

Local Cave & Mine Leader Award

Vertical Leader Ropework



Local Cave & Mine Leader Vertical Leader Ropework

Disclaimer

Neither the authors nor British Caving Association assume any responsibility for the improper application of the techniques or principles outlined in this document. Use of these techniques are at the user's risk. The techniques illustrated in this document provide supporting information for the Local Cave & Mine Leader Vertical Leader Award syllabus and should be read with the remit of that award in mind. This document is not a substitute for attending a certified training course.

This document is openly available on the condition that it is not distributed for commercial gain, other than in support of any British Caving Association Award Scheme. You are welcome to share and use all or parts of this document, however please acknowledge the authors.



Local Cave & Mine Leader Vertical Leader Ropework

Introduction

This document has been produced on behalf of the Qualification Management Committee (QMC) of the British Caving Association. It has been written to support candidates preparing for the Vertical Cave and/or Mine Leader Award, which deals with vertical cave and/or mine systems, including pitches up to 18m.

This document has been written by Richard Hill, photos by Martyn Farr, illustrations by Petro Gurido and Gethin Thomas, together with support from Trainer/Assessors of the LCMLA scheme. Edited by Gethin Thomas, Stephan Natynczuk & Gary Evans.

Updated October 2024.

Contents

Packing a Tackle Bag

Rigging

- Main anchor
- Traverse line
- Y hang
- Group lower
- Releasable abseil
- Ladders
- Double lifeline

Belay Devices & Rope Choice

Problem Solving

- Hair in abseil device
- Foot in ladder
- Tired novice
- Z rig
- Counterbalance
- Traverse line

Personal SRT Progression

- SRT Kit
- Deviations
- Re-belays
- Retrievable abseil
- Problems

Local Cave & Mine Leader Vertical Leader Ropework

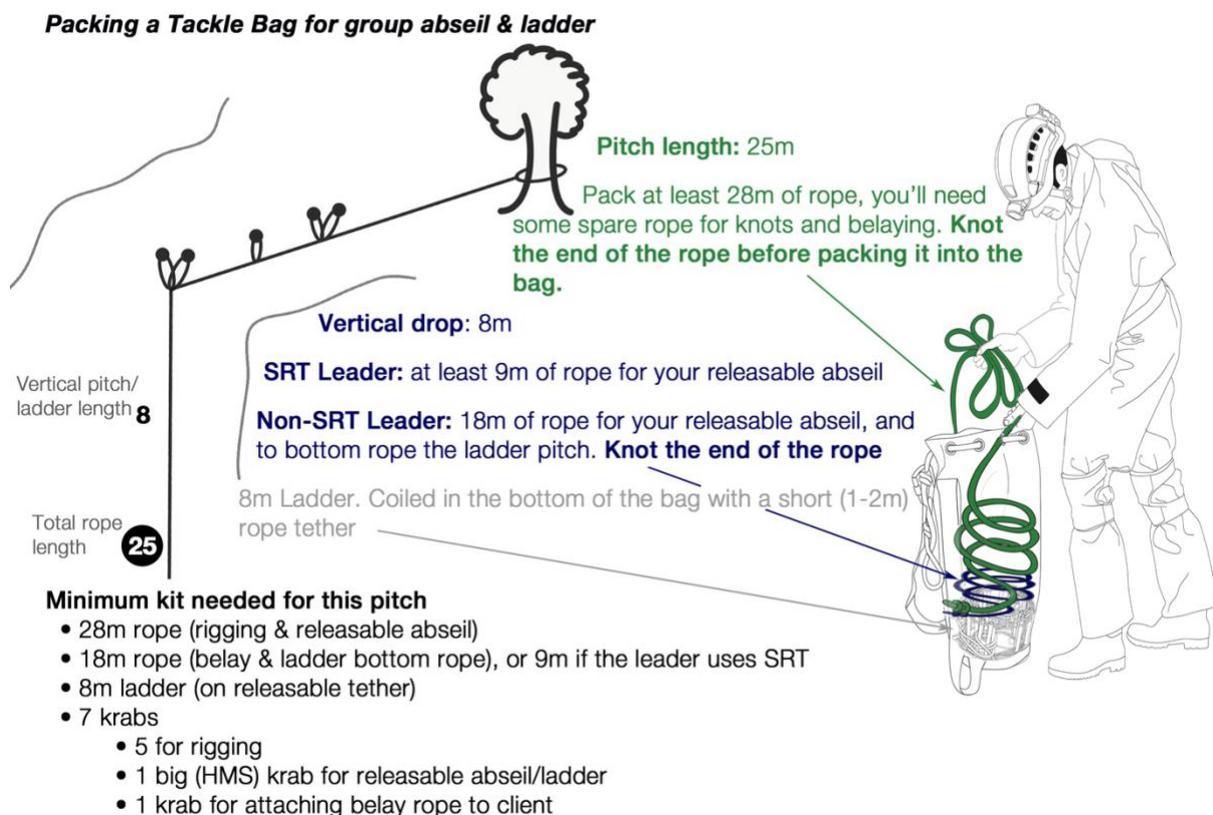
Packing a Tackle Bag

Before setting out on a vertical trip, the leader needs to ensure they are packing the right amount of kit to rig and manage each pitch.

The amount of kit packed will depend on whether the leader will be using SRT themselves, or will need to climb down and back up a ladder. If the leader has passed their SRT for leader module, each pitch may be rigged for SRT, together with one additional rope to abseil on and a ladder (both the length of the longest pitch in the cave/mine), which may be taken between multiple pitches. If the leader has not completed the SRT module, then the leader will need to leave a ladder fixed to each pitch, together with an additional rope which is twice the length of the ladder pitch (plus a few meters for knots), to be used to belay the leader back up the ladder.

Rigging topos are available to provide information on the length of ropes needed, together with the necessary rigging equipment for each pitch. Topos for pitches commonly laddered may also have the length of ladder needed noted on the topo. Leaders will need to interpret the rigging topo to ensure they have the correct equipment.

The following illustration may help understanding what kit should be packed for a pitch, as well how it should be packed.



Local Cave & Mine Leader Vertical Leader Ropework

Rigging

Before approaching a pitch, the leader must ensure they are safe by securing the rope and then themselves to a robust anchor. The initial anchor should either be a 'bombproof' single point, such as a significant tree, a large boulder or substantial thread, or two shared natural or artificial anchors.

If using two anchors, the rigging should be such that when loaded, each anchor equally shares that load. If the anchors are close together, a knot such as a bowline on a bight, fusion knot, or double figure of eight on a bight (bunny ears) are useful, if the anchors are a little further apart, a combination of two knots such as bowline and alpine butterfly, or figure of eight on the bight might be more appropriate. The first three knots give a Y hang with two loops which may prove useful in a rescue situation but may be more awkward to rig in some circumstances and potentially use more rope.



Equal loading on 2 artificial anchors (Eco or 'P' Anchors)

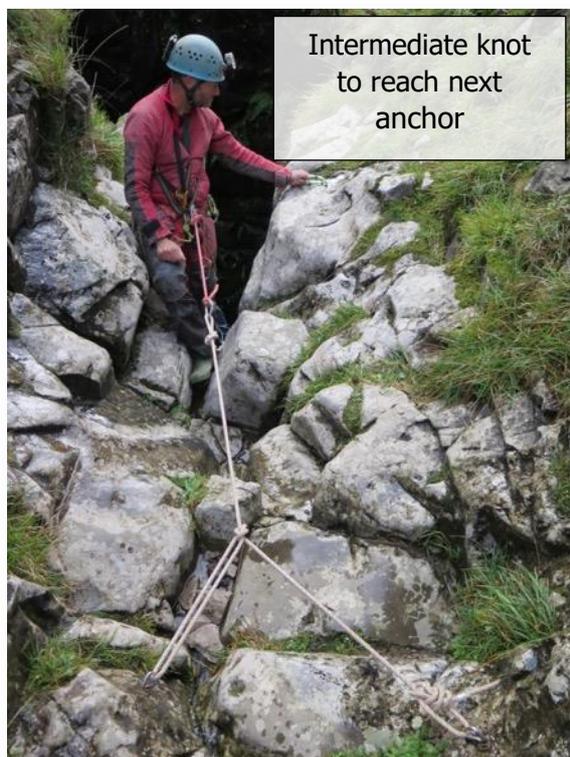
Local Cave & Mine Leader Vertical Leader Ropework

Rigging: Traverse Line

Many pitches require a traverse to access a point where the abseil (and/or ladder) are best hung. The traverse will usually be rigged at shoulder height and under tension on a series of artificial anchors.

Natural threads may be rigged with a sling and karabiner.

The traverse should be rigged using alpine butterfly knots. The leader should be able to reach from one anchor to the next by clipping their cowstail into the loop of the previous knot and reaching out. If not see below.



