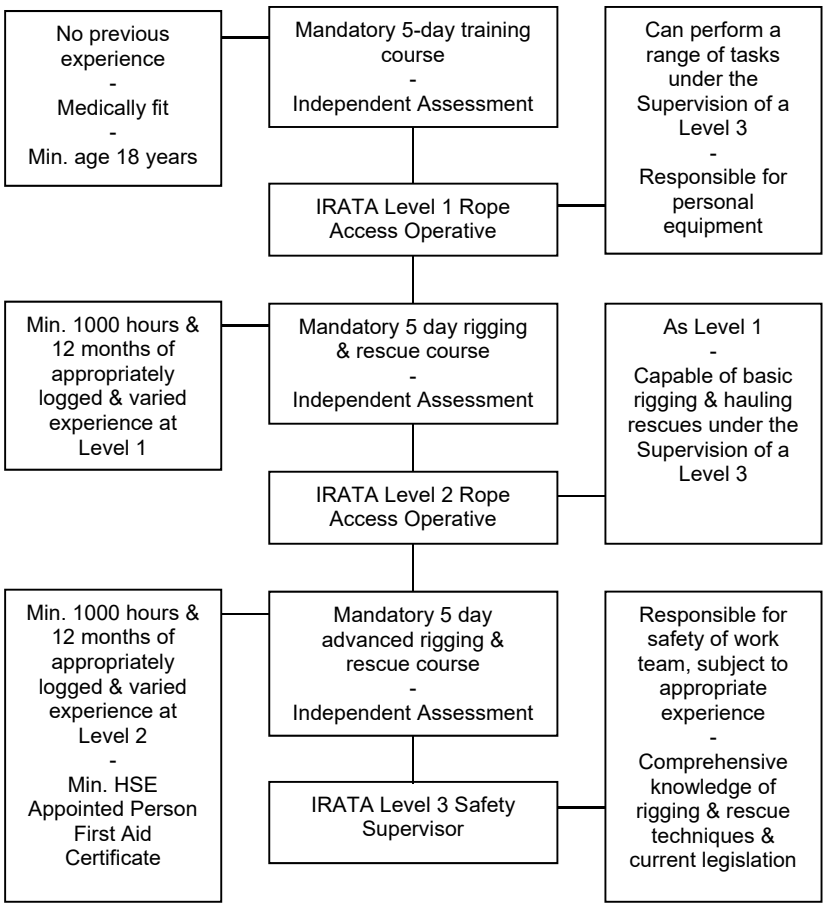
Members are required to abide by a Code of Ethics and are subject to a strict audit by independent, qualified inspectors to ensure that all of the Association's requirements of Quality Assurance, Safety, Training and Working Practices are being met.

The respected IRATA qualification scheme is now well established throughout the world and boasts over 100,000 registered operatives.

For further information on IRATA membership, contact them at the address below:

IRATA International, 1st Floor, Unit 3, Eurogate Business Park, Ashford, Kent, TN24 8XW, England. Tel: + 44 (0) 1223 754 600, Email: info@irata.org, Web: www.irata.org

IRATA Training, Assessment & Certification Scheme (TACS)



Mandatory 5-day refresher training & Independent Assessment every 3 years at all Levels of IRATA certification
-
Contact IRATA for current requirements for attaining IRATA Instructor & Assessor Status

Legislation and Governance

An Act sets out the general duties both employers and employees have towards themselves and members of the public.

Regulations have been passed in recent years to support the Act and provide more detail and focus attention on important areas of health and safety in the workplace.

At a federal level Australia does not have a single piece of legislation to govern safe working at height so It falls onto states and territories to create and implement such Acts. However there is common concepts, duties and Requirements through-out all states and territories.

Below shows what piece of legislation covers each state and territory. The Work Health and Safety Act of 2011 is common amongst all but Western Australia and Victoria.

Employers Duties

Employers are under a general duty to ensure, so far as is reasonably practicable, the health, safety and welfare of all their employees at work. This includes:

- The provision and maintenance of plant and systems of work that are safe and without risks to health;
- Making arrangements to ensure the absence of risks to health with the use, handling, storage and transportation of articles and substances;
- The provision of such information, instruction, training and supervision as is necessary to ensure the health and safety at work of their employees;
- The maintenance of any place of work under their control, in a condition that is safe and without risks to health, and the provision and maintenance of a means of access to, and egress from, the place of work that are safe and without such risks;
- The provision and maintenance of a working environment for employees, which is safe, without risks to health and adequate, with regard to facilities and arrangements for their welfare at work.

Employees & Self-Employed Persons Duties

Employees & Self-Employed persons are under a duty to take reasonable care for the health and safety at work of themselves and any other people who might be affected by their acts or omissions, and to co-operate with their employers and others to enable them to comply with statutory duties and requirements.

In addition, they must not intentionally or recklessly misuse anything provided in the interests of health, safety and welfare in the pursuance of health and safety law.

Controlling Hazards & Reducing Risk

There are three main reasons why we need to maintain high standards of safety in the rope access industry:

Moral Reason

Modern 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 Reason

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

Legal Reason

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.

Industrial rope access is a safe method of working because operatives understand their health and safety duties to themselves, colleagues and members of the public.

The following section shows what you need to do to work safely and refers to the regulations and other documents to reinforce the importance of this subject in UK industrial law.

Compliance and Enforcement Organizations

Worksafe (Vic) is a statutory authority. Its mission is, 'working with the community to deliver outstanding workplace safety, together with quality care and insurance protection to workers and employers'.

Safe Work SA is the Authority in South Australia, Like WorkSafe its goal is to ensure a safe working environment for both workers and employers.

Note: the equivalent organisation in the UK is the Health and Safety Commission (HSC) and its operating arm, The Health and Safety Executive (HSE).

Statutory Obligations

The statutory obligations are spelt out in several Acts of Parliament including:

- 'health, safety and welfare in the workplace under the *Occupational Health & Safety Act 2004 (VICTORIA)*
- health, safety and welfare in the workplace under the *Work Health & Safety Act 2011(SA, NSW, TAS, NT)*
- health, safety and welfare in the workplace under the *Occupational Health & Safety Act 1984 (WA)*
- Workers' compensation and the rehabilitation of injured workers under the *Accident Compensation Act 1985* and the *Accident Compensation (WorkCover Insurance) Act 1993*
- Employer insurance and premium under the *Accident Compensation (WorkCover Insurance) Act 1993*
- Explosives and other dangerous goods under the *Dangerous Goods Act 1995*
- The transport of dangerous goods by road under the *Road Transport Reform (Dangerous Goods) Act 1995*
- High-risk equipment used in public places and on private premises under the *Equipment (Public Safety) Act 1994'.*

Legislative Hierarchy

Legislative Act	Work Health and Safety Act 2011 Occupational Health and Safety 2004 (VIC) Occupational Health and Safety 1984 (WA)
Regulations	WHS Regulation 2011 OHS Regulation 2017 (VIC) OHS Regulation 1996 (WA)
Codes of Practice	Managing Risk of Falls in the workplace
Standards	AS/NZS 22846-2:2012: Personal equipment for protection against falls - Rope access systems - Part 2: Code of practice

The Health & Safety Executive

The Health and Safety Executive (HSE) have spent over 40 years modernising the structure of health and safety law in the UK. Things that can prompt their action are:

- Changes in technology, industries and the associated risks;
- Evidence of accidents and ill health, plus any public concern;
- Receiving European Directives.

Where the HSE consider further action is necessary, they have three main options:

Guidance

Guidance can be specific to the health and safety problems of an industry or of a particular process used in a number of industries.

The main purpose of guidance is:

- To help people understand what the law says;
- To help people comply with the law;
- To give technical advice.

Following guidance is not mandatory, however, if it is followed, it will normally be sufficient to comply with the law. Guidance is continually updated in line with changing technology, risks and associated control measures.

Codes of Practice (COP)

Codes of Practice give practical examples of good practice and advise how to comply with the law by providing a guide to what is 'Reasonably Practicable'.

An Approved Code of Practice (ACOP) is a Code of Practice usually written by the HSE or other government agency, as opposed to being written by a 'Learned body', e.g. IRATA ICOP.

Codes of Practice have a special legal status. If there is a prosecution for a breach of health and safety law and the provisions of the relevant 'COP' have not been followed, a court can find them at fault unless the law has been met in another way.

Regulations

Regulations are law, approved by Parliament and usually made under the The Occupational Health & Safety Act 2004 (OHS Act)

Guidance and Codes of Practice give advice, but employers are free to take other measures. Some risks are so great that it would be inappropriate to leave employers

discretion in deciding how to manage them. Regulations identify these risks and set out specific action that must be taken. Often these requirements are absolute.

Control of Noise at Work Regulations

The Control of Noise at Work Regulations, require action to be taken to protect employees from hearing damage at each of the following Action Levels:

- First Action Level: 80dB(A) Daily or Weekly Personal Noise Exposure ($L_{EP,d}$);
- Second Action Level: 85dB(A) Daily or Weekly Personal Noise Exposure ($L_{EP,d}$);
- Peak Action Level: 87dB(A) Daily or Weekly Personal Noise Exposure ($L_{EP,d}$).

Generally, where there are excessive noise issues on a work site, suitable ear protectors are provided close to where you enter the noisy area.

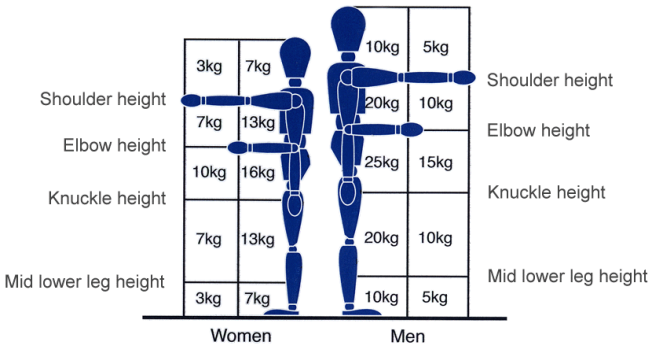
Manual Handling Operations Regulations

The Manual Handling Operations Regulations require employers to 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 operative. A risk assessment can be carried out to assess tasks that could pose a risk of acute or chronic injury.

Note: *Consideration should be given to the effects of manual handling operations during hauling and counter weight exercises and also where manual lifting or hauling operations are carried out when your feet are not against a solid structure.*

Guidelines for Manual Handling



Construction Design & Management CDM Regulations

The Construction (Design & Management) Regulations apply to all construction work likely to pose significant risks to workers and other parties.

The regulations place duties on clients, designers, planning supervisors and principal contractors to create a safe working environment for employees during the construction, alteration, conversion, fitting out, renovation and repair of a structure.

They also have a duty to produce a building or structure that is safe to maintain, refurbish and eventually demolish by the eventual owner.

The regulations will apply where:

- The project lasts for more than 30 days or involves more than 500 person days of work;
- The project requires there to be 5 or more people on site at any one time;
- The project involves demolition processes;
- Any design work.

The regulations will not apply where:

- Work is carried out on the residence of a domestic householder (except notification to HSE);
- Works of minor construction carried out on occupied premises (offices, shops etc.).

It is useful for supervisors of rope access teams to understand the two CDM documents described below, as they may have to be consulted as part of the work.

Pre Construction Information

This series of documents provides the focus for health and safety during the construction phase of the project.

In the first instance, the client appoints the CDM Co-ordinator (CDMC) who then prepares the Pre Construction Information and makes this available to tendering contractors. The Pre Construction Information includes the following:

- A general description of the work and timings within the project;
- Details of risks to workers as far as possible at that stage;
- Information required by potential Principal Contractors to demonstrate competency;
- Information for preparing a Health and Safety Plan for the construction phase, including welfare provision.

The Principal Contractor who wins the contract then develops the Construction Phase Plan. This document is the foundation for the management of all health and safety issues on the construction site. The Construction Phase Plan should include:

- Arrangements that ensure the health and safety of all who may be affected by the work;
- Arrangements for managing health and safety and the compliance with health and safety law;
- Information about welfare facilities and arrangements on the site.

The Health and Safety File

The Health and Safety File is a record of information for the end user/owner who will have the responsibility for maintaining the structure. It highlights the risks that have to be managed during the maintenance, repair or renovation of the building. The CDM Co-ordinator ensures that it is prepared and presented to the Client on project completion.

Once received, the end user/owner has to ensure that the file is maintained and updated. They will also ensure it is made available to those who will work on any future design, building, maintenance or demolition of the structure. Information contained in the file will vary with each structure but will typically include:

- Drawings and plans used throughout the construction process;
- The design criteria;
- Details of the equipment and maintenance facilities within the structure;
- Maintenance procedures required for the structure;
- Any manuals supplied by specialist contractors and suppliers of equipment showing maintenance requirements and procedures;
- The location and nature of any utilities and services including emergency and fire fighting systems.

Site Documentation

It is recommended that the following documentation 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 access and safety equipment on site and which gives equipment identification numbers, cross referenced to batch or individual test certificates or certificates of conformity, and detailing the Safe Working Load (SWL) or Working Load Limit (WLL), where appropriate;
- Information about the use and care of any chemicals that may be used on the site;

- A detailed risk assessment of the proposed scope of works;
- A safety method statement 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, Log Books or similar evidence of competence, to be carried by all persons who are working using rope access techniques.

The Control of Substances Hazardous to Health Regulations COSHH

Using hazardous substances can put people's health at risk. The Control of Substances Hazardous to Health Regulations (COSHH) require employers to:

- Assess health risks to rope access operatives and others;
- Act to prevent or control exposure to hazardous substances;
- Provide and maintain safety control measures;
- Monitor and record measures and employees' health.

Hazardous substances include any materials, mixtures or compounds used or produced at work which are harmful to a persons' health in the form in which they occur in the work place.

The Chemicals (Hazard Information & Packaging for Supply) Regulations (CHIP), require commercial chemicals and substances to be 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.

It should provide a list of active ingredients as well as information about disposal hazards and any adverse effects on the environment.

Note: This information may not be sufficient to safeguard your health and safety.

You should produce a COSHH risk assessment in order to try to eliminate the need for the use of the hazardous substance or material;

- If this is not possible, could the hazardous substance or material be substituted for a less hazardous substance or material;
- If this is not possible, could the nature of the substance or material be changed, e.g. dilution or pellets instead of powder;
- Consider other methods to minimise the risk;

- Residual risk can be minimised by the use of appropriate PPE.

Note: MSDS information will not show the effects chemicals have on textile products. It may be necessary to consult with both the chemical and equipment manufacturer or carry out specific testing to verify this.

The IRATA ICOP gives detailed information on the testing of textile equipment contaminated with the most commonly used industrial or naturally occurring chemicals found in typical industrial rope access work environments.

Note: The document provides valuable information for those tasked with carrying out COSHH Risk Assessments for rope access applications.

Management of health & safety at work regulations MHSW Regulations

The Management of Health & Safety at Work Regulations require employers to 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 systems, 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.

Risk Assessments

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;
- 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 the rope access team is expected to operate and identify any hazards that could reasonably be expected to cause harm;
    - Consider how your actions may create hazards that could cause harm to others. Prioritise the hazards that could result in major harm or affect several people;
    - Consider the 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 may be at risk from each of the hazards.

3. Evaluate the Risk and Decide whether Existing Precautions are Adequate. If Not, State Actions Required to Control Risk:

A formula for evaluating the 'Risk Rating' arising from each hazard is shown below:

Risk = Frequency x 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 work;
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 or eye;
5. Fatality.

Multiplying the numbers together produces a 'Risk Rating' which can be categorised thus:

- Critical Risks 15 - 25 (High)
- Significant Risks 8 - 12 (Medium)
- Minor Risks 1 - 6 (Low)

This industry-accepted method of evaluating risk is based on a broad judgement of the Frequency and Severity values.

Note: Some hazards, e.g. working at height, may require a more detailed analysis of the Frequency and Severity values to ensure the correct PPE is selected to mitigate all potential hazards to an acceptable level.

There are a number of variations in risk assessment formatting and a number of different methods of evaluating the 'Risk Rating' with the term Frequency often replaced with the term Likelihood, this being the Likelihood of an accident occurring based on the Frequency of similar historical accidents.

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

- Remove the hazard completely;
- Try a less hazardous material or option;
- Prevent access to the hazard;
- Organise work to reduce exposure to the hazard;
- Increase level of information, training and supervision;
- Issue appropriate PPE and provide training in its safe use.

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 and understood by all team members who must comply with the safety measures put in place to reduce the level of risk.

If there are other people in or around your team's worksite, inform them about any hazards that your work could cause them and what precautions are being taken.

The significant findings from the risk assessment should always be recorded. The 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;
- The persons exposed to the risks.

Keep the risk assessment for future reference. It will help should your precautions be questioned or if you become involved in any civil action. It will also remind you to address safety matters and help to show that you have done what the law requires.

5. Review your Risk Assessment and Revise it when Necessary:

- Review your risk assessment at regular intervals and revise it when necessary;
- Hazards may change in the same environment over time;
- New equipment, procedures or work materials can create additional hazards;
- Changing working environments may introduce significant new hazards;
- Young or inexperienced operatives joining the team may require further action to be implemented.

Reasonably Practicable

Health & Safety Legislation often use the term ‘Reasonably Practicable’ when suggesting working methods which will reduce or minimise risk in the workplace.

‘Reasonably Practicable’ is a narrower term than ‘Physically Possible’.

A computation must be made in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether money, time, trouble or additional risk), is placed in the other.

If it is shown that there is a gross disproportion between them, e.g. the risk being insignificant in relation to the sacrifice, the defendants discharge the onus on them.

In essence, when making sure a risk has been reduced, deciding what is reasonably practicable is about weighing the risk against the sacrifice needed to further reduce it.

The decision is weighted in favour of health and safety because the presumption is that the employer implements the risk reduction measure. To avoid having to make this sacrifice, they must be able to show that it would be grossly disproportionate to the benefits of risk reduction that would be achieved.

Thus, the process is not one of balancing the costs and benefits of measures, but rather of always adopting the safest measures, except where they are ruled out because they involve grossly disproportionate sacrifices.

Balancing Risk & Sacrifice

Evaluating the Risk Rating

Hazards should first be identified and the Likelihood and Severity ratings applied.

Hazard No.	**Hazard** (Example)	**Likelihood of Harm**	**Severity of Harm**	**Risk Rating**
1	Grit blasting	4	5	20
2	Spray painting	3	4	12
3	Water wash down	2	3	6

	Severity of Harm				
Likelihood of Harm	**1 Low**	**2 Low**	**3 Low**	**4 Low**	**5 Low**
	2 Low	**4 Low**	**6 Low**	**8 Medium**	**10 Medium**
	3 Low	**6 Low**	**9 Medium**	**12 Medium**	**15 High**
	4 Low	**8 Medium**	**12 Medium**	**16 High**	**20 High**
	5 Low	**10 Medium**	**15 High**	**20 High**	**25 High**

If the Risk Rating scores 8 or above, additional control measures should be identified.

Hazard No.	**Additional Risk Control Measures** (Example)	Remedial Action Date
1	Adherence to work procedures & permit to work system	01/01/18
2	Adherence to work procedures & permit to work system	01/01/18

Safety Method Statement

A safety method statement is prepared from the results of the risk assessment. The safety method statement sets out 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 points:

- Introduction, originator and date;
- Copy of the relevant risk assessment;
- Scope of works and sequence of events;
- Details of all personnel including; qualifications, levels of competency, training requirements and team structure including the name of the person with overall responsibility for controlling any necessary safety arrangements;
- Special equipment, plant, machinery and welfare provision, e.g. portable toilets;
- Arrangements for safeguarding personnel and third parties, including the general public. Exclusion of third parties from the work area;
- Emergency considerations such as rescue, evacuation and fire procedures;
- Locations and means of fixing the stability of any lifting equipment;
- Details of Personal Protective Equipment (PPE) and other risk control measures to be used;

- Communications;
- Permit to Work / Isolation of Services;
- Any environmental limitations that may apply, e.g. wind speed, rain;
- How hazardous substances will be controlled (COSHH).

