Training Manual

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Positional Deviation and some serious aid climbing

INTRODUCTION

Welcome to your Belay Rope Access training manual. Your training will primarily be practical but this manual is designed to give you the essential information you will need to become certified at level 1, 2 or 3 and to be a reference guide for your future career in rope access.

Industrial rope access as an industry was born in the early 1980's and grew out of skills developed in caving and climbing by isolated groups of individuals who saw the potential for a cost efficient method of working at height in the offshore oil industry. Becoming accepted by the established health and safety bodies as a safe method of access to difficult locations was the impetus behind the formation of the Industrial Rope Access Trade Association (IRATA).

Since then the industry has grown internationally with the IRATA method being adopted as the standard by safety bodies around the world. As the profile of rope access and its extremely low incident rate has been noticed, more industry sectors are using the IRATA system to carry out a wide variety of work at height, from film and television to window cleaning, offshore wind farms to historic building conservation and tensile fabric construction.

IRATA continually strives to improve safety within the work at height industry and works closely with member companies and other related organisations to compile incident reports and share the lessons learned. Training is also revised on a regular basis to reflect new equipment and techniques and changes to legislation.

The British Standards Institute BS7985 Code of Practice for Rope Access published in 2002 was based on the IRATA Guidelines which represented many years of cooperation with the HSE. The new standard to BS ISO 22846-1 and 2 has superseded BS7985 and a comparison study has shown that the IRATA International Code of Practice (ICOP) and Training, Assessment and Certification Scheme (TACS) represent a superior standard.

Hence the IRATA system has become the gold standard for work at height and rope access worldwide and has been widely imitated by other national organisations and government safety bodies.

GLOSSARY OF TERMS

Rope Access – Describes a variety of techniques using ropes and harnesses to safely access a hazardous location for the purpose of carrying out a task.

Work Positioning – When a person is supported in tension or suspension by personal protective equipment (PPE) in such a way that a fall is prevented or restricted.

Work Restraint – When a person is prevented by means of PPE from reaching an area where they may be subject to a fall from height.

Fall Arrest – Technique whereby a person uses PPE designed and intended to arrest a fall to prevent the user from colliding with a structure or the ground. In addition the fall arrest system used must limit the impact force on the users body in a fall to less than 6kn.

Work at Height – All work activities where there is a need to control a risk of falling any distance liable to cause personal injury to the operative or a third party.

Fall Factors – A measure of the severity of a fall. It is a ratio between the distance fallen and the length of the line or lanyard which arrests the fall. Divide the distance fallen by the lanyard length.

Breaking Strain / Load – Theoretical load at which an item of equipment will fail.

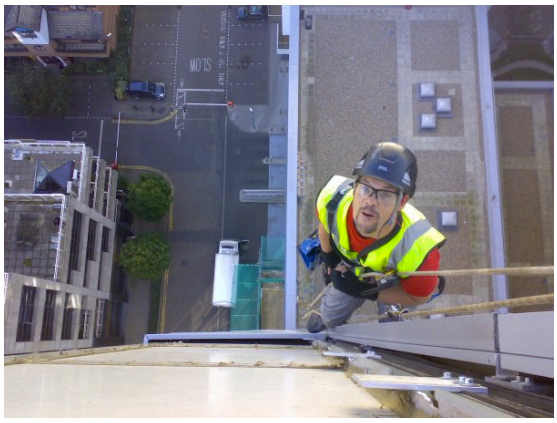
WLL – Working Load Limit. Manufacturer specified maximum working load to be applied to an item in normal use and in particular configurations.

SWL – Safe Working Load. Decided by a competent person depending on the circumstances of the lift and load and normally considered to be 10% of the breaking load for textile items and 20% for metal items.

Hazard – Anything that could cause harm to a person or property

Risk – The likelihood of harm occurring.

Krab – Karabiner. See Equipment section Page 12.



LEGISLATION

HASWA – The Health and Safety at Work Act 1974. It states that employers and employees, designers and manufacturers have responsibilities for the health and safety of persons that might be affected by work activities.

Employees must take reasonable care for the health and safety of himself and of other persons who may be affected by his acts or omissions at work. Cooperate with their employer as far as is necessary to enable the employer to fulfil any duty or requirement imposed on them by the relevant statutory provisions.

MHSWR – The Management of Health and Safety at Work Regulations.

Specifies that risk assessments and method statements must be carried out to identify hazards and suitable control measures to minimise the risk.

WAHR – Working at Height Regulations 2005.

States that individuals have a responsibility to themselves and others. They must also use any equipment provided for them by their employer in accordance with the instructions for use and any training they have been given.

PPE – Personal Protective Equipment. Controlled by the PPE regulations 2002.

PPE must be provided to persons to protect them against any hazards identified in the risk assessment. It must be the last resort when all reasonably practicable ways of removing the source of risk have been exhausted.

LOLER – Lifting Operations and Lifting Equipment Regulations 1998.

Require thorough inspection by a competent person of equipment used to raise or lower loads (including people). Records must show the name of the inspector, date and place of inspection and the results. Equipment should be traceable and marked with a SWL.

PUWER – Provision and Use of Work Equipment Regulations.

Requires proper equipment must be provided for a task and suitable training be given in its use.

COSHH – Control of Substances Hazardous to Health Regulations 2002.

Requires an assessment to be carried out of any potentially hazardous substances and that control measures are out in place to prevent harm or damage.

RIDDOR – Reporting of Injuries, Diseases and Dangerous Occurrences Regulations.

Requires the reporting of work-related incidents, diseases and dangerous occurrences. Deaths, major injuries, incidents resulting in more than 3 days lost time, diseases and dangerous occurrences must be reported.

HIERARCHY OF RISK

The Working at Height Regulations (WAHR) set out a clear hierarchy for the management of risk and selection of equipment when working at height.

AVOID – Where it is reasonably practicable to avoid the need for working at height this option must be used. For example in a theatre using a lighting gantry, which can be lowered to the stage, so that technicians don't have to climb and expose themselves to a risk of falling.

PREVENT – If there is no reasonably practicable alternative to work at height then reasonably practicable and suitable measures must be put in place to prevent a fall which protect a group of people rather than an individual. For example erecting hard barriers on an exposed edge or using work restraint methods to physically prevent a person entering an area where they may fall.

MITIGATE – If the risk of a fall from height cannot be eliminated then suitable equipment must be deployed to minimise the distance and consequences of a fall. The first choice should be work restraint which physically prevents an individual from falling. The second choice should be work positioning or rope access using a twin anchor system. The last resort should be fall arrest. See page 27.

The regulations require that collective protection takes priority over personal protection.

The regulations require the following;

1. All work at height is properly planned and organised.
2. All work at height takes account of weather conditions.
3. Those involved in work at height are trained and competent.
4. The location of the work is safe.
5. Equipment is properly inspected.
6. The risks from fragile surfaces and falling objects are properly controlled.

RISK ASSESSMENT

This is a requirement of the Management of Health and Safety at Work Regulations (MHSWR). The five steps to risk assessment are:

Step 1: Identify the Hazards

A site visit is essential to identify potential hazards. No two jobs are exactly the same. Account must be taken of weather conditions, changes that might occur during the work and conflicting activities such as crane movements or members of the public interfering with ropes.

Step 2: Decide Who May be Harmed and How

Who will be harmed by each hazard, members of the work party or the public? Could property of the environment be affected by the task? For example using cleaning chemicals above a water source.

Step 3: Evaluate the Risk

Evaluate the likelihood of a hazard occurring (the risk) and put in place control measures to reduce the risk. You must do everything that is reasonably practicable to protect people from harm. If the hazard cannot be removed then can the risk of it occurring be reduced? For example when working over a public area, if the entire area cannot be cleared of people can barriers be erected and all tools and equipment used by the technicians be attached by lanyards to prevent dropped objects harming the public.

At the end of this process the risk of any hazards must be Low.

Step 4: Record your Findings

Write down the results of your assessment using a clear and easily readable format. Free risk assessment forms are available for download from the internet.

Your assessment should involve all members of the work team and other interested parties such as the client or property owner.

Step 5: Review

As stated above, no two jobs are exactly the same and few jobs or workplaces don't change over time. New equipment, procedures and hazards can occur. The risk assessment must therefore be reviewed every time there are changes. Even after a short break or during the task conditions may change so constant review of the risk assessment is essential. Lessons learned must be recorded to enable future work to be planned with this information taken into account.

METHOD STATEMENT

The Method Statement is a document stating the procedure, which should be followed to carry out a task safely. It should detail the steps the team should take and the equipment they require and should be communicated to the team in a briefing before the commencement of the task.

