



Intermediate SRT
Student Manual

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Inside front cover

Intermediate Single Rope Techniques Training Course

Published by the Vertical Section of the
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Illustrations by Bruce Smith
Courtesy of On Rope 1, Inc. and *On Rope*



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Warning: Serious injury or death could result from the use of the techniques and equipment described in this manual.

The Executive Board of the Vertical Section of the NSS Inc. provides this manual as a guide to Internal Organizations of the NSS for teaching safe vertical practices. All instructors and persons practicing vertical rope work should use sound judgment and a lot of common sense. Under no conditions does the Vertical Section sanction use of this material by any one not under the direct supervision of a qualified vertical instructor.

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How it all works

Start

-Vertical Section Contact
-Obtain course package
-Put name in system

VS Training Coordinator

Course Booklet given to each student includes:
-Introductory materials
-8 units of goals and materials needed to reinforce the learning experience
-3 Goals of the Course

Student and Grotto officer

Grotto Mentor assigned the task to initiate training

Student and Mentor

Specialist Mentors assist student through each unit

Knots

-Butterfly
-In-line Figure Eight
-Bowline on a Bight
-Double Figure Eight
-Helical Hitch

-Verify basic knot skills are known

Belaying

-Top belay using a Grigri, and or a Munter Hitch
-Self belay
-Can release a self belay device

Harnesses

-Can don and adjust to fit at least three different types/ makes of harnesses

Equipment

-Can safely rappel using 5 or more rappel devices and know the limitations of each
-Can safely use 4 or more mechanical ascenders and know the advantages and disadvantages of each

Rigging

-Can demonstrate the attributes of a safely rigged rope
-Pursues non-invasive rig points whenever possible
-Places a knot at the bottom of the rope and knows why.
-Can deploy, coil or bag, and transport team gear to and from a rigging site
-Set 3 bolts and hang from them

Ascending Methods

-Can rig and efficiently use a Frog System
-Can rig and safely use a Mitchell System
-Can rig and safely use a Rope Walker System
-Can Rig and use a Knot System

Rescue Skills

-Can safely operate a haul system
-Can safely pick-off an injured climber from a rope and bring them to the ground
-Can ascend/ descend to an injured climber and rappel them to the ground

END

VS Training Coordinator will return a signed and completed certificate noting completion of course

Submit completed form to the VS Training Coordinator

Caving

Safely lead at least 3 multi-drop cave trips- Taking charge of rigging and the welfare of the participants

Vertical Section Training Coordinator's involvement

Intermediate Single Rope Techniques

Goals of the Course

1. Successfully negotiate a multi-drop cave environment under adverse conditions/situations, both up and down, in an efficient manner.
2. Perform all the skills outlined in the Basic Training Course.
3. Demonstrate and be actively involved in group leadership and assume command if the leader becomes disabled.

A Mentor

A **mentor**: a trusted friend, counselor or teacher, usually a more experienced person. Some professions have "[mentoring](#) programs" in which newcomers are paired with more experienced people in order to obtain good examples and advice as they advance. Schools sometimes have mentoring programs for new students or students who are having difficulties.

Mentors provide their expertise to less experienced individuals in order to help them advance their careers, enhance their education, and build their networks. Many of the world's most successful people have benefited from having a mentor.

If you are fortunate enough to be selected as a Mentor, be good at what you are expected to do. Read the section on being a good Trainer on page 9

The "Whys"

Always seek the root reasons behind all the things you learn. Learn the "Whys". If you can answer why you are doing something a certain way and it makes sense to you and to others, chances are you are doing it right. If you are doing things just because you heard it should be done that way or your friend Bill said to do it that way then chances are you do not fully understand the depth of your topic and there is a good chance it needs to be revisited. Always seek higher knowledge. Separate proven methods and techniques from lore and rumor. Be diligent with your knowledge for it is the ultimate force that will pull you through the most difficult of situations.

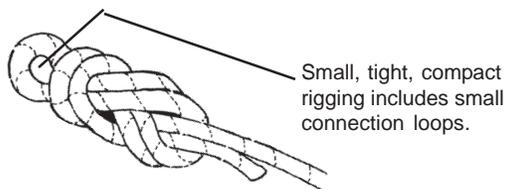
Knots

Goals of this Unit

1. Master 5 additional knots that you may or may not have learned in the Basic Vertical SRT Course

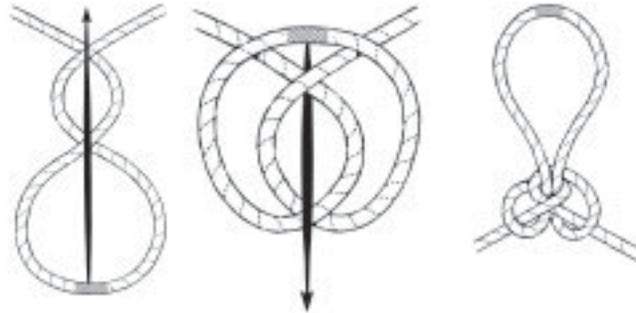
Thoughts about knots. Using and understanding all the aspects of the knots you choose to use is the most important part of the knot subject. Learn a few and know them well.

1. Practice making knots with rope the size you intend to use in the field.
2. Make the knots compact and small.
3. Make the loops in the knots the size of those things they may encircle.