Permit 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.

The 'Permit to Work' will generally be obtained from the local issuing authority, e.g. Offshore Installation Control Room**.**

The system should ensure that all the necessary safety arrangements have been implemented prior to the commencement of any works, e.g. Isolations and Shutdowns.

Note: The conditions relating to the 'Permit to Work' system must always be strictly followed.

Typical 'Permit to Work' Signage

Work at Height Regulations: Occupational Health and Safety (Preventions of Fall) Regulations 2003.

The Work at Height Regulations, formally incorporated within the Construction (Health, Safety & Welfare) Regulations (since withdrawn and now incorporated within the Management of Health & Safety at Work Regulations) and the Workplace (Health, Safety & Welfare) Regulations, address all issues surrounding working at height, in all industries.

Following the risk assessment this hierarchy should allow you to select the most appropriate methods and equipment for work at height. The overriding principle is to prevent, so far as is reasonably practicable, any person falling a distance likely to cause personal injury:

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 falling still remains, steps should be taken to minimise the distance and consequences of such falls. This includes the correct selection and use of work equipment;

4. At all stages give **Collective** protective measures, e.g. guardrails, precedence over personal protective measures, e.g. safety harnesses.

Within the above framework the Regulations require you to:

- Assess the risk to help you decide how to work safely;

- Follow the hierarchy for safe work at height – Avoid, Prevent, Minimise, and always give Collective measures priority;

- Plan and organise the work taking account of weather conditions and the possibility of a rescue, e.g. worker suspended from a lanyard following a fall;

- Ensure those working at height are competent to do so;
- Make use of appropriate work equipment;
- Manage the risks from working on or near fragile surfaces;
- Inspect and maintain the work equipment to be used and inspect the place where the work will be carried out, including access and emergency egress.

Fall Protection Hierarchy

1. Avoid work at height		
2. Carry out work from an existing place of work		
	Collective	Personal
3A. Work equipment which prevents a fall	Guardrails, Scaffolding, Mobile Towers, Multi-User MEWP's	Personal Fall Prevention & Work Restraint Systems, Single User MEWP's
3B. Work equipment which minimises the distance and consequences of a fall	Safety Nets ≤2m below Soft Landing ≤2m below Safety Nets ≥2m below	Personal Fall Protection Systems used in: Fall Factor 0 Fall Factor 1 Fall Factor 2
3C. Work equipment which minimises the consequences of a fall	Soft Landing Systems, Safety Nets at low level ≤6m below	Injury Reduction Systems, e.g. Life Jackets
3D. Work equipment which does none of the above	Ladders & Unguarded Platforms	

Collective Prevention - Guardrails
Collective Prevention - Scaffolding
Collective Prevention - Mobile Towers
Collective Prevention - Multi User MEWP's
Personal Prevention - Personal Fall Prevention
Personal Prevention - Work Restraint
Personal Prevention - Single User MEWP's
Collective minimise height & consequences - Safety Nets ≤2m below
Collective minimise height & consequences - Soft Landing ≤2m below
Collective minimise height & consequences - Safety Nets ≥2m below
Personal minimise height & consequences - Personal Fall Protection
Generally accepted as:

Fall Factor 0	- Rope Access
Fall Factor 1	- Work Positioning Systems
Fall Factor 2	- Fall Arrest Systems
Collective minimises consequences	- Soft Landing Systems
Collective minimises consequences	- Safety Nets at low level ≤6m
Personal minimises consequences	- Injury Reduction Systems
Does none of the above	- Ladders & Unguarded Platforms

Provision & Use of Work Equipment Regulations PUWER

The Provision & Use of Work Equipment Regulations support the LOLER regulations. BS7985 'Code of practice for the use of rope access methods for industrial purposes' and the IRATA ICOP reference PUWER for the supply and safe use of all work equipment, both personal suspension equipment and other tools, machinery etc. used on the worksite. PUWER suggests the following:

Suitability of Work Equipment

All work equipment should be constructed or adapted so 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 of Work Equipment

Employers and others are to ensure that work equipment is maintained in an efficient state, in efficient working order and in good repair. Where the work equipment has a maintenance log, this should be kept up to date.

Specific Risks when Using Work Equipment

The use of equipment is restricted only to competent persons who are given the task of using it. Consideration should be given to ensuring reactive tools cannot compromise the rope system of the operative using the particular tool. Only suitably competent persons can maintain or repair equipment.

Work Equipment Information and Instructions

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

Work Equipment Training

All users of 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.

Prevention of Dropping Work Equipment

Whilst working at height, work equipment, e.g. tools, which are light in weight, should always be attached to the operative by means of a suitable lanyard. Heavier tools should be attached to an independent rope system.

Lifting Operations & Lifting Equipment Regulations LOLER

The Lifting Operations & Lifting Equipment Regulations (LOLER) had a major impact on the rope access industry when they were first introduced.

The term 'Lifting Equipment' means work equipment that lifts, supports or lowers a 'Load' and includes the attachments used for anchoring, fixing or supporting it.

LOLER applies to many items used in rope access work including ropes, harnesses, connectors, strops and rigging equipment as the term 'Load' includes a person.

In association with the HSE, IRATA produced an advisory document (ACOLAR - LOLER) explaining how LOLER applies to the industrial rope access industry. The document, currently withdrawn, is undergoing review by the HSE.

The Three Principal Aims of LOLER

- Lifting operations are properly planned and managed;
- Lifting equipment is used in a safe manner;
- Lifting equipment is thoroughly examined at suitable intervals by a competent person.

Strength of Lifting Equipment

Lifting equipment must have adequate strength for its intended use. Equipment should be selected which meets the standards relevant to its intended use.

Stability of Lifting Equipment

Ensure that the lifting equipment has adequate stability and will not collapse or overturn when working. Where lifting equipment is anchored to other work equipment or structures these must be able to withstand the forces that may be imposed upon them.

Lifting People

The risk of a person falling must be eliminated by using an independent safety system, carrying out daily inspections and ensuring suitable training is provided.

Marking of Lifting Equipment

All lifting equipment should be marked with its Safe Working Load (SWL). Rope access equipment is designed specifically to support the weight of one person, therefore, rope access equipment is automatically rated with a SWL of one person in normal use.

The manufacturer's user information may allow this to be increased to two people in the event of a rescue due to the factor of safety built into the equipment, however this can seriously alter the handling characteristics of a device.

Due to most of the equipment used in the industrial rope access industry being subject to particular service conditions, e.g. different size and type of rope with varying levels of wear, they are not generally marked with a SWL. Instead, the user information supplied with the product will define the SWL or WLL that can be applied in certain configurations.

Test loads of e.g. 80kg, 100kg, 136kg, 140kg and 150kg are applied depending on the application and/or the requirements of the EN or other National or International Standard to which they may have been tested against.

All components of a rope access system should be identifiable in such a way that they can be traced back to their documentation, e.g. Certificates of Conformity, Test Certificates and Examination Reports.

Organisation of Lifting Operations

Rope access work should be properly planned by a competent person, adequately supervised and carried out in a safe manner with work teams being made up of at least 2 operatives, one of whom is deemed competent to supervise.

Third parties should be excluded from around the anchors and where possible, in the area below where rope access work is taking place by the use of appropriate barriers and sentries if required.

The planners should take account of visibility and communication between operatives, the work environment and any other hazards in the area, e.g. wind, rain, ice, high voltage lines, hot works, abrasion, and chemicals.

All operatives should be trained and capable of inspecting the items of PPE they are using. Operatives should carry out visual and tactile checks each time they use the equipment.

The supervisor should be capable of inspecting ropes, rigging gear and anchors.

Note: A Level 3 Safety Supervisor should supervise all rope access work.

Thorough & Periodic Examinations

LOLER requires all Lifting Equipment to be Thoroughly Examined:

- Before first use;
- Upon receiving the item from a third party;
- 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.

Additional Periodic Examinations should be carried out where the risk assessment has identified high wear and tear, where exceptional circumstances could occur which may jeopardise the safe use of the equipment or other dangers in the period between Thorough Examinations.

Only competent and impartial persons who have appropriate knowledge and experience to detect defects or weaknesses and assess their importance in relation to the safety and continued use of the lifting equipment should undertake a thorough examination or periodic inspection.

The competent person should make a written report of the state of the equipment at the time of the Thorough Examination.

If a defect is discovered which could become a danger to people, the employer should be informed and the lifting equipment quarantined against further use until the defect is rectified.

In addition to the above examinations it is also a requirement that ALL lifting equipment undergoes a 'Pre-Use Check' prior to the commencement of each and every use. There is no requirement for the results of this to be recorded.

Records

A Certificate of Conformity indicating the standard to which the equipment conforms

and any strength requirements should be kept for all safety critical items of equipment for as long as it remains in use.

Thorough Examination reports for the previous two years should be made available for inspection by the authorities.

All components of the rope access system should be traceable to the original Certificate of Conformity and Thorough Examination reports. A coded marking system should be used.

Personal Protective Equipment PPE Regulations

The Personal Protective Equipment at Work Regulations (PPE) require that:

- Employers provide suitable and sufficient Personal Protective Equipment (PPE) when a risk to health and safety cannot be eliminated or minimised in some other way;
- Employers supply training and information about the hazards and how to use the PPE. They also have to ensure that the PPE is being used, e.g. supervision, safety audits;
- PPE be inspected, maintained and stored correctly;
- Employees use the PPE provided, not interfere with it, and report any defects or deficiencies in use.

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

- Category I ('Simple', e.g. gardening gloves, non-specialist coveralls);
- Category II ('Intermediate', e.g. welding gauntlets, protective footwear);
- Category III ('Complex', for protection against mortal danger).

Note: Industrial safety helmets that give protection against falls from height would generally be considered Category III PPE.

Most rope access suspension equipment will fall into 'Category III' 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. ISO9001, or be subject to periodic independent batch testing.

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 high standards of safety, operatives are encouraged to wear the appropriate PPE for the full duration of the work activity creating the hazard.

Note: *To counter the causes of degradation, the PPE Regulations require components to be examined at least every twelve months.*

The HSE Specialist Inspector Report No. 59 'Issues surrounding the failure of an energy absorbing lanyard' recommends that, with regard to textile items, the frequency should be increased to every six months. However, for use in 'arduous environments' the frequency should be increased to every three months or more frequently if the risk assessment shows special hazards.

Most rope access worksites would be considered an 'arduous environment'.

Reporting of Injuries, Diseases & Dangerous Occurrences Regulations RIDDOR

Reporting specified injuries, diseases and dangerous occurrences is a legal requirement under the Reporting of Injuries, Diseases & Dangerous Occurrences Regulations (RIDDOR).

If there is an accident or incident connected with work and:

- An employee or self employed person is killed or suffers a major injury (including as a result of physical violence), or;
- A member of the public is killed or taken to hospital.

You must notify your company-nominated person immediately, e.g. by 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 person/s and the accident.

Take photographs, measurements and make detailed notes as soon as possible after the incident. A completed accident report form must follow the initial notification within 15 days.

In addition, any accident where the time lost by the injured person is over 7 days or any dangerous occurrence seen should also be reported to your company-nominated person.

The employing company should record any accident where the time lost by the injured person is over 3 days but less than 7 days. There is no requirement to report this to the HSE.

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

Any Principal Contractor governing your site will also have to be informed.

Note: Under RIDDOR (2013) the requirement for the reporting of 'Over 3 Day' injuries was amended to only report 'Over 7 Day' injuries to the HSE.

Further information on the amendments to RIDDOR is available from the HSE website: www.hse.gov.uk/riddor/reporting-change.htm

Reportable Injuries, Diseases and Dangerous Occurrences under RIDDOR

1. 'Over Seven Day' Injuries:

    - Any injury that results in absence from work for more than 7 days must be reported.

2. Major Injuries (Partial List):

    - Any fracture, other than to the fingers, thumbs or toes;
    - Any amputation;
    - Dislocation of the shoulder, hip, knee or spine;
    - Loss of sight (whether temporary or permanent);
    - A chemical or hot metal burn to the eye or any penetrating injury to the eye;
    - Any injury resulting from an electric shock or electrical burn (including any electrical burn caused by arcing or arcing products) leading to unconsciousness or requiring resuscitation or admittance to hospital for more than 24 hours;
    - Any other injury leading to hypothermia, heat-induced illness or to unconsciousness requiring resuscitation or admittance to hospital for more than 24 hours;
    - Loss of consciousness caused by asphyxia or by exposure to a harmful substance or biological agent;
    - Acute illness requiring medical treatment or loss of consciousness because of the absorption of any substance by inhalation, ingestion or through the skin;
    - Acute illness requiring medical treatment where there is a reason to believe this resulted from exposure to a biological agent or its toxins or infected material.

3. Diseases (Partial List):

    - Inflammation, ulceration or malignant disease of the skin due to ionising radiation;
    - Malignant disease of the bones due to ionising radiation;

- Blood dyscrasia due to ionising radiation;
- Cramp of the hand or forearm due to repetitive movements;
- Hand-arm vibration syndrome;
- Hepatitis;
- Leptospirosis;
- Tetanus;
- Asbestosis;
- Occupational dermatitis;
- Occupational asthma.

4. Dangerous Occurrences (Partial List):

- The collapse, overturning or failure of any load bearing part of any lift or hoist, crane or derrick, mobile powered access platform, access cradle or window cleaning cradle, excavator or fork lift truck;
- Plant or equipment coming into contact with an un-insulated overhead electric line in which the voltage exceeds 200 volts, or causing an electrical discharge from it by coming into close proximity to it;
- Electrical short circuit or overload resulting in a fire or explosion that either stops the plant it is serving for more than 24 hours or which had the potential for causing a fatal injury;
- Complete or partial collapse of a scaffold more than 5m high, or erected over or near to water such that someone could fall from the scaffold and drown, or of the suspension arrangements on a slung or suspended scaffold that could cause the working platform or cradle to fail;
- The complete or partial collapse of a building being constructed, reconstructed, altered or demolished which involves the fall of material heavier than 5 tonnes, or of any floor or wall used as a place of work.

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.

Harnesses should conform to the relevant standards for their particular application. Industrial sit harnesses are designed for Work Suspension, though may also be used for Work Restraint purposes, and must conform to the European performance standard EN813. Some harnesses satisfy EN813 and also conform to the work positioning standard EN358.

Fall arrest situations require a full body harness conforming to EN361. Some 'combination' sit harnesses also conform to the requirements of an EN361 full body harness, making them a useful multi-purpose rope access harness.

Mountaineering harnesses complying with EN12277 are not suitable for industrial rope access purposes.

Harnesses & Adjustable Work Seat

Work Seats

Where the operative is required to be suspended for an extended period it would be advisable to use a work seat.

It is attached to the harness system in such a way as to provide an independent system. In the unlikely event of a failure in the work seat, the operative would still maintain 2 independent points of attachment to both the working and safety ropes.

There are a number of designs with differing methods of attachment to the harness.

Connectors

Connectors, e.g. Carabiners, ‘Maillon Rapides’ etc., should be of at least the double closure variety as these provide the minimum required level of security from accidental detachment. Steel screwgate carabiner type connectors are the most common.

Note: In certain situations, double closure twistlock type connectors may lead to “rollout” and subsequent detachment.

Triple closure type connectors may be more appropriate in certain situations and are the recommended type of closure mechanism for connectors used in arboriculture.

Steel connectors should be chosen when making attachments to other metal anchors, e.g. cables or bolt hangers. Large opening ‘MGO’ connectors are also available.

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

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

To avoid abnormal loading, it may be appropriate to use a ‘captive eye’ connector or use, e.g. a rubber retaining string to maintain the connector in the correct orientation.

Suitably shaped and torque tightened ‘Maillon Rapide’ connectors may be more appropriate where permanent or semi-permanent attachments are required or where multi-directional loading or potential mis-loading may occur.

Carabiner type connectors should conform to EN362 with a MBL of 22kN. Maillon Rapide type connectors should conform to EN12275Q or EN362.

Selection of Connectors

Descender Devices

Descender devices are used to 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.

Descender devices 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.

Ideally the descender device should have a panic grip override facility and a ‘Fail to Safe’ method of threading rope into the device.

Descender devices used in the rope access industry should conform to EN12841C or, in some cases, EN341A (the standard for descender devices used in rescue systems).

Petzl Rig & I’D Descender Devices

Ascender Devices

Ascender devices are attached to and used to ascend 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, when attached to the rope, must be avoided as this can cause serious damage to the sheath. During testing to EN12841B & EN567, an ascender device should be capable of holding a 400kg load for 3 minutes.

The current standards for rope adjustment devices are EN12841B or EN567.

Note: *For normal operations both descender and ascender devices should be used to hold the weight of one person only. During an emergency a competent person may increase this load to a maximum of two persons, subject to specific requirements for such use as determined by the manufacturer.*

Selection of Petzl Ascender Devices and Adjustable Foot Loop

Back Up Devices

Back Up 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 generated without causing significant damage to the safety rope.

Devices should be chosen which cannot be overridden by the user grabbing the device or grabbing the rope above the device which are likely outcomes during a fall.

Petzl ASAP 'Self-Trailing' (Passive) fall arrest devices meet the requirements of both EN12841A and EN353-2, these being the standards for rope access back up devices and mobile fall arrestors for flexible lines respectively.

Note: *When used with a Petzl 'Absorbica' energy absorber, Petzl ASAP devices provide a significantly increased level of protection than is provided by any other device currently on the market, particularly for 2 person rescue loads.*

Petzl ASAP Lock & ASAP Back Up Devices & 1 Person ASAP'sorbers

Petzl ASAP Lock & 2 Person Absorbica

Ropes - General

Polyamide or polyester ropes of a 'Kernmantle' construction are considered suitable for rope access applications, i.e. constructed with a load bearing core (kern) and an outer protective sheath (mantle) providing resistance to wear and the ingress of dirt and grit.

Dynamic Rope

Dynamic ropes conforming to EN892 (UIAA①) Full Rope, with a min. 11mm Ø will stretch up to 8% when an 80kg load is applied, depending on the manufacturer. In a shock-loading situation a dynamic rope can stretch in excess of 50%.

A typical dynamic rope is likely to stretch over 75% of its original length before failure.

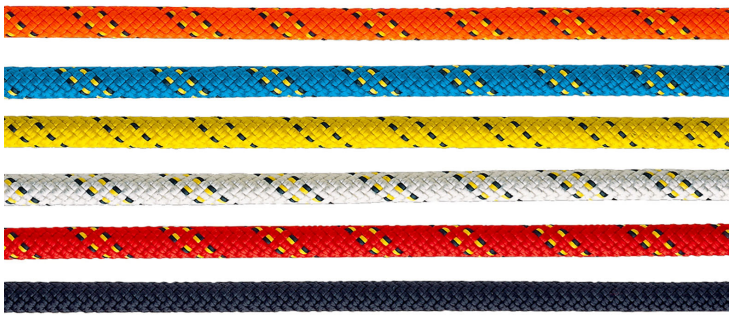
Dynamic rope is subjected to a series of FF1.78 falls with an 80kg load, generally breaking after being subjected to in excess of 12 x FF1.78 falls (Min. 5 x FF1.78).

Industry best practice suggests dynamic rope should not be subjected to Fall Factors in excess of FF1 and should be retired after a single fall.

Note: The Working Load Limit (WLL) of a dynamic rope is 'one person'.

In a FF1.78 situation with Fig. 8 knots, dynamic rope conforming to EN892 (UIAA ①) will reduce the impact force of an 80kg mass to ≤12kN. Double the maximum force allowable in industry!!!

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



Selection of Low Stretch & Dynamic Ropes

Low Stretch Rope

EN1891A Low stretch ropes (with a min. 10.5mm Ø) should be used for general rigging. This rope has undergone testing (without knots) to ensure a Minimum Breaking Load (MBL) of 22kN and a maximum elongation (stretch) of 5%.