As a minimum it should contain the following;

- The location of the task
- The scope of work
- Minimum team structure and qualifications
- Method of access and egress
- Equipment required
- Details of PPE and other hazard control measures
- Details of anchors to be used
- Communications
- Waste and housekeeping
- Hazardous substances
- Emergency procedures and equipment (Rescue Plan)

PERMIT TO WORK (PTW)

A permit to work system may be in place at your worksite, particularly in hazardous areas such as building sites, oil and gas facilities or Nuclear Energy Plants. The PTW system will be in place to prevent hazards such as live electrical conductors, hot exhausts or sewage outlets from causing harm to the work team during the task by isolations. It is designed to prevent conflicting work activities causing harm to you or others.

EXCLUSION ZONES

Exclusion zones must be set up to protect people from falling objects from above during rope access operations. They may be necessary at different levels and also at anchor level on top of a building for example to prevent interference with ropes by members of the public or other workers on a site. They may take the form of hard or soft barriers, warning signs or even a grounds man to verbally warn of the danger. Your exclusion zone must be of sufficient size to account for objects being blown away from the structure by the wind as afar as reasonably practicable.
As a rule of thumb an exclusion zone must be placed 1m out from the structure for every 1m of vertical height but on a 100m high building in a city centre this would not be practicable or reasonable if the task were window cleaning for example. As always the risk must be assessed fully by the team taking many factors into account.

LOLER

In rope access the Lifting Operations and Lifting Equipment Regulations 1998 apply to any operation in which a person is raised or lowered. It requires that all operations are planned and managed, that equipment is used in a safe manner and inspected thoroughly at suitable intervals by a competent person.
All equipment must be marked and traceable with a certificate of conformity declaring that the item meets the standard to which the equipment must conform.

LOLER requires that a Safe Working Load be indicated on the equipment. Rope access kit is specifically designed to support a person rather than a specific mass. All items of rope access PPE are therefore automatically rated for a SWL of one person in normal use. The factor of safety built into the kit means that in a rescue scenario the equipment may be used by two persons.

Thorough examinations by a competent person are deemed to be appropriate at no more than 6 monthly intervals. Periodic inspections may be required if a competent person deems it necessary due to hard use for example in a chemical works or geotechnical operations.
In addition to the thorough examinations a pre and post-use check is required by LOLER to pick up on obvious faults and to determine if the equipment will function correctly and is safe to use. Suspect items should be quarantined, checked by a competent person and if irreparable, destroyed before disposal to prevent it being used by a third party.

PPE

There are three categories of PPE:

1. Simple. E.g. Non-specialist coveralls or gardening gloves.
2. Intermediate. For protection against specific serious hazards. E.g. Hard hat, fire retardant coveralls, safety boots.
3. Complex. For protection against mortal danger. E.g. Harnesses, rope access equipment. This equipment must conform to a directive standard after testing by an independent testing organisation.

When PPE is purchased a certificate of conformity stating the item meets the requirements of the PPE regulations and conforms to the standards it claims must be provided. The CE mark is not a sign of quality but simply an acknowledgement that the item meets the minimum standards for that type of PPE. Buying from reputable sources is essential as increasing amounts of counterfeit PPE are finding their way onto the market, which do not meet the standards and could potentially cause serious harm to their users.

COSHH

The Control of Substances Hazardous to Health Regulations 2002 require employers to protect workers and other people from any harm which may arise from work activities using hazardous substances. These could include chemicals, dusts or fumes or fibres, which might harm a person through contact, ingestion or inhalation.

The regulations are concerned with the effect on the person not their PPE but for a rope access technician any substance which could damage their kit must be considered. For example an industrial painter may be required to use solvent-based paint so in addition to respiratory protection for their lungs and splash protection for their skin consideration must be given in the risk assessment for protection of their ropes and harness with canvas rope protectors and disposable coveralls.

This is not an exhaustive list of legislative requirements and other territories will have their own demands, laws and regulations, which must be adhered to.

In addition, every worksite you attend and every company will have procedures and local rules you must understand and abide by.

The most important thing to remember is to never start something that makes you feel uncomfortable. If you have any safety concerns you have a duty to yourself and others to stop the job. No job is worth risking your life for.

LOGBOOKS

On successful completion of your first IRATA assessment you will be issued with a logbook. Your logbook will become your passport to you rope access career and must be kept up to date with details of the number of hours you were engaged in rope access activities, the type of work you were doing and the rope access manoeuvres undertaken. This is important for those who wish to progress up the levels as evidence of a breadth of experience is required to be considered for assessment at levels 2 and 3. Logged hours should be a true reflection of time spent involved in rope access activities and signed for by the supervising level 3 or line manager. In addition IRATA companies are now required to submit monthly records of logged rope hours for their technicians in electronic form. This is a safety check to prevent fraudulent amassing of hours by unscrupulous technicians that could harm the safety record and the reputation of our industry.

IRATA International training, assessment and certification scheme

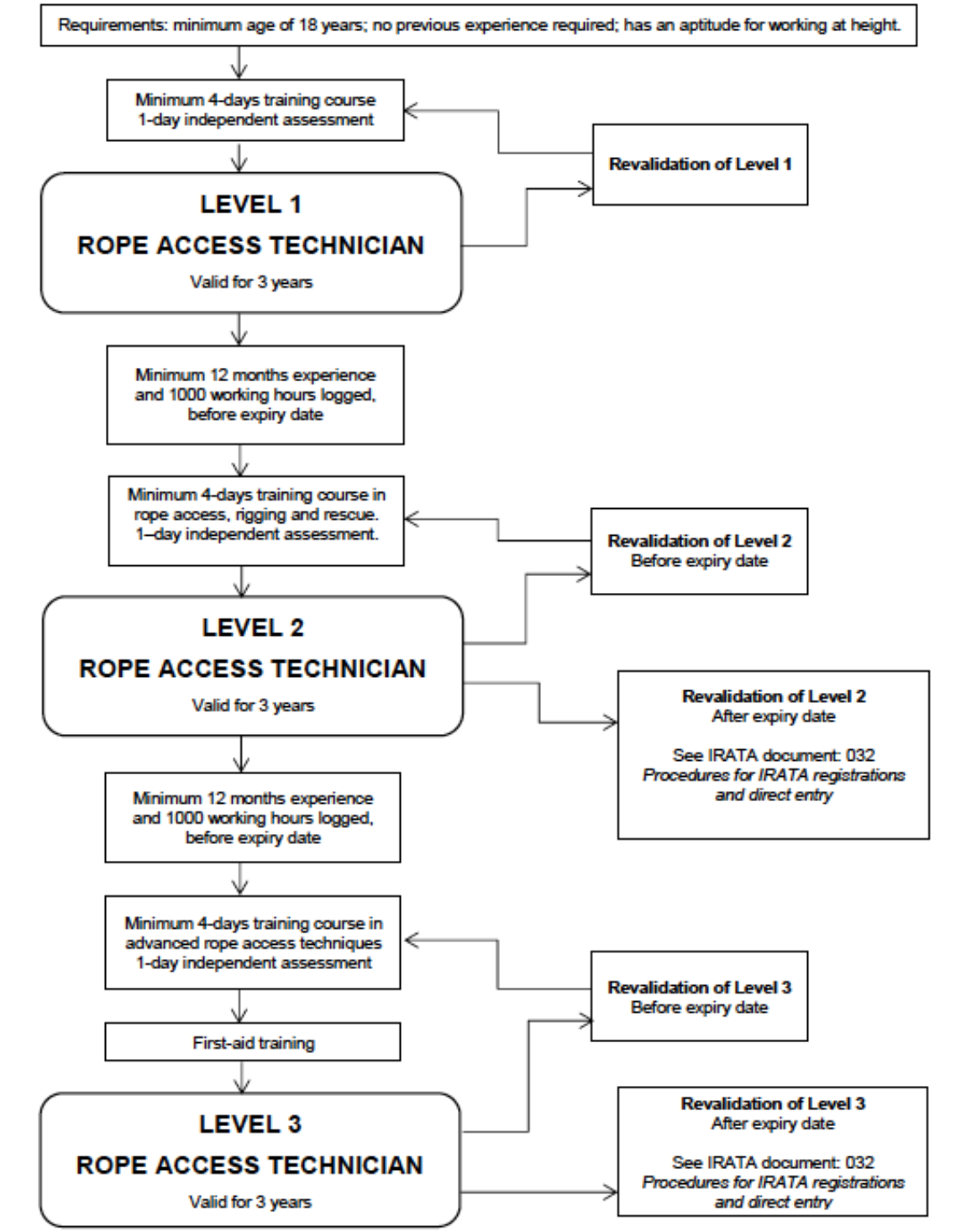


Figure 1 – Flowchart showing qualification process

EQUIPMENT

EUROPEAN STANDARDS

The following European Standards are applicable to the rope access PPE equipment commonly in use for work at height and rescue.