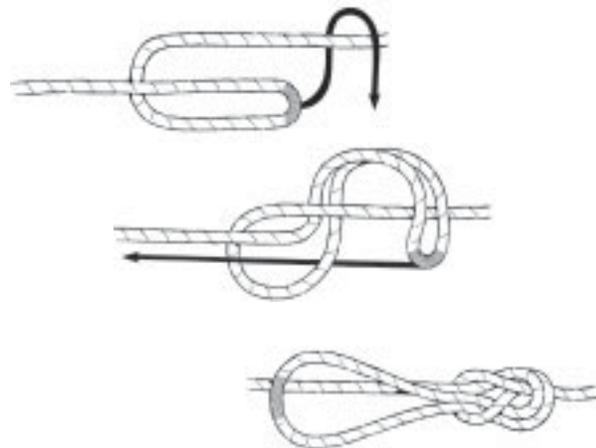
4. Very few knots need what some people refer to as back-up knots. In all the knot text books including some of the great historical reference texts, back-up knots are never mentioned. Clifford Ashley in his incredible book *Ashley's Book of Knots* says, "**a knot is never 'nearly right;'** It is either **exactly right or it is hopelessly wrong, one or the other; there is nothing in between.**" By adding some version of a helper back-up knot we contribute to the knot being "hopelessly wrong."
5. Dress and stress a knot. Will it make it stronger? Maybe not, but it will allow it to be inspected from a distance. This is very important for a safety officer to be able to identify and verify that the knot is tied correctly.

Butterfly Knot



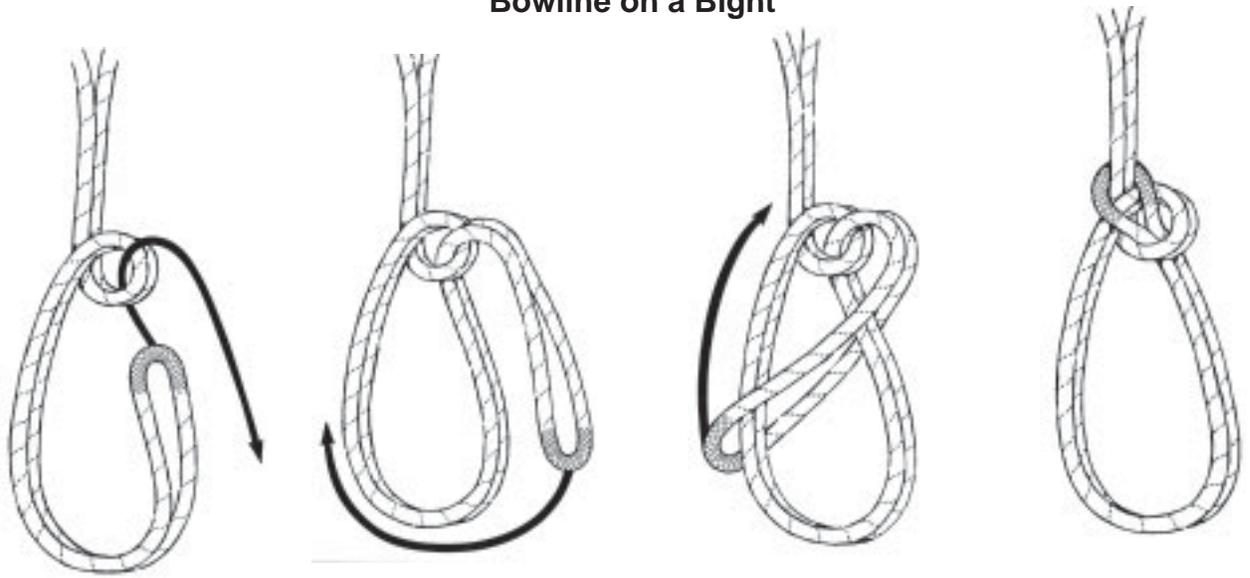
Butterfly Knot is a great mid-line knot and is useful for tying out a bad spot on the rope or attaching a carabiner to a point on the rope. It does tend to bend the rope radically through the bends of the configuration resulting in a lower- than-average breaking strength. Most texts rate it about 60-65%. It is omni-directional and very easy to inspect. It seems to work best with softer ropes.

In-Line Figure Eight



In-line Figure Eight is one of the eight knots in the family of eights and qualifies as a mid-line knot. It is a directional knot and is very useful when tying a Trucker's Hitch. It requires the knowledge of making the knot in both directions. It too, radically bends the resulting configuration rendering it a knot that is lower than average in breaking strength much like the Butterfly Knot.