Stretch is tested by applying a pre-load of 50kg, increased after 3 minutes to 150kg. The % stretch is measured between these loads. This could however be misleading. When a 100kg load is applied to an un-weighted rope, stretch could be ≤10%.

Type A, low stretch ropes are also tested through a series of Fall Factor 1 (FF1) tests with a 100kg load, generally breaking after approx. 10 x FF1 falls (Min. 4 x FF1 falls).

Industry best practice suggests low stretch rope should not be subjected to a Fall Factor in excess of FF0.3 and should be retired after a single fall.

The WLL of low stretch rope is 1/10th of its quoted MBL.

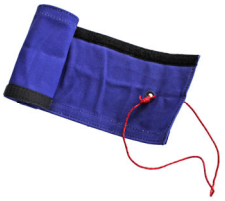
Before first use, low stretch rope should be conditioned by soaking in cold fresh water and allowed to dry naturally. This ensures the lubricants used in manufacture are removed. Shrinkage of ≤10% is likely during this process, dependent on the particular manufacturer, with ≤5% further shrinkage likely during use.

Canvas Rope Protectors

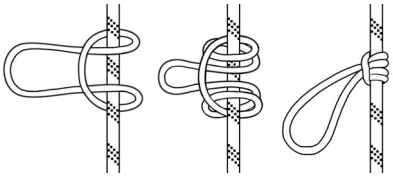
Rope protectors are used when it is not practicable to eliminate ropes rubbing against a part of the structure or natural feature likely to cause light abrasion.

Rope protectors are usually made from heavy-duty canvas with a wrap around, Velcro closure. Attachment loops should be tied either directly to the structure or with a 'Prussik Knot' around the safety rope. In some cases it may be appropriate to install rope protectors to both working and safety ropes.

Rope protectors do not require EN certification.



Canvas Rope Protector



Prussik Knot

Note: Canvas type rope protectors are not suitable for protection against very abrasive or sharp surfaces or edges.

Wire Slings

Where there is a risk of abrasion at anchorage points, wire slings (often referred to as wire strops) should be chosen over textile webbing slings.

Slings can be manufactured to any length but would generally have a min. Ø of 7mm.

Wire slings are often covered with a plastic sleeve in order to protect against damage to protective coatings on structural steelwork.

Wire slings should conform to EN795B or have a SWL of 500kg (F.O.S. 5:1)

Typical Protected Wire Sling (Wire Strop)

Grating & Edge Guards

Where rope protection is required against very abrasive or sharp surfaces or edges and it is not practicable to rig the ropes so as to avoid the hazard, proprietary Grating and/or Edge Guards should be chosen.

Always ensure they are adequately secured to the grating or building/structure edge.

Grating and Edge Guards do not require EN certification.

Typical Grating & Edge Guards

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 (load bearing) stitching will usually be of a contrasting colour or shade of 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.

Note: Due to the effects of localised abrasion and a minimum 20% strength reduction, avoid attaching main anchorage slings with a Larks Foot Knot (Choker Knot) or Prussik Knot unless it is specifically designed for such use, e.g. SpanSet Wrappa.

For protection against light abrasion webbing slings can be manufactured or retro-fitted with protective tubular textile sleeves.

Slings should conform to EN795B, BS/EN1492-2 or EN566 and lanyards to EN354

Attachment Slings

SpanSet 'Wrappa' Anchor Sling

Protected Webbing Sling

Cow's Tails

Appropriately knotted cow's tails are used to connect the operative's harness to the structure via suitable attachment slings or for making temporary attachments during rope manoeuvres.

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 requires them to be made from dynamic rope conforming to EN892 (UIAA ①) Full Rope, with a min. 11mm Ø.

If the longest cow's tail were 0.6m in length, including its connectors, with a maximum Fall Factor of FF1 and no energy absorption being allowed for, the maximum impact force generated with a 100kg mass could be ±6kN (600kg).

Note: *The length of the cow's tail should be kept as short as possible and never beyond the limit of the operative's reach when under tension.*

Allowing for the energy absorption of the rope and knots, a cow's tail could, therefore, be up to 1m in length with a maximum Fall Factor of FF1. Where fall distances or Fall Factors are in excess of this then suitable and appropriate length energy absorbing lanyards should be used.

Traditional (2 x Long & 1 x Short Loop) Cow's Tail Arrangement.
Re-threaded figure of 8 to Harness Attachment Ring
& Re-threaded figure of 8 End Terminations

Adjustable Lanyards

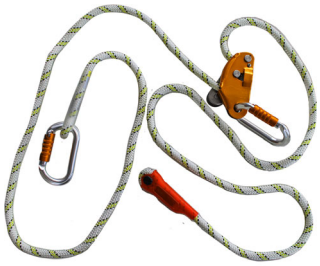
Adjustable lanyards are used to connect an operative to a suitable attachment point on the structure. They may be used to prevent operatives from entering an area where a fall from height could occur or used for suspension purposes in conjunction with a suitable length energy absorbing lanyard.

Adjustment can be by a simple buckle arrangement, pre-adjusted before entering the hazardous area, by the use of a locking mechanism allowing adjustment whilst in partial suspension, or more commonly, by the use of descender type adjustment devices which can be adjusted by the user whilst in full suspension. They are available in a variety of lengths to suit the application.

Lanyards, which are adjustable whilst in partial or full suspension, are a popular more flexible alternative to the traditional rope Cow's Tail arrangement.

Adjustable lanyards should conform to EN354, EN358 and/or EN795B and may also conform to EN12841C.

Pre-Adjusted Lanyard



Petzl Grillon Adjustable Lanyard

Petzl Progress Adjust Lanyard

Energy Absorbing Lanyards

Energy absorbing lanyards are used to connect an operative's fall arrest harness with a sternal or dorsal attachment loop to a suitable attachment point on the structure. In the event of a fall, the lanyard will limit the fall distance and reduce impact forces on both the operative and the structure to below 6kN. The lanyard webbing or rope construction should have a minimum rated static strength of 22kN. The longest length available is 2m, however, lanyards should be chosen which reduce the potential fall distance to an absolute minimum. Lanyard legs may be elasticated to help prevent potential tripping hazards.

Single energy absorbing lanyards are used to protect a worker whilst entering a small hazardous area via, e.g. a pre-installed safety harness eyebolt or temporary anchor strop. They can be used for connecting an operative to a permanent fall arrest system, e.g. a 'Latchway ManSafe' system, or a temporary system, e.g. a 'SpanSet Horizontal Safety Line', from a safe location.

Where progress up, down or around a structure is required then a twin energy absorbing lanyard should be utilised thus ensuring continual attachment whilst progression is made.

Energy absorbing lanyards should conform to EN355.

Retractable Lanyards

Retractable lanyards are used to connect an operative's fall arrest harness to a suitable attachment point. In the event of a fall the lanyard will immediately arrest the fall thus limiting the fall distance and as such, the impact force on the operative to well below the maximum 6kN.

The webbing or wire rope construction should have a MBL of 22kN. They are available in a variety of lengths from 2m upwards.

Where practicable, retractable lanyards should be positioned directly overhead.

Note: *Retractable lanyards should not be used for work restraint purposes unless the maximum extended length prevents a fall. They should not be used in the horizontal plane unless such use is clearly stated in the manufacturer's user instructions.*

Retractable lanyards should conform to EN360.

Vertical Fall Arrest Systems

Vertical fall arrest systems generally come in two varieties, rigid and flexible. Rigid systems are usually permanently installed with either an alloy rail or stainless steel wire, and temporary, flexible systems, are usually installed with a kernmantle rope.

Permanent fall arrest systems are most commonly installed on open, unprotected ladders. Operatives using such systems should ensure that the mobile fall arrest device connected to the rail or wire is attached to the sternal (chest) attachment point on the harness. As operatives climb up or down, the device will travel with them. Should an operative lose their footing and fall, the device will immediately lock and arrest the fall.

If safe access is required beyond the reach of the system, other suitable equipment should be utilised to ensure a fall cannot take place, or to reduce the fall distance to a minimum, e.g. an adjustable lanyard and/or a twin energy absorbing lanyard.

Rigid fall arrest systems should conform to EN353-1. Flexible fall arrest systems should conform to EN353-2.

Temporary Vacuum Anchors

This patented temporary vacuum anchor fall protection system was designed originally for use in aviation maintenance and aircraft manufacture. The system is powered pneumatically without the need for electricity or batteries. The system has no metal on metal contact and so is ideally suited for use on some finish painted surfaces, where there are no other anchor points for the attachment of safety equipment.

Weighing less than 6kg they are easy to install and provide a highly portable single-user system. The supplied compressed air cylinder can easily be re-filled.

The system can be used in both wet and dry conditions and within a wide range of temperatures. Safety features include up to 20 minutes full strength suction even following the unlikely failure of the air supply.

Temporary anchor systems should be tested to meet the requirements of EN795.

Note: Specific substrate testing by the manufacturer may be required to ensure suitability for the application.

Latchways Temporary Vacuum Anchor

Pulleys

Pulleys are used in combination with ropes, connectors, descender and ascender

devices to allow mechanical advantages to be employed for hauling operations.

A snap-gate pulley carabiner can be used, in conjunction with a handled ascender device to aid ascending the working line when using an autolock descender device.

Pulleys may be single or double sheaved and have fixed or swing sided cheeks depending on the application and may have plastic, phosphor bronze or ball bearing mechanisms.

Pulleys should conform to EN12278.

Pulley Carabiner In Use

Selection of Single & Double Sheaved Pulleys

Rigging Plates

Multi-holed rigging plates may be used to provide more organised positioning of connectors in complex rigging configurations. They are available in a variety of sizes.

Rigging plates should be CE marked and have a MBL of 36kN.

Multi-Holed Rigging Plates

Foot Loops & Etriers

Adjustable rope or webbing foot loops are used primarily to aid ascending ropes and are used in conjunction with an upper, often handled, ascender device and harness attached chest ascender or autolock descender device.

Multi stepped Etrier foot loops can also be used for ascending ropes but are more commonly used during vertical and horizontal aid climbing operations.

Foot loops and etriers are not classified as PPE and as such do not require EN certification, however, some adjustable foot loops meet the requirements of the adjustable work restraint lanyard standard, EN358.

Adjustable Foot Loop / Lanyard (EN358) & Multi Stepped Etrier

Helmets

The helmet should provide resistance to side impacts as well as impacts from above. 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.

Helmet standards can be very confusing. Some models conform to the industrial standard EN397 in respect of the shell, and the mountaineering standard EN12492 in respect of the 50kg chinstrap.

These models are hybrids and as such do not conform to any standard. They are however regarded as being the most suitable helmet for work at height applications.

In certain high temperature locations it may be appropriate to use a helmet with ventilation holes, conforming only to EN12492.

One reason vented helmets do not conform to EN397 is the possibility of weld splatter from above dropping into the vent holes. An effective Risk Assessment should remove such a potential hazard.

Helmets without a peak will prove beneficial when working in a vertical environment. Some models allow for the installation of ear defenders, face shields and head torches.

Note: *When working at height, helmets should always be worn with the chinstrap fastened.*

Helmets are available in a variety of colours; however, some industries only allow certain colours to be used, e.g. to avoid confusion with train signalling systems or to allow differentiation between experienced and less experienced operatives on large worksites.

Typical Work at Height Safety Helmets

Fully Equipped for Safe Work at Height

Vertical Rope Work Kit Fall Arrest & Work Positioning Kit

(Full Body Harness with Chest Ascender, Back Up Device, Descender Device, 4 Step Etrier, Handled Ascender, Adjustable Foot Loop/Lanyard & Helmet. Adjustable Length Lanyard, Twin Energy Absorbing Lanyard, MGO & Triple Action Connectors & Helmet)

Equipment Strengths, Limitations & Certification

Breaking strengths may vary depending on particular product specifications from different manufacturers. The Minimum Breaking Load (M.B.L.) requirement for rope adjustment devices is 15kN. Below are examples of M.B.L's for other EN standards.

EN1891A – 10.5mm Ø Low Stretch Kernmantle Rope	MBL - 22kN
EN362 – 10mm Ø Steel Screw gate Connector	MBL - 22kN
EN795B – 25mm Round Webbing Sling	MBL - 22kN
BS/EN1492-2 – Round Webbing Sling (Purple / WLL 1T)	MBL - 70kN

Force Calculations

- Acceleration due to gravity = 9.81m/s/s (Generally expressed as 10m/s/s);
- Peak Impact Force (PIF) = Mass x Acceleration; expressed in Newton's (N);
- As an approximation 1kN (Force) = 100kg (Mass);
- As an approximation 1J (Energy) = 1kg (Mass);
- Potential energy in a fall situation = Mass x Gravity x Height Fallen (M x G x H), e.g. 100 (kg) x 10 (g) x 4 (m) = 4000 (expressed in Joules (J)) = 40kN.

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.

A delta shaped Maillon Rapide type connector, which can be loaded in a number of configurations may have a WLL marked on it, as the MBL for each configuration may be different.

If a connector could only possibly be loaded in its intended direction of use then it may have a SWL marked on it, e.g. a lifting shackle.

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) of the weakest link in the system must never be knowingly exceeded.

As a general rule in rope access, all wire slings, carabiner and Maillon Rapide connectors will have a SWL that is equal to 1/5th of their Minimum Breaking Load (MBL), thus giving a Factor of Safety of 5:1.

Textile items, e.g. webbing slings, lanyards and ropes, will have a WLL that is equal to 1/10th of their Minimum Breaking Load (MBL), thus giving a Factor of Safety of 10:1.

Textile lifting slings conforming to BS/EN1492-2 will have a quoted WLL with a Factor of Safety of 7:1, e.g. WLL 1000kg = MBL 7000kg.

In cases where the item of personal protective equipment does not have a clearly definable Breaking Load (BL), e.g. dynamic rope, the SWL should be regarded as being one person. For 2 person rescue loads, a competent person may increase the SWL to a maximum of 250kg, subject to strictly following the recommendations of the manufacturer.

Note: In the USA and the EU, the use of the term SWL is gradually being replaced with the term WLL.

CE Marking

Ensure that all Personal Protective Equipment (PPE) carries a CE mark. For 'Category III' PPE, CE marking indicates that the product has been independently type tested and meets the basic requirements of the PPE Directive and the subsequent Personal Protective Equipment at Work Regulations.

The prime function of CE marking is to protect against barriers to trade within the European Union.

Note: CE marking alone does not mean the item is fit for the intended application. When purchasing or choosing an item of PPE, ensure first that it conforms to the appropriate EN or other standard for that particular application and that the item will operate effectively in that particular environment and configuration.

The 4-digit number following the CE mark is a reference to the official notified body who carried out the type testing on the product, e.g. CE 0082 refers to the notified body, Apave Sudeurope, based in Marseille, France.

Equipment Certification

A 'Certificate of Conformity' should be obtained for the product, stating that it meets the above requirements and conforms to any standard it claims to meet.

The PPE Regulations require the following:

- The product undergoes independent type testing to a particular standard;
- The manufacturer installs a quality management and assurance standard such as ISO9001, or;
- The manufacturer subjects the product to regular batch testing at an approved test house.

Note: Conformance to an EN standard should only be used as an initial guide in

the equipment selection process. It is important to ensure equipment functions correctly in the particular environment and that safety features cannot be over-ridden by the user.

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, e.g. an independent 'Certificate of Testing'.

Certificate of Conformity / Thorough Examination

URBANABSEILER
INDUSTRIAL ROPE ACCESS TRAINING
MELBOURNEAUSTRALIA

Urban Abseiler Pty Ltd
106 Moore Street
Coburg
Victoria
Melbourne
3058
Australia
Tel: 0427 822 335
E-mail: info@urbanabseiler.com.au
Web: www.urbanabseiler.com.au

Certificate of Conformity / Through Examination to:
Peak Engineering
3/12 Jesmond Road
Croydon
Victoria
Melbourne
3136
Australia

Date: 01/06/2018
PO: SI-5001
Page 1 of 1

Certificate of Conformity / Thorough Examination

Code	Description	Quantity	Conformity
C79AAA1	Petzl - Avao Bod Croll Fast *Size: Size 1*	2	CE, EN361,358,813,12841 B
B18BAA	Petzl - Ascension *Hand: Right Handed*	12	CE, EN567, EN12841 Type B
B71ALU	Petzl - ASAP Lock	2	CE, EN353-2, EN12841 Type A
LO71	Lyon - Anchor Strop *Length: 1m*	6	CE, EN795 Type B, PD CEN/TS16415
M72ASL	Petzl - Oxan Screwgate *Colour: Gold*	30	CE, EN362

The above equipment has been thoroughly examined by a competent person in accordance with PPE Regulations. LOLER and the manufactures recommendations and is deemed to be in a serviceable condition. Conformity to relevant standards is stated where appropriate.

Signature:

A. J Lambert

Alan Lambert – Director – Urban Abseiler

Date: 01/06/2018

ABN 51 613 067 940

Standards & Norms *(Contact BSI for most current revisions)*

EN166	Personal Eye Protection – Specifications;
EN341	Personal protective equipment against falls from a height. Descender devices for rescue;
EN352	Hearing Protectors – Safety requirements and testing;
EN353-1	Personal protective equipment against falls from a height. Guided type fall arresters. Part 1: Specification for guided type fall arrestors on a rigid anchorage line;
EN353-2	Personal protective equipment against falls from a height. Guided type fall arresters. Part 2: Specification for guided type fall arrestors on a flexible anchorage line;
EN354	Personal protective equipment against falls from a height. Lanyards;
EN355	Personal protective equipment against falls from a height. Energy absorbers;
EN358	Personal protective equipment against falls from a height. Work positioning systems;
EN360	Personal protective equipment against falls from a height. Retractable type fall arrestors;
EN361	Personal protective equipment against falls from a height. Full body harnesses;
EN362	Personal protective equipment against falls from a height. Connectors;
EN363	Personal protective equipment against falls from a height. Fall arrest systems;
EN365	Personal protective equipment against falls from a height. General requirements for instructions for use and for marking;
EN397	Specification for Industrial Safety Helmets;
EN564	Mountaineering equipment – Accessory cord – Safety requirements and test methods;
EN565	Mountaineering equipment – Tape – Safety requirements and test methods;
EN566	Mountaineering equipment – Slings – Safety requirements and test methods;
EN567	Mountaineering equipment – Rope clamps – Safety requirements and test methods;

BS/EN795	Protection against falls from a height – Anchor devices – Requirement and testing;
EN813	Personal protective equipment for prevention of falls from a height – Sit harnesses;
EN892	Mountaineering equipment – Dynamic mountaineering ropes – Safety Requirements and Test Methods;
EN958	Mountaineering equipment – Energy absorbing systems for use in Klettersteig (via ferrata) climbing – Safety requirements and test methods;
BS/EN1492-2	Textile slings. Safety. Round slings, made of man-made fibres, for general-purpose use;
EN1891	Personal protective equipment for the prevention of falls from a height – Low stretch kernmantle ropes;
BS/EN1909	Safety requirements for cableway installations designed to carry persons: Recovery and evacuation;
BS7883	Code of practice for the design, selection, installation, use and maintenance of anchor devices conforming to BS/EN795;
BS7985	Code of practice for the use of rope access methods for industrial purposes;
BS8437	Code of practice for selection, use and maintenance of personal fall protection systems and equipment for use in the workplace;
BS8454	Code of practice for delivery of training and education for work at height and rescue;
BS8610	Personal fall protection equipment – Anchor systems – Specification, *(Supplement to BS/EN795)*;
EN12278	Mountaineering equipment – Pulleys – Safety requirements and test methods;
EN12492	Mountaineering equipment – Helmets for mountaineers -- Safety requirements and test methods;
EN12841A/B/C	Personal protective equipment for prevention of falls from a height: Work positioning systems – Rope adjustment devices;
EN15151	Mountaineering equipment - Braking devices - Safety requirements and test methods;
BS/ISO22846-1/2	Personal equipment for protection against falls - Rope access systems - Part 1: Fundamental principles for a system of work - Part 2: Code of practice *(International rope access standard)*.