• Connectors (Karabiners)	EN 362 / EN 12275
• Work Positioning Harnesses	EN 813 / EN 358
• Ascenders	EN 567 / prEN 12841
• Descenders	EN 341 / prEN12481/ISO22159
• Helmets for Industrial Rope Access	EN 397 and/or EN 12492
• Ropes, Low Stretch	EN 1891
• Ropes, Dynamic	EN 892
• Chest Harnesses	EN 12277
• Back-up devices	EN 353-2 / EN 12841
• Harnesses, Full Body	EN 361
• Anchor Lines	EN 1891 / EN 353-1
• Energy Absorbing Lanyard	EN 355
• Work Positioning Belt	EN 358
• Anchors	EN 795
• Lanyards	EN 354
• Pulleys	EN 12278

HELMETS

Helmets for rope access must conform to the mountaineering standard EN 12492 that stipulates a chinstrap designed to retain the helmet in a fall. In addition most worksites require a helmet that conforms to the industrial standard EN 397 that stipulates resistance to lateral deformation from an impact, use at low temperatures (-30 Celsius), electrical insulation and molten metal splash protection.

Helmets should not have a peak to give all round vision and should be comfortable for extended use.

Your helmet requires regular inspection inside and out for cracks, deformation and damage to the cradle and straps. Make sure the adjustment system is operational and there are no signs of chemical contamination. Stickers or permanent marker pens should not be applied to the polycarbonate shell as they contain potentially damaging solvents.

Helmets can be washed in water and mild soap but never with solvents or harsh detergents.

ROPES

Low Stretch conforming to EN 1891 Type A. Kernmantel rope has a load-bearing core of parallel or braided strands surrounded by a tightly woven sheath. It is designed to be flexible, easy to knot, strong for its diameter and hardwearing. The name low-stretch describes the percentage increase in length as the rope stretches when the static load is increased from 50kg to 150kg. In the case of someone falling the high impact forces generated are passed onto the body with very little shock absorption.

Dynamic Ropes conforming to EN 892 are used for lead climbing, traversing and aid climbing with cowstails. The energy absorbing capacity of dynamic rope must ensure that forces endured by the technician in a fall are below 6kn. Dynamic rope is not usually certified by the manufacturer to have a specific breaking load but will be designed to be subjected to a certain number of dynamic falls after which it should be retired. As with all equipment

dynamic rope must be able to withstand any forces that it is subjected to. Ropes should be checked before and after every use for cuts, abrasion, soft or particularly hard areas and signs of chemical contamination or heat damage. They should be stored ready for use in a clean, dry area undercover away from sources of contamination such as solvent fumes. They may be washed in mild soap, rinsed thoroughly and hung to dry naturally in a well-ventilated area away from direct sunlight or heat.

HARNESSES

An item conforming to EN 813 or EN 358 denotes a work positioning harness suitable simply for rope access work in suspension. In reality technicians will be faced with a variety of situations in their working life, which require the use of a full body harness combined with fall-arrest lanyards, when using Y-lanyards and also when using the ASAP or Rocker for example. It is therefore more common for harnesses conforming to both EN 813 and EN 361 to be used in rope access. Examples such as the Petzl Avao Top Croll and Heightec Matrix Full allow the technician to switch easily between work positioning, work restraint and fall arrest modes without switching harnesses.

Pre and post use checks must be carried out to check for signs of abrasion, furring of the webbing, condition of stitching or discolouration. Metal fittings should be checked for corrosion, sharp edges and function. Harnesses can be washed in mild soap and dried naturally away from direct sunlight or heat.

DESCENDERS

Conforming to EN 12841 Type C ISO 22159 or EN 341 class A. The Petzl Stop, Rig and ID are the most common types in use. The Stop is still widely issued to rope techs on and offshore and, whilst it doesn't have the anti-panic function of the ID, in the hands of an experienced and well trained tech, is more versatile and user friendly.

Pre and post-use inspections should check for deformation, cracks, pitting or flaking of aluminium parts, build up of dirt, wear indicators and function. Excessive wear on cams or deformation could indicate an excessive loading of the device and could lead to loss of braking function. Cracks have been found on the upper pulley of Stops and whilst this doesn't affect the safe operation of the device it highlights the need for thorough inspection. The Stop will allow the rope to creep under large loads so a braking karabiner must be used during rescues.

Both Stops and Rigs are also prone to accidental or deliberate misuse. The side plate may not become fully engaged and the operating handle may be squeezed unintentionally by a karabiner whilst the technician is changing from ascent to descent mode. Technicians may overload the descender when rigging tensioned lines or use techniques for descending loaded rope using the device. Inexperienced trainees shall seek authorization from the trainer prior to completing their rescues and demonstrate a separate function check of the descender. Extra protection may be used when negotiating obstacles in descent (for example attaching a cowstail to the structure when abseiling over an edge. A ground belay may be used during initial rescue training and a form of ground protection (bouldering mattress for example) shall be used during two person rescues by Level 1's. The trainer shall ensure that the rescuer has demonstrated full control of the descent prior to allowing the rescue to continue.
Close supervision and training shall emphasize the importance of avoiding incidents and carrying out function checks before descending, especially with a casualty in a "rescue" scenario.

BACK-UP DEVICE

The S-Tec Duck that we use at Belay conforms to EN12841 and is becoming a popular replacement for the shunt. It is more robust in harsh and dirty environments and more versatile than the ASAP. Close supervision and training shall emphasize the importance of independent function checks and the requirement for independent movement of the Duck during rescue. Trainees will be shown how to attach and remove the Duck whilst limiting the chances of a dropped object. They must ensure the device is kept high when carrying out function check on descender and when stationary. The trainer shall ensure best practice is followed as per manufacturer's instructions.

The Petzl shunt is designated as a rope clamp in the European Mountaineering Standards for PPE and conforms to EN 567. It was never designed to be a back-up device but the rope access industry adopted it as the norm for many years. The manufacturer has stated that it should not be used as a back up or fall arrest device whilst towed by a cord and it is finally being phased out by the industry. Other devices are starting to replace the shunt as a back-up device but it remains a useful and versatile non-aggressive rope clamp to have on the harness of trained and experienced technician. It begins to slip when a force of 3kn is applied and works on single or double ropes which makes it useful for creating equally tensioned lines for rescue or as a spare ascender.

The Petzl ASAP conforming to EN353-2 and EN12841 is also a commonly used back-up device for rope access. Used with an energy-absorbing lanyard (Petzl Absorbica L57) conforming to EN 355 and attached to your sternal attachment point it will arrest a fall during rescue even when grabbed. Like all devices, though, it can be used incorrectly by poorly trained and supervised technicians. It also suffers badly in high wear environments such as Geotechnical and grit blasting works and cannot be cleaned like other devices meaning technicians and companies may be tempted to soak the ASAP in solvent and lubricate the mechanism against the instructions of the manufacturer. The complexity of the ASAP system and potential for user error leading to failure is what lead Belay to choose the Duck-R.

Pre-use checks should focus on the functionality of the device, deformation, cracks and excessive wear. Specific instructions for the inspection of each device are available from manufacturers' websites and should be studied carefully prior to use.

PULLEYS

Must conform to EN 12278. Can be fixed cheek or swing sided. Check for deformation, corrosion and poor function, which may indicate it, was overloaded.

ASCENDERS



Ascenders are used in conjunction to allow the technician to ascend the ropes vertically. The most common items, shown above are the Petzl Ascension and Croll conforming to EN 567 and EN 12841 Type B. Due to the angled teeth these ascenders must not be used in a situation in which a shock load may occur as damage to the rope sheath can result. With excessive loading of greater than 5kn static load sheath damage can also occur.

Pre and post-use inspection is essential and deformation of the body, poor operation of the cam and missing teeth are problems to watch for.

CONNECTORS


Karabiners (krabs) conforming to EN 362 should have a locking gate either with a screw or automatic bayonet style mechanism and generally are made of steel when used in rope access as alloy items can suffer cracking when subjected to harsh working conditions and marine environments. They may be stamped with a minimum breaking load of between 20 and 50 kilo Newton but this capacity is dramatically reduced when loaded incorrectly across the screw gate or with an open gate. Care should be taken to only load a krab along the spine or major axis.

Maillon Rapides conforming to EN 362 and EN 12275 are more suitable than karabiners when a long term rigging solution is required. The most common shape in rope access is the Delta type shown above. This type can be loaded in any direction. Only maillons stamped with a CE mark may be used as PPE and the gate must be firmly screwed shut to the manufacturer's specified torque to achieve maximum strength. Function checks are essential to highlight connectors that may have been overloaded or deformed.