Here (picture, left) the rigger has used an intermediate rigging knot to enable him to reach the next anchor, in this case a 'P' or Eco anchor. The rigger puts his cowstail into the alpine butterfly, making use of the locking karabiner on his cowstails, so that he can reach the next 'P' anchor. Any intermediate knots could be left in place to aid derigging, or removed to make progress for the group easier. If removing the knot may need replacing to de-rig safely. This is one of the reasons BCA award holders must have at least one lockable karabiner on their cowstail.

Cowstails are an essential piece of equipment for cavers to prevent a fall. Cowstails are usually tied of

Local Cave & Mine Leader Vertical Leader Ropework

dynamic climbing rope of 9 to 11 mm diameter. The two ends consist of barrel knots attached to two karabiners. This prevents the karabiner spinning and allowing crossloading. In a vertical situation the user may slip and be suspended in mid-air and so the cowstails should be attached directly to a climbing style harness or the central maillon of a caving harness. A leader in this situation would normally have unequal length cowstails as used in SRT and at least one of the karabiners must be locking, however it may be appropriate for the group members to have equal length cowstails of a similar length to the long cowstail in a SRT setup.

Toothed jammers and some descenders are not designed to be fallen onto. For this reason, generally the rigger should not be rigging or derigging using those devices. A slip whilst rigging especially onto a jammer could generate a fall with enough force created to damage the rope or jammer. There may be exceptions to this rule, such as a gentle rising traverse or easy ground where a slip would not result in a fall.

Rigging: The Pitch Head

The traverse will finish at the head of the pitch where there should be 2 anchors close together to ensure the pitch is hung from two anchors.

The abseil and ladder can be hung from a single anchor, however, the belay must be rigged from both anchors.

In most cases the abseil or ladder will be better hung from the anchor nearest the traverse rope and as high as possible to make it easier for the group to access; however this might vary depending on the pitch. When rigging the pitch head leaders should consider:

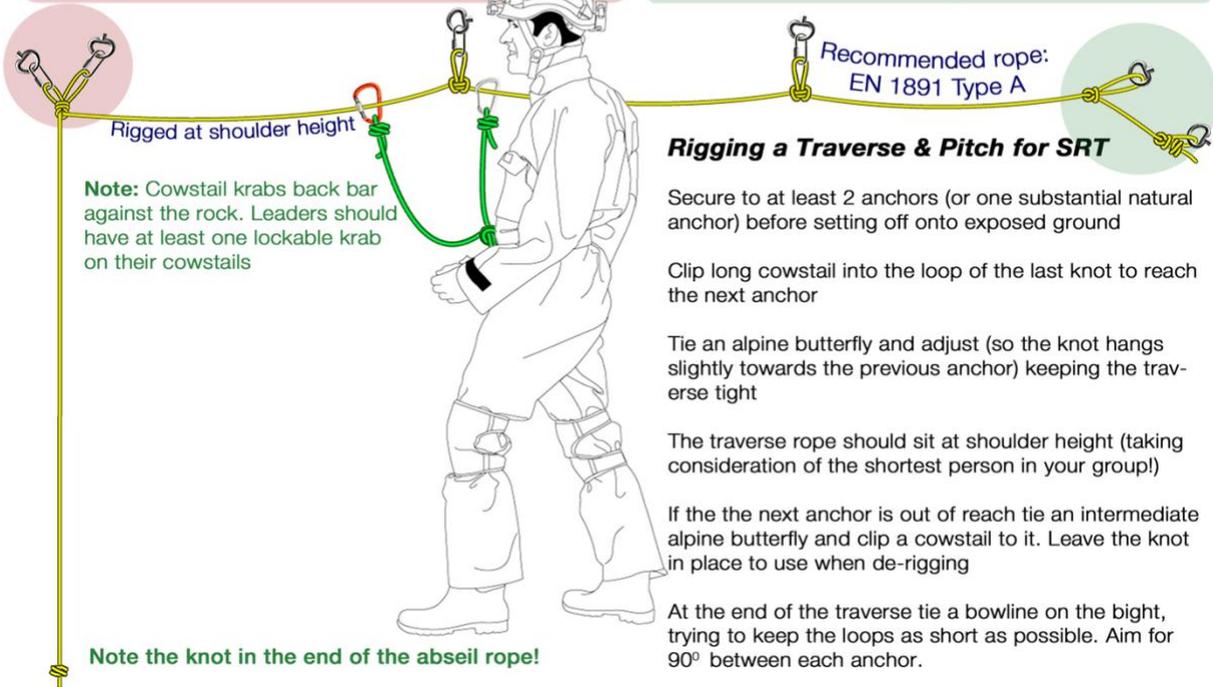
- Where will the abseil/ladder go/hang?
- Where will the abseiler step on or off?
- How easy would it be to carry out a rescue?
 - Note; keeping the rigging high will normally help with this
- Is the leader using SRT to progress through the cave/mine

Local Cave & Mine Leader Vertical Leader Ropework

Tip: Aim for 90° between each anchor, to keep the rigging high, more user friendly for clients or as a belay point.

IMPORTANT: A Bowline on the Bight (illustrated at the pitch head) is a very useful knot to belay/haul from however if used both loops of the knot must be clipped into

Tip: Tie a slip knot (that slips when the end leading away from the initial anchors is pulled) where you want the first bowline. Pass the tail of the rope through the nearest anchor and the loop of the slip knot. Secure the tail to the furthest anchor and tie off with a bowline. Pull the slip knot to form another bowline and adjust



Local Cave & Mine Leader Vertical Leader Ropework

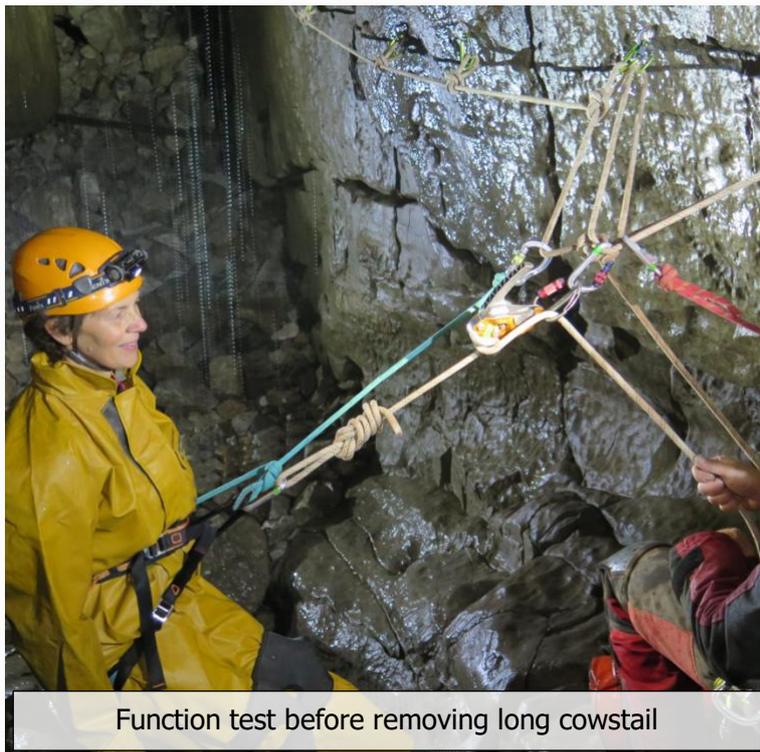
Group Lower

The leader may decide to lower the group down the pitch. If this is the case then the leader needs to take into account what might go wrong and the belay system that is used. A simple Italian Hitch lower works well but if a group member gets hung up on something, can the leader haul that group member sufficiently to sort the problem? To allow an emergency haul the leader should have a pulley and jammer readily available, as the hang up may involve a helmet strap around the neck necessitating a swift switch to a haul. If an assisted braking belay device was being used, this could be converted to a haul fairly quickly, particularly if the leader is using SRT, as will be explained further on in this document.

In these photos the leader has placed a belay device (RIG) in both loops of the Y hang. The group member has come along the traverse line using cowstails to safeguard her progress.



Local Cave & Mine Leader Vertical Leader Ropework



Function test before removing long cowstail

When close to the pitch head the leader will attach the lifeline to the group member. The group member can then remove her short cowstail and the leader can function test the belay device before the group member's long cowstail is removed and she is lowered to the base of the pitch.

The rope being used for the lower is the same rope as the traverse line so that once the whole group is down the SRT qualified leader can simply lower all of the rope down and abseil the pitch. Note the leader has rigged his belay device on two karabiners, this has helped him orientate the device for greater control.