Equipment Marking

Equipment should be indelibly marked so that it may be individually traced to all relevant certification.

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

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

Petzl Equipment Marking

Petzl products manufactured before 2016 are marked with batch and individual serial numbers in the factory. The markings give details on manufacture, control and traceability, e.g. 06237FC0123.

When the above serial number is looked at in detail it gives valuable information when equipment is logged into service and for on-going inspection and withdrawal from service due to reaching its recommended useable lifespan. It also provides valuable information in the unlikely event of a recall of the product by the manufacturer.

The above example serial number can be described thus; 06, 237, FC, 0123:

- 06 Year of manufacture;
- 237 Day of the year;
- FC Workstation & inspector control;
- 0123 Unique production number.

Petzl products manufactured from 2016 may be marked with, e.g. 16B0078666114.

The above example serial number can be described thus; 16, B, 0078666, 114:

- 16 Year of manufacture;
- B Month of the year (A to L) – (B = February);
- 0078666 Batch/Lot number;
- 114 Unique production number.

Other Equipment Marking

In cases where the equipment manufacturer does not uniquely mark their equipment it will likely be necessary to make your own markings. This should be carried out in a manner that will not affect the integrity of the equipment. The product manufacturer will give advice on the best location to carry out such marking. Some commonly used methods of marking equipment are described below:

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;
Webbing	Mark the serial code on the information tag attached to the webbing item;
Harnesses	Mark the serial code on the information tag attached to the harness;
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.

Rope lengths cut directly from the drum or box should be marked with the rope's original Batch Number, its type, e.g. Low Stretch or Dynamic, and its new length.

Ideally, markings should be placed on both ends of the rope.

Typical Rope End Markings

Equipment Examination

Equipment examinations play a central role in the rope access industry. They generally fall into three categories:

- Pre-Use Check (Before each use and continuously during use);
- Periodic Examination (Interim Inspection);
- Thorough Examination (Detailed Inspection).

Any item showing signs of defect or alteration without the approval of the manufacturer should be withdrawn from service immediately. Rope access technicians have certain responsibilities toward equipment examination.

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.

The manufacturer's recommendations on the obsolescence of equipment should be strictly adhered to. In certain circumstances however, this maximum service life could be as little as a single use.

Note: Metal items manufactured by Petzl have an indefinite life expectancy (obsolescence). Textile and predominantly plastic items manufactured by Petzl have a max. life expectancy of 10 years from the date of manufacture. Removal from service will be the responsibility of the competent person carrying out the examination.

Upon completion of the examination, equipment should be marked in such a way as to clearly demonstrate the examination has been carried out and the equipment is fit for continued use. This should be done in such a way as to ensure the safe functioning of the equipment is not compromised, e.g. colour coded self-adhesive labels.

Inspection, Cleaning & Maintenance of 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. The HSE Specialist Inspector Report No. 59 gives details on current frequency of inspection recommendations for textile items of equipment.

In the case of kernmantle 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 and outer sheath, whilst visually checking the sheath for damage etc.

Webbing equipment should be inspected for cuts, nicks, tears, abrasion, broken stitching, chemical contamination and distortion of the weave pattern, thus indicating that the product may have 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 another item of textile equipment.

Another significant cause of abrasion, which is often overlooked, is the ingress of dirt and/or grit 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 noticed in its early stages.

In order to reduce the effect of abrasion by dirt, textiles may be washed in clean water at a maximum temperature of 30°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, place equipment in a suitable bag to protect against mechanical damage. Choose the '30°C Delicate Synthetic' setting with no spin cycle.

Do not use a high-pressure hose.

Dry any wet equipment naturally in a well-aired 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. from falling rocks, will have a detrimental effect on textile equipment with the strength loss being proportional to the severity of damage.

Over loading 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 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 and/or in the IRATA ICOP.

Note: An effective Risk Assessment should prevent dangerous chemicals from coming into contact with textile products on the worksite.

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 descender 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.

Inspection, Cleaning & Maintenance of Metal Equipment

Metal items such as carabiner and Maillon Rapide type connectors, ascenders, descenders, back up devices and harness buckles should be inspected to ensure 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.

Metal equipment can be cleaned in clean hot water (max. 100°C) and using a detergent or soap which must be thoroughly rinsed afterwards. A non-metal abrasive pad or scrubbing brush may assist, e.g. nylon. Always refer to the manufacturer's instructions on care and maintenance.

Inspection, Cleaning & Maintenance of 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, maintenance and recommended frequency of examinations.

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 and well ventilated area. To remove traces of adhesive, e.g. stickers, you may use methylated spirits.

Examination of Eyebolts for Rope Access

BS7985, Code of practise for the use of rope access methods for industrial purposes, states that all eyebolt anchors used for the purpose of rope access should comply with the requirements of EN795.

Regulation 9 of LOLER requires such eyebolts to 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.

Examination of Eyebolts for Lifting Loads other than People

A removable threaded eyebolt, screwed into a 'Load' as an attachment for, e.g. lifting slings, is 'an accessory for lifting' and should be thoroughly examined every 6 months.

An eyebolt or pad eye used as an anchor for supporting lifting equipment, such as a winch, is lifting equipment and needs to be thoroughly examined at least every 12 months (as opposed to every 6 months in the case of lifting equipment for lifting persons) under LOLER.

A pad eye (or link) permanently fastened to a load to connect lifting slings is deemed to be part of the load. They are required to be maintained in a safe state, be of adequate strength and undergo a pre-use check.

There is a duty under PUWER to maintain eyebolts and pad eyes in a safe condition.

Examination of Eyebolts for Fall Arrest

An eyebolt acting as an anchor for a fall arrest lanyard is not a lifting accessory and does not require examination under LOLER. Instead, it is considered to be part of the fabric of the building, structure, etc. and comes under the provisions of the Workplace (Health, Safety & Welfare) Regulations.

EN795 requires examination of such bolts at least every 12 months by a competent person. Examination after installation and at regular intervals subsequently is also likely to be necessary to comply with the general requirements of the Health & Safety at Work, Etc. Act 1974, i.e. the duty of an employer to ensure, so far as is reasonably practicable, the health and safety of employees.

A competent person should carry out the examination in accordance with the guidance and recommendations given in EN795 and BS/EN7883.

Equipment Inspection Responsibilities of Rope Access Technicians

A rope access technician has a number of responsibilities under LOLER for inspecting equipment, depending on their level of competence:

Level 1 Rope Access Technician Responsibilities

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. Understand key requirements of LOLER, i.e;

- Rope access operations should be planned and managed;
- Equipment should be used in a safe manner;
- Equipment should be identified and examined regularly;
- Understand the principles of certification and traceability.

Level 2 Rope Access Technician Responsibilities

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 Rope Access Safety Supervisor Responsibilities

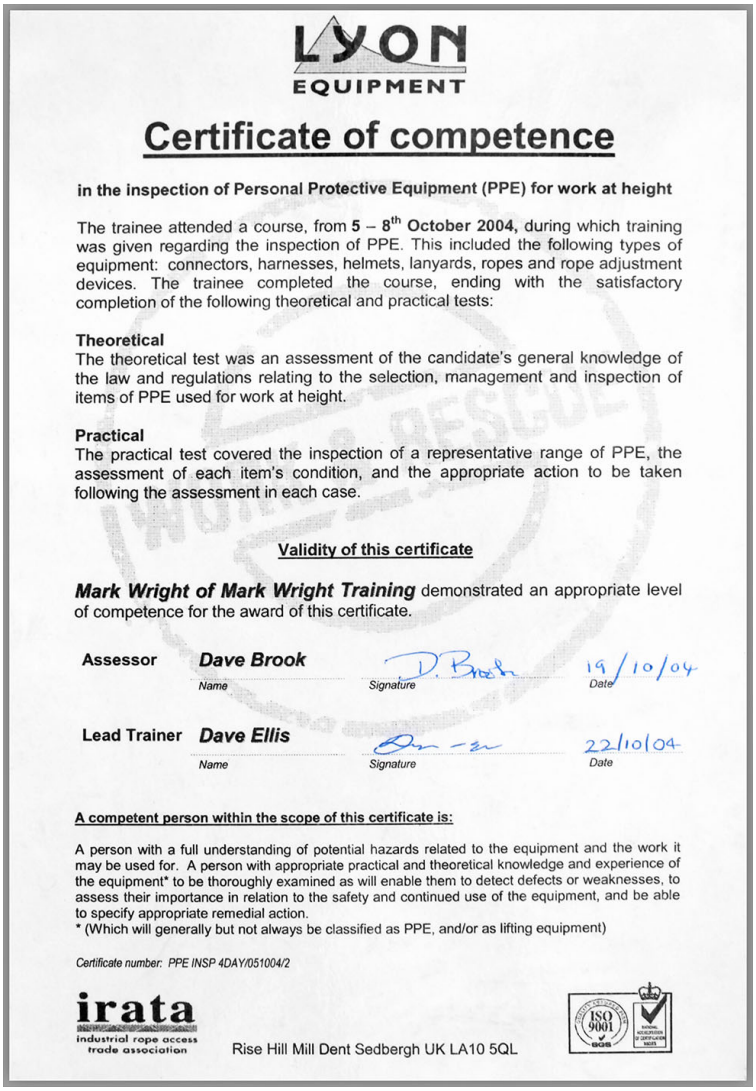
1. As Level 2;
2. Be able to produce an examination scheme for any given item of lifting equipment;
3. Be able to plan rope access operations;
4. Be aware of factors of safety for metal and textile items;
5. Understand the SWL for key items of rope access equipment;
6. Explain the key requirements of the regulations relating to rope access equipment and operations, i.e;

- 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;

7. Understand the strength and properties required of anchorages suitable for use in rope access operations;
8. Be aware of the relationship of LOLER with other key legislation.

Note: The current IRATA Level 3 Safety Supervisor course syllabus does not cover equipment examination in sufficient detail to qualify them as a competent person for carrying out 'Thorough Examinations' of PPE.

Persons who may be required to carry out a 'Thorough Examination' of PPE should hold a suitable and recognised qualification.



LYON EQUIPMENT

Certificate of competence

in the inspection of Personal Protective Equipment (PPE) for work at height

The trainee attended a course, from **5 – 8th October 2004,** during which training was given regarding the inspection of PPE. This included the following types of equipment: connectors, harnesses, helmets, lanyards, ropes and rope adjustment devices. The trainee completed the course, ending with the satisfactory completion of the following theoretical and practical tests:

Theoretical
The theoretical test was an assessment of the candidate's general knowledge of the law and regulations relating to the selection, management and inspection of items of PPE used for work at height.

Practical
The practical test covered the inspection of a representative range of PPE, the assessment of each item's condition, and the appropriate action to be taken following the assessment in each case.

Validity of this certificate

Mark Wright of Mark Wright Training demonstrated an appropriate level of competence for the award of this certificate.

Assessor	***Dave Brook*** *Name*	*Signature*	19/10/04 *Date*
Lead Trainer	***Dave Ellis*** *Name*	*Signature*	22/10/04 *Date*

A competent person within the scope of this certificate is:

A person with a full understanding of potential hazards related to the equipment and the work it may be used for. A person with appropriate practical and theoretical knowledge and experience of the equipment* to be thoroughly examined as will enable them to detect defects or weaknesses, to assess their importance in relation to the safety and continued use of the equipment, and be able to specify appropriate remedial action.
* (Which will generally but not always be classified as PPE, and/or as lifting equipment)

Certificate number: PPE INSP 4DAY/051004/2

irata industrial rope access trade association

Rise Hill Mill Dent Sedbergh UK LA10 5QL

ISO 9001 BAS

PPE Examiner Qualification (Example)

Reporting Lost or Defective Equipment

The law requires that:

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

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

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 adequately separated before being inspected and subsequently returned into service or destroyed by a suitably competent person.

Disposal of Defective Equipment

A suitably competent person should dispose of all safety related equipment withdrawn from service, 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 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.

Equipment 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 manufacturer's 'User Information', it should be stored in a dry, well-aired 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.

Coiling & Bagging Ropes

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, e.g. during an aid climb.

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 are to be avoided.

Longer ropes are best bagged 'double' in an equipment sack as large coils can become unmanageable and more prone to snagging. When bagging ropes it is important to ensure suitable stopper knots are first tied in the rope ends before being fed into the equipment sack. It will usually be necessary to occasionally tamp the rope down into the equipment sack to ensure its full volume is utilised.

Where rope is to be removed directly from the drum, it will first require securing to allow rotation of the drum. The rope is then unrolled from the drum into a heap on a clean floor or protective pad. Once conditioned, cut and marked, the rope can be coiled or bagged 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.

Typical Equipment Sack

Coiling Ropes

Rope Coiling Method to Avoid Tangles

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 safety rope and cannot suffer a fall likely to cause personal injury.

In practice, one of these ropes will act as a primary suspension or 'Working Rope' with the second acting as a 100% redundant 'Safety Rope'. Each rope should at least have its own separate anchor system, however ropes should be rigged so that if one should fail, a shock load would not be passed on through the system, e.g. to the operative, or the anchor, by the use of a 'Y' Hang rigging system for each rope.

Any potential fall should not cause an operative to impact the ground. All practical measures should be taken to ensure operatives avoid any injurious impact with the structure or other obstructions if there were such a fall.

The adverse effects of high winds should be removed by, e.g. only working on the lee side of a structure 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, two 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 close together then consideration should be given to the effects of any repetitive sideways movement in the loaded ropes which could cause alternate full loading of the two anchor points instead of equally sharing the full load at all times.

Where the anchor points for a 'Y' Hang are located further 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.

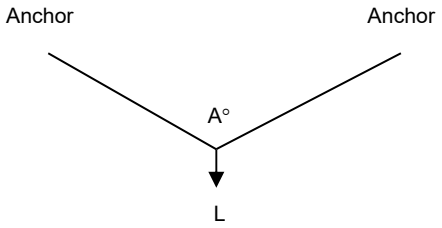
Note: Consideration should always be given to the effects of the failure of one of the 'Y' Hang anchors, regardless of their distance apart.

Using two such anchors for each half of the 'Y' Hang can lessen this potential, thereby preventing a swing should any one element of the system fail.

'Y' Hang Loading Formula

The formula for calculating the anchor point loading on 'Y' Hangs is as follows:

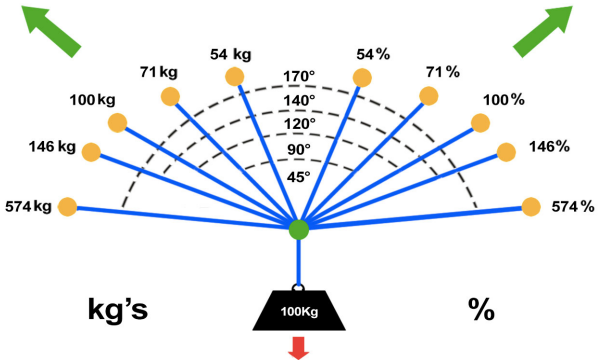
$$\text{Load at each anchor} = \frac{L \div \text{Cosine } ½ A}{2}$$



If we take a 'Y' Hang with an angle (A) of 120° and a load (L) of 100kg the above formula can be calculated thus:

$$\text{Anchor Load} = \frac{L \div \text{Cos } ½ A}{2} = \frac{100 \div \text{Cos } 60°}{2} = \frac{100 \div 0.5}{2} = \frac{200}{2} = 100\text{kg}$$

Vector Forces



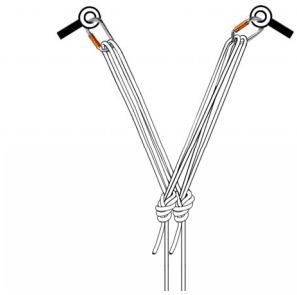
Resulting Vector Forces with 'Y' Hang Anchor Systems

Note: *The resulting vector forces increase exponentially as the 'Y' angle increases. With a 100kg load and a 'Y' angle of 178°, the effective load at each anchor would be +/- 2,873kg. When the 'Y' angle is increased to 179°, these loads would increase to +/- 5,747kg, more than 3 x the breaking strength of a typical knotted, 11mm low stretch rope!!*

‘Y’ Hang with Double Figure of 8 on the Bight (Bunny Knot)

Used to make a ‘Y’ Hang when anchor points are close together

(Only 1 rope system has been shown above for clarity)



Double Fig. 8 on the Bight
(Anchors typically up to 1.5m apart)

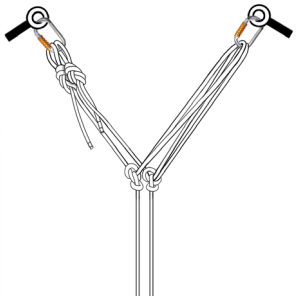
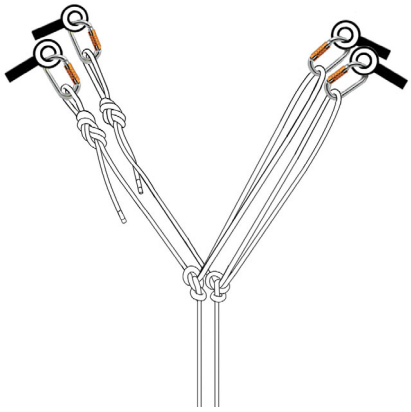


Fig. 8 / 9 on the Bight & Alpine Butterfly
(Anchors typically up to 2m apart)

‘Y’ Hang with Figure of 8 / 9 on the Bight and Alpine Butterfly

Used to make a ‘Y’ Hang when anchor points are wider apart

(Only 1 rope system has been shown above for clarity)



Wide ‘Y’ Hang Rigging System
(Anchors typically more than 2m apart)

Re-belays

Re-belays are used to re-anchor both working and safety ropes to, e.g avoid sharp edges, very abrasive surfaces or to afford more efficient access to the worksite below.

A re-belay is a double anchor point part way down the drop into which the ropes are knotted and attached in the same manner as for the primary anchor system.

Re-belay loops should hang at least 1m below the anchor point to ensure the manoeuvre can be carried out easily during both normal and rescue operations.

Deviations

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

A deviation may be a sling or wire strop attached to a part of the structure, and then attached to the ropes via connectors 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 could occur.

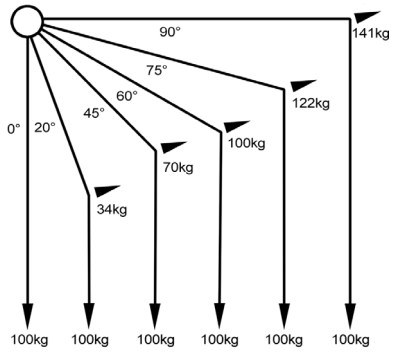
An assessment of the risks associated with the failure of a deviation should be carried out prior to the rigging and subsequent use of a deviation.

Single anchor deviations should be rigged to a maximum of 1.5 m or 20 degrees from vertical and is utilised where the consequence of failure of the deviation is negligible.

Double anchor deviations
should be rigged to a maximum of 1.5 m or 20 degrees from the vertical and is utilised where the consequences of failure present a risk to the technician, rope or property.

Note: It is imperative that the failure of a deviation cannot lead to the catastrophic failure of both working and safety ropes. In such situations it may be necessary to install a Double Deviation or consider installing a Re-Belay.

Deviation Anchor Loads



Rope Protection

Rope protectors should only be used when it is not practicable to eliminate ropes rubbing against a part of the structure, cliff face or rock slope in any other way, e.g. a re-belay or deviation.

Commercially made edge guards are the best type of rope protection where sharp or very abrasive edges are present. For protection against light abrasion, heavy-duty canvas rope protectors with, e.g. a 'Velcro' or magnetic closure mechanism are used.

It is not advisable to use plastic materials as friction generated by rope movement could lead to the rope protector quickly wearing through.

Some rope protectors are manufactured from heat resistant material to protect against damage caused by hot pipes, however they only give limited protection.

If it is not possible to attach a single rope protector directly to the structure, the attachment string should be tied with a 'Prussik Knot' around the safety rope only with the canvas wrapped around both working and safety ropes, ensuring the rope protector remains in position when the working rope is weighted and stretched.