WIRE STROPS / TAPE SLINGS

Wire strops must conform to EN 795 (anchor devices) or EN 566 (slings) and generally will have a SWL of 1 tonne. A plastic sheath is common and provides some protection for the strop and also for the structure it is wrapped around. Pre-use inspection should focus on any kinking in the wire showing the nylon core, deformation of the eyes and damage to the ferrules allowing the wire ends to slip through.

Tape slings are versatile, lightweight and cheap. Conforming to EN 795 or EN 566 they must be inspected thoroughly for cuts and abrasion. Wash in clean water and dry away from direct heat. Pre-use inspection should highlight any damage to stitching, furring or nicks in the tape. Furring caused by abrasion and even Velcro can reduce the load bearing capacity of a nylon sling even more than a cut in the side. Following the manufacturer's instructions is essential.

FALL ARREST LANYARDS

Conforming to EN 355 and with scaffold hooks for continuous connection to a ladder or structural fixing when climbing masts and towers.

Practical training is essential to prevent improper use and the failure of the shock-absorbing element to deploy. Must be attached to the sternal or dorsal attachment points on a full body harness conforming to EN 361.

KNOTS

Knots are the critical links in your system. They are what connect you to the structure from which you are suspended. The manufacturer of the rope has no control over what kind of knot you tie. You have ultimate responsibility for making sure they are correct.

The following are the basic knots that a technician at any level should be able to tie without hesitation. In an emergency situation a delay whilst someone tries to remember a knot could lead to disaster so practice is essential!

These photos are just a guide. Technicians should use www.animatedknots.com to practice what they are taught on this course and learn useful new knots to add to their repertoire.

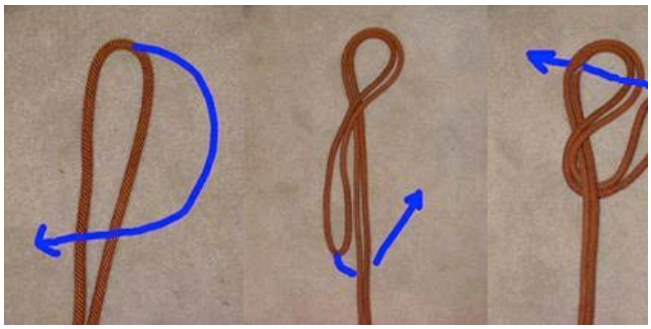
BOWLINE

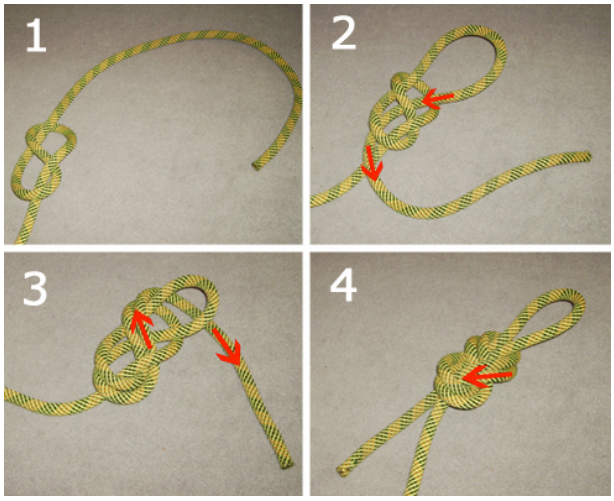
Sometimes forgotten, the bowline is a versatile knot that is used every day for tying on tools and equipment securely.

OVERHAND

Creates a secure, compact loop in the end of a rope and if tightened properly will not come loose. This makes it hard to undo after loading. 30% loss of strength in the rope using overhand knot.

FIGURE 8





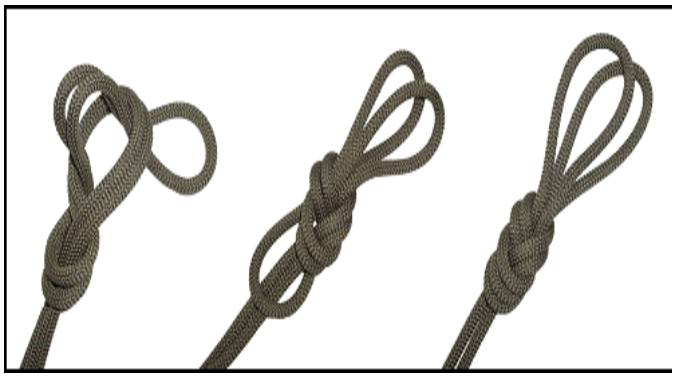
A suitable knot for attaching to an anchor point. Easy to tie and non-slip under load. 30% loss of strength in the rope using figure 8 knot.

Can be re-threaded as shown for tying into the metal D-ring on your harness or around a structural or natural anchor.

FIGURE 9

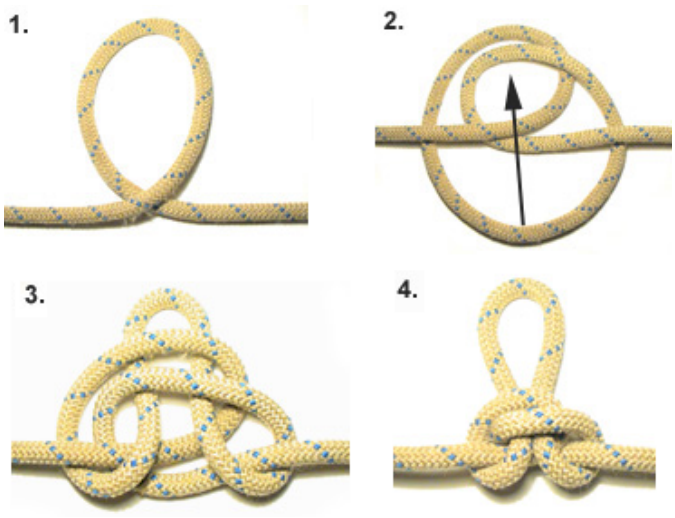
With an extra turn compared to a figure 8 the figure 9 is regarded as the most suitable anchor knot because it can easily be undone after loading. 20-25% loss of strength.

DOUBLE FIGURE 8 (BUNNY EARS)



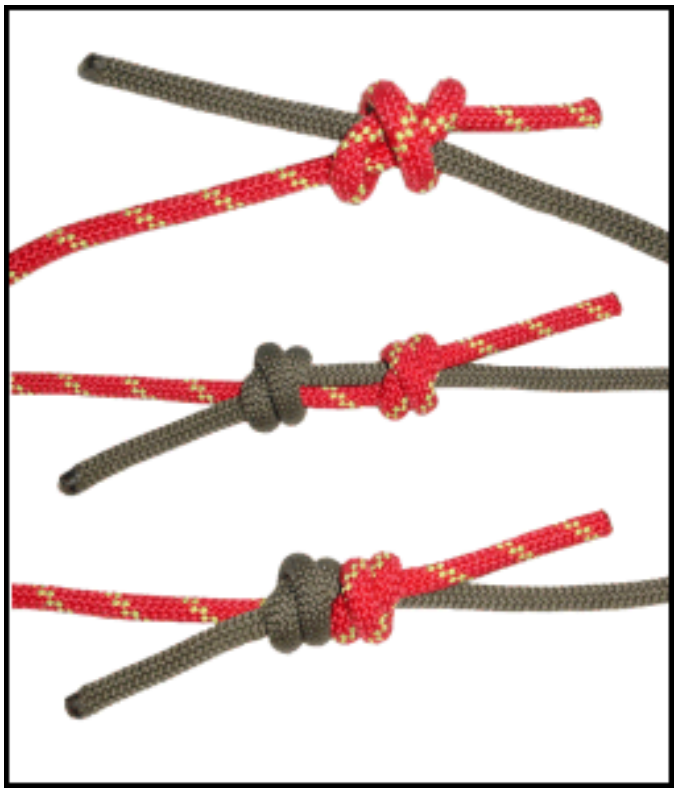
Can be used to create a Y-hang from two anchors to share the load. 25-35% loss of strength in rope. Must be dressed correctly to avoid slippage.

ALPINE BUTTERFLY



The best inline knot allowing a multi-directional loading and isolating of damaged areas of rope. 30% loss of rope strength.

STOPPER / BARREL KNOT



When abseiling on ropes that do not reach a safe floor area it is essential that stopper knots to prevent the technician from descending off the ends are tied at least 50cm from the end.

Used as the basis for a barrel knot it forms the best shock-absorbing knot for terminating cowstails.

It also forms the basis of a double fisherman's knot used to join two lengths of rope together.

RIGGING

The IRATA rope access system demands that a user requires two forms of attachment, a working line and a back-up. The lines must be independently attached to sound anchors. The above picture shows a standard Y-hang configuration with figure nines and alpine butterflies on each rope. The load is shared between the two anchors and the internal angle of the Y is less than 90°.