Bowline on a Bight

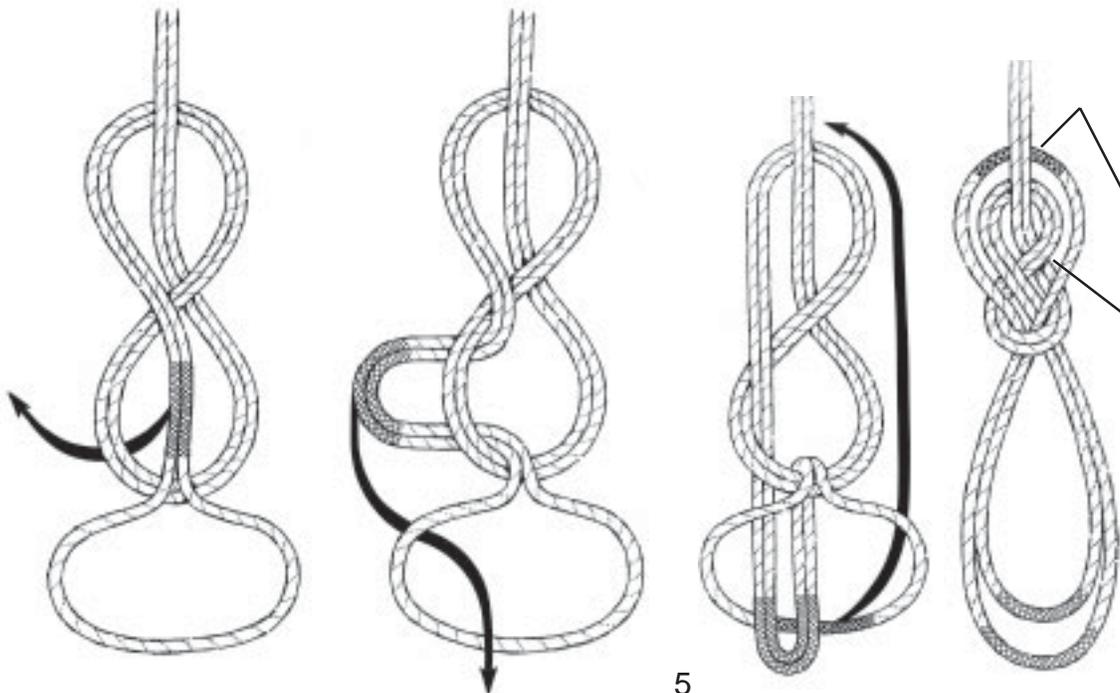


Bowline-on-a-Bight is also a mid-line knot and is one of the preferred double loop knots because it unties so easily, even after extraordinary tightening. It too is multi-directional and is a great knot to include in one's arsenal.

many Firefighter training texts. Most users, however, use this knot as a mid-line knot for rigging to multiple points or for an end-line connection point. Many people feel the double loop provides better loop durability because there are two loops. The weak point of the knot, however, is like any other Figure Eight on a Bight where the standing line enters the knot. In a pull test the knot will break at this point.

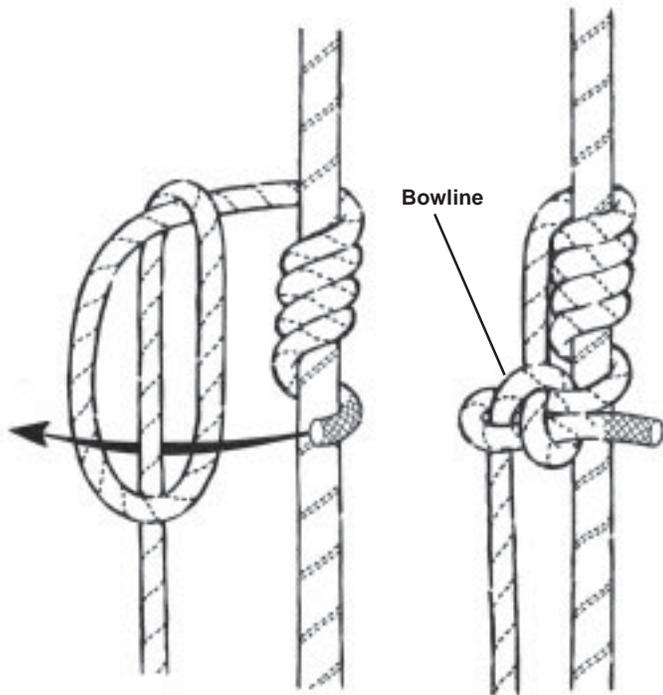
Double Figure Eight

The Double Figure Eight is a large complicated knot that can be used for either an end-line knot or a mid-line knot. It can be used as an emergency harness according to



To properly dress this knot, be sure that this part is tucked here in the end during the dressing and stressing.

Helical Hitch



The Helical Hitch is a very easy to use gripping knot much like a Prusik. It slides easier than a Prusik and requires much less rope than a Prusik to tie. As a gripping knot, however, it only suspends from one cord, whereas a Prusik suspends from two cords. If you can tie a Bowline you can tie a Helical. All a Helical Hitch is a Bowline that has the bowline loop rope rotated around and around and around the main rope. Its gripping ability depends on the number of coils. Typically, 5 coils is the minimum number of coils and can include as many as 10 coils.

Famous Ashley Quotes

“The question of what knot is best for a particular need is perhaps the most important of all to be considered.”

“Perhaps the most difficult task I have attempted is to sort out the terminology of knots and to ascribe to them their rightful names.”

“At sea, the whole subject of knots is commonly divided into four classifications: *hitches, bends, knots and splices.*”

“It appears to be true that a rope is weakest just outside the entrance to a knot.....”

“A knot is never “nearly right”; it is either exactly right or it is hopelessly wrong, one or the other; there is nothing in between.”

“There is nothing quite as rewarding as tying a beautiful knot”

Anita Briem
Journey to the Center of the Earth 3D

Take time to refresh your skills with the other necessary knots you learned in the Basic Vertical Single Rope Techniques Course.

Overhand Knot
Ring Bend (Water Knot)
Bowline
Figure Eight
Figure Eight on a Bight

Figure Eight Follow-through
Double Overhand Bend
(Double Fisherman’s Bend)
Triple Overhand Bend
Prusik Hitch

Belaying

Goals of this Unit

1. Top belay a person using a Grigri, and or a Munter Hitch
2. Put together and use a self belay Activate it to make sure it works.
3. Develop the skills to release a self belay device, like a Prusik or Shunt

A Belay is a safety or back-up in the event that a primary system fails.

Even with a belay, the risk of serious injury or death remains. However, a belay when applied properly can provide an additional margin of safety.

Belaying is controversial. There are many forms of descending belays: top belays, bottom belays and spelean shunt belays. In addition there are numerous ascending belays.

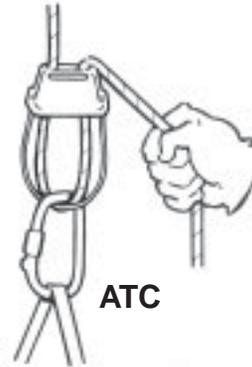
Research the various belay methods and become familiar with how they work. Practice using belays. Secure a heavy load (body weight) from a limb or high place while belayed and release the primary line. Try to catch a falling load with the belay. Practice until you can do this.

It is best to secure the belay device you intend to use to an anchor and operate the belay from the side. Throwing the rope around your waist and attempting to stop a load with your fleshy mid-section is "old school." Modernize your approach as described earlier.

Belay Devices

Belay devices should be two-way operational. Figure Eights are bi-directional but do not provide very much stopping power. Grigris on the other hand are bi-directional and do a good job of stopping a falling load. Racks make terrible belay devices. They only work in one direction. Be sure you have a way to loosen a belay once it has activated.