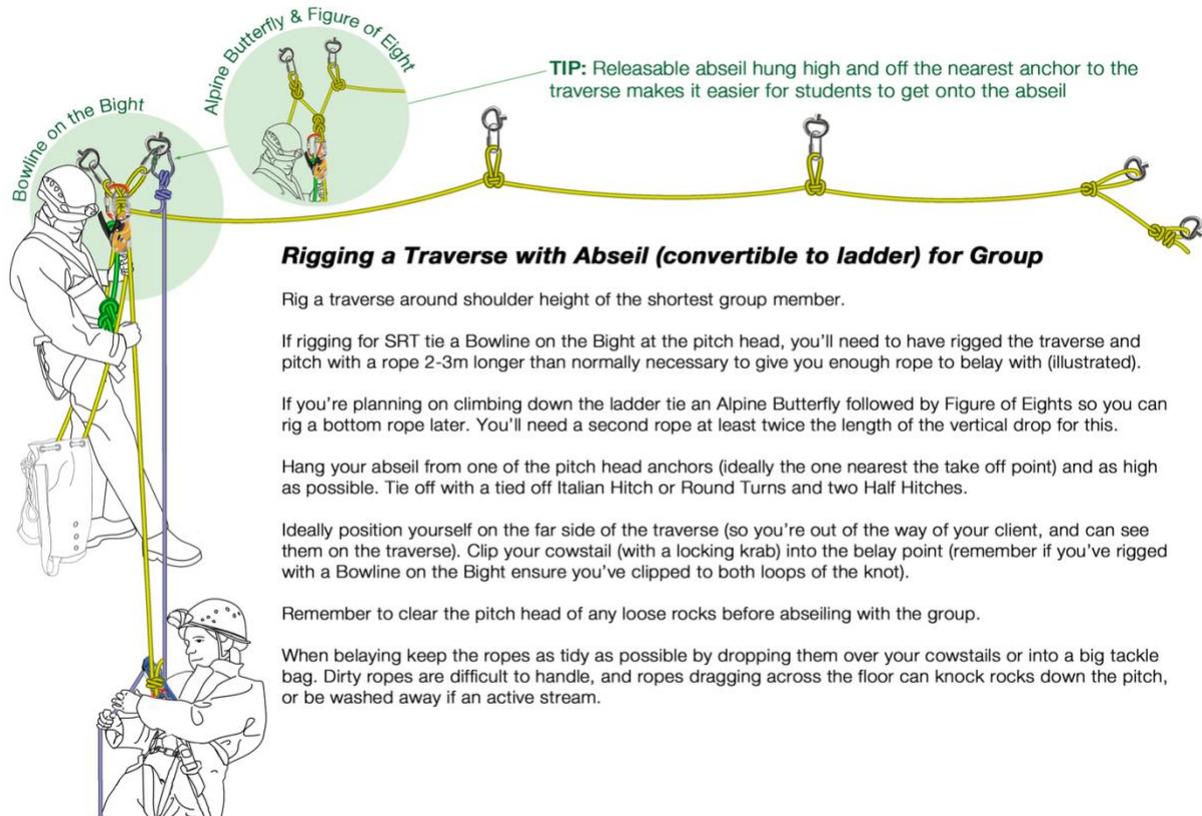
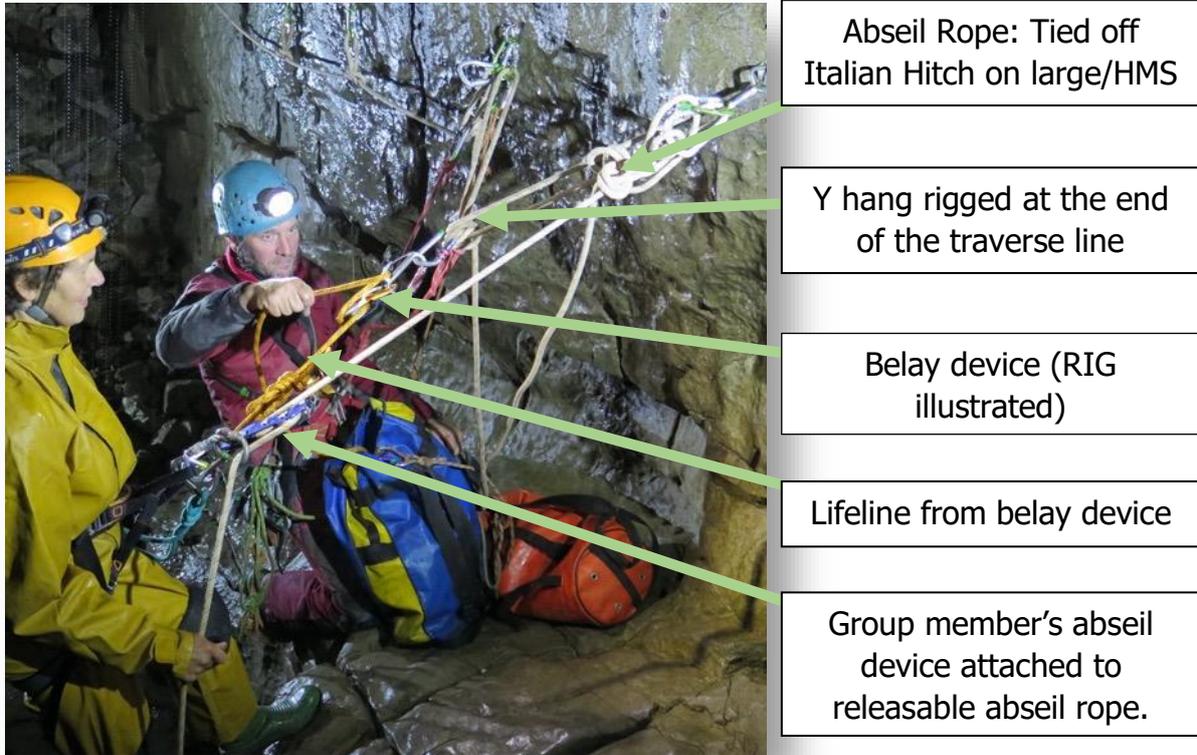


Lower using a RIG (with additional friction/frieno krab)

Local Cave & Mine Leader Vertical Leader Ropework

Releasable Abseil

If abseiling with a novice group, it may be prudent to rig the pitch so the abseil rope could be released (in the event of hair entrapment for example) and the novice belayed. Underground this can all look very confusing, so surface practice is essential.



Local Cave & Mine Leader Vertical Leader Ropework

Ladders

Ladders are usually 8 or 10 metres long but can come in any length. Traditionally they were connected together with a very weak (250kg/N) C link but may also be joined with a maillon on each side. The limit for Local Cave/Mine Vertical Leader pitch length is 18m for any one pitch but a cave or mine with multiple pitches may be permitted to a suitably competent leader.

The ladder should be hung as high as sensibly possible to allow the group members to step off onto the traverse line easily. However, the most important factor is the positioning and working of the belay system from the Y hang.



The ladder should be rigged in such a way that it could be released in the unlikely event of a foot or leg entrapment.

A length of suitable cord at the head of the ladder should be tied off with a releasable knot or in an emergency, cut. Wire tethers are best avoided when using ladders with groups as they can be difficult to release in a rescue.

Consideration should be given to the length of ladder necessary. A

Local Cave & Mine Leader Vertical Leader Ropework

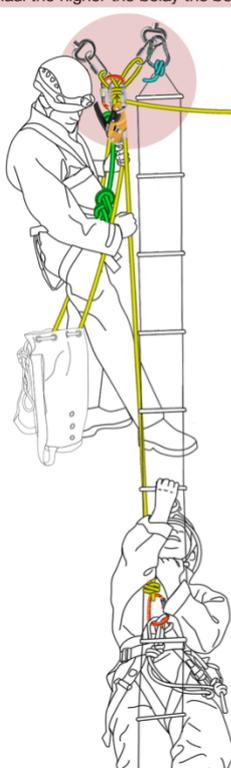
travelling ladder as long as the longest pitch is all that is necessary if the leader is using SRT for personal progression. If the leader is using ladders to ascend the pitch(es) more equipment will be needed, and the leader will need to be belayed when climbing the ladder by an appropriately competent second.

If the leader has passed their SRT for Leader module the leader can ascend the rope, then rig the ladder for the group members to climb.

Ladders must be lowered carefully down the pitch (as illustrated in these photos) to prevent it getting tangled or dropped onto the group below. If possible secure the ladder to the head of the pitch before removing it from the bag, if not, attach it to a cowstail or sling when rigging.

Note: Rig as high and as efficient as possible. Aim for 90° between each anchor. If you need to switch to a haul the higher the belay the better!

Tip: Use a length of accessory cord to tie the top of the ladder to a releasable knot such as an Italian hitch, or round turn and 2 half hitches. Fit as high as possible, from the nearest bolt to the pitch head, to make it easier to get off the ladder. Aim to have at least 1 of the ladder rungs above your traverse. It's a good idea to have at least 1-2m of spare cord so the ladder can be released and lowered a good distance if necessary without the risk of dropping the ladder!



Managing a Ladder and Traverse with a Group

Use the same rigging/belay stance as the abseil pitch. Make sure your ladder is as high as possible. Remember your group will need to move from the ladder to the traverse so try to have at least one ladder rung above the traverse rope.