In many cases one unquestionably sound anchor is sufficient and double figure eight knots (Bunny Ears) can be used to create a basic anchor system and ensure that a shock load can't be applied to the system in case one of the knot loops fails.

The most important factor after anchor strength when rigging is protecting your ropes. The primary method is to rig them away from danger either with a re-belay or deviation. Only as a last resort should edge protection be considered and a canvas rope protector or carpet square may **NOT** be sufficient. See Annex A.

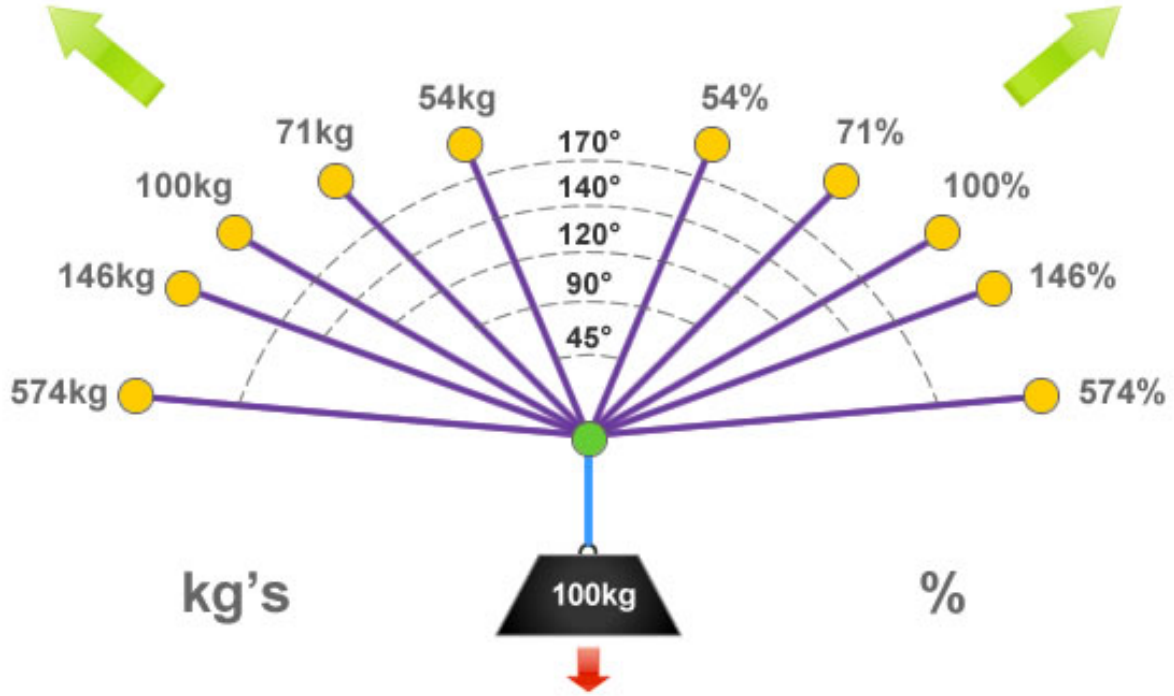
In certain circumstances a set of ropes for descent may be rigged so that they can be retrieved from the ground. This is known as a pull-through. Either an alpine butterfly or figure eight may be used. Care must be taken to ensure an adequate radius to prevent the krab being bent across its spine.

Before committing to the descent the technician must check that the correct rope is used!

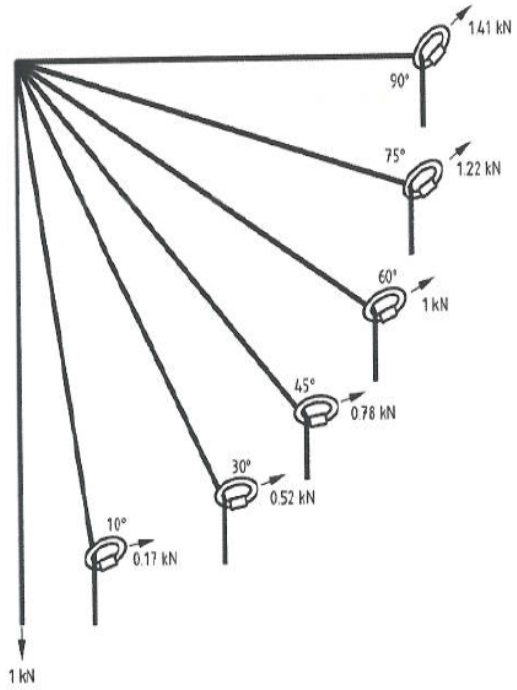
Shown here is a tensioned tramway (Tyrolean Traverse). Using a maximum of 3:1 mechanical advantage both lines are tensioned equally to share the load. The small deflection of the lines imposes large forces on the anchors that must be considered.

When used by a technician for access an independently attached rope can be used to control movement along the tramway.

If used for casualty extraction an independent double rope system is required to control the descent. Another method is a cross haul which can reduce the load placed on the anchors through a reduction in angle.



The diagram above shows the importance of keeping the internal angle of a Y-hang below 90°. The load is shared between the two anchors. It can be seen that with an angle of 120° and a 100kg load on the ropes a 100kg load is being applied to both anchors. Increase the angle even further and the load on each anchor starts to come close to the theoretical SWL of some anchor slings so in this case (such as when rigging tensioned tramways) thought must be given to sharing these high loads by doubling up your slings for example.

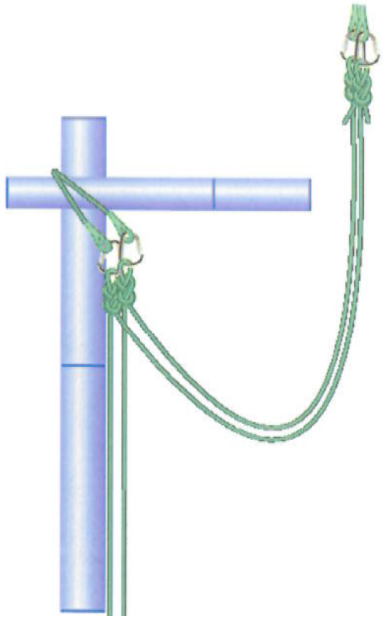


The diagram on the left illustrates the forces generated when your ropes are rigged through a deviation. Deviations are used either for positioning the technician at the worksite or for taking ropes away from danger such as a sharp edge or heat source.

Positional deviation may use a single point of attachment but protection deviations should be thought out carefully to take into account the consequences of an anchor failure leading to a potential swing injuring the technician or the ropes coming into contact with the thing you were deviating them away from. These deviations must be treated as you would a main rigging point no matter how low the deviation angle.

RE-BELAY

A re-belay is a better option in most cases for avoiding hot pipes or sharp edges as the loading forces on the anchors are more predictable and the danger of a pendulum swing is reduced. They also allow access to the underside of walkways, overhanging roofs and on very long drops can be inserted at suitable intervals to prevent too much rope stretch. On buildings over 100m in height it can be difficult to get the rope to pass through your descender at the top because of the weight of rope below and hard to stop it near the bottom because of the heat generated in the device.



LIFELINES

Single horizontal lifelines are often used to provide a safety system when working near an exposed edge. They can be used for work restraint to physically prevent a technician from going near the edge but should not subsequently be used as part of a work positioning system. Double lifelines are preferable.

Intermediate running belays without knots should be placed a maximum of 5m apart. This allows more shock load to be absorbed by the rope and not the anchors and the main anchors rather than the running belays take the load.

The rope should be hand tensioned through a descending device.

The lifeline incline must be a maximum of 15°. Anything above this should be treated as a vertical rope.

The lifeline should be rigged as high as possible to reduce the fall factor.

Rigging for rescue should always be used if practicable. Releasable anchors which allow raising or lowering of a casualty without committing a rescuer onto the ropes reduces the risk of creating more casualties.