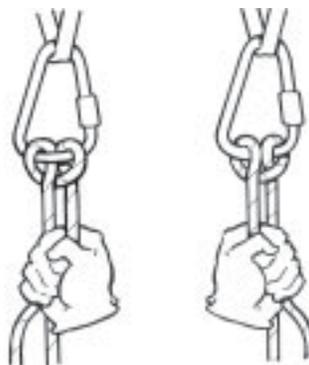
Common Devices



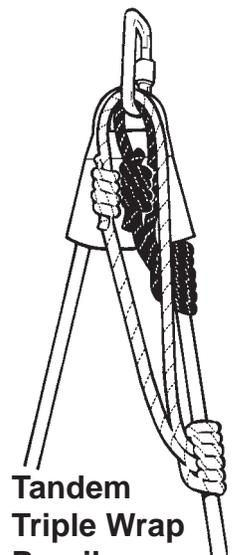
ATC



Grigri



Munter Hitch



Tandem Triple Wrap Prusiks

Words of Caution

A belay should never distract the user from performing the original intended task. If one is rappelling their focus should be on rappelling. Distractions that cause one to rappel dangerously should be avoided. A French Wrap rappel belay, for example, may divide the user's attention between the two activities-a dangerous situation.

There is a school of climbers that feel no belay is the best approach. If a belay tugs, inhibits the function of the original activity, throws a climber off balance, or redirects his/her attention, it is the wrong approach. Some believe the best safety margin is achieved by knowing exactly what to do when, and doing it with deliberate precision. Eliminating distractions is the first step in focusing on performing the needed skills with precision.

Harnesses

Goals for this Unit

1. Know how to use at least three harnesses and all the adjustments

Harnesses are the integral component that safely connect people to ropes. Routinely the leader of a group needs to ensure that harnesses are fitted properly, buckles properly fastened, webbing is not folded or rolled and padding is situated so that it provides comfort to important sensitive areas. A group leader needs to monitor how long people have been hanging in harnesses so that harness straps don't end up restricting the flow of blood and causing problems with pooling blood pockets which prevent the timely return of a muscle's fuel source to its cleansing and regeneration organs.

"No element of the harness must be allowed to interfere with breathing or create painful pressure on any part of the body."

Amphoux 1982

Know the Pitfalls

In a sit harness there are a number of sensitive organs that lie under the waist belt, including the pancreas, kidneys, liver, spleen, stomach and other abdominal sensitive areas. Medically, the user after sitting motionless in a seat harness for only 10 minutes will experience numbness, nausea, extreme paresthesia, abdominal distress, severe breathing distress and symptoms of suffocation. A good comfortable fit is very important. Cavers have suffered for years with thin, minimalistic sized harnesses to limit the volume of their pack.

Being a minimalist carries a double edged sword. It helps by reducing weight and bulk, but leaves the user with a smaller safety factor and a reduced back-up system on which to fall back on. A well padded harness often solves medical concerns, but bloats the size of your cave pack.

"There is no human tolerance to be suspended by a Thoracic Belt." i.e. Chest harness

Seat Harnesses

Most cavers use a seat harness. It should be used as designed. Read and know what the manufacturer instructs in their user documents. If they declare that a by-pass carabiner on a belay loop style harness is dangerous and the user's weight will more than likely end up cross loading the carabiner gate, then do not use a by-pass carabiner.

Learn how to use each type of buckles the manufacturers incorporate with all the various styles of harnesses.

Learn where all the adjustments are for each person.

Recognize immediately if someone's harness is donned improperly or a buckle is incorrectly fastened.

Take the responsibility of a leader who watches over your group and all those safety things that will keep them alive. It is more than just your gear that you need to know a lot about.

Full Body Harnesses

Post fall suspension in any harness was rarely a concern until Brinkley's study in 1988. His full body harness tests proved that a user only has about 30 minutes suspended in such a harness before intolerable pain resulting from circulation problems begins. Death follows soon thereafter.

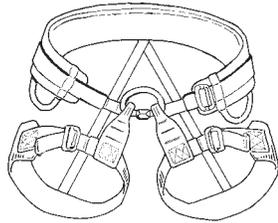
"The essential element [in a seat harness] is the strap under the buttocks. It rests, in fact on the pelvis, the most rigid and solid element of the human frame and is cushioned by larger areas of flesh."

Amphoux 1982

Harnesses



Endurance



Goliath



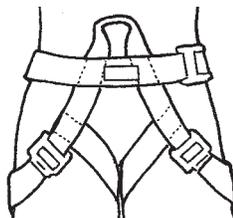
Fractio



Super Avanti



Padded Endurance



Lookout



PMI Delta



Pit Viper



Expedition Goliath



Spectrum

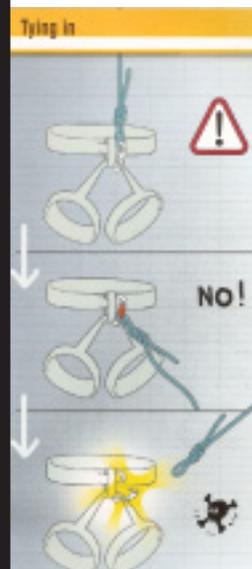
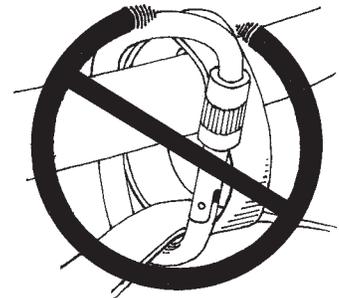
Know the harnesses that may be on your next caving trip. Which buckles on which harnesses are commonly called "Triple pass?" What is a cinch buckle? Does it require a third pass?