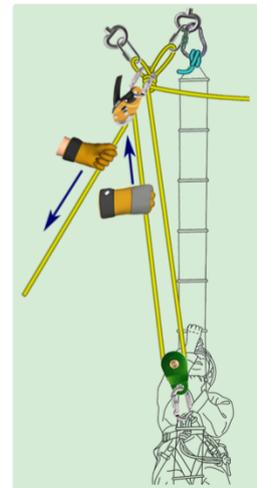
Keep the life-line tight as tight as possible on your client at all times, semi-static ropes should not be fallen on.

Encourage good technique in climbing the ladder:

- Keep as vertical as possible
- Encourage the group to climb with their hands around the back of the ladder
- Encourage heels on one rung and toes on the next
- Don't skip ladder rungs, climb slowly and steadily

If you suspect a client is going to struggle with the ladder, and you have enough rope, drop a pulley on a loop of rope to the client. Have them clip this to their harness (avoid any twists) and secure the other end to your belay device.

This will create a 2:1 mechanical advantage system making it easier for you to provide a very tight rope, or even a haul.



Local Cave & Mine Leader Vertical Leader Ropework

Double Lifeline

In some caves or mines the leader may choose not to use SRT, rather climb down then back up a ladder themselves. If rigging this way the leader will need a competent second who can belay the leader when he/she climbs down and back up the pitch.



Pulley fixed to pitch head to belay leader down ladder

then back up a ladder themselves. If rigging this way the leader will need a competent second who can belay the leader when he/she climbs down and back up the pitch.

Once all the group are down, the leader needs to re-rig the pitch head so that he/she can be belayed whilst climbing down the ladder. In this picture (left) the leader has placed a pulley (in both loops of the Y hang) one end of the rope is attached to the leader and the other

belayed by a competent second on the ground.

The leader could lower themselves down the pitch, however, they must take great care not to get tangled in the ladder as they go (having the group pull the ladder to one side can help avoid this). The leader should be capable of switching between lowering themselves and re-ascending the rope if needed. This can be achieved if using a self-locking device (such as a Druid, Eddy, STOP or RIG, see illustration highlighted in red on the next page) by attaching a jamming device or prussik above the



Leader preparing to ascend ladder, belayed by second

Local Cave & Mine Leader Vertical Leader Ropework

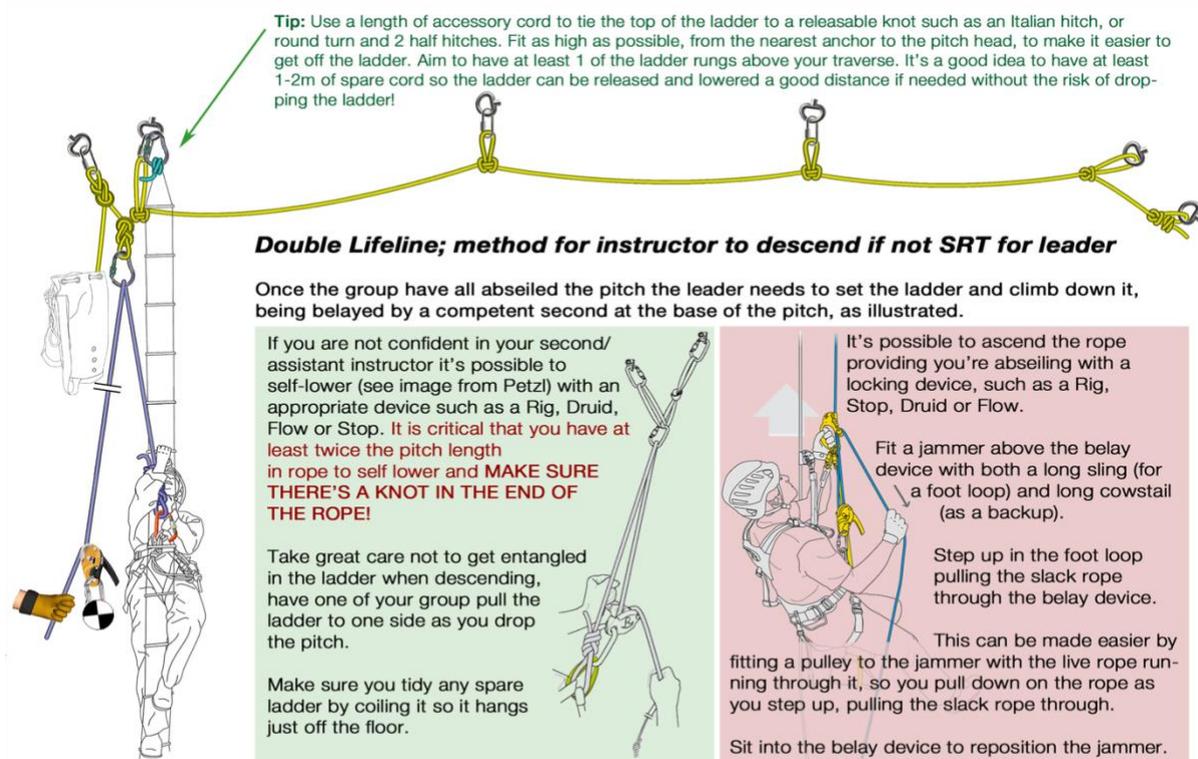
descender with a sling for a foot loop, then stepping up in the foot loop whilst simultaneously pulling the rope up and through the descending device. This can be made marginally easier by running the rope from the descending device back up through a pulley on the jammer/prussik and pulling down as the leader steps up. This method of ascending a rope is effective, if well practiced, although not particularly efficient. It would be far wiser to complete the SRT for leader module!

On returning to the ladder pitch, the leader is belayed whilst climbing the ladder from the base of the pitch by a competent second (see photo on the previous page). This needs careful judgement as to whether this person is capable/skilled/safe to do this. The belayer could be secured to the ground as well, or the belay device could be directly attached to anchors.

Prior to the leader climbing a ladder, belayed by a competent second, the leader must satisfy themselves that the second can demonstrate;

- Consistent rope handling techniques not releasing the dead rope at any time
- Consistently attentive, always maintain a tight rope, and aware of the need to maintain a tight rope given belaying with a low stretch rope
- Maintaining the dead rope in the appropriate position to enable the belay device to engage
- Able to lower demonstrating good control

Note the lifeline is knotted to make a continuous loop to enable it to be pulled down by subsequent group members, thus preventing it becoming threaded through the ladder.



Local Cave & Mine Leader Vertical Leader Ropework

Suggested Life-lining Systems/Devices for the Vertical Leader Award

The following notes have been drawn up based on correspondence with manufacturers, testing, users' experience, and consideration by Trainer/Assessors of the LCMLA and CIC schemes when selecting appropriate devices for life-lining within the Local Cave and/or Mine Vertical Leader Award.

This list is by no means definitive given there are numerous other devices on the market that may be suitable for use as part of a life-lining system. However, if selecting an alternative device, leaders are advised to satisfy themselves that the chosen device has been designed for use with EN1891 (low-stretch) ropes, are suitable for belaying/life-lining (i.e. conform to EN 15151-1), and are made of suitably robust materials to withstand the underground environment.

Rope Choice

It has been common practice to use EN1891 (low-stretch) ropes when life-lining underground in preference to EN892 dynamic climbing ropes.

Dynamic ropes are specifically designed to absorb some of the impact force transferred to a person should they fall. However, the stretch of a dynamic rope can be significant, particularly if the pitch is long. This can result in a person falling some distance or even hitting the ground before a fall is arrested. When underground even a minor injury can result in a serious rescue and so the chance of any fall must be limited. Dynamic ropes are also less efficient to haul with, less tolerant to wear, and tested to arrest a certain number of falls rather than hold a specific load. Taking these points into consideration a low-stretch (EN 1891) rope kept as tight as possible during use is arguably preferable for vertical rope work.

Leaders must bear in mind that any dynamic fall onto a low-stretch rope may result in significantly higher impacts, which may injure a falling climber or damage equipment. When life-lining with a low-stretch rope the following guidelines must be followed

- Ropes should be kept as tight as possible at all times
- If life-lining from the head-of-a-pitch, the rope should be positioned high to ensure that it is kept tight and above the climber until they have transferred to a traverse rope (normally onto cowstails), or safe ground
- If life-lining from the bottom of a pitch climbers should never climb above the karabiner/pulley at the head of the pitch

Local Cave & Mine Leader Vertical Leader Ropework

Examples of Suitable Devices

The following list presents devices which manufacturers have confirmed are appropriate for abseiling with one or two people (in a rescue situation), can be used as part of a life-lining system from both a harness or a fixed anchor, lowering, for short hauls, and used with low stretch (EN 1891 low-stretch) ropes.