Note: If rope protectors are used to protect against more aggressive abrasion, it may be advisable to use them doubled or protect each rope separately.

Consideration should be given to the effects of the safety rope stretching in the event of a failure of the working rope. In some cases, this could introduce upwards of 20% stretch, requiring the installation of a number of canvas type rope protectors.

Note: Due to the potential slippage of rope-attached canvas rope protectors, they are regarded as the least effective way of avoiding abrasion.

Canvas rope protectors are not suitable for protecting against sharp edges or very abrasive surfaces of any kind.

Double Wrapped 1m Canvas Rope Protector

Anchor Points - General

All anchor points used for full suspension should be unquestionably reliable and capable of withstanding any potential loads to which they may be subjected.

Suitable anchor points include structural steelwork, mechanically and chemically bonded anchors, concrete features, substantial geological features, large trees and cradle rails that have been proven to hold 6kN for 15 seconds between fixings.

BS7985 recommends anchor points used for full suspension have a MBS of 15kN, however some, e.g. non-safety critical deviation anchor points, may be weaker.

BS8437 recommends anchor points used for work restraint purposes have been proven to hold 3kN in the direction of intended use.

When ropes are tensioned, e.g. 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.

Mechanically & Chemically Bonded Anchors

Rope access anchors should comply with EN795 and the substrate must be proven to withstand a min. 12kN force applied to a sample area of $0.6m^2$ over a period of 3 minutes in the direction in which the force would be applied in service. The installation of such anchors should be in accordance with BS/EN7883.

The strength of concrete in existing structures is rarely known but can generally be safely assumed to be greater than $30N/mm^2$. Trial tests are therefore not needed in concrete structures if the type test was carried out in a sample of no more than $30N/mm^2$. Trial tests may be justified if the condition of the concrete has deteriorated sufficiently to suggest its strength may be lower than that of the test sample.

BS7985 ‘Code of practice for the use of rope access methods for industrial purposes’ and the IRATA ICOP, require anchorage systems to have a minimum strength of 15kN. In the case of eyebolts or other types of temporary anchors, this minimum strength may be obtained by using the ropes to link and equally load two EN795 anchors by the use of suitable and appropriate knots, e.g. a “Y” Hang.

Where there is likely to be full weight loading of a single anchor point, e.g. bolt anchors used for aid climbing, then it is important to ensure the structure is suitably engineered to withstand a force of 15kN in the direction of intended use.

Anchor bolts are available for use in brick, stonework, rock and steel. The main fixing types are mechanical, chemical and bolt through. Selection depends on the substrate the anchor is to be fixed to, e.g. a resin 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 requires removal after use. Sleeve type resin or expansion anchors can be left in the hole, the hanger plate removed and the hole capped. It can then be re-used on return visits by uncapping the hole, replacing the hanger plate and appropriately re-testing of the anchor.

The manufacturer's installation instructions must be followed closely. Some general points of good practice are listed below:

- Anchor bolts for rope access must always be used in pairs;
- The host substrate should be checked for cracks and weaknesses;
- The correct anchor type must be selected for the substrate material;
- 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;
- Hole diameter is dependent on the diameter of bolt and fixing type;
- For full strength the minimum distance between 12mm bolts should be 150mm. Manufacturers may allow closer placement under strict conditions.
- Holes should be cleaned out to remove loose material using a brush and then blown with a blower. This is especially important for chemical anchors;
- Expansion bolts should be torqued to the manufacturer's specified values;
- Resins have specific curing times which may be temperature sensitive;
- The bolt head or hanger should sit flush with the surface;
- Before use, an outward (axial) pull test of 6kN must be applied to all anchor bolts for 15 seconds to confirm the soundness of the fixing.

Selection of Mechanically & Chemically Bonded Anchors & Typical Pull Test Rig

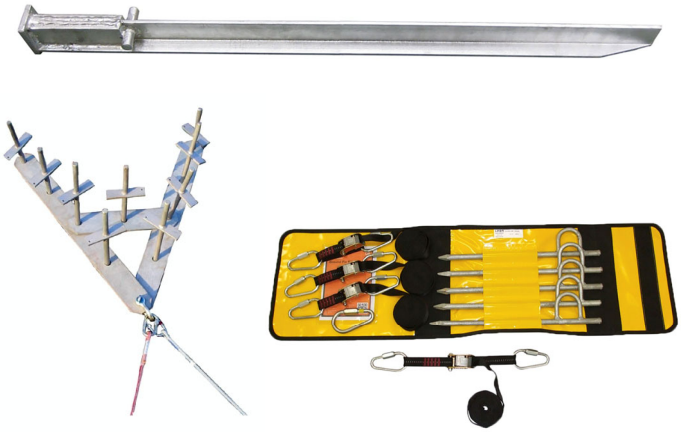
Ground Anchors

It is appreciated that operatives may be required to work in areas where no anchor points are readily available. When working on geotechnical sites it may be necessary to utilise suitable ground driven anchors or large trees or rock features.

In some cases it may be possible to rig rope systems to suitable points on a motor vehicle that has been effectively isolated and rendered immovable.

Companies carrying out these types of rigging methods will have their own documented procedures for ensuring the highest levels of safety are maintained during such use. Further guidance is given in the current IRATA ICOP.

Steering Wheel 'Anchor Warning' Cover



Typical Ground Anchor Systems

Dead Weight & Counterweight Anchor Systems

Occasionally there are no anchor points on the roof of a building and, subject to a maximum slope angle of 5°, it may be appropriate to use dead weight or counterweight anchor systems.

Particular account should be taken of cantilever or frictional effects. Wet or icy conditions can significantly affect the frictional performance of some systems.

The frictional resistance of dead weight anchor systems used for work restraint purposes should be tested to ensure there is no movement when subjected to a load of 4 x that which could be applied in such a situation, i.e. 400kg.

In the event of a rescue, full suspension systems may have to support two persons.

Consideration should be given to any abnormal 'Off-Plumb' loading which could be applied in normal use or during rescue operations as loads transfer between systems.

Always refer to the manufacturer's instructions before using these anchor systems.

Note: Counterweight lifting support beams, e.g. Parapet Wall 'A' Frames, are usually designed with a 'Factor of Safety' of only 3:1. In some cases it may be appropriate to build additional redundancy into the system.

Example of Dead Weight Trolley & 'A' Frame Anchor System

Beam Clamps & Beam Anchors

Appropriately designed beam clamps and beam anchors can provide a simple and portable attachment point for both rope access and fall arrest purposes.

They should be attached to a suitable ‘H’ section steel beam that is sufficiently strong to take the intended loads that may be applied in any eventuality.

For specific details always refer to the user information supplied with the product.

Traditional Beam Clamp

Typical Adjustable Fall Arrest Beam Anchor

Using Roof Buildings & Structures as Anchorages

A traditional method of making anchorages on the roof of a building is to install steel cables around suitable roof buildings.

Cables are assembled to allow the attachment of working and safety ropes, allowing them to radiate out to the required points on the roof edge, being protected against any further abrasion along the roof. Cables should be protected at tight corners to prevent damage to both cables and roof buildings.

For each cable 'Eye', a minimum of 3 x 'Bulldog' type clips should be attached with the 'Saddle' on the 'Live' end of the cable and spaced at 4 times the diameter of the cable. Thimbles should be used in the eyes to help protect the cable from deformation.

Note: Cable based systems are usually 'Engineered' for specified maximum working loads, Work procedures should be strictly followed to ensure safety.

Where structural steel is to be used as anchorages it is important they are soundly attached. All fixings should be present and checked for tightness. Where steelwork is considered too abrasive for textile slings, suitable wire strops should be utilised.

Note: Welded fixings may require Non Destructive Testing (NDT) prior to use.

Example of a Cable Based Temporary Anchor

'U' Bolt Saddle & Nuts 'Bulldog' Cable Clip

'Never Saddle a Dead Horse'

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. Work teams should always consist of a minimum of two operatives.

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.

It may be advisable for operatives who have had a significant break from rope access work to undergo appropriate refresher training prior to the commencement of any future rope access work. Newly qualified operatives should be subject to close supervision until they are deemed competent to work under the supervision of a more experienced operative.

Should the worksite have more than 1 discrete working area then it is important to ensure that all areas have an appropriate level of supervision, e.g. a maximum 4:1 ratio.

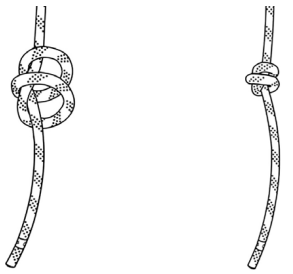
Pre Use Equipment Check

All rope access equipment needs to be checked prior to each use. Newly qualified rope access technicians should have their equipment inspected by the Level 3 Safety Supervisor or their nominated, competent person.

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.



½ Double Fisherman's 'Stopper' Knot

Safe Access To & From the Ropes

- Operatives shall attach or detach from working or safety ropes, 2m 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 suitable length energy absorbing lanyard should be used.

Descending

- 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;
- At the top of the rope drop, 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 the descender in such a position that when the working rope is under tension it will overcome the edge of the drop and sit within 0.3m of the top of the drop;

Note: The correct procedure for locking off a descender will be found in the information leaflet supplied with the descender device.

- Move over the edge in a controlled manner until your weight is transferred to the working rope;
- Check that all equipment is loaded correctly and that it is safe to descend;
- Unlock the descender device and descend. The right (controlling) hand should always maintain a firm grip on the rope approx. 0.5m below the descender device throughout the descent;
- Ensure the back up device travels freely down the safety rope as you descend;
- In the case of some autolock descender devices, e.g. Petzl Rig, it is possible to depress the control handle fully, whilst maintaining control of the descent with a strong grip of the controlling hand, however, this requires considerable effort, is needless and potentially dangerous. Far better to find the correct balance between the depression of the handle and tension control of the working rope tail;

- The controlling arm should be tucked into the body and the controlling hand positioned on the working rope tail approx. 0.5m below the descender device, thus allowing the device to be safely locked if damage to the rope sheath is discovered during the descent;

- If both hands are required for a work task, ensure the descender is locked;

Note: In the unlikely event of a failure of the working rope or losing control of the descent, the back up device will automatically lock onto the safety rope.

- To release a back up device that has accidentally loaded onto the safety rope, first ensure that the descender device is securely locked. Attach a handled ascender to the safety rope below the back up device, stand in the foot loop and the stretch in the safety rope should allow you to safely disengage the back up device. In the unlikely event of this method not being successful, 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;

Note: A cow's tail or other suitable lanyard should be attached to the handled ascender whenever it is removed from a rope to ensure that it cannot be dropped, thus causing a hazard for people working below and making the subsequent removal of a loaded chest ascender very difficult.

- After taking in any slack rope from the system, stand in the foot loop so the handled ascender is loaded and the working rope should ride smoothly through the chest ascender. If the rope drags through the chest ascender, hold the rope coming out of the bottom of the ascender in your hand or grip it between your feet as you stand. Sit back and rest on the chest ascender;

- Lift your feet and move the handled ascender further up the working rope;

- Repeat the process by standing up in the foot loop;

- The technique used for ensuring the back up device moves freely up the safety rope should not affect the operation of the device.

Changing from Ascent to Descent

- Attach the descender device onto the working rope, directly below the loaded chest ascender;

- Take in any slack rope through the descender until approximately 50mm remains between the descender and the chest ascender;

- Lock the descender device;

- Position the handled ascender at head height, stand up in the foot loop, disengage the chest ascender and sit back onto the descender, ensuring the attachment connector is not mis-loaded;

- Remove the handled ascender and foot loop from the working rope, unlock the descender device and begin to descend.

Changing from Descent to Ascent

- Stop and lock the descender device;

- Attach the handled ascender to the working rope above the descender, leaving room between the two to allow attachment of the chest ascender;

- In one movement, stand up in the foot loop, locate the chest ascender onto the working rope, close the cam and sit back onto the chest ascender;

Note: Opening the chest ascender cam before standing up in the foot loop will make this manoeuvre easier to perform.

- Remove the descender from the working rope and begin to ascend.

Descending using Ascenders

For occasional rope decent while in ascent mode

Simple technique:

With your chest ascender clamp and foot loop on the rope, place the fore finger of your right hand on top of your chest ascending cam, with your finger nail contacting the working line. Stand in the foot loop to unweight the chest ascending device, while simultaneously pushing your chest ascender cam down to partially disengage the cam from the rope. Hold the cam in the partially open state with your fore finger and squat down in your foot loop. The chest ascending device should move freely down the rope. Relax and let your chest ascender take your full weight and move your foot loop ascender down and repeat as required, insuring your back up device is following. Expect to descend in 200 mm to 300 mm increments in one fluid movement.

Ascending using Descenders

For occasional rope climbing uses

When the handle is in "descent" mode, the rope slides freely in the up direction. The user need only move upward and take up slack as he goes to stay in tension on the rope.

Caution: when the handle is in "descent" mode, the user must continuously hold the brake side of the rope.

Simple technique:

Install a rope clamp and foot loop on the rope above the descending device Stand in the foot loop to unweight the descending device while simultaneously pulling the brake side of the rope. Smoothly transfer your weight to descending device, move the foot loop up and repeat the manoeuvre.

Rope to Rope Transfer

- Before attempting any rope to rope transfer, ensure you are first in descent mode with your descender device fully loaded and locked;
- Take hold of the new ropes and attach both ascenders to one of them, taking care to pull through all slack rope so that the chest ascender is in tension;
- Attach a second back-up device high up on the new safety rope, if a second back-up device is not available, tie an Alpine Butterfly high up on the new safety rope and attach a cow's tail.
- Descend the original working and safety ropes until the weight is transferred to the new ropes;
- Remove the descender and back up device;
- Continue with the ascent or change into descent mode.

If a number of rope to rope transfers are to be carried out, or the transfer is very wide then it may be advisable to utilise two back up devices. This will allow the transfers to be carried out without the tying of any additional knots.

During a 'Snatch Rescue' it may be possible to utilise two descender devices and two back up devices for carrying out this manoeuvre.

Note: If the failure of any one item of equipment would result in an 'out of control' swing, e.g. wide rope to rope transfer, then 4 independent attachment points should be maintained throughout the manoeuvre, i.e. 2 in each direction.

Passing Deviations - General

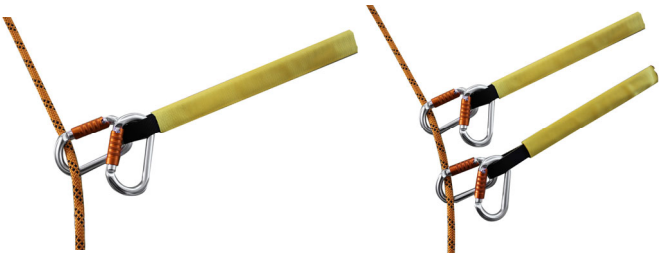
Where the direction of the ropes is required to be changed slightly, either to avoid light abrasion or to afford the operative more efficient access, a single deviation may be installed.

Passing Deviations in Ascent

- Ascend until level with the deviation anchor point;
- Place the ropes below your chest ascender and back up device into the spare connector of the deviation. Once in place pull yourself into the deviation anchor point sufficiently enough to remove the original deviation connector and gently lower out using the trailing ropes below;
- Continue with the ascent.

Passing Deviations in Descent

- Carry out the above operation in reverse.



Single Deviation Double Deviation

(Only 1 rope system has been shown above for clarity)

In the diagrams above, a Single Deviation is being used to avoid an area of light abrasion and a Double Deviation is being used to avoid an area of heavier abrasion or a rough and potentially sharp surface.

The additional connector allows the manoeuvre to be carried out in both normal and 'Snatch Rescue' operations without the need for an additional lanyard or cow's tail being attached to protect against dropping the deviation sling during the manoeuvre.

Double Deviations should be passed separately. In some cases an additional temporary attachment can be made to the structure via, e.g. a cow's tail, or a third deviation could be utilised, depending on the particular application. Some rescue scenarios may benefit from the addition of a pulley in the system to reduce friction.

Passing Knots - General

If the drop is particularly long, it may be necessary to join ropes together using a suitable knot. Whenever a joining knot is tied, a safety 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 below the damaged section in order to make a safe attachment during knot passing manoeuvres. An Alpine Butterfly knot is the most suitable for both the isolation of the damaged section and for providing an additional safety loop to attach a suitable length cow's tail.

During 'Snatch Rescue' operations, an additional descender device may be used to switch ropes, thus bypassing the knot with only the back up device requiring removal. With this method there is the potential for significant rope stretch as a rescue load is applied to an un-weighted rope. Alternatively, a re-belay may be made at the knot by using an ascender device as the attachment point, thus eliminating the potential for significant rope stretch. During the descent, care should be taken to ensure excessive dynamic loads are not applied to the ascender device being used as the anchor point.

Passing Knots in Descent (Knot Isolating a Damaged Working Rope)

- Descend until the damage isolation knot is approx. 50mm from the entry point into the descender device. This effectively locks the descender device;
- Attach the handled ascender to the working rope above the descender, stand in the foot loop and attach the chest ascender above the descender;

- Remove the descender and replace it on the working rope below and close to the isolation knot and lock it;

- Progress downwards on the ascenders (Reverse Prussiking) until the chest ascender is just above the knot. This can be achieved by first opening the cam slightly on the upper handled ascender and sliding it down to head height. By standing in the attached foot loop it is possible to open the cam slightly on the chest ascender and then bending the legs to lower the device down the rope;

- Alternating the process in short steps will allow safe downward progression;

Note: Ascender cams should never be fully opened during the above manoeuvre.

- Stand in the foot loop, remove the chest ascender and sit back on the descender;

- Remove the handled ascender, unlock the descender device and continue to descend.

Passing Knots in Descent (Knot Isolating a Damaged Safety Rope)

- Descend the working rope until just below the damage isolation knot in the safety rope and lock the descender;

- Attach a second back-up device below the knot on the safety rope and remove the original back up device.

If a second back-up device is not available.

- Tie an Alpine Butterfly knot approx. 200mm below the damage isolation knot and attach a short cow's tail to the loop of the Alpine Butterfly knot;

- Remove the backup device and re-attach it between the damage isolation knot and the Alpine Butterfly knot;

- Remove the cow's tail, untie the lower Alpine Butterfly knot, unlock the descender and continue to descend

Passing Knots in Ascent (Knot Isolating a Damaged Safety Rope)

- Upon reaching the damage isolation knot, position the back-up device directly below the knot. Attach a second back-up device above the knot on the safety rope and remove the original back up device.

If a second back-up device is not available.

- Tie an Alpine Butterfly knot approx. 200mm below the damage isolation knot and attach a short cow's tail to the loop of the Alpine Butterfly knot;

- Remove the backup device and re-attach it above the damage isolation knot;

- Remove the cow's tail, untie the lower Alpine Butterfly knot.

Passing Knots in Ascent (Knot Isolating a Damaged Working Rope)

- Ascend the ropes until just below the knot;
- Remove the handled ascender and replace on the working rope above the knot;
- Step up a little to bring the chest ascender just below the damage isolation knot. Attach and lock a descender device below the chest ascender to provide suitable protection whilst moving the chest ascender;
- In one movement, stand up in the foot loop, remove the chest ascender, replace it above the knot and sit back onto the chest ascender;
- Remove the descender device and continue to ascend.

Note: Alternatively, a temporary Alpine Butterfly knot can be tied below the chest ascender and a short cow's tail attached. The long cow's tail should be removed from the handled ascender to ensure the short cow's tail would arrest any potential fall and not a toothed ascender device.

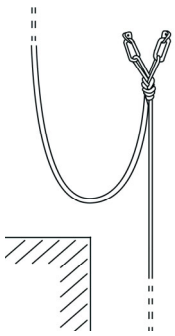
Damaged ropes should be removed from service as soon as possible.