Training

Everyone is in one form or another a closet instructor. They routinely have no formal training and when confronted with speed bumps that are out of their realm of experience they make up their own rules. This continues to plague all training organizations. Maintaining and insuring training standards is a challenge that all of us bear.

It is so easy to fall back on methods and ways you learned long ago. Ask yourself "Why" you have chosen to do something a certain way. If your answer is "I have always done it this way" then maybe that is not the best way after all. Expect more substance from an answer than "I have always done it this way." Be a better trainer. Be a better student. Pursue the truth. There are many myths, legends and a lot of lore about harnesses. Being able to separate all the fantasy from facts becomes your job in the end.

By-pass Carabiner



A by-pass carabiner, as shown above, is discouraged by most manufacturers. Petzl plainly shows the Skull and Crossbones of the problems as shown on the left. This demonstrates how lore and myth have generated a world wide transference to incorrect and dangerous information.

Equipment

Goals of this Unit

1. The student should be able to safely rappel using 5 or more rappel devices and know the limitations of each.
2. The student should be able to safely use 4 or more mechanical ascenders and know the advantages and disadvantages of each.

Rappelling is the most dangerous thing we do. Being suspended from a single point of attachment requires a focused approach to this activity. Many people ask if they should use a second point of attachment and monitor this point while controlling the first primary method of descent. Where it may seem like a logical thing to do, it is the opinion of the VS that a focused effort is the best approach. We do not suggest, using a cell phone, i-pod, eating your lunch, or even taking a drink of water during a rappel.

A rappeller should rappel and only rappel, resisting all other distractions. The very life of the rappeller is based on his/her ability to rappel safely. Resist distractions and monitor everything that happens to you and to all of your equipment during your rappel.

If there is an activity that a rappeller needs to do while on rope, stop rappelling, lock off the rappel device and complete the required task. Then continue safely rappelling.

Use all your senses. Feel the heat through your gloves. Watch the reaction of your rope, feel the rigid reaction to your weight on your anchor, smell the rope and metal interaction as they heat to insure you are not extending your margin of safety, monitor the dryness in your mouth as you move through space on your terms and listen to every noise around you and all the gear that you are using. Listen for others who may be shouting warnings or attempting to get your attention.

If you choose to use a French Wrap then you

Rappelling

are asking your 5 senses to keep track of all these things with regard to your second point of attachment as well. Multi-tasking may be okay while you are watching TV, but during a life and death situation, like rappelling, focus on one thing and only one thing.

Mentor Tips and Activities

Rappelling

Have your rappelling mentor carefully explain 5 of the following common descent devices and the limitations of each. Then rappel with each device until you feel you could coach someone else in the wilderness. Know enough to get someone out of trouble if they were using such a device and experienced problems. A leader needs all the characteristics of a mentor/teacher and provide team members with important tips to insure their safety.

The mentor should ensure that the student uses a QAS and reinforce its virtues.

Examples of rappelling devices:

14" Rappel Rack

14" Rack with a hyperbar

18" Rack (long rack)

24" Rack (long rack)

Micro Rack (3 varieties)

Petzl Stop

Figure 8

ATC or similar

Whaletail

Rappel another person down a drop from a fixed position

Rappel with another person secured to the eye of your rack

|

Common Rappelling Considerations

1. Check all equipment before moving to the edge with your QAS.
2. Rappel with a controlled speed.
3. Hand position correct? Brake hand does not change between devices, however, the control hand when using a rack adjusts the bars, on a Figure 8 it holds the rope above the rappeller and maintains balance...and so on.
4. Keep your back straight and face/hair away from the rappel device and rope.
5. If against a wall, maintain stable feet positions.
6. Feet spread apart, no jumping or bounding. Respect your anchor and rope.
7. Keep other equipment, clothes, and body parts out of the rappel device.
8. Stay alert at all times.
9. Pre-establish a signalling system. Communicate clearly when on or off rope.
10. As a student, study and research the best ways to use various devices. Seek out the opinions of other people whom you respect.
11. Practice adding and subtracting bars during a descent.
12. Check the surface before landing.
13. Squat to relieve rope tension, then stand up.
14. Quickly de-rig from your rappel device.
15. Clear the landing zone.
16. Signal "Off Rope" only when you are clear of the drop.
17. Listen for "OKay" from the proper source(s).

Environmental Concerns

1. Weather or drop conditions, wet, muddy
2. Load being rappelled: To safely control big loads one needs more friction.
3. An honest assessment of the skill of the rappeller should be made.
4. Start with more friction than needed if there is any doubt of how many bars will be needed.
5. Assess the drop for rock fall dangers.

Rappel Devices

The various designs and materials can affect your rappel greatly.

Size, condition, and type of rope
Position of brake and control hand
Mass to be rappelled
Environment (rain, mud, clear)

Rack Specific:

Distance between bars
Size of the bars
Type of bars (aluminum, Stainless Steel, Titanium, steel, etc.)
Number of bars engaged
Offset bars

Heat dissipation

A leader should thoroughly understand the importance of heat dissipation and keeping your rappel device cool.

-Aluminum heats up quickly, but cools off and dissipates the heat quickly. (Note: the sticky point of nylon is 250°). Nylon's melting point is 480° but it loses all of its integrity at about 330°. The rope will take on the consistency of jello.

-Steel heats up slowly and cools slowly as well.

-Titanium seems to take on many of the same characteristics as aluminum.

-The more metal mass, the more efficient the rack will be in removing heat from the rope, thus decreasing the chance of the heat building to a rope damaging temperature. An ATC has some of the smallest metal mass and will reach dangerous temperatures sooner than most devices.

Materials

-Aluminum wears out the fastest, and leaves gray aluminum particles on the rope.

-Steel lasts longer. Hollow bars remain cooler during a rappel.

-Titanium is strong and light, but brittle and more expensive.