	<p>RIG/ID (both the pre and post 2018 models, RIG post 2018 illustrated): Provided they are used within the current manufacturer's guidance are appropriate devices to life-line, abseil and perform short improvised rescues. They are less appropriate for longer rescues due to the high levels of friction. Can be used in a Tyrolean.</p>
	<p>STec Flow: Provided they are used within the current manufacturer's guidance are appropriate devices to life-line, abseil and perform short improvised rescues. They are less appropriate for longer rescues due to the high levels of friction. Can be used in a Tyrolean. Made of harder wearing components so may last longer than a RIG/ID although heavier and more expensive. Option of "panic lock" and non-panic lock available. Subjective testing indicates it's a little harder to haul through the device.</p>
	<p>ISC D4: Provided they are used within the current manufacturer's guidance are appropriate devices to life-line, abseil and perform short improvised rescues. They are less appropriate for longer rescues due to the high levels of friction. Can be used in a Tyrolean. Subjective testing suggests the device can be a little 'snatchy' in use as a descender.</p>
	<p>Edelrid Eddy: Provided they are used within the current manufacturer's guidance are appropriate devices to life-line, abseil and perform short improvised rescues. They are less appropriate for longer rescues due to the high levels of friction. Can be used in a Tyrolean. Set up the opposite way to a GriGri which can be confusing for some. Has an anti-panic function which users need to be familiar with.</p>

Local Cave & Mine Leader Vertical Leader Ropework

Examples of Suitable Devices (continued)

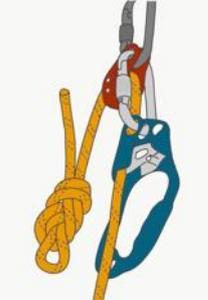
	<p>CAMP Druid/Druid Pro: Provided they are used within the current manufacturer's guidance are appropriate devices to life-line, abseil and perform short improvised rescues. They are less appropriate for longer rescues due to the high levels of friction. Can be used in a Tyrolean. Compact but robust device, however tricky to fit on and off the rope (needs to be removed from the carabiner, manufacture suggest a piece of cord is used to prevent dropping the device). Only officially endorsed by the manufacture for 11mm rope, however correspondence with the manufacturers indicate recognition of correct function with lesser diameter ropes. Subjective experience found it challenging to give slack rope to a client climbing down a pitch/ladder.</p>
	<p>CAMP Giant: Provided they are used within the current manufacturer's guidance are appropriate devices to life-line, abseil and perform short improvised rescues. They are less appropriate for longer rescues due to the high levels of friction. Can be used in a Tyrolean.</p>

Alternative systems that requires additional diligence

	<p>Italian (Munter) Hitch: Useful for short pitches or in an improvised system. Prolonged use, particularly when lowering, can cause the rope to kink significantly and become difficult to handle.</p> <p>Can be used to haul (although there's significant friction) or used to rig a Tyrolean (however the knot "flips" when loaded, significantly reducing the tension in the system).</p>
-------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Local Cave & Mine Leader Vertical Leader Ropework

Inappropriate Lifeline Devices

	<p>STOP (pre 2019 model): EN341. Rescue Descender. Suitable for descent with a one or two-person load. Suitable to lower a one-person load from a belay at the head of a pitch. Not endorsed by the manufacturer for life-lining. Can also be used to rig a Tyrolean.</p>
	<p>STOP (2019): The updated (2019) Petzl STOP has been tested to the EN 15151 Type 5. This is the standard for an "Assisted-breaking descending device", and so has not been tested to the standard to arrest a dynamic load. The manufacturer confirmed the device should not be used for life-lining. Can be used to rig a Tyrolean.</p>
	<p>Pulley/Jammer Systems: Shown to damage ropes with even a small dynamic fall. Should not be used or taught as a life-line system for the Vertical Leader award. Must not be used to support a tensioned line in a Tyrolean.</p> <p>Appropriate in some configurations (not with the jamming device on the "dead" side of the pulley; see warning notice on the BCA website) as a progress capture device for long hauls (although candidates must be aware of the difficulty in converting from a haul to a lower).</p>
	<p>Traxion devices: As with the pulley/jammer system. See Petzl technical notices on their website. Should not be used or taught as a life-lining system for the Vertical Leader award. Must not be used to support a tensioned line in a Tyrolean.</p> <p>Appropriate as a progress capture device for long hauls (although leaders must be aware of the difficulty in converting from a haul to a lower).</p>
	<p>Pivot (DMM): DMM's manufacturer's instructions only endorse the use of their belay devices with EN1891 ropes to abseil (not to belay).</p> <p>Discussions with DMM highlighted concerns over the potential impact forces generated from falling onto a low-stretch rope if using the Pivot, or other DMM belay devices. Other manufacturers of similar type devices may endorse their use with low-stretch ropes, however at the time of writing no other manufacturers have been approached.</p>

Local Cave & Mine Leader Vertical Leader Ropework

Inappropriate Lifeline Devices (continued)



GriGri: The GriGri 1 was endorsed by Petzl for use in life-lining underground. The GriGri 2 was not endorsed for use with low stretch ropes (EN1891), however the more recent GriGri's do have a note supporting the use of low stretch ropes for top-roping on the Petzl website. Petzl also indicate, on their website, methods to belay from a pitch-head and endorse the GriGri's use for rappelling.

However, Petzl also indicate that prolonged use in hauling (for example) generates such high friction that the device may wear out the lighter weight materials of the new GriGris, therefore they have significant limitations. Would suggest these devices are not taught or used within the Vertical Leader award. Limited use in rigging a Tyrolean; manufactures endorse a 3:1 haul with one person at the most and experience of the device has highlighted it is difficult to release under high tension.

Problem Solving: Hair Entrapment

If a person abseiling gets hair or an item of clothing caught in the abseil device, then the leader should lock off the belay system and releases the abseil rope until the person abseiling can free themselves. Once the person abseiling is free, the leader can tighten the abseil rope then lower the person abseiling, until both ropes are loaded and the abseil can continue. Worst case scenario, the leader may need to release the abseil rope completely and lower the person abseiling to the ground.

If the leader has not rigged a releasable abseil then he/she will need to raise the person abseiling a short distance by converting the belay to a haul. If the person abseiling is light, the easiest way to do this is for the leader to attach themselves to the (dead) rope coming from the belay device and commit their full body weight to it, whilst pulling up on the (live) rope attached to the person abseiling, creating a counterbalance. Alternatively, a 3:1 or Z-Rig haul can be constructed by attaching a jammer and pulley to the live rope and hauling (as outlined in the following pages).

Problem Solving: Ladder Foot Entrapment

Historically a common problem when cavers used big boots, particularly boots with hooks for the laces; wellies have significantly reduced this issue. Keeping a tight rope on the climber when belaying reduces the chance of a climber falling and entrapping a foot or leg. If a climber slips and drops a leg through the ladder and the ladder has been rigged with a locked off Italian Hitch, it is simply a case of locking off the belay system, undoing the ladder's attachment cord, and lowering the ladder until the person climbing the ladder is free. Once the person climbing the

Local Cave & Mine Leader Vertical Leader Ropework

ladder is free the ladder is raised again, locked off, and then the leader unlocks the belay system and the person climbing the ladder continues to ascend.

Problem Solving: Tired Climber

Good leadership, judgement and coaching should significantly reduce the need for a leader to resort to a full rescue. Keeping a tight belay on a person climbing a ladder, coupled with some encouragement, can be enough to assist a tired climber up a pitch. However, if it is looking like a person may need additional help, it is worth planning ahead by re-rigging the pitch to drop a loop of rope on a pulley to the tired climber to create a 2:1 mechanical advantage system (if there's enough rope), or having a number of people climb the pitch ahead of the tired person to help with a haul.

If a group member requires assistance, then the leader could use a counterbalance system or a Z-Rig haul. The decision on which system to use could be down to the comparative weights of the leader and tired group member, although are normally only appropriate for short hauls. If the group member becomes exhausted or unable to help themselves a more complex hauling system may be necessary. In such an instance it may be preferable to lower the casualty to the ground to evaluate the situation.

Before committing to a long or complex haul, the leader must consider the complexity of the pitch, belay system, equipment available, conditions underground, condition of the group and how far from the entrance the group are. In the majority of cases if dealing with a physically injured caver, it is advised to ensure the group are safe then call for assistance rather than committing to a complex haul that may cause further injury to a casualty. Leaders must be mindful that an extended period of inactivity whilst suspended in a harness (with an unconscious casualty for example) can be harmful to a casualty. Any longer haul is best thought through before initiating.

Z-Rig (3:1 mechanical advantaged haul) & Counterbalance

To construct the Z-Rig, the leader should first lock off the belaying device (some devices have an auto-lock function, others require tying off. Although auto-lock devices don't necessarily require tying off it may be prudent to tie a slip knot on the dead end of the rope in case of accidental release). A karabiner (ideally a pulley on a karabiner) should be fitted to the loose rope from the belay device (dead rope) and attached to a jammer. The jammer should then be fitted to the tensioned rope (live rope) leading to the tired climber so that it can slide down toward them. Care should be taken that the jammer does not slide out of reach. Once secured the leader should release the belay device and pull on the rope leading from the jammer to haul the tired climber.