Passing Re-anchor (Common name Re-Belays) - General

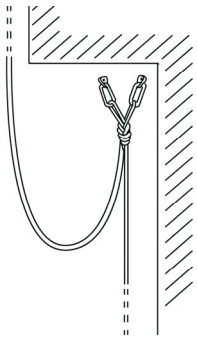
Where the direction of the ropes are required to be changed and it is not practicable to use a deviation either to avoid abrasion or to afford the operative more efficient access, a re-belay should be installed. A re-belay is a double anchor point part way down the drop into which the ropes are knotted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

During 'Snatch Rescue' operations the re-belay can be treated as a rope to rope transfer utilising both the rescuer's and casualty's descender and back up devices.

Note: To help avoid unnecessary tangles, ensure all attachments to the casualty are made to the left of other equipment and ropes positioned on the right.



Re-Belay Rigged to



Re-Belay Rigged for Better

Passing Re-Belays in Ascent

- Ascend until directly below the re-belay.
- Changeover to your descender, lock it off and then remove your chest ascender.
- Attach your second back-up device and place it high up on the new safety rope above the re-anchor
- Attach your chest ascender and hander ascender on to the new working rope above the re-anchor.
- Transfer your weight onto your newly placed ascending gear.
- Remove your descender from the original ascent ropes and continue ascending the new ropes above the re-anchor.

Passing Re-Belays in Descent

- Descend until level with the re-anchor and lock off the descender.
- Transfer your back-up device to the back-up rope below the re-belay.
- Install your chest and hand ascender onto rope below the re-anchor
- Continue descending until all your weight is transferred to the chest ascender, correct rigging of the re-belay should provide a sufficient loop of slack to allow this.
- Disconnect descender from the loop rope, and re-attach it to the working rope below your chest ascender and lock it off.
- Remove your original back up device.
- Stand up in the foot-loop, detach your chest ascender from the rope, sit back on the descender remove your foot loop and continue with the descent.

Note: Where a wide re-belay has been rigged, consideration should be given to the effects of a failure of any single part of the system. In some cases it may be more appropriate to treat the obstacle as a wide rope to rope transfer and maintain 4 independent attachment points, i.e. 2 in each direction, throughout the manoeuvre.

Passing Rope Protectors

When passing Rope Protectors installed to protect against light abrasion, either in ascent or descent mode, in normal or ‘Snatch Rescue’ operations, it is the Rope Protector itself that is removed and replaced on the rope and not the operative’s or rescuers personal suspension equipment.

- Upon reaching the rope protector, lock the descender device;
- Separate the two parts of the rope protector, e.g. unfasten the Velcro closure;
- Unfasten the attachment loop 'Prussik Knot' from around the rope and re-attach either above or below its previous position as required;
- Re-wrap the rope protector around both or separate ropes, depending on the application, ensuring they are positioned centrally to the abrasion point;

Note: If in descent mode, it may be necessary to descend past the obstacle in short stages, gradually fixing the rope protector as the descent is made.

Ensure the attachment knot is set and secure by pulling down on the rope protector after installation.

Pull Through Systems - 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 safety ropes should be passed around the structure ensuring both ends of each rope have a stopper knot and that they reach safe ground;
- Tie a knot on one side of each rope, e.g. Alpine Butterfly, just below the structure and attach suitable connectors to the loops created;
- In turn, attach these same connectors to the ropes hanging on the opposite side of the structure and pull tight;
- First attach your back up device and then your descender device to the live ropes, check and descend;
- Upon reaching ground level, remove all equipment and stopper knots and gently pull the ropes down taking care when the rope ends fall to the ground.

Pull Through Systems - 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 'Throw Line' over the structure;
- Attach the working and safety ropes to the 'Throw Line';
- Tie appropriate knots in the middle of the working and safety ropes and using suitable connectors thread the 'Throw Line' through them.
- Pull the 'Throw Line' until the working and safety ropes are in their final position and tie a Stopper Knot in the lower end ready for ascending.

Note: *The 'Pull Through' method of rigging and de-rigging ropes has a higher level of risk attached due to possible abrasion problems on the hidden side of the structure and the potential for attaching to the wrong side of the rope.*

It is recommended this method is restricted to experienced operatives only, and use it as a once-only method of access and/or egress.

Depending on the shape of the structure it is possible that the connector could be mis-loaded during use.

Consideration should be given to the use of appropriate 'Maillon Rapide' (M/R) connectors, which are less susceptible to damage through mis-loading than traditional carabiner type connectors.

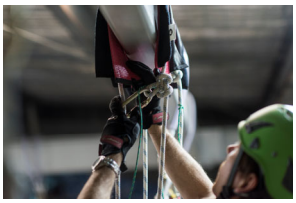
Consideration should also be given to utilising wire strops in the rigging system where angular or very abrasive surfaces are or may be present.

Pull Through Systems

Traditional Pull Through System with M/R Connector

Wire Strop Pull Through System for Abrasive Surfaces

(Only one rope system has been shown above for clarity)



Horizontal Aid Climbing

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

Two long cow's tails and one short cow's tail, or other suitable lanyards, will be required, so as to maintain two independent points of attachment whilst re-positioning a third.

The routine detailed below is for moving onto a horizontal aid route from a set of ropes:

Horizontal Aid climbing (fixed anchors)

- Attach a cow's tail directly into the aid climbing anchor point and place your croll onto the rope thus shortening the cow's length to suit.
- Attach a second cow's tail into a second independent aid climbing anchor point.
- Attach a Third cow's tail into the same anchor point as your first cows tail.
- Move your short cow's tail to the same anchor point as the leading cow's tail.
- Remove the leading cow's tail and move it forward to the next free anchor point.
- Remove the trailing cow's tail and re-attached to the short cow's tail anchor point.
- Stand in your foot loop and etrier and remove the short 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 whilst still maintaining two attachment points.
- Aim to be suspended from the short 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.

The following routine is for making horizontal progress along a structure by utilising three suitable wire strops or protected webbing slings:

Horizontal Aid Climbing (moveable anchors)

- Attach the leading and trailing (long) cow's tail connectors, foot loop and etrier to the outermost slings and attach the short cow's tail to the central sling;

- De-weight the central sling by standing in the foot loop and etrier and move this sling in the direction of travel;

- Re-weight the central sling and move the leading and trailing slings in the same direction;

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

Note: *In some industry sectors, e.g. North Sea (Norwegian sector) and in the Entertainment industry, it is common practice to utilise two adjustable work positioning lanyards instead of a short and/or long cow's tail/s.*

When used with a twin energy absorbing lanyard the technique allows for continual suspension. This is not only safer but often more efficient than other methods.

The technique also allows for the easier retrieval of an unconscious operative who may have become incapacitated.

It is important to ensure that energy absorbers are never accidentally loaded whilst in use.

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 fixed anchor you can reach.

- Attach a second cow's tail to fixed anchor point as high as you can reach before leaving the ground.

- Stand in the foot loop or etrier and place your croll onto the upper rope thus shortening the cow's length to suit.

- Attach a Third cow's tail into the same anchor point as your second cows tail.

- Stand in the upper etrier, remove the lower cow's tail and re-attach to the fixed anchor.

- While standing in your Etriers remove and replace your croll onto the upper lead cows tail.

- Move the third “trailing cows tail” up one fixed anchor.

- Repeating the procedure; systematically leap frogging the leading 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 shortened 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.

NOTE: Special consideration shall be given to prevent the climber for exceeding a FF1 whilst making upward progress.

Horizontal Tensioned Traverse Lines

A horizontal tensioned traverse line used for full or partial suspension will normally comprise two separate ropes running side by side in a horizontal plane, each rope being separately anchored at both ends.

Note: All horizontal and diagonal tensioned traverse lines should be tensioned with a maximum 3:1 mechanical advantage to avoid excessive loadings of the anchor points.

- Operatives should make two attachments to both traverse lines and maintain them throughout the traverse. This can be achieved by attaching a combination of short and/or long cow’s tails or lanyards to the lines;

- In addition to the above, other equipment may be used to assist movement along the traverse lines in certain situations, e.g. a back up device and ascender device. The back up device can be placed on one traverse line, trailing behind the operative to help control the descent down the first half of the traverse. A handled ascender and foot loop will assist the operative during the second, upward half of the traverse;

Note: When under load, the angle of the traverse lines at the load point may exceed 120° with a consequential increased anchor loading potential.

This potential increased loading can be reduced by ensuring both ropes in the system are loaded equally. The Level 3 Safety Supervisor will be

responsible for the calculations involved in rigging such a system.

- Operatives should be aware that unnecessary dynamic movement whilst traversing will place additional peak loads to the anchor point and associated connectors that may exceed their designed Working Load Limit (WLL) or Safe Working Load (SWL).

Note: Horizontal tensioned traverse lines should always be rigged through autolock descender devices to ensure they can be quickly released during rescue operations.

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/or 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 lines can be attached via suitable rope adjustment devices to enable the system to be tensioned or slackened as necessary.

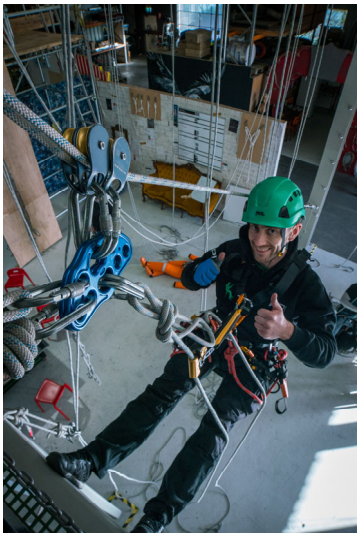
If diagonal lines are to be tensioned, the angles created when loaded should be considered. Deflection is likely to be small resulting, as in the case of Deviations, with potentially high loads being applied to the anchor points.

If diagonal lines are used to redirect the path of a descent or ascent from the vertical the operative should descend or ascend his/her working and safety ropes in the normal way, whilst having two extra attachments to both diagonal lines.

The diagonal lines can then be taken in or out through the rope adjustment devices by a second person at any point during the ascent or descent enabling the operatives work position to be adjusted in both vertical and horizontal planes.

If horizontal or diagonal 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 rope systems whilst maintaining two independent attachments to the traverse lines.

Note: Diagonal tensioned traverse lines should always be rigged through autolock descender devices to ensure they can be quickly released during rescue operations.



Horizontal Life Lines & Work Restraint Systems

One method of fall prevention is to restrict the operative's travel so they cannot enter the zone where a fall could occur.

This can be fall arrest equipment, work positioning equipment or a simple belt attached to a lanyard of limited length so as to prevent access to the danger zone.

SpanSet Horizontal Life Line System

The same tensioned line systems used for full or partial suspension can 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 and that operatives are familiar with the maximum length of cow's tail or lanyard to be used on the system.

Note: In a Work Restraint situation It is acceptable to utilise a single rope or lanyard, e.g. when working from a 'Latchways ManSafe' system.

Latchways ManSafe Fall Prevention System

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 usually be necessary to choose fall arrest equipment. This will include a full body harness that meets the requirements of EN361 for fall arrest harnesses, a twin energy absorbing lanyard conforming to EN355 and a double lanyard system to allow forward progression without disconnecting from the structure. The lanyards should conform to EN354. For some applications, rope based 'Lead Climbing' systems may be considered appropriate.

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;

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

Lanyard (2m) + Deployment (1.5m) + Safety Factor (2.5m) = 6m.

Always follow the manufacturer's user instructions when calculating appropriate clearance distances.

When working at heights of less than the clearance distances detailed in the manufacturer's user instructions, e.g. when first leaving the ground, it is always good practice to maintain as high a point of attachment on the structure as possible. In the event of a fall, the impact force with the ground or supporting structure would be significantly 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 (PIF) could be in excess of the 6kN that a body can absorb;
- When using a twin energy absorbing lanyard 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. In the event of a fall onto both lanyards the maximum peak impact force applied to the body could 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 PIF of a 100kg person falling double the length of the lanyard to below 6kN. Consideration should be given to operatives who are considerably lighter or heavier, as the impact forces generated could be significantly higher;
- Never clip the lanyard's connector 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 (MBL) in this orientation.
- Large 'Scaffcrab' type connectors can also be affected by 'Cross Loading', e.g. when connecting to irregular shaped structures such as electricity pylons.
- Always consider how the connector will be loaded in the event of a fall.

BS/EN365 Personal protective equipment against falls from a height – General requirements for instructions for use and for marking, gives general requirements for periodic inspections of PPE against falls from a height.

Twin Energy Absorbing Lanyard In Use

Lead Climbing & Belaying Techniques

Lead Climbing is a type of Fall Arrest technique 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.

Note: Lead Climbing is not covered in the IRATA training syllabus. In the hierarchy of hazard management the 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:

- That the work cannot be carried out in a safer manner;
- Each of the hazards involved in the operation, with the aim of eliminating or minimising the associated risk;
- The choice of equipment to be used;
- The competent operatives who will manage each element of the task;
- The safest and quickest method of rescue in the case of an accident.

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

- The climber should wear a harness that complies with the Fall Arrest specification EN361. Ropes should be tied directly to the fall arrest attachment point on the front of the harness with appropriate knots;
- The maximum peak impact force on any operative in any potential fall should never be greater than 6kN;
- The system used should ensure any fall distance is kept to an absolute minimum;
- Two independently belayed rope systems should be used;
- 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 could place a force in excess of 12kN on the supporting running belay!!

Your system of work needs to minimise the falling distance to ensure running belays and any other equipment incorporated within the system is not overloaded.

- Dynamic ropes conforming to EN892 (UIAA ①) should be used. 11mm diameter ropes are recommended, however, the use of 11mm Ø 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:

Note: To be used only after a 'Site Specific' risk assessment has been carried out.

- A belay is prepared, consisting of two appropriate anchor points. Two suitable 'Autolock' belay devices, e.g. Petzl Rig, 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 his/her full body harness with suitable knots. Do not use carabiner type connectors 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 an independent safety 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 and removes the running belays, 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 voice activated two-way radios.

Fall Factors

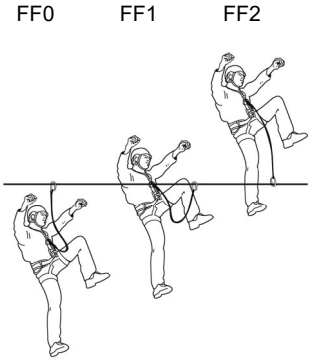
Fall Factors (FF) measure the relative severity of a fall in terms of the shock loads

placed upon the equipment and user.

The Fall Factor 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 Fall Factor is kept to a minimum. Whilst dynamic rope is capable of withstanding a FF2 fall when new it is good practice not to exceed FF1, and likewise it is good practice not to exceed FF0.3 with low stretch rope.



Fall Factors

Note: Testing has shown that even close to FF0, the dynamic loads applied to both anchor point and operative could equate to double their actual weight.

During lead climbing operations any potential fall should be mitigated by the use of appropriately spaced 'Running Belays' to help reduce the Fall Factor, fall distance and the subsequent forces placed on the system.

The higher a climber ascends a structure with sufficient running belays, the lower the resulting Fall Factor, however, reducing fall distance is also a very important factor.

It is possible to generate Fall Factors in excess of FF2. If you were attached to a sloping anchor point and fell, the fall height would be calculated from the height at which you fell to the height at which your fall was finally arrested. If the vertical distance were 4m, with a 1m cow's tail (4m + 1m), this would constitute a FF5 fall!!

Some equipment manufacturers produce energy absorbers specifically for these high Fall Factor situations within the sport of mountaineering however these generally do not meet industrial standards.

Rope Terminations

Knotted Rope Terminations

A variety of knots are available for different rigging applications. Most knots used in industry are tied in the end of a rope however, in certain circumstances, mid-rope knots may be more appropriate, particularly when tying wide ‘Y’ Hangs.

When tying any knot it is always important to ensure they have small termination loops and are correctly dressed and set with a min. 100mm tail. All parts of the knot should be neat and tidy with no twists. All the strands of the knot should run in parallel and the knot should always be pre-tensioned by hand prior to use.

As well as providing an appropriate attachment loop in the rope, knots also offer valuable energy absorbing capabilities should there be any dynamic loading to the anchor system. For this reason it is advisable to regularly re-tie rigging knots so as to ensure they do not become over tight and subsequently very difficult to untie.

Most knots will result in strength loss of between 30% - 35%. Whilst this may appear high, even with knotted terminations, the ultimate strength of a typical low stretch rope would still be in excess of the minimum anchor strength requirements of industry.

Knotted Rope Termination

Sewn Rope Termination

Sewn Rope Terminations

Sewn rope terminations are an alternative method of terminating ropes, however they do not provide the flexibility of a knotted termination. A sewn termination will cause the strength of the rope to reduce by only 10% - 15%, however, they provide significantly reduced energy absorbing capabilities when compared with a knot. They are usually made with a small loop and supplied with a protective sleeve to protect the stitches.

To meet the EN1891A (Low Stretch rope standard), sewn rope terminations are required to have a MBL of 22kN.

Tying Knots

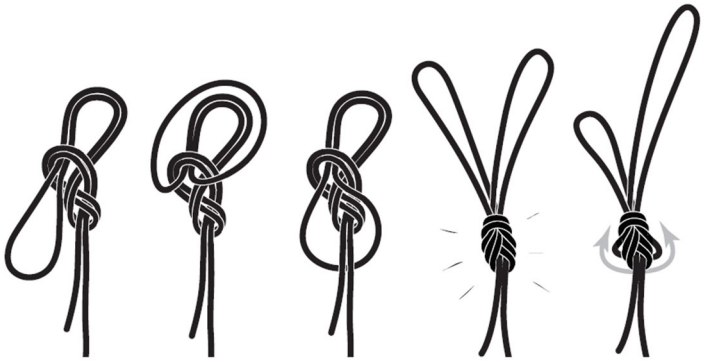
All candidates shall demonstrate tying, dressing and setting the following knots, and have an awareness of their strengths, applications and limitations:

1. Double figure-of-eight on a bight (‘bunny’ knot);
2. Rethreaded figure-of-eight

3. Figure-of-nine on a bight;
4. Figure-of-eight on a bight;
5. Alpine butterfly;
6. Scaffold or ‘barrel’ knot;
7. 1/2 Double Fisherman’s Stopper Knot

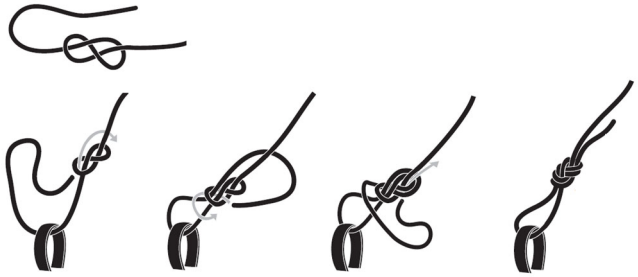
Double Figure 8 on the Bight Knot (Bunny Knot)

Used to link and equalise two anchor points in a ‘Y’ Hang configuration. Due to the knot using a lot of rope, they are more useful when anchor points are close together.



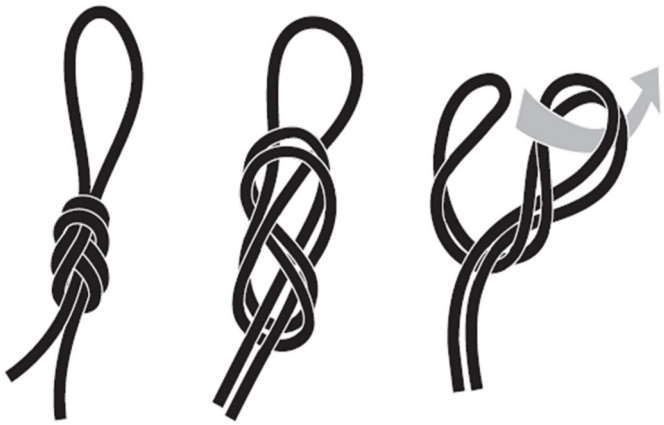
Re Threaded Figure 8 on the Bight Knot

The preferred method of making attachments around tubular steelwork, tying directly into eye bolts or tying directly into a harness during, e.g. lead climbing operations.