WORKING AT HEIGHT

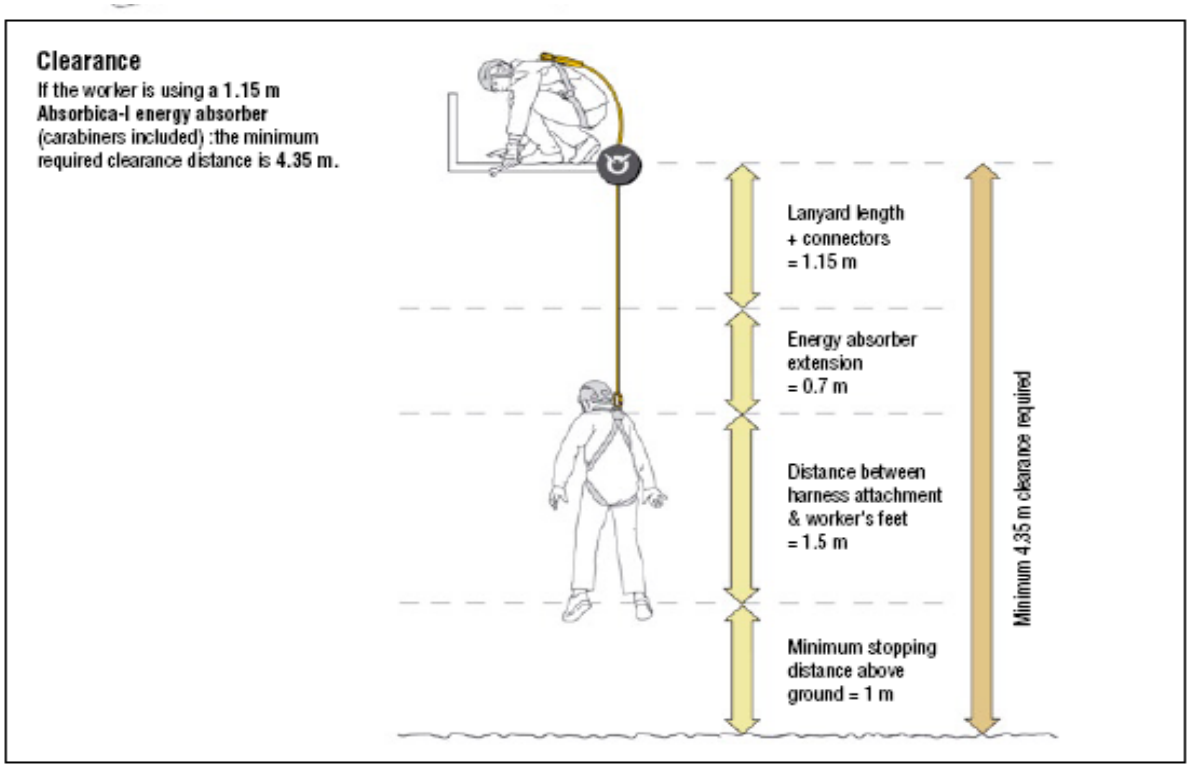
CLIMBING WITH FALL ARREST LANYARDS

The principle behind climbing with fall arrest lanyards is to ensure that if the technician were to slip and fall they should not experience an impact force through their body of more than 6kn. To achieve this a full body harness with a sternal attachment point conforming to EN 361 is combined with an energy absorbing lanyard conforming to EN 355. The user must remain upright after the fall and the sternal attachment point allows them some chance of regaining their footing after a fall to allow self-rescue. Unlike the dorsal point it reduces the risk of injuring the face against the structure.

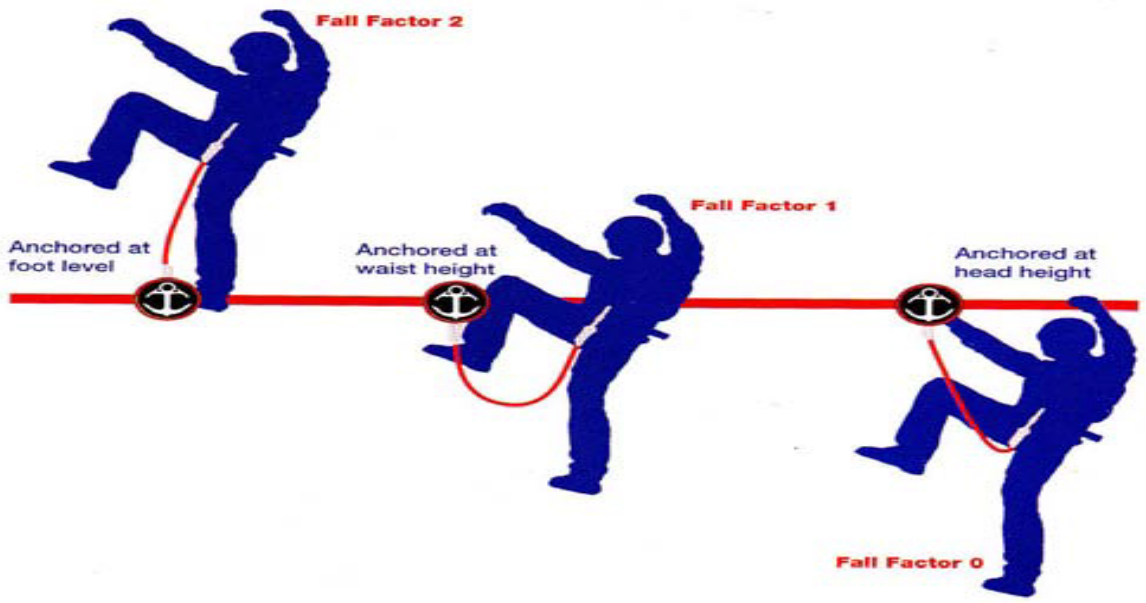
When climbing the structure the user's hands and feet are the primary attachment points with the lanyard as the back-up so as the climber advances only one lanyard is required to be attached to the structure at a time. Using a twin shock-absorbing lanyard for work positioning or to rest during a climb is prohibited as the user will still only be attached to it by one point of contact and it may damage the ability of the lanyard to deploy during a fall.

Incidents have occurred when users have clipped the spare lanyard back to an attachment point on their harness and fallen. The load has passed across the stitching causing it to fail.

The diagrams below highlight the risks associated with working at height using fall arrest PPE. Careful risk assessment must be carried out to evaluate if the right tools are being used for the task. Just putting on a harness and lanyards doesn't make it safe



Fall Factor expresses the proportional seriousness of a fall. It is the relationship between the length of the fall and the rope available to absorb the impact force of the fall. **FALL FACTOR = LENGTH OF THE FALL ÷ LENGTH OF ROPE. A FALL FACTOR OF MORE THAN 1 IS POTENTIALLY LIFE THREATENING.**



RESCUE

He's just cut an artery. What do you do?

A rope access team should be self sufficient as far as possible. One of the many benefits of using rope access is the capacity of a team to rescue itself if something were to go wrong.

A rescue plan should always be in place before any rope access task begins and should be included in the risk assessment stage of job planning as well as being described in the method statement. If the details of rescue aren't thought about at this stage it is impossible to guarantee that the right equipment or people will be available at the worksite when something goes wrong.

Complex rescues should be rehearsed and rigging for rescue should be considered to prevent time wasting and confusion during an emergency. As a minimum all the necessary kit should be available at the worksite and everybody involved in the task must be aware of how to use it. It must be kept separate from normal work kit and not used unless it is required for rescue.

Before charging in to rescue a work colleague it is vital that the situation is dynamically risk assessed to prevent making a bad situation worse. Why is the casualty incapacitated? Is there a risk that they have been overcome by toxic gas? If so could sending in a rescuer simply create another casualty? If they have suffered a heart attack could they be better off staying in position rather than being shoved about by an over eager rescuer? Priority must be given to first aid if that is required rather than trying to get the casualty to the ground as quickly as possible.

SUSPENSION INTOLERENCE (Pre-SYNCOPE)

First aid management for harness suspension when working at height

Following completion of an evidence based review of published medical literature on the effects of a fall triggering harness suspension, HSE confirms that no change should be made to the standard first aid guidance for the post recovery of a semi conscious or unconscious person in a horizontal position, even if the subject of prior harness suspension. The sometimes-quoted suggestion of recovery in a semi-recumbent or sitting position was considered to be without any sound evidence base and may prove dangerous through prolonging the lack of blood return to the brain.

When contemplating working at height, and in particular when considering the use of a fall arrest system, employers need to consider any emergency or rescue procedures that may be required and the drawing up of an emergency and rescue plan. It is not acceptable just to rely on the emergency services. Emergency procedures need to be considered for reasonably foreseeable circumstances. The measures need to be covered in the risk assessment and planned prior to the work activity being carried out. The key is to get the person down safely in the shortest possible time and before the emergency service response. If employers cannot do this, then harness work is not the correct system of work. Motionless head up suspension can lead to pre-syncope [light headedness; nausea; sensations of flushing; tingling or numbness of the arms or legs; anxiety; visual disturbance; or a feeling they are about to faint] in most normal subjects within 1 hour and in a fifth within 10 minutes.

A casualty who is experiencing pre-syncope symptoms or who is unconscious whilst suspended in a harness should be rescued as soon as is safely possible.

● If the rescuer is unable to immediately release a conscious casualty from a suspended position, elevation of the legs by the casualty or rescuer where safely possible may prolong tolerance of suspension.