Local Cave & Mine Leader Vertical Leader Ropework

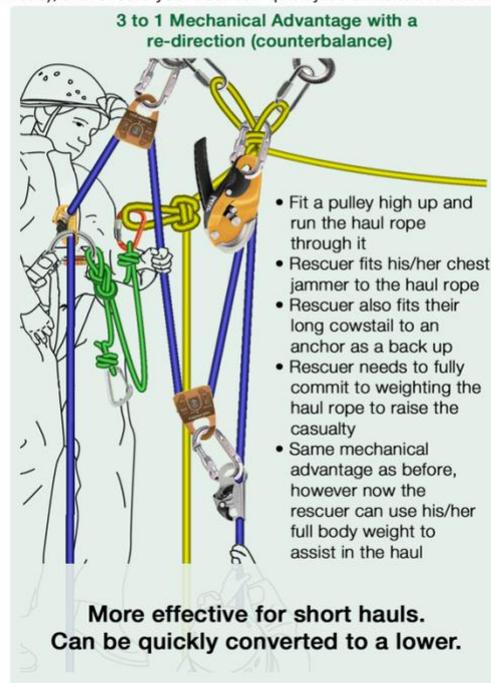
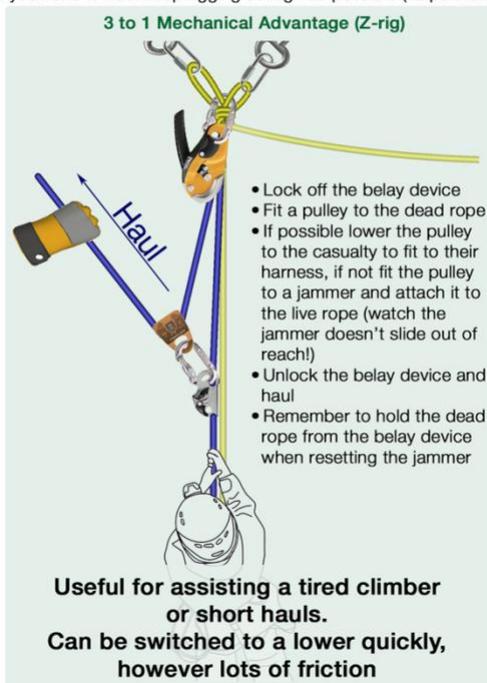
If the tired climber requires more help (or is heavy) then the leader could fit another karabiner (again ideally a pulley and karabiner) as high as possible above the tired climber and run the rope from the jammer through it (as illustrated in this photo). The leader can then attach their chest jammer if equipped for SRT, or a belay device or Italian Hitch if not, to that rope so they can commit their full body weight to the haul rather than pulling with their hands. The leader must use their cowstails to keep themselves secure throughout the haul, although they may use only their long cowstail if fitted with a locking karabiner to make the hauling process more efficient.



Z-Rig with Counterbalance

Problem Solving & Hauls (1 of 3)

- Do the simple things first: Keep a tight belay, give people a chance to rest
- Weigh things up, is it better to lower someone if they're hurt and get help?
- If you have to haul keep rigging as high as possible (helps managing the pitch head), and ensure your haul can quickly be switched to a lower



Local Cave & Mine Leader Vertical Leader Ropework

There are more complicated hauls (illustrated below) that may be used if the tired group member is on the ground and it is a sensible option to rescue them with those available to assist. In such a case, Traxions or similar devices could be used. A Traxion must not be used for belaying a climber or in a situation where the device could be dynamically loaded. If using such a system, the leader must be well practiced in quickly converting a haul to a lower and must be careful not to overdo the hauling (by using too many helpers for example).

If too many people are used to haul, and the person being hauled snags a shoulder, or gets caught on a rock, they may be injured or equipment damaged. It is better to rotate small teams of two or three during a haul, rather than have a whole group pull at the same time.

If converting to a lower leaders must ensure they are either significantly heavier than the casualty, or preferably anchored to the ground to ensure they are not pulled up and into the Traxion. Failure to anticipate being pulled up can result in failure of a belay device or inadvertently releasing a rope (in some cases even if a device is locked off).

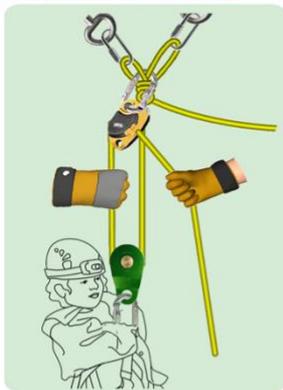
Problem Solving & Hauls (2 of 3). Advanced hauls: Using Traxions or Pulley/Jammer devices

Caution

Although efficient the following systems can be difficult to convert to a lower. These techniques should be practiced frequently.

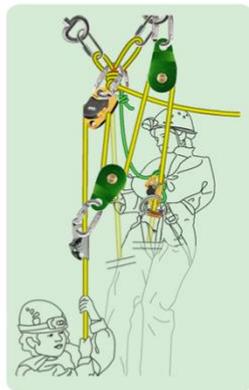
Rigging needs to be set before the client loads the rope (i.e. lower the client to the floor then set up the haul). Consider re-rigging your pitch to make the haul as quick and efficient as possible if necessary.

Tests have indicated any dynamic loading of these systems may cause rope or component failure. **These systems must not be used to belay.** Positioning the jammer on the "dead" side of a pulley has shown to seriously damage components if dynamically loaded and so **must not be used.**



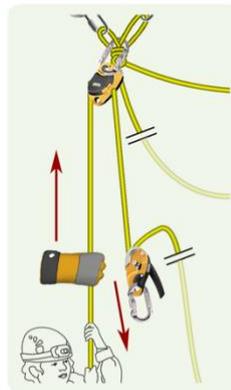
2:1 Mechanical Advantage

A simple counterbalance can be effective, however by fitting a jammer and pulley to the hauling rope (left rope in this illustration) this can be converted into a 6:1 system



3:1 Mechanical Advantage

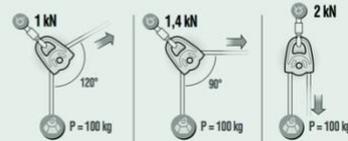
Useful if you don't have enough rope to drop a loop to a client. Best rigged as a counterbalance (as illustrated).



To lower

- Check the jamming device/Traxion is locked
- Remove all other pulleys/jammers
- **Anchor yourself to the ground/low down in addition to the main belay point (you're likely to get pulled up when lowering)**
- Fit your descender to the loose rope coming from the Jammer/Traxion and take in any slack
- Sit into the harness (pulling the other end of the rope up can help here) to release and disengage the cam of the jammer/traxion
- Lower the client as normal

Note: pulleys are force amplifiers. The illustration below (from Petzl) indicates the reduction in load on the anchors when hauling from different directions. Hauling from a different direction also reduces the efficiency of a haul



Produced by OMC to support the LCMLA Vertical Leader Award. For Educational purposes only

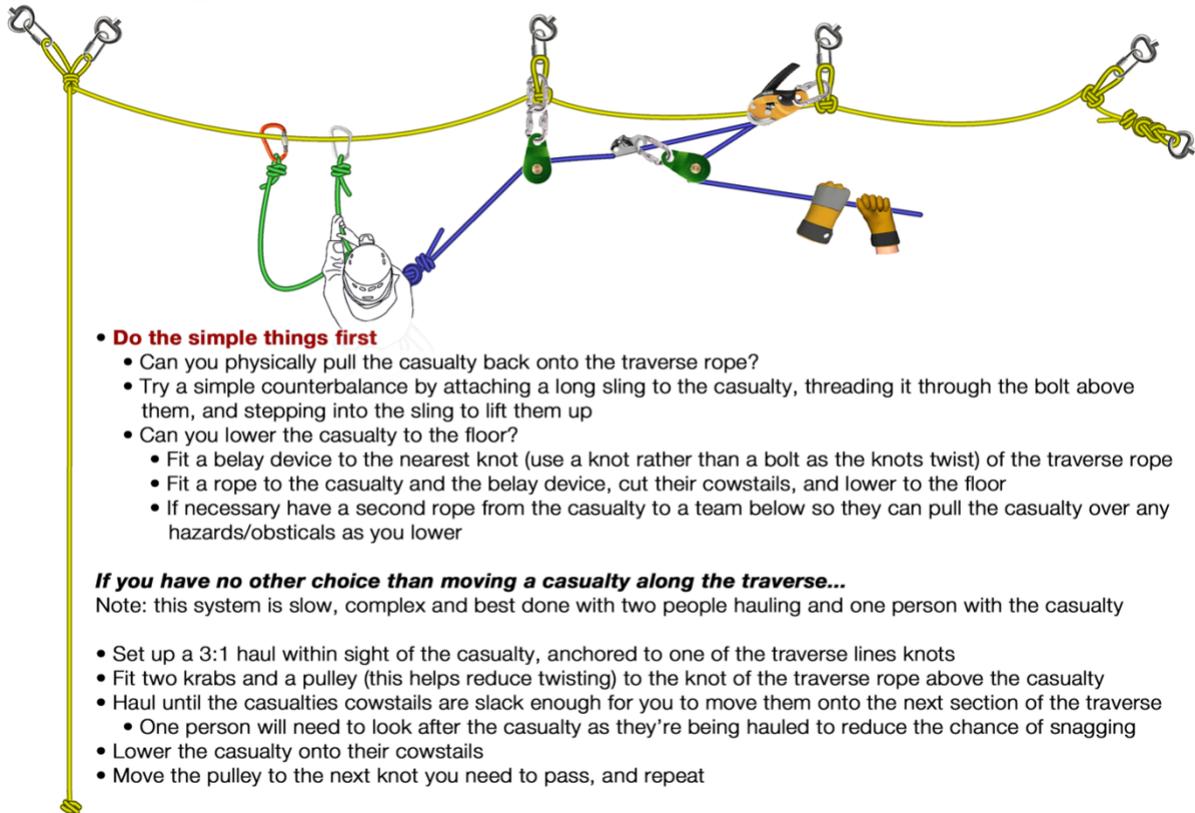
Local Cave & Mine Leader Vertical Leader Ropework