Equipment

Ascenders As the years pass, more and more ascenders infiltrate the market. Many of these may have practical applications when incorporated with a QAS. Some work best for a rope climbing system. Some have teeth and some have a cam which seem to be a little softer on the rope.

Get to know as many as possible

- Become familiar with the safety mechanisms.
- Be able to discuss the strengths of the various models.
- Which ones have straight teeth and which ones have aggressive hooked teeth?
- Which ones fit a gloved hand?
- Does one have greater hand comfort over another?
- Discuss the virtues of cams over handled ascenders.
- What does QAS really mean?* *Answer below
- Jumars, (no longer available, however leaders should know about them).
- Crolls are specifically designed for the Frog System chest ascender, but can be used as a left handed, non-handled, ascender.
- Basics are right handed, non-handled ascenders.
- Does the ascender you intend to use grip the rope during wet or muddy conditions?
- Will it down climb conveniently?
- Does it work on multiple sizes of ropes?
- Do you know that Rescucenders are rated to slip at 4 kN? (safety issue for rescue)
- ABC ascenders seem to have a superior operational mechanism.

Know your gear along with everyone else's.



What are they best used for?

- Know your gear**
- ABC Chest
 - Basic B18
 - Panteen B02
 - Ascension B17L
 - Croll B16
 - Rescucender B50
 - Ascension B17R
 - Gibbs #1
 - ABC Handled Ascenders

*QAS means Quick Attachment Safety which implies one hand operation. Cams that require two handed operation don't qualify.

Climbing Systems

There is nothing magical about Three Points of Contact.

This is an urban myth.

There are **Three Criteria** for all good reliable climbing systems.

- 1. If any component were to fail the climber will not fall.**
- 2. If any component were to fail the climber will not fall upside down.**
- 3. If any component were to fail the climber can call into use a third, ready-to-use ascender to fix, make safe, or replace the failed component.**

Gary Storrick

Almost universally, all systems use only 2 ascenders. As one ascender holds the climber in place, the other one is advanced up the rope. After all, we only have two legs and can only move one ascender at a time. If we had three legs, the rules might be different.

Some climbers suggest using a third, floating, ascender. This is suggested under requirement no. 3 above. Folks who rope-walk routinely ride their QAS above their chest roller. If an ascender fails, the climber can immediately take inventory of their situation and chances could be good that the climber could make some minor modifications, switch his/her climbing method to a Texas system and continue.

In the 1980's there was considerable amounts of research done on the use of tethers to make sure if any component failed the climber would never fall or fall upside down and would have a ready-to-use ascender to ensure recovery.

Take time to look up some of these classic older articles that ensured safety.

Goals of the Climbing System's Unit

1. Rig and safely operate an efficient operational Frog System.
2. Rig and safely operate an efficient operational Mitchell System.
3. Rig and safely operate a Rope Walker System. i.e. Double Bungee System or Single Bungee System (Very few people use Single Bungee Systems anymore.)
4. Rig and safely use a knot climbing system.

Other system parameters

-Chicken loops must be strong enough to hold a climber's weight in case they invert and become suspended from a foot ascender.

-Cinch buckles adjust more readily and help facilitate quick, necessary adjustments.

-Establish a regular system of inspection and replacement of worn components.

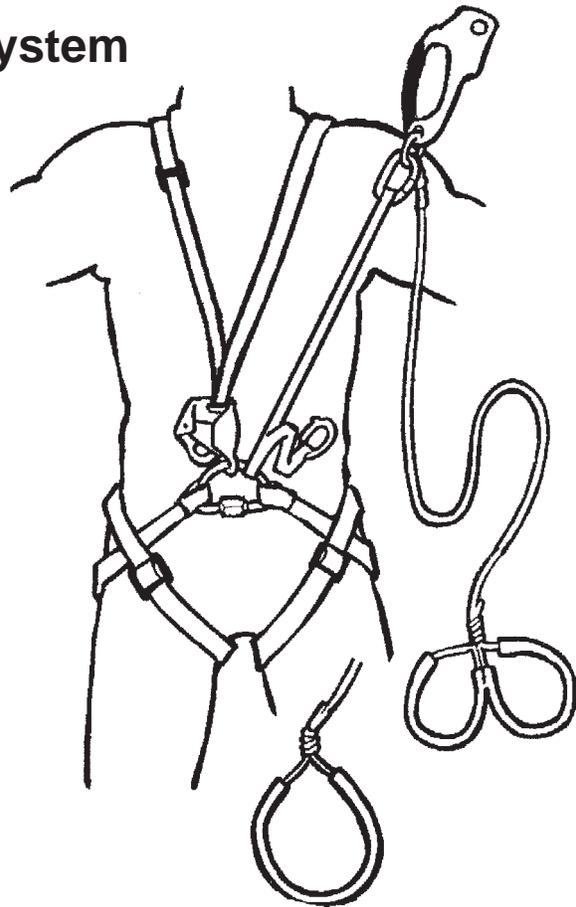
This last parameter is easy to say, *"Yeah! Yeah! Yeah! I inspect my stuff everytime I use it."* I would suggest that many people say this, but do little about it. After all, it is expensive to throw away gear. It is so easy to say, "Ah! It will last another trip!"

Challenge yourself to critique the condition of your own gear as harshly as we so often critique others. Dirty gear is not virtuous. Dirt on gear probably reduces its life by as much as half. Dirt should be scrubbed from around sewn stitches or they will rot. Dirt causes nylon to prematurely dry rot. Dirt and moisture causes buckles to rust and age prematurely. It has often been said that, "If it's not muddy, you're not a caver." This approach to safe caving is dangerous. In reality, just the opposite is true.