● First responders to persons in harness suspension should be able to recognize the symptoms of pre-syncope. These include light-headedness; nausea; sensations of flushing; tingling or numbness of the arms or legs; anxiety; visual disturbance; or a feeling they are about to faint.

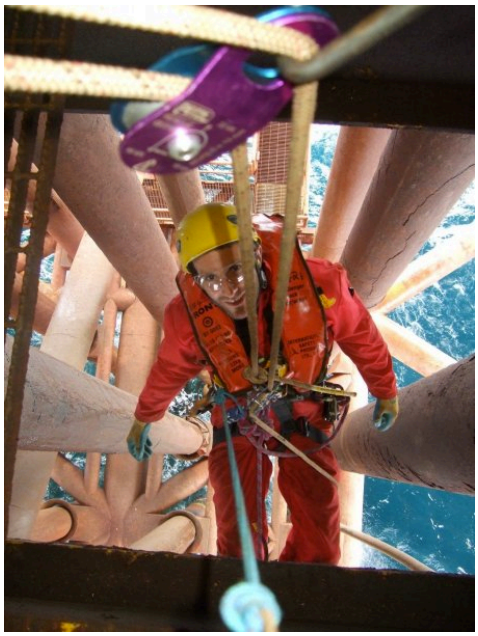
When the casualty is recovered to the ground therefore first aid should be carried out as normal and an unconscious person with normal breathing put into the recovery position. First aid training is required for Level 3 team leaders and I can personally recommend the remote first aid training given by the National Access Rescue Centre in Kendal where training is carried out in a realistic working environment.

Of course avoiding a rescue in the first place is the best option and proper planning and preparation will hopefully mean you never have to put your rescue training into practice.

REMEMBER: RIG FOR RESCUE

HAULING SYSTEMS

Hauling systems can be required for various reasons. Ready rigged rescue systems for confined space rescue as shown in the above photo can be planned in advance and the necessary equipment supplied. Improvisation with minimal kit, however, is a skill that must be learned to progress through level 2 and 3.



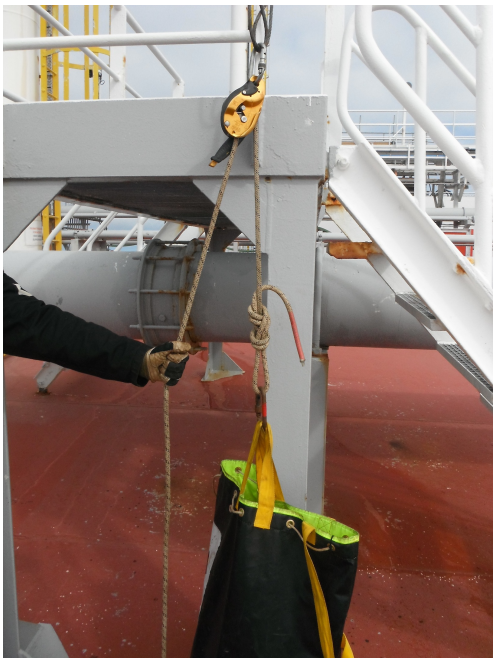
Spot the mistake and win a prize!!

Pulleys serve several purposes. They reduce friction in a deviation as shown (left) where a hauling system has been set up to retrieve the technician from under the deck of an oil platform in case he is incapacitated. The pulley adds about 5% friction to the force required to haul the casualty compared to about 50% for a karabiner alone.

They can change direction of a rope to provide a better position for hauling.

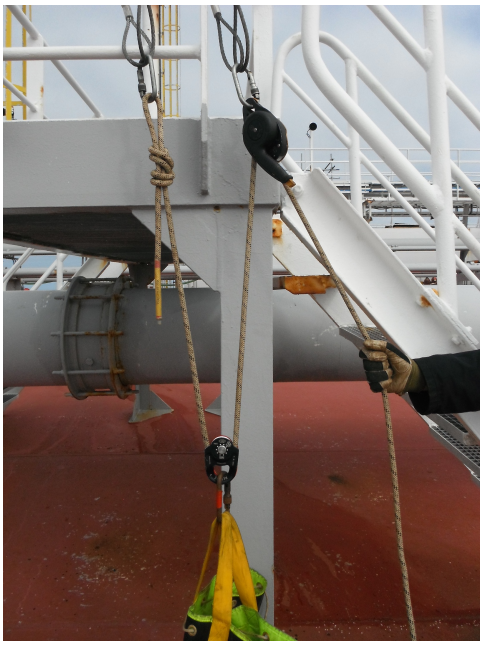
And, most importantly, they provide mechanical advantage to the rescuer.

For a pulley to provide mechanical advantage it must be able to move. In the photo (right) there is no mechanical advantage because the pulley (replaced here by an ID descender to lock the rope) is fixed to the structure. It is only changing the direction of the haul and is called a 1:1 ratio. The descender also adds friction increasing the force required to haul the load.



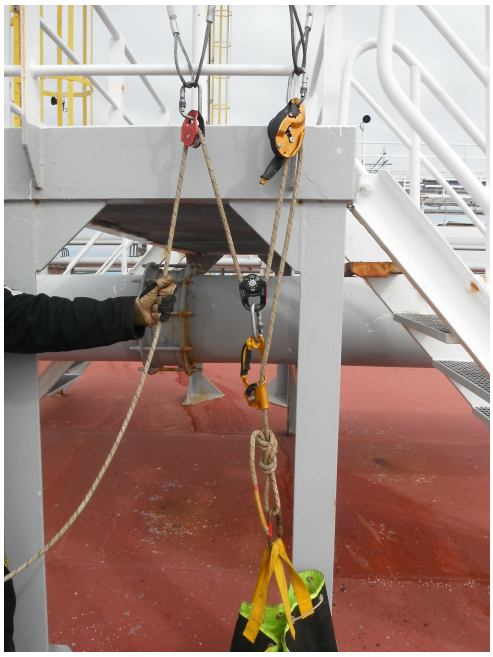
When selecting a pulley system to use consideration should be given to the amount of rope required.

The photo (right) shows a 2:1 system for a ready rigged rescue system this is fine but if the load must be lowered from a 50m crane perhaps, over 100m of rope would be required.

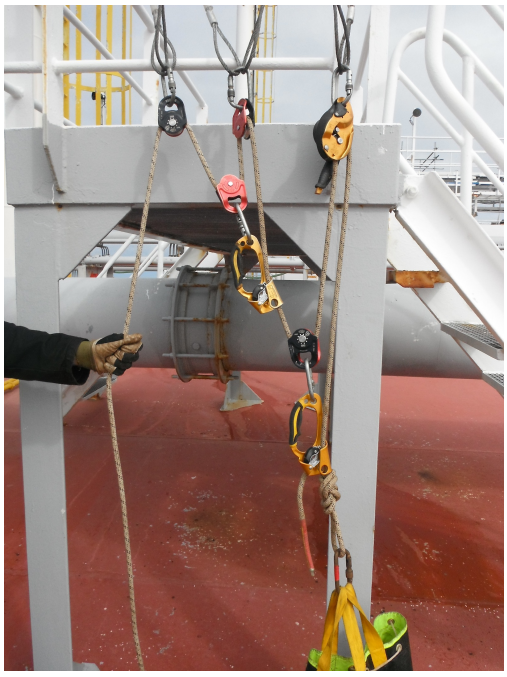


Commonly called a Z-rig this is a 3:1 ratio system providing (if the friction of the ID is ignored) mechanical advantage to the rescuer to haul the load.

Increasing the mechanical advantage means the rescuer has to pull 3 metres of rope through the Z-rig to lift the load 1 metre. Starting off with a low ratio and only adding pulleys if required is the best option.



All hauling systems should be used in conjunction with a back-up rope. This may require a team effort. Good communication is vital.



The photo (left) shows a 9:1 system illustrating how a single rescuer, if required, can raise a heavy casualty. The downside is that the rescuer must pull 9m of rope through the system to raise the casualty just 1m which will quickly lead to fatigue.

Consideration must be given to the state of fitness of not only the technician but also the rescuer.

CROSS HAULING

Using two separate hauling systems a team can transfer a casualty horizontally without the need for tensioned lines. This puts less strain on the anchors and gives more control to the rescuers. With practice a team can carry out a seamless transfer of a casualty or load. Communication is vital and this will be emphasized in the practical training.

BASIC ROPE MANOEUVRES

Rescue: Get into descent mode

- Abseil level with casualty and clip cowstail into casualty's D-ring. Clip short link from your stop karabiner into casualty's D-ring.
- Put casualty in an upright position.
- Descend casualty so they are hanging on your short link
- Remove casualty's ID and ASAP.
- Put the control rope of your ID through extra friction karabiner that is clipped into your D-ring below the ID
- Unlock the ID
- Abseil to the ground

Passing an edge or obstruction at top

Remember *to approach any edges with caution!!*

Always protect the ropes from sharp edges and to put the rope protection back in place before descending. Always have at least one point of contact when working on a roof or platform.