Problem Solving: Traverse Line Rescue

The simplicity or otherwise of the traverse leading to a pitch head may influence the decision on whether to haul an injured or tired person. Even a short simple traverse may be a challenge to manage a casualty along.

The Z-Rig or 3:1 haul can be transferred to the traverse line and used in the same way to haul a casualty along the traverse. The system illustrated below relies on the casualties cowstails, with the haul to aid pull the casualty along the traverse and raise them so the cowstails can be moved to the next section of the traverse. As a result, the haul can be positioned at any point across the traverse simply attached to a loop in the traverse rope, given it's not wholly supporting the casualty. The haul can be re-positioned depending on how complex the traverse is. This haul is best achieved with the help of several people to be successful, some to haul, others to help manoeuvre the client and reposition their cowstails.

Problem Solving: Traverse (3 of 3)



• Do the simple things first

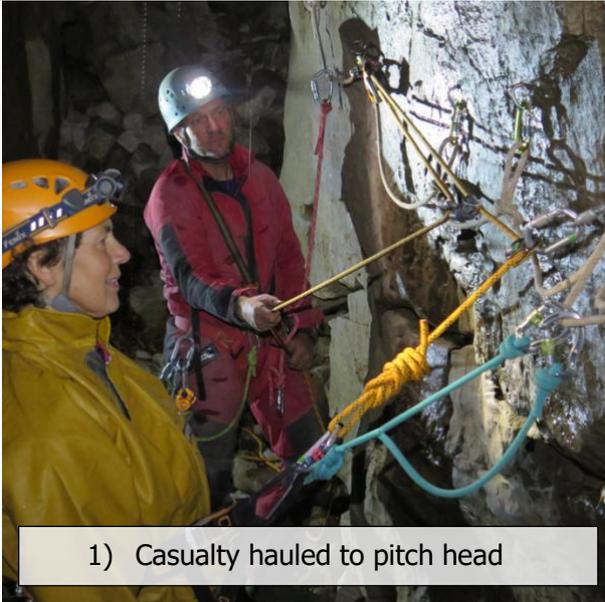
- Can you physically pull the casualty back onto the traverse rope?
- Try a simple counterbalance by attaching a long sling to the casualty, threading it through the bolt above them, and stepping into the sling to lift them up
- Can you lower the casualty to the floor?
 - Fit a belay device to the nearest knot (use a knot rather than a bolt as the knots twist) of the traverse rope
 - Fit a rope to the casualty and the belay device, cut their cowstails, and lower to the floor
 - If necessary have a second rope from the casualty to a team below so they can pull the casualty over any hazards/obstacles as you lower

If you have no other choice than moving a casualty along the traverse...

Note: this system is slow, complex and best done with two people hauling and one person with the casualty

- Set up a 3:1 haul within sight of the casualty, anchored to one of the traverse lines knots
- Fit two krabs and a pulley (this helps reduce twisting) to the knot of the traverse rope above the casualty
- Haul until the casualties cowstails are slack enough for you to move them onto the next section of the traverse
 - One person will need to look after the casualty as they're being hauled to reduce the chance of snagging
- Lower the casualty onto their cowstails
- Move the pulley to the next knot you need to pass, and repeat

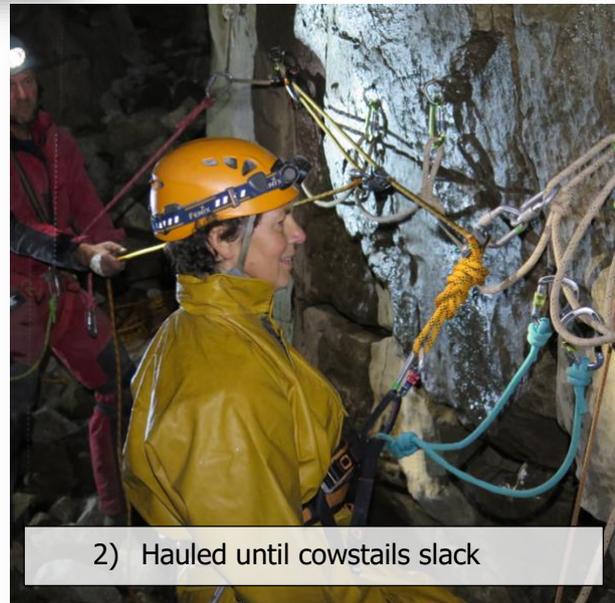
Local Cave & Mine Leader Vertical Leader Ropework



1) Casualty hauled to pitch head

In this photo the casualty has been hauled to the pitch head and then secured with her cowstails. The rescuer has then repositioned the haul system to haul the casualty across the traverse line. Ideally another person would be with the casualty to reassure and manoeuvre.

The casualty is hauled until the cowstails are slack.



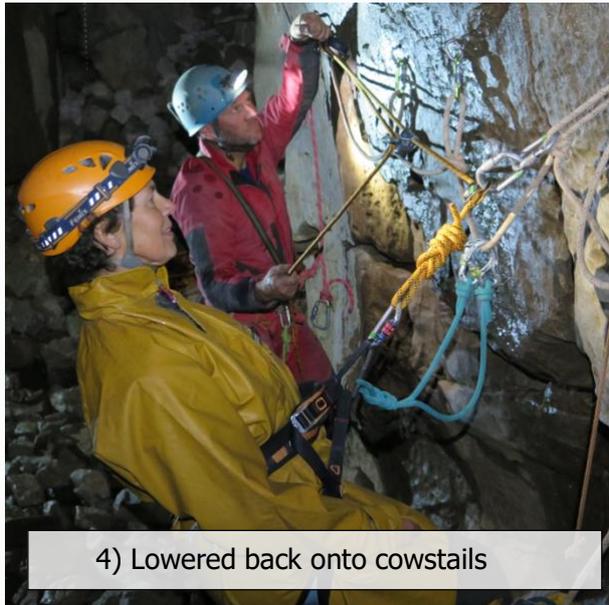
2) Hauled until cowstails slack



3) Cowstails repositioned

The casualty's cowstails are then moved across to the next stretch of traverse line.

Local Cave & Mine Leader Vertical Leader Ropework



4) Lowered back onto cowstails

The lifeline is then lowered so that the weight of the casualty is taken on their cowstails.

The pulley can then be moved along to the next midpoint anchor and the process repeated until the casualty is across the traverse line.



5) Haul system repositioned (if needed)

Before any of this is undertaken careful consideration should be given to the welfare of the casualty and the rest of the group. Is the casualty in a significantly better place having been hauled? Would it have been better to stabilise the casualty at the base of the pitch in a group shelter and then the leader could head out and raise the alarm rather than delay what may be the need for cave rescue anyway.

Local Cave & Mine Leader Vertical Leader Ropework

Personal SRT Progression

The SRT for Leader of the Local Cave & Mine Leader allows the leader to use SRT techniques on the pitches. This may mean less equipment has to be carried, it is in line with what recreational cavers generally do and enables the leader to have more equipment to hand in case of an emergency. However, it does mean that if a leader has a problem and cannot ascend a pitch, then the group cannot get out of the cave. All equipment should be used in accordance with manufacturer's guidelines.

SRT Equipment

A standard SRT kit has several component parts. The components that are Personal Protective Equipment must have a CE mark and be regularly inspected according to current HSE regulations. Several manufacturers produce caving equipment and there is a lot more choice when it comes to preferences.

Harness - these sit lower than a climbing harness and so should not be used for climbing due to the risk of inverting. Some manufacturers insist on the use of a chest harness with the sit harness to keep the caver upright. Most are joined at the front with a metal connector (see below) that needs to take a multi directional load.