Frog System

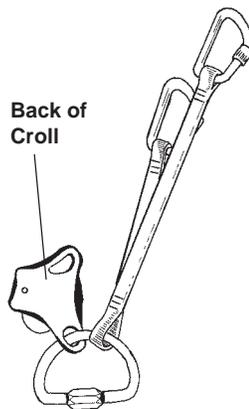
Features:

- Compact and versatile
- Fairly light weight
- Requires a sit-stand motion
- Can be tiring to use
- Designed for tall, lean, physically fit climbers
- Negotiates rebelay points with ease
- Often worn while caving
- Requires precision adjustments for optimum progress
- One of the less expensive ways to ascend
- Requires a harness that incorporates a half round



Loading the Half Round

Make sure there is free access to the gate side of the Croll. The user must be able to easily manipulate the cam as the situation dictates. In other words, place the Cows Tail in the half round away from the gate side of the Croll as shown.



What is the short Cow's Tail used for?

1. The short Cows' Tail is very important when attempting to cross a rebelay. Special instruction is needed and practice at a low altitude before such a maneuver is attempted. More people get hurt or die attempting this one single maneuver than any other vertical skill.
2. The short Cow's Tail is important when attempting changeovers. Understanding this one simple trick will allow you to changeover at lightning speed.

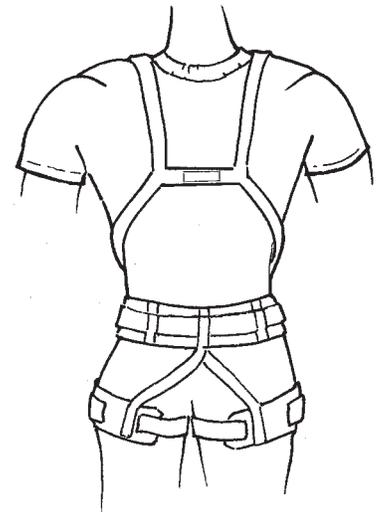
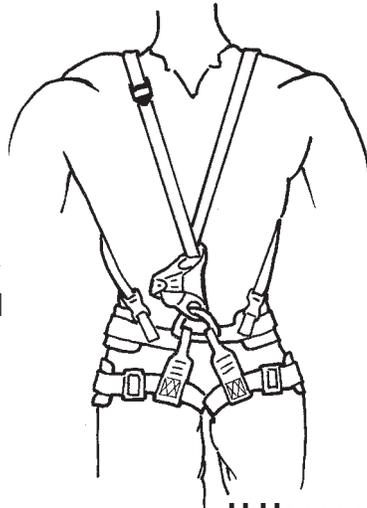
Frog Climbing Tips

1. Let your legs, not your arms do most of the work. Curl your legs under your butt and stand straight upward. After a good climb, your butt should be sore, not your arms.
2. Froggers can self-start easily by dropping the rope between their feet and pinching the rope between the feet (or boots) (holding it down simulating a bottom belay) during the stand-up phase of a cycle.
3. Stand straight up. If a climber finds that they are climbing at an angle, then valuable energy is lost during each cycle as each stroke's energy will need to be redirected into a straight down force providing an upward motion.
4. There is a variety of other techniques that a Frogger must learn. Seek special training and instruction on the use of the Frog System. Be careful and prudent. Proceed with caution. Start with small climbs and practice rebelayes outside.

Adjustments

Easy Adjustment to the Foot Sling

1. Put on your system
2. Put both feet in the foot loop(s)
3. Hold the top ascender just above the Croll.
4. Adjust the foot loop cord length so that it is tight. This a good starting point. If the user's muscle tone is not firm, the precise adjustment method may be necessary.



H Harness Adjustments

Precise Adjustment

1. Put on your system and attach it to a rope.
2. Attempt the "stand up" part of the climbing cycle.
3. Measure the distance deficiency between the top of the Croll and the bottom of the handled ascender.
4. With your weight on your foot sling measure the same distance down from the handled ascender and mark the rope with the piece of tape, chalk pen, whatever.
5. Get off the rope, untie the foot loop and retie the Triple Overhand Noose or adjust the webbing at the buckle(s) to conform to the new shorter distance.
6. Put on the system one more time and test the system to verify that it works properly and that the maximum gain up the rope is being achieved with each stroke.

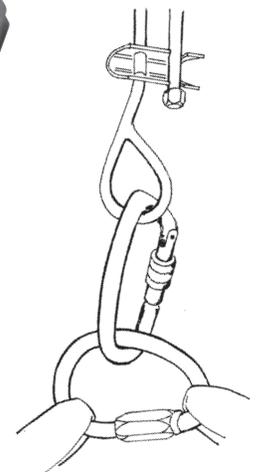
Start by positioning the center rear cross strap low between your shoulder blades, (as shown) about where a bra strap would go (if you wore one). The ladder lock (plastic buckle) on the right shoulder can be extended or shortened so it remains user convenient. The two male side release buckles should each reach down the user's sides and snap onto the female side release buckles sewn into the harness or loop through the waist belt in the front and connect.

Rappelling with a Frog System

European Froggers use the Petzl Stop or a device that has the capability to load from the bottom. The virtues of such a device are difficult to describe, but will become apparent when used.



If Rappelling with a rack, the one that best interfaces with the half round is the 90° twisted eye rack. This allows the user to change bars easier.



Cow's Tail adjustments

The length of the long Cow's Tail should be such, that when you hang from your foot ascender only (no Croll attached) you should just be able to get your hand into the handle of the ascender. If a climber is very tall or very short, special tailor-made Cow's Tails may be necessary.