Ascend pass an edge

- Attach ASAP to back up rope
- Attach Croll (chest ascender) and Jumar (hand ascender) to working rope
- Ascend to just below the edge.
- Move ASAP over the edge
- Attach Duck to working line above the edge or attach cowstail to knot above the edge if present.
- Stand up and scramble over the edge.
- Stay low until you have attached a cowstail to a high point.

Descend pass an edge

- Move safely to the edge using the highest attachment points you can, keeping in mind to keep the ASAP as high up the rope as possible
- Take the stretch out of the rope and attach ID on the working rope so that it will sit just over the edge
- Attach footloop to knot with spare karabiner
- Place foot in footloop
- Stand up and turn around
- **Before** sitting down, make sure that both ropes are protected
- Sit and remove footloop
- Move ASAP down below the edge
- Descend

Rebelay and rope transfers

Remember that the rebelay is just a rope transfer and when you are on your way back down to stop your descent when level with the knots

Ascend through the rebelay

- Attach ASAP to back up rope
- Attach Croll (chest ascender) and Jumar (hand ascender) to working rope
- Ascend to the knots
- **Changeover** into descent (ID)
- Attach Duck to back up rope of the second set of ropes
- Attach the Croll (ascender) on the working rope of the second set of ropes
- Attach Jumar (hand ascender) to working rope of the second set of ropes
- Abseil down onto second set of ropes until weight is fully transferred
- Remove ID from original set of ropes
- Remove ASAP from original set of ropes
- Ascend (up) to the top

Descend through the rebelay.

- **Changeover** into descent (ID)
- Descend
- Stop your descent when level with the knots
- *Locate the second set of ropes*
- Attach spare Duck to back up rope of the second set of ropes
- Attach the Croll (ascender) on the working rope of the second set of ropes
- Attach Jumar (hand ascender) to working rope of the second set of ropes
- Abseil down onto second set of ropes until weight is fully transferred
- Remove ID from original set of ropes
- Remove ASAP from original set of ropes and attach to the new back-up rope.
- Remove Duck
- **Changeover** into descent (ID)
- Descend

Passing Knots.

Ascend past knots.

- Attach ASAP to back up rope
- Attach Croll (chest ascender) and Jumar (hand ascender) to working rope
- Ascend up to knot
- To pass knot on back up rope, attach Duck above knot then move ASAP above knot.
- Remove Duck
- To pass knot on working rope attach ID below the Croll and lock off
- Changeover onto descent mode.
- Ascend up to the knot in your ID.
- Stand up in footloop and re-attach Croll above knot
- Take lock off ID and detach from rope.
- Continue to ascend

Descend pass knots.

- Prepare to descend (go down) by doing a Changeover from ascent mode (Croll) to descend mode (ID)
- Descend on to knot
- Attach the Croll (ascender) on the working rope **above** the ID
- Remove the ID, re-attach it directly under the knot and lock off the ID
- Descend using your Croll and hand Jammer.
- When just above the knot step up and out of Croll and sit down onto your ID
- Remove Jumar (Hand Ascender)
- To pass the knot on the back up rope attach Duck Below the knot
- Remove ASAP and re-attach below the knot
- Remove Duck
- Take control of ID and descend.

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ANNEX A

IRATA International code of practice for industrial rope access Part 3 of 5: Informative annexes: Annex P

Annex P (informative)
Recommended actions for the protection of anchor lines
Introduction

Annex P gives advice and other information that could be relevant to users of rope access methods and is one of a number of informative annexes in Part 3 of this code of practice. This informative annex should be read in conjunction with other parts of this code of practice, should not be used in isolation and is not intended to be exhaustive. For further advice, readers should refer to relevant specialist publications.

P.1 General

P.1.1 This informative annex provides a table (**Table P.1**), which takes a hierarchical approach in the recommended order of actions to obtain the best achievable method of protection for anchor lines at a worksite.
P.1.2 Once it has been established that rope access is an appropriate access system and the hazards have been identified (see 1 in **Table P.1**), the lower the number chosen between 2 and 4 in the column titled *Decision* and the corresponding action taken (see the column titled *Action*), the more effective and reliable the protection system is likely to be. This process may be remembered (in English) by the acronym **RAP**:
Remove (the hazard, where feasible)
Avoid (the hazard)
Protect (against the hazard).
P.1.3 Anchor line protection is covered in more detail in **Part 2, 2.7.10**, **2.11.3.1** and **2.11.3.2**. Pre-use checks and inspection are covered in **Part 2, 2.10**.

P.2 Examples of hazards

The following are examples of hazards that should be taken into account when protecting anchor lines. This list is non-exhaustive:
a) sharp edges such as may be found on steel work, cable trays, gratings, glass façades, composite panels;
b) abrasive edges and surfaces such as coping stones, rock protrusions, corroded structures;
c) trapping and cutting areas such as manhole covers, hatches, doorways;
d) heat sources and the risk of melting from such as hot pipes, exhaust gases, lighting;
e) hot work such as welding or cutting;
f) corrosive substances such as chemical deposits or spillages;
g) tools such as angle grinders, chainsaws, ultra-high-pressure lances, grit blasters, power drills.

Please see table below for hierarchy for protection of ropes against hazardous surfaces

Decision		Action *(Assumes it has been established that rope access is a suitable method of work)*
1. Hazard identification Have all the hazards in the planned anchor line path been identified and is it possible to rig anchor lines away from any hazard or to protect them against those hazards?	**Yes** ➡	Identify all hazards in the path of the anchor line for its entire length and taking into account the duration of the rope access task. Include any potential rescue scenario. Allow for any potential vertical and transverse movement of the working line and safety line either while under load, e.g. during working or rescue operations, or when not under load, e.g. due to the effects of vibration or wind. Consider the consequences of working line failure, e.g. deployment of the back-up device; stretch of the safety line; anchor lines moving over an edge in a set-up rigged for rescue. **Go to 2**
	No ➡	Use another access method. **Go to 6**
2. Remove the hazard Can the edge/other hazards be eliminated?	**Yes** ➡	Where feasible, remove the hazard, e.g. remove grating; remove sharp or abrasive surfaces; ensure any heat sources are isolated. **Go to 5**
	No ➡	**Go to 3a**
3a. Avoid the hazard Can the anchor lines be rigged so they hang completely free and clear of the hazards (i.e. without the use of re-anchors or deviations)?	**Yes** ➡	Rig anchor lines (e.g. using Y-hangs) so that they hang free and clear of the hazard(s) for their entire length and for the duration of the rope access task. Consider, as an additional safety measure, the appropriateness of protecting against the hazards that have already been avoided by the free hang, e.g. by placing a fire blanket over any hot pipes in the vicinity of the anchor lines. **Go to 5**
	No ➡	**Go to 3b**
3b Avoid the hazard Can the hazard be avoided by a method other than a completely free hang? *3b continues on next page.*	**Yes** ➡	Examples of this type of hazard avoidance (in order of preference) are: smooth-surfaced scaffolding tube clamped in position over which the anchor lines run; deviations of suitable strength connected independently to the working line and the safety line; anchor lines re-anchored. If re-anchors are used, ensure the anchor lines are not exposed to the hazard at any time, e.g. by placing edge or anchor line protection (**see 4**). **Go to 5**

3b continued	**No** →	**Go to 4** (see next page).
4. Protect against the hazard If the hazard, e.g. edges; abrasive surfaces; heat sources, cannot be avoided, can effective protection appropriate for the task be installed?	**Yes** →	Carry out a thorough assessment of the hazards to define the level of robustness of protection required, e.g. whether edge protectors and/or anchor line protectors are appropriate and which type should be used. Install protection based on whether it is an edge to be protected against or an abrasive, smooth, or hot surface or heat source and whether the contact angle is small or large. Select types of protection which have been demonstrated to control the particular type of hazard. Ensure edge protectors, anchor line protectors and anchor lines stay in their intended position. Protectors that do not enclose the anchor line are easier to pass and to observe damage than wrap-around sheath types, particularly at a top edge. Where individual enclosed anchor line protectors are to be used, each anchor line should be independently protected. **Go to 5**
	No →	**Go to 6**
5. Final verification Is the level of protection robust enough to reduce the chance of damage to the working line to an acceptable level and also ensure safety line integrity will remain uncompromised in the event of a working line failure?	**Yes** →	Define the method chosen, including implementation within the rescue plan. Verify as outlined in the first column on the left (beneath the heading *Final verification*). Start work only after a pre-use check for system integrity and recheck regularly.
	No →	**Go to 6**
6. DO NOT PROCEED		