Central Maillon - usually a semi-circular or delta shaped maillon. Alternatively a karabiner style such as the Petzl Omnitract are available.

Cowstails - a length of full weight dynamic rope normally between 9 and 11mm diameter to safeguard the caver. It has a karabiner at each end, one must be a locking type, and the rope is connected directly to the central maillon.

Descender- Several manufacturers produce these - a self-locking type is recommended.

Chest Jammer- Several manufacturers produce these - enables the caver to ascend the rope without slipping back down.

Chest Harness (not PPE) - Several manufacturers produce these. From a simple length of tape that is wrapped around the caver to various styles of tape and buckle shapes with varying amounts of comfort.

Hand Jammer - Several manufacturers produce these. Enables the caver to ascend the rope without slipping back down.

Security cord - A length of rope connecting the caver to the hand jammer. It is usually connected to a long opening oval maillon at the cavers end and an oval karabiner at the ascender. Some cavers combine this into one length of cord with the foot loop which can enable a variety of setups and techniques to be used. The

Local Cave & Mine Leader Vertical Leader Ropework

security cord should not be dynamically loaded in use. 6-8mm low stretch rope is recommended.

Foot loop (not PPE) - some cavers use a length of adjustable tape separate to the security cord.

Foot Jammer- Pantin and similar make upward progression much easier



Chest harness- strap type

Chest jammer

Cowstails attached out of the way

Security cord and footloop attached out of the way

Central connector- semi -circular maillon

Long opening oval maillon connecting security cord to harness

Harness

Descender (Petzl Stop) plus attachment carabiner and friction carabiner



Local Cave & Mine Leader Vertical Leader Ropework

Deviations and Re-belays

Once the traverse line and pitch have been rigged and the group have descended the pitch then the leader needs to abseil down. The leader might have to rig additional anchors for deviations and re-belays. The Vertical Leader award is limited to simple pitches only, and so the leader is unlikely to need to negotiate many deviations or re-belays. A deviation is where a sling or length of cord is secured to an anchor and clipped to the abseil rope to pull it away from a rub point. A re-belay is where the hang of the rope is re-hung from two anchors.

Descending

The leader will already be at the pitch head and be attached by cowstails

- The leader should attach their descender to the pitch rope
- Pull as much slack through the descender as possible to put them as close to the Y hang as possible
- They should then lock off the descender and hang on the pitch rope
- The short cowstail can then be removed
- Unlock and function test the descender
- Lock descender again
- Remove long cowstail
- Descend

Rigging a deviation in descent

- Abseil to level with the deviation anchor
- Lock off descender
- Attach crab and cord to anchor with screwgate karabiner or tie cord directly into an anchor
- Connect cord with snapgate crab above descender
- Adjust cord length
- Unlock descender and descend

Rigging a re-belay in descent

- Abseil until just above anchor/s
- Lock off descender
- Attach short cowstail to anchor
- Unlock descender and descend until short cowstail is tight
- Lock descender
- Estimate length of re-belay loop required and then tie appropriate knot/s
- Attach knot to anchor/s
- Put long cowstail into knot or re-belay loop

Local Cave & Mine Leader Vertical Leader Ropework

- Unlock and remove descender and place on rope below re-belay, pull through slack and lock off again
- Remove short cowstail and function test descender
- Lock descender and remove long cowstail
- Unlock descender and descend pitch

Removing a deviation on ascent

- Ascend pitch rope until hand ascender hits deviation crab
- Remove deviation cord totally and continue up pitch

Removing re-belay on ascent

- Ascend until hand jammer is 15cm below re-belay knot
- Attach long cowstail to rebelay knot
- Remove chest jammer by standing in footloop and place on pitch rope above re-belay
- Pull through the slack
- Remove hand jammer and place above chest jammer ensuring no tangles
- Ascend to function test
- Undo re-belay knots and remove long cowstail
- Ascend pitch

Retrievable abseil

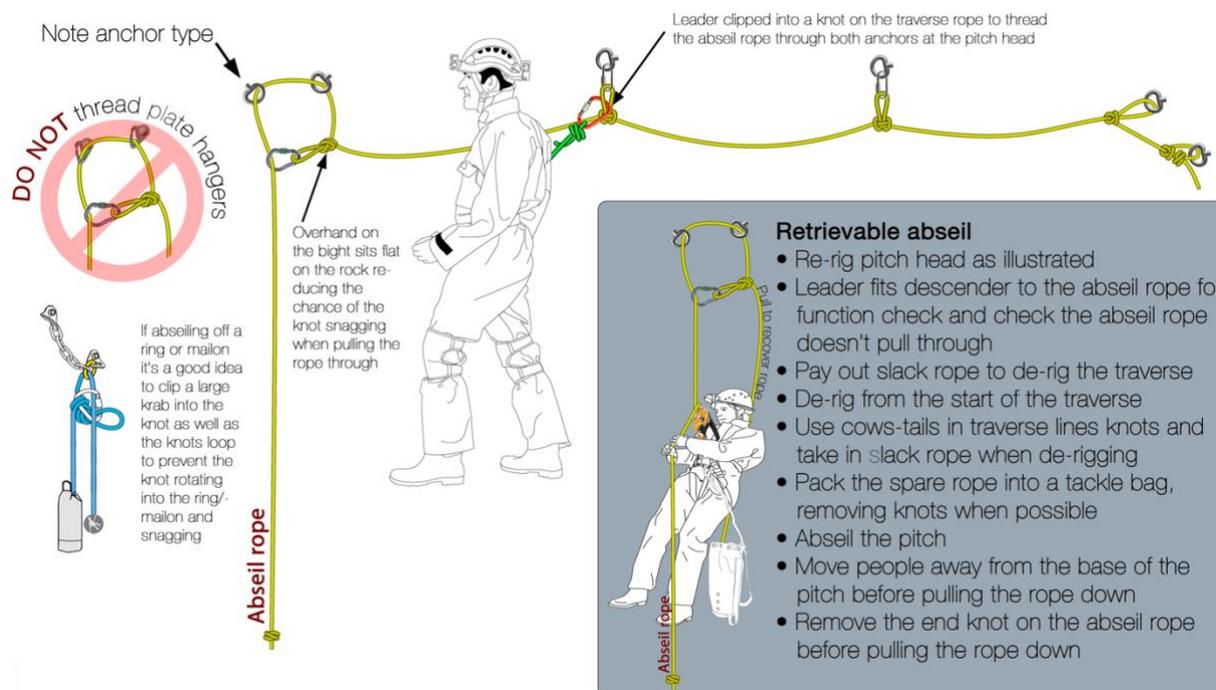
For simple pitches which are not required for the return journey (i.e. pull through trips where the leader has **fully** satisfied herself/himself that the exit route is clear and accessible to all within the party) then it may be possible for the leader to retrieve their abseil rope once the group have descended.

Retrievable abseils form part of the revised (as of 2020) SRT for Leader Module and are only appropriate for pitches where access to the pitch head is straightforward, or where an abseil can be rigged from safe/easy ground. To set this up;

- To re-rig the pitch head the leader should protect themselves by clipping into the last alpine butterfly of the traverse, nearest the pitch head (see illustration)
- Undo the knot at the pitch head
- Pull up the abseil rope and untie the knot at the end of the rope
- Thread the rope through both anchors at the pitch head taking care to avoid excess twisting **Note plate anchors should not be threaded, and are not appropriate for this technique**
- Re-tie the end knot and lower the rope to the floor

Local Cave & Mine Leader Vertical Leader Ropework

- *If the pitch head is rigged with a chain and central mailon or ring specifically for pull-throughs, then thread the rope through the central mailon/ring*
- Tie an overhand knot on the bight knot on the opposite side of the rope which is on the floor
- Clip a karabiner into the overhand on the bight and to the abseil rope
 - *If threaded through a mailon/ring clip a karabiner into the loop of the knot, the body of the knot and the opposite rope. This should prevent the knot rotating into the mailon/ring once loaded and jamming*
- Fit the descender to the abseil rope and confirm the device functions and is secured to the correct rope
- De-rig the traverse from the start of the traverse towards the pitch head, paying out rope from the descender and taking it back in as well as clipping cowstails into the knots of the traverse rope to protect yourself
- Descend the pitch checking the retrievable side of the rope reaches the ground, if it does not a second rope can be tied to it
- Once on the ground untie the end knot on the abseil rope and pull the opposite side to recover the rope taking care to have all clients away from the base of the pitch due to potential rock fall



Problems

As the only SRT capable person in the group, the leader needs to be able to sort out simple problems such as failed or lost kit by improvising or substituting equipment. For example, the loss of a jammer could be easily solved by using the technique illustrated on page 14 to ascend a rope. Loss of descender could be resolved by using an Italian Hitch, preferably backed up with a prusik or appropriate back up device such as a Rescucender or Duck if available.