Note: It is not recommended to use ‘Overhand Knots’ at the ‘open ends’ of cow’s tails or other ropes due to the possibility of excessive slippage under load.

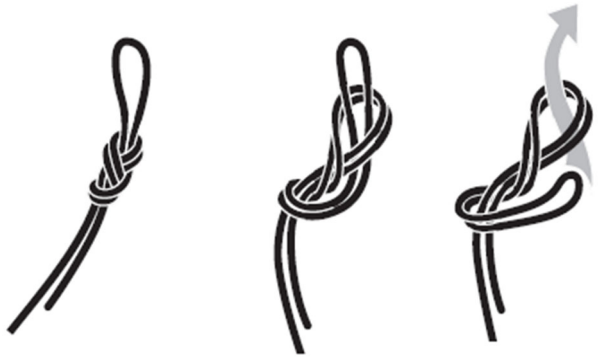
Figure 8 on the Bight Knot



Used to form a loop in the end of a rope as a main anchor point.

Figure 9 on the Bight Knot

Used to form a loop in the end of a rope as a main anchor point. Easier to untie than a Figure 8 on the Bight knot, particularly after heavy loading. It is tied in the same manner as a Figure 8 on the Bight but with an extra ½ twist

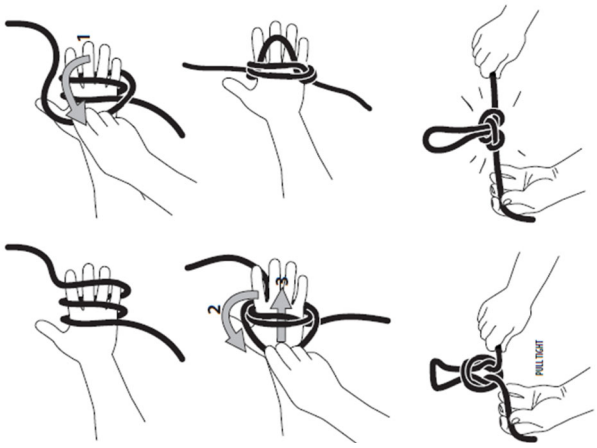


Alpine Butterfly Knot

Used as a mid-rope knot suitable for multi-directional loading. Ideal for rigging wide ‘Y’ Hang rigging systems and as a temporary mid-rope knot.

When used as a temporary mid-rope knot to allow a connection point for, e.g. passing obstacles or dealing with tangles, it provides the highest level of protection in the event of it being accidentally left in place after use.

Should another operative or attending rescuer need to climb the rope, the knot would not be abnormally loaded, as would be the case with Figure of 8 or 9 on the Bight knots.



Scaffold Knot

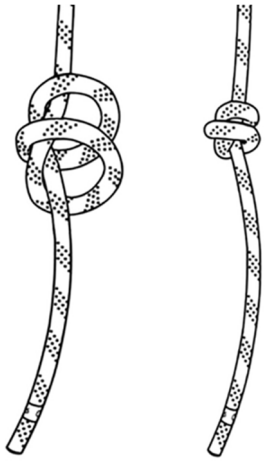
Scaffold Knot (often incorrectly referred to as a Barrel Knot) is strongly recommended for the ends of cow's tails due to its excellent dynamic capabilities.

It is also recommended for use on the live end of a rescue rope, minimising the mis-loading of connectors and other devices during remote hauling operations.

It can be tied as a Double Twisted Scaffold knot (below) or by adding an additional twist to make a Triple Twisted Scaffold knot, offering greater energy absorbing capabilities.

1/2 Double Fisherman's Stopper Knot

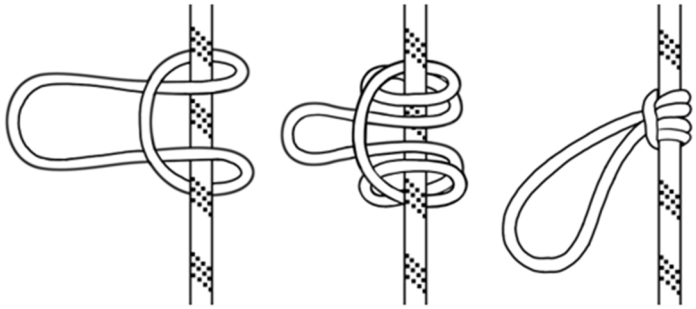
Used as a security stopper knot in the lower end of a rope, approx. 300mm from the rope end. Always ensure the knot is set correctly after tying.



Prussik Knot

Used for tying a canvas type rope protector to working and/or safety ropes.

Always ensure the knot is tied neatly. Rope protectors should be pulled downwards after installation to 'tension set' the knot correctly and ensure no slippage is possible through rope vibration.

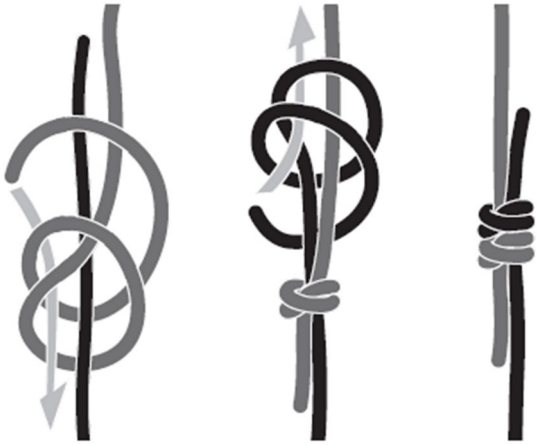


Note: Ensure the joining knot in the Prussik Knot loop does not interfere with the correct tying, dressing and setting of the knot around the rope

Double Fisherman's Knot

Used to join ropes of equal diameter. Usually tied with an additional loop knot, e.g.

Figure 8 on the Bight, to provide an attachment point while equipment is being moved.



Note: Always consider the impact of rope joining knots during rescue operations.

Correctly Tied, Dressed & Set Knots

Typical Knots Used in the Rope Access Industry

(*Clockwise from bottom left), Prussik Knot, Alpine Butterfly Knot, Figure 9 on the Bight Knot, Double Figure 8 on the Bight Knot, Double Fisherman's Knot, Figure 8 on the Bight Knot, Scaffold Knot, ½ Double Fisherman's 'Stopper' Knot, Bowline on the Bight Knot finished with a ½ Double Fisherman's 'Security' Knot.*

Suspension Syncope

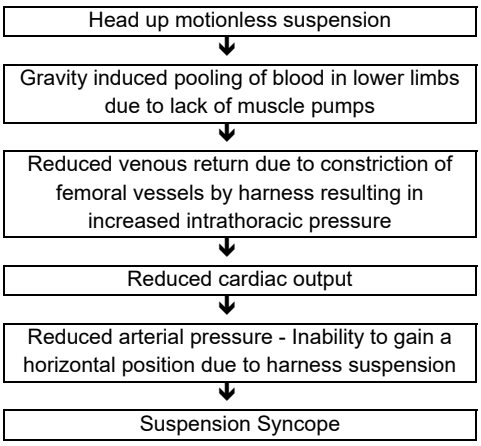
Anecdotal evidence suggests that an immobilised person suspended in a harness will begin to deteriorate after as little as four minutes leading to coma and possibly death.

Suspension Syncope (also known as Suspension Intolerance and formally known as

Suspension Trauma) is a condition in which a person suspended in a harness for a long period without movement can experience pallor, cold sweats, nausea, ringing in the ears, blurred vision, dizziness, feeling faint, loss of consciousness and eventual death. Evidence suggests it mainly affects persons suspended from a dorsal attachment point.

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.

Pressure from the harness straps on veins and arteries could also be a contributory factor to this retention of blood in the venous system, which reduces the circulating blood volume available to the heart. Thus, the circulatory system is disturbed. This can lead to critical reduction of blood to the brain and the symptoms described above. The process, which could lead to Suspension Syncope is described below:



Note: 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, suspended in harnesses, were told not to move, most experienced many of the symptoms of suspension syncope, some including loss of consciousness, in just a few minutes. Others managed for longer before reporting symptoms.

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;

Note: Using a 'Work Seat' is advisable when working in suspension for extended periods or when carrying out rescue training.

- 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, repositioning the harness leg loops thus minimising circulatory problems and avoiding a rapid return of venous blood to the heart.

Note: Recent recommendations from the HSE suggest that, during the rescue of an unconscious casualty, the priority should be given to getting the casualty into a safe, accessible location and placed in the recovery position. A lack of oxygenated blood to the brain for in excess of 4 minutes is likely to lead to death.

Following the rescue of a conscious casualty they should be allowed to make themselves comfortable.

Following any such rescue, medical advice should always be sought.

Rescue

The requirement for rescuing any team member that becomes incapacitated whilst working at height should be identified at the 'Risk Assessment' stage and should be fully described in the 'Method Statement'.

The main priority in any rescue is to ensure the condition of the casualty does not worsen. Following this it is essential to have a back up system and increase friction on descender devices to allow for additional rescue loads that could be applied and to afford better control of the descender device.

If the rescue scenario is particularly complex, a 'Practice Rescue' should be carried out to ensure the rescue procedures are effective, speedy and, above all, safe.

Rescue equipment, including a suitable First Aid kit, should accompany all operational rope access teams. This will include sufficient equipment to rescue an operative from any of the rope access and/or fall arrest 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 available to assist.

To reduce the potential risk to rescuers and ensure a safe and timely emergency egress of the worksite, a 'Rig for Rescue' system should be pre-rigged, where practicable, before work commences.

'Rig for Rescue' systems are easily implemented for most rope access operations. They can either be built into the primary rigging system or as an independent, easily installed 'Dedicated Rescue Kit'.

Where a 'Rig for Rescue' type system is not installed, it may be necessary for a competent rescuer to physically attend the casualty, referred to as a 'Snatch Rescue'.

Before a rescue is implemented it is important the 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 are to:

- Ensure the rescuers do not endanger themselves;
- Provide appropriate First Aid Treatment & Prevent further injury;
- Evacuate the casualty to a safe location where suitably qualified persons can administer effective treatment.

Casualty management must be addressed throughout the rescue, with rescuers taking sufficient steps so as not to worsen any injury already sustained by the casualty.

The Level 3 Safety Supervisor should hold, as a minimum, an appropriate Appointed Person First Aid 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.

It should be noted that all rescues may be performed from a separate set of ropes and can be approached from either above or below. Such rescues can often be simplified if an additional set of ropes and equipment is available.

Snatch Rescue from Adjacent Rescue Ropes (Casualty in Descent Mode)

Rescue Carried Out from Below

Before implementing any 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.

- Ascend an adjacent set of pre-rigged rescue ropes;
- Upon reaching the casualty, place them in as near upright a position as possible without endangering the casualty further. This may be achieved by temporarily attaching a connector to the casualty's sternal harness attachment point and in turn, connecting it to the casualty's loaded working rope, above their descender device. The rescuer should consider the ABC of first aid (Airway, Breathing & Circulation), and deal with the casualty's condition in the strict order of: Breathing, Bleeding, Bones;
- Position all working and safety ropes over the right leg and then, using a long cow's tail or other suitable lanyard, make a connection into the casualty's main harness attachment point. To ensure that potential rope tangles are not introduced, this connection should be made to the left of all working and safety ropes and any other devices and should remain in place throughout the rescue;
- Change into descent mode and remove the casualty's back up device;
- Make an attachment from your descender device attachment connector to the top of the casualty's chest ascender or sternal harness attachment point

with a short lanyard or chain of 2 or 3 connectors. This connection should again be made to the left of all working and safety ropes to ensure rope tangles are not introduced;

Note: If the casualty is too high to carry out the operations as detailed in the bullet points above, unlock the casualty's descender device and simply lower them to a more suitable position.

- Operate the casualty's descender device to lower him/her onto the lanyard or chain of connectors and then remove it from the rope. Remove the temporary connector from the casualty's sternal harness attachment point;

- Before unlocking your descender device, employ a breaking connector to create additional friction to the system. Descend slowly and in a controlled manner whilst observing good casualty management;

- Having descended to a safe location, stop when your feet are at ground level but the casualty is still suspended. If possible, detach your harness from the descender device connector and step away. The casualty can now be lowered by the attending rescuer with much more control into the most suitable position for his/her condition until the arrival of the emergency services.

Rescue Carried Out from Above

- Descend an adjacent set of rescue ropes and upon reaching the casualty follow the rescue procedures as detailed above.

Snatch Rescue from Casualty's Own Ropes (Casualty in Descent Mode)

Rescue Carried Out from Below

Before implementing any 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.

- Ascend the casualty's safety rope with your back up device on the casualty's working rope;

- Upon reaching the casualty, place them in as near upright a position as possible without endangering the casualty further. This may be achieved by temporarily attaching a connector to the casualty's sternal harness attachment point and in turn, connecting it to the casualty's loaded working rope, above their descender device. The rescuer should consider the ABC of first aid (Airway, Breathing & Circulation).

- Attach your descender device to the safety rope, close to the casualty and lock off. Position all working and safety ropes over the right leg and then.

- Attach your second back up device above the casualty and then remove your original back up device; use a cow's tail or lanyard to make an attachment into the casualty's main (Ventral) harness attachment point

ensuring potential rope tangles are not introduced. This should remain in place throughout the rescue; To ensure that potential rope tangles are not introduced, this connection should be made to the left of all working and safety ropes and any other devices and should remain in place throughout the rescue;

- Climb as high as possible up the casualty's safety rope then remove the casualty's back up device. Climbing as high as possible up the casualty's safety rope can be made easier by relocating your upper (handled) ascender above the casualty's back up device;

- Make an attachment from your descender device connector to the top of the casualty's chest ascender or sternal harness attachment point with a short lanyard or chain of 2 or 3 connectors. This connection should again be made to the left of all working and safety ropes to ensure rope tangles are not introduced;

Note: If the casualty is too high to carry out the operations as detailed in the bullet points above, unlock the casualty's descender device and simply lower them to a more suitable position.

- Operate the casualty's descender device to lower him/her onto the short lanyard or chain of connectors and then remove it from the rope. Remove the temporary connector from the casualty's sternal harness attachment point;
- Before unlocking your descender device, employ a breaking connector to create additional friction. Descend slowly and in a controlled manner employing the braking connector and avoiding any jerky movements that could shock load the system and observing good casualty management;

- Having descended to a safe location, stop when your feet are at ground level but the casualty is still suspended. If possible, detach your harness from the descender device connector and step away. The casualty can now be lowered by the attending rescuer with much more control into the most suitable position for his/her condition until the arrival of the emergency services.

Rescue Carried Out from Above

- Descend the casualty's safety rope with your back up device on the casualty's working rope and upon reaching the casualty follow the rescue procedures as previously described.

Note: If the casualty's safety rope is loaded, 'Reverse Prussik' down the safety rope, attach your descender device below the casualty's back up device, change into descent mode and then follow the rescue procedures as previously described.

If this manoeuvre does not stretch the safety rope sufficiently to remove the casualty's back up device then follow the procedures for de-weighting a loaded safety rope during a rescue.

Snatch Rescue from Casualty's Own Ropes (Casualty in Ascent Mode)

Rescue Carried Out from Below

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.

The rescue procedures detailed below are for operating from the casualty's own ropes. These procedures would be made much simpler, speedier and safer if carried out from an adjacent set of pre-rigged rescue ropes.

- Ascend the casualty's safety rope with your back up device on the casualty's working rope. The casualty should already be in a near upright position via his/her chest ascender attachment;

- Upon reaching the casualty, attach your descender device to the safety rope, close to the casualty and lock off. Attach your second back up device above the casualty and then remove your original back up device;

- use a cow's tail or lanyard to make an attachment into the casualty's main (Ventral) harness attachment point ensuring potential rope tangles are not introduced. This should remain in place throughout the rescue;

- Change into descent mode, climb as high as possible up the casualty's safety rope and remove the casualty's back up device. This may be made easier by relocating your upper (handled) ascender above the casualty's back up device and utilising your descender device as an ascender;

- Make an attachment from your descender device connector to the top of the casualty's sternal harness attachment point with a short lanyard or chain of 2 or 3 connectors;

- Attach your foot loop or suitable sling to the top of the casualty's chest ascender or sternal harness attachment point and then pass the foot loop or sling through a connector attached to the bottom of a handled ascender, which should be placed above the casualty on their working rope;

- Stand in the foot loop and pull upwards on the casualty's harness waist belt. This will lift the casualty enough to enable his/her chest ascender to be disconnected;

- Lower the casualty until he/she is suspended from your descender device and then follow the rescue procedures as detailed above.

Note: This same 'Counter Weight' technique can be used in most rescue procedures requiring the removal of a casualty's loaded cow's tail or lanyard, e.g. during a vertical or horizontal aid climb rescue.

Rescue Carried Out from Above

- Follow a combination of the procedures as previously described.

Deviation Rescue

Rescue the casualty from above a deviation. You will need to snatch the casualty and then descend down through the deviation to the ground.

Single Anchor Deviation

- If the deviation angle is small, it should be possible to descend through the deviation with the casualty in the same manner as when performing the manoeuvre as an individual.
- Additional equipment can be added to the deviation to make attaching to the deviation easier i.e. a chain of karabiners or a sling extension.

Double-Anchor Deviation

Install a second descender on the back-up rope below the deviation and transfer onto it. While you are weighting two descenders, move your back-up device above your original descending device, then place a second back up device below the deviation on the tail of your original working line. Transfer your weight complete onto the second descender and remove your original descender – manger the slack in the system between the two back up devices, remove the upper back up device and continue downward.

Rescue through Rope to Rope Transfer

Horizontal movement with a casualty can be achieved by performing a rope-to-rope transfer access the casualty either from above or below, a second set of ropes will be required for horizontal progress.

- Access the casualty on the first set of ropes and performs a snatch rescue.
- A second descender and back-up device are installed onto the transfer ropes. Pull through the slack and place your back-up device into a high position. You need to have four points of contact at all times throughout the transfer.
- Start to descend the first set of ropes using a friction carabiner. You will begin to transfer across to the second descender on the second set of ropes. By alternating between the two descenders, you will be able to maintain a horizontal movement. Using a hand ascender and a pulley and setting a z rig on the ropes you are going towards, you will be able to move up the rope so you can maintain height if needed. Always make sure you pay attention to your back-up devices.
- Once all weight has been transferred and you are hanging in vertical position, all connections to the first set of ropes can be removed.
- Using a friction carabiner descend with the casualty, make sure that you pay attention to rescue protocol, slow and steady decent and ensure that the casualty's condition doesn't worsen. When your feet are on the floor and the casualty is still in suspension. Disconnect yourself and step away.

A variation to this rescue is if the casualty becomes incapacitated part way through a rope to rope transfer. This is a rescue known as **Mid-Transfer rescue (Level 3 rescue)**.

Typically, progress of a technician through a rope to rope transfer, entails the use of a descender to descend onto the ascenders on the transfer rope the ascender will dictate the direction of travel.

The basic method to perform the rescue of a casualty from a **Mid-Transfer rescue** in the same direction as the casualty was travelling, from above.

- The rescuer accesses the casualty with their back-up device on the casualty's working line.
- Connect a cow's tail to the casualty when they are within reach and remove their back-up device.
- Make a hard link to the casualty.
- Descend the casualty onto the hard link.
- Disconnect the casualty's descender and attach it to your main attachment point on your harness, then attach it to the transfer ropes under the casualty's chest ascender, pull through any slack.
- Snatch the casualty off of their ascenders and lower the casualty gently on to their descending device.
- The rescuer now uses their descender as a self-haul device by passing the trailing rope from the descender through a carabiner or pulley attached to an ascender placed above the descender. If an ascender and foot loop are now clamped onto the trailing rope, then by standing in the foot loop a mechanical advantage of 2:1 can be achieved and the combined load of rescuer and casualty can be hauled in the direction of travel.
- Start to descend the first set of ropes using a friction carabiner. You will begin to transfer across to the second descender on the second set of ropes. By alternating between the two descenders, you will be able to maintain a horizontal movement. Using a hand ascender and a pulley and setting a z rig on the ropes you are going towards, you will be able to move up the rope so you can maintain height if needed. Always make sure you pay attention to your back-ups.
- Once all weight has been transferred and you are hanging in vertical, all connections to the first set of ropes can be removed.
- Using a friction carabiner descend with the casualty, make sure that you pay attention to rescue protocol, slow and steady decent and ensure that the casualty's condition doesn't worsen. When your feet are on the floor and the casualty is still in suspension. Disconnect yourself and step away.

Rescue through Re-Anchor (commonly called Re-belay)

Rescue the casualty from above the re-belay. You will need to snatch the casualty and descend down through the re-belay. This rescue is very similar to a rope to rope transfer rescue. A good practice is to ensure when rigging the re-belay, leave a nice

big loop between anchors to ensure a smooth rescue the large loop allows you to descend below the rebuilt anchor and access the ropes below with ease.

- Access the casualty and performs a snatch rescue.
- Descend with the casualty using a friction carabiner until you are level with the intermediate re-belay anchors, make sure that you pay attention to rescue protocol, slow and steady decent and ensure that the casualty's condition doesn't worsen.
- A second descender and back-up device are installed onto the exit ropes below the re-belay and as high as you can. At the same time make sure that the loop of the re-belay stays clear of you both, you don't want to get trapped in the loop.
- Start to descend the top set of ropes; the weight will transfer across to the second descender below the re-belay. When completely transferred across remove first descender and back-up.
- Using a friction carabiner descend with the casualty, make sure that you pay attention to rescue protocol, slow and steady decent and ensure that the casualty's condition doesn't worsen. When your feet are on the floor and the casualty is still in suspension. Disconnect yourself and step away.

If the casualty is stuck in the bottom of the loop of the re-belay, it may be possible to affect a rescue form the access ropes below the re-anchor.

- Reach across to the casualty and attach to them with a cow's tail and hard link.
- Set up a 2:1 z rig with a hand ascender and pulley on your work line. Haul yourself and the casualty enough so you can disconnect their gear. Then gently transfer them over to you.
- Using a friction carabiner descend with the casualty, make sure that you pay attention to rescue protocol, slow and steady decent and ensure that the casualty's condition doesn't worsen. When your feet are on the floor and the casualty is still in suspension. Disconnect yourself and step away.

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 as previously described, it will be necessary to turn the casualty's descender device into a make-shift ascender.

By placing an ascender above the descender device and attaching the trailing rope from the descender device via a connector and pulley (if available) into the ascender, pulling down on the trailing rope gives a theoretical 2:1 mechanical advantage. By attaching an additional ascender and foot loop to the trailing rope and applying your full body weight should ensure the combined load of rescuer and casualty are easily lifted and the back up device can be disengaged.

This same technique can be utilised to recover a casualty who has descended into a re-belay loop and is incapacitated.

Counter Weight Rescue

The same technique, as previously described, to counter weight a casualty from their loaded chest ascender can be used when carrying out both vertical and horizontal aid climb rescue procedures.

Rescue ropes are first attached to the casualty's sternal attachment point on their harness, which in turn are attached via autolock descender devices, or other suitable equipment, to the structure.

This may be directly above the casualty or where the system can be safely and easily operated by the attending rescuer. Ropes may then be diverted by, e.g. a pulley, to afford easier and/or safer implementation of the rescue procedure.

Following the points below should ensure an efficient counter weight lift of even a heavy casualty, enabling their cow's tails or lanyards to be removed from their anchor points with relative ease:

- Ensure slings and/or foot loops are maintained in a near vertical orientation;
- Ensure slings and/or foot loops cannot be trapped by other equipment;
- Ensure any counter weight system is always attached to the ventral harness attachment point;
- Ensure the positioning of stitched joints in slings and/or foot loops does not interfere with the counter weight procedure;
- With a straightened counter weight leg, pull the casualty's harness up firmly by placing a hand behind the ventral attachment point webbing.

Hauling & Lowering Systems - General

By using a combination of pulley's, descender and ascender devices and connectors, elaborate hauling and lowering systems can be designed and assembled allowing for the speedy evacuation of an injured operative from the most difficult of locations.

Wherever practicable, rescue systems utilising 'Gravity' should be used to lower the casualty to a safe position where effective first aid treatment can be administered.

Typically, 2:1, 3:1, 5:1 and 9:1 mechanical advantages (theoretical) and counterweight systems are used during the hauling element and these can be subsequently disengaged allowing the casualty to be safely and speedily lowered to a safe position.

During all hauling and/or lowering operations, a secondary safety system should always be utilised. This could be an additional autolock descender device, rigged at the anchor point, or rigging a 'Self-Trailing' back up device, e.g. a Petzl ASAP.

Note: *Using a Petzl ASAP for lowering long distances can cause the safety rope to run too quickly through the device and activate the locking mechanism. A short haul will usually allow the locking mechanism to be disengaged.*

Maintaining a light grip and a redirection carabiner on the ASAP trailing rope during the lowering operation should reduce this likelihood.

When working over long distances, it is advisable to rig hauling and/or lowering systems with both working and safety ropes in constant tension, thus reducing the effects of excessive stretch in the event of a rope failure.

Consideration should be given to lowering elements of a rescue being at a different

angle to the hauling element with a subsequent potential for rigging strops to slip, e.g. during ‘’Cross-Hauling’ operations.

‘Rig for Rescue’ systems can be installed at the anchor point for most rope access operations. Working and safety ropes can be rigged through a combination of descender and back-up devices attached directly to the anchor point. Once rigged, and devices appropriately locked, operatives attach to the live parts of the rigged ropes in the normal manner.

Where the rescue scenario requires the casualty to be lowered to a safe location, the descender devices can be unlocked and appropriately controlled by the rescuer.

Note: Sufficient rope should be available at the anchor point station to allow for the full lowering distance.

Where the casualty is required to be hauled to a safe location, a simple, pre-attached, mechanical advantage system can be attached to the live part of the casualty’s suspension system and subsequently hauled. Additional equipment can be pre-rigged to the system allowing increased mechanical advantages to be utilised.

Note: Whilst most of the ‘Rig for Rescue’ systems are capable of being operated by a single operative, it is always advisable to have additional rescue personnel available to assist with the operations.

Dedicated Rescue Kits & Rigging for Rescue

A ‘Dedicated Rescue Kit’, pre-rigged with all the appropriate equipment for immediate installation to the rigging system or fall arrest anchor, is a common alternative to conventional ‘Rig for Rescue’ systems, which are often built into the primary anchor system.

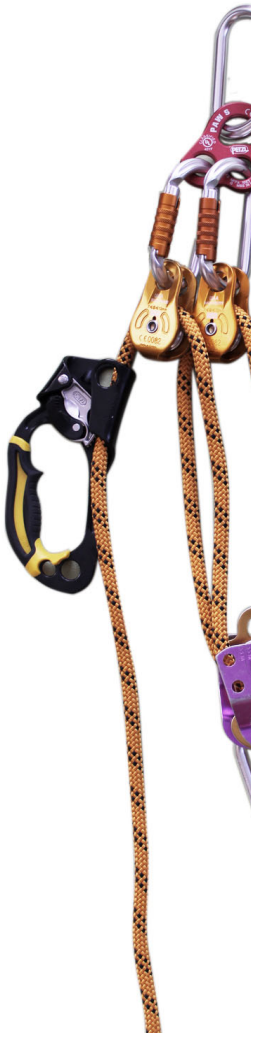
Typical Dedicated Rope Access & Fall Arrest Rescue Kits

Self-Trailing and Manually Operated ‘Rig for Rescue’
Safety Rope Management Systems

Manually Operated 'Rig for Rescue' Lowering Systems
Utilising Additional Friction for Safer Control

Autolock Hauling Systems - 3:1 Mechanical Advantage

Autolock Hauling Systems - 5:1 Mechanical Advantage



Autolock Hauling Systems - 2:1 Mechanical Advantage

Autolock Hauling Systems - 9:1 Mechanical Advantage

Other Access & Safety Systems

Mobile Elevating Work Platforms (MEWP's)

Mobile Elevating Work Platforms (MEWP's), e.g. Cherry Pickers & Scissor Lifts, should only be operated by suitably competent persons who will ensure it is in safe working order and that site an environmental conditions are suitable for its safe operation.

MEWP's should not be used to lift or lower equipment. The SWL of the machine should never be exceeded.

Never stand on the toe guards.

It is recommended by both the International Powered Access Federation (IPAF) and the HSE that a harness and suitable length 'Restraint Lanyard' be attached to an appropriate point on Boom type MEWP's to ensure operatives are not thrown out of the basket if driving over uneven ground or being struck by another vehicle.

Note: The harness attachment point on most MEWP's is not capable of withstanding the dynamic forces that could be applied if using a 2m energy absorbing lanyard. The harness attachment point could simply fail or in extreme cases the MEWP could overturn!!

Whilst working over water there is no recommendation for a harness and lanyard, however a suitable buoyancy aid should be worn.

MEWP 'Cherry Picker'

Scaffolding

Only suitably competent persons should erect, alter, dismantle or inspect a scaffold. All scaffold installation should be carried out in accordance with current legislation.

Scaffolds should be inspected on a weekly basis. Some sites operate a ‘Scafftag’ system.

The ‘Scafftag’ (or other suitable signage) states the current status of the scaffold structure detailing the maximum SWL per square metre or maximum number of people.

Where mobile and static access towers are in use it is important to ensure that outriggers, stabilisers and ties are in place before use and ensure the manufacturer’s quoted SWL’s for the tower are not exceeded.

Access should be gained from the ladder sections positioned internally. Never climb up the outside of the tower.

Never place ladders on the top of a mobile tower.

Never move a mobile tower with persons or materials on it.

Mobile Access Tower

Ladders

Ladders are used extensively as a means of access in all industry sectors. It is important to ensure they are inspected prior to use by a suitably competent person.

When positioning ladders ensure they stand 1m out for every 4m in height to the point of rest.

They should extend sufficiently to provide a safe handhold whilst stepping on or off the ladder at the top onto a working platform.

Ladders provide access for 1 person only and should not be used at heights greater than 9m.

They should not be painted as defects may not be visible during inspection.

Whilst in use they should be footed at the base whilst being secured at the top.

Whilst climbing, operatives should ensure they maintain 3 points of contact, e.g. 2 x hands and 1 x foot or 1 x hand and 2 x feet.

In certain situations, ladders may be used as a working platform, however, only when the work is of a short duration.

Note: *Whilst the HSE do not put an actual figure on this, it should be regarded as a few minutes as opposed to a few hours in duration.*

When using stepladders, it is important to stand no higher than 3 rungs from the top and to maintain contact with one hand whilst ascending or descending.

Lightweight Telescopic Ladder

Safety Nets

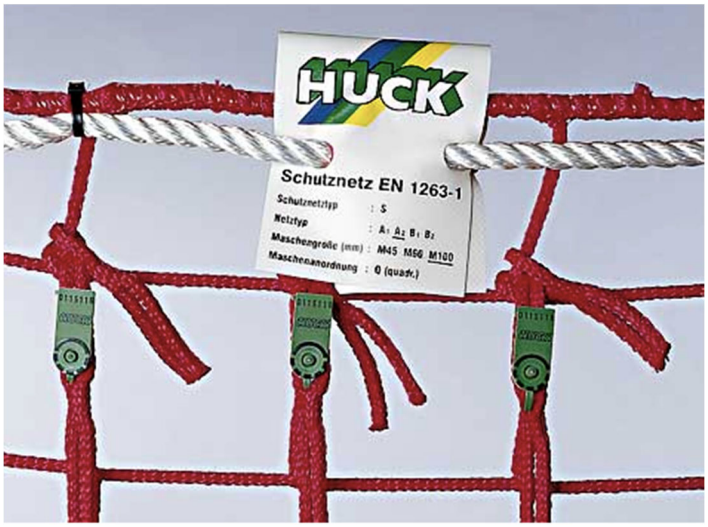
It should be pointed out that Safety Nets are used to provide a 'Collective' means of 'Arresting' the fall of a person working above it and not a means of 'Preventing' a fall.

Safety Nets should be manufactured and installed in accordance with EN1263-1/2 and have a minimum clearance distance below them of 3m.

Tie cord distances should not be more than 2.5m however the distance will usually be at the spacing of the Purlins, which are generally 1.7m.

10% sag should be introduced into the net system during rigging operations to ensure that anchor point loads do not exceed 6kN in the event of a fall.

Safety nets are purchased with a number of 'Test Cords', which should be tested on an annual basis to ensure sufficient net strength due to the effects of Ultra Violet radiation.



Typical Fall Arrest Safety Net & UV Test Cords

Glossary of Terms

ACOLAR: HSE document explaining how LOLER applies to the industrial rope access industry. (Currently under review).

ACWAHT: The HSE led 'Advisory Committee for Work At Height Training'.

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.

ANETVA: 'Association National De Empresas De Trabajos Verticales'. Spanish rope access association.

ARAA: Australian Rope Access Association.

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.

Back Up Device: A rope adjustment device for a safety rope of appropriate type and diameter, which accompanies the user during changes of position or allows adjustment of the length of the safety rope, 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 ropes 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 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.

Caving: The recreational pastime of exploring wild caves. The rope climbing equipment and techniques invented in the deep caves around Grenoble in France are constantly being developed to cater for the ever-expanding industrial work at height market. Exploring a deep alpine cave could involve using all of the techniques detailed in the IRATA Level 1 training syllabus. In the early years of the industry most of the workforce was made up of experienced cavers and climbers.

Carabiner: Widely adopted English spelling of Karabiner, from the German Karabinerhaken meaning spring hook. 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 (screwgate), automatic locking device (twistlock) or similar.

CDM: Construction (Design & Management) Regulations.

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.

CHSW: Construction (Health, Safety & Welfare) Regulations. Now incorporated within the CDM Regulations.

CITB: Construction Industry Training Board.

Climbing: The recreational pastime of using hands, feet or other parts of the body to ascend steep rock faces or structures. Dynamic climbing ropes, harnesses and other items of safety equipment are used to protect the climber should they fall. In the early years of the industry most of the workforce was made up of experienced climbers and cavers.

Competent Person: A person with sufficient professional or technical training and knowledge, actual experience and authority to carry out their assigned duties, recognise potential hazards, detect defects or omissions, which may have health and safety implications and specify remedial actions to mitigate the implications.

Certificate of Conformity: A certificate issued by the manufacturer or equipment supplier confirming that the item of equipment meets the requirements of appropriate National or International Directives and conforms to any standard that it claims to meet.

Connector: An openable device 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 variety, e.g. screwgate carabiner, twistlock carabiner, Maillon Rapide or similar.

COSHH: Control of Substances Hazardous to Health Regulations.

Cow's Tail: A short length of dynamic rope connected to the main attachment point of the harness. Sometimes referred to as a device or attachment lanyard.

CSCS: UK based, Construction Skills Certification Scheme.

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

DPMC: 'Developpement Promotion Metiers Sur Cordes'. French rope access association.

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

ECRA: European Committee for Rope Access. Committee represented by the leading rope access associations in the EU with an aim of harmonizing rope access standards.

EN: European Norm or Standard.

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

Etrier: Multi-stepped portable textile ladder.

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: 'Fach-und Interessenverband Fur Seilunterstutzte Arbeitstechnike eV'. German rope access association.

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

Health & Safety Commission (HSC): The former UK Government body that formulated health and safety legislation for industry before being integrated within the Health & Safety Executive.

Health & Safety Executive (HSE): The UK Government body that formulates and enforces health and safety legislation for industry.

IPAF: International Powered Access Federation. Trade & Qualification body responsible for ensuring the safe use of Mobile Elevating Work Platforms (MEWP's).

IRATA: Industrial Rope Access Trade Association.

Kernmantle Rope: From the German Kernmantel. Textile rope manufactured with a load bearing core (kern) and enclosed by a protective sheath (mantle).

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

kN: Kilonewtons. 1000 Newton's. SI unit of Force. (See also N. Newton).

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

Lifting Plan: Equipment requirements and methods to be used for a lifting operation.

LOLER: Lifting Operations & Lifting Equipment Regulations.

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

Maillon Rapide; (Quick Link) A type of connector formed as an open loop and closed by a threaded sleeve.

MCG: Major Contractors Group.

MGO: Mousqueton Grande Ouverture, Large opening connector, often referred to as a Scaffhook.

MHSW: Management of Health & Safety at Work Regulations.

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.

MSDS Sheet: Materials Safety Data Sheet, sometimes referred to as a COSHH Sheet. Information sheet detailing the chemical ingredients and the appropriate PPE that should be worn whilst using the particular chemical.

N: Newton. This is the SI unit of force. 9.81N is the force required to suspend a mass of 1kg under the force of gravity. It is commonly approximated to 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 Newton's. All Fall Arrest systems should reduce the PIF to a maximum of 6kN.

PPE: Personal Protective Equipment.

prEN: A provisional, or preparatory EN standard, 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. The result can then be 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 anchor point is not possible.

PUWER: Provision & Use of Work Equipment Regulations.

RAFAA: 'Rope Access & Fall Arrest Association', formally SAIRAA. South African rope access association.

RIDDOR: Reporting of Injuries, Diseases & Dangerous Occurrences Regulations.

Rig for Rescue: A rescue system which enables the retrieval of a workmate to take place without the need for a rescuer to put themselves at risk by having to descend or ascend to the position of the injured person.

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 a rope, will enable the user to vary their position along it.

Running Belay: A method of reducing the Fall Factor and, more importantly, the Fall Distance whilst lead climbing a structure using dynamic belaying techniques. The dynamic climbing rope is clipped into connectors attached to the structure at regular intervals as the operative physically climbs the structure.

Safety Line; Safety Rope: A rope provided as a safeguard to protect against falls if the operative slips or if the primary means of support, e.g. the working rope, anchor point 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) that an item of equipment may raise, lower or suspend under particular service conditions.

SAIRAA: South African Industrial Rope Access Association. See also RAFAA.

Semi Static Rope: Another 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 where work is taking place. 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.

Shock Absorber: See also Energy Absorber.

SI: The International System of Measurement. The modern form of the metric system and the most widely used system of measurement.

SOFT: ‘Samarbeidsorganet For Tilkomsteknikk’. Norwegian Rope Access Association

SPRAT: Society of Professional Rope Access Technicians. US rope access association. Qualification favoured by many wind energy companies.

Static Rope: An old term for a rope with lower elongation characteristics than dynamic rope, superseded by the term ‘Low Stretch’ rope. Static Rope normally 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. Some polyester ropes manufactured in the US have very low stretch characteristics and are often referred to as Static Rope. Currently these ropes do not meet the requirements of EN1891A and are not CE marked. Due to laws relating to CE marking and the sale of safety products within the EU these ropes are not currently available to the European market.

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

Suspension Syncope: Formally known as Suspension Trauma. A condition where a person suspended in a harness can experience pallor, cold sweats, nausea, ringing in the ears, blurred vision, dizziness, feeling faint, unconsciousness and eventual death.

SYFFORHA: 'Syndicat Francais Pour La Formation En Hauteur'. The French Union for Training at Height.

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

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

UIAA: **'**Union Internationale Des Associations D'Alpinisme'. International Mountaineering & Climbing Federation.

UKOOA: United Kingdom Offshore Operators Association.

Via-Ferrata: (Iron Road) Traditionally a cableway set up both horizontally and vertically in the Italian Dolomites. By attaching a suitable twin energy absorbing 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 high Fall Factors and reducing impact forces on the body to acceptable levels within the Mountaineering standards.

WAHR: The Work at Height Regulations.

WHSW: Workplace (Health Safety & Welfare) Regulations.

Working Line, Working Rope: A rope 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 its final rating.

Work Positioning: Techniques enabling a worker to be supported in tension or suspension by personal fall protection equipment, where a fall is prevented or restricted.

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 but with the harness remaining as the primary means of attachment.

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

Notes

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