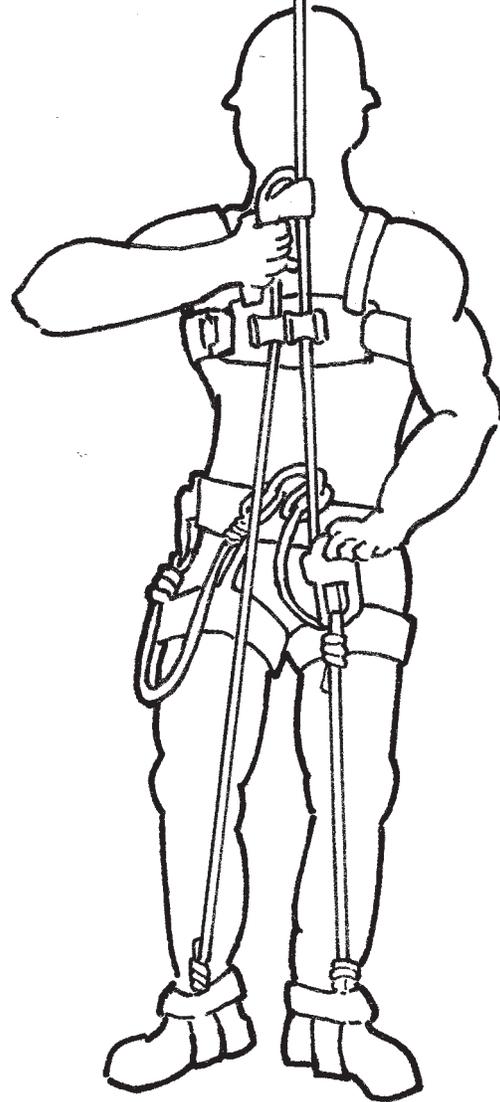
Mitchell System

Features:

- Very fast on rope
- Very versatile on rope
- Can down climb very fast
- Requires the use of both hands during movement
- Resting requires the positioning of the QAS above the upper ascender or creative tether use
- Any harness works with the Mitchell
- Can tax your lower back muscles
- Works well for very long climbs if the climber is in shape
- Good for tandem climbing

Mentor should:

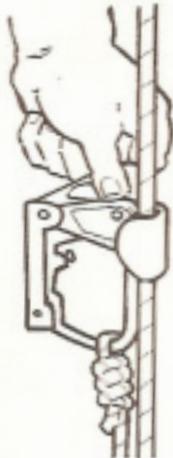
- Observe the student positioning the chest plate high on their chest (high above the nipple line).
- Observe the student not walking on their foot stirrups.
- Observe the student verifying that when on rope the long cord positions the upper ascender just above the double chest plate when both feet are together.
- Observe the student using components from the Mitchell System to climb Texas.
- Observe the student's ability to self start.
- Observe the student's ability to inspect and evaluate the condition of the Mitchell System they are using.



Mitchell Climbing System

Self Starting and Down Climbing

1. Hold the short ascender with your index or middle finger as shown.
2. Thumb the cam as shown to release the cam if necessary.
3. Whether self starting or down climbing this skill is an important one to master.



The **Mitchell System** has as many as 6 points of contact that need to be secured prior to ascending.

1. Attach the top ascender above the chest roller on the main rope.
2. Attach the bottom ascender below the chest roller on the main rope.
3. Attach the chest roller around the main rope (passive attachment).
4. Attach the chest roller around the long foot cord (passive attachment).
- 5-6. Attach the safety tether(s) to your seat harness.

Rope Walking

Features:

- Fastest system on rope
- Hands free if the climber desires
- Medium bulk and weight
- Versatile
- Easy to rest
- Negotiates rebelay points with difficulty
- Any harness works
- Requires a stand-up walking motion
- Can tax your lower back muscles
- Works well for the very long climbs
- Good for tandem climbing

Mentor should :

- Observe student taking care of the life of the bungee cord.
- Observe the student not walking on their foot stirrups.
- Observe the student keeping bungees and tethers untangled.
- Observe the student break the system down to a Texas and changeover in under 5 minutes.
- Observe the student inspect and evaluate the condition of the Dbl Bungee system he/she is using.
- Observe the student self-start.

Self Starting

Attempt to allow the right foot ascender to track up the rope (raise your foot so the ascender follows the natural line of the hanging rope).

A Double Bungee Rope Walker is shown above



System Donning and Sequencing

- Put the seat harness on first
- Put the chest harness on second
- At the base of the rope put the foot stirrups on.
- Connect the safety tether to the harness at this point.
- Attach the rope to the system from the bottom up. Foot ascender--then knee ascender--then chest roller.
- Attach the bungee cord to the chest roller.
- Finally, attach the QAS above the roller and make sure it is secured into the seat harness carabiner.
(experienced climbers may choose to climb without a QAS)

Chest Harness Donning

Always tighten the chest first and the shoulder straps last. Position the 2" buckle between the user's armpit and the chest plate. The chest plate should ride high on the chest, well above the nipple line. The bungee cord should be sized using a high positioned chest roller as a guide.

Knee Ascender Adjustment

The knee ascender should be situated so that the bottom of the ascender rides in the middle of the kneecap. Any higher and there is a risk of the ascender slapping the user in the groin and any lower and the knee ascender can clash into the bottom ascender with each step

Operation

After securing all three ascenders to the rope, double checking to ensure that all screw gates are locked, ascenders are secured, and the roller is properly seated, begin climbing up the rope very much like you might walk up stairs. Take small steps at first. Establish a rhythm. Work on style and form. Watch your system work.

Climbing with Knots

Features of this System:

- Compact and light
- Classic way to climb, nostalgic
- Sit-stand motion requires a lot of energy
- Pushing or pulling knots up the rope can be tiring.
- Slow on and off the rope
- Climbing speed varies with skill and practice
- Climbing time on rope is considered overall slow
- Emergency procedures such as a changeover or pick-off is extremely difficult when using knots and a lot of practice is required.
- Back-up method that every leader should be able to pull from their pack in an emergency.

Tips

- Many times a gripping ascender hitch can be used to replace a lost or malfunctioning mechanical ascender.
- When climbing with a gripping knot try to keep it short. It should never be so long as to be above the user's head.

Ascending Methods

There are numerous ways someone can use knots to climb up a rope, but there are two knot systems that have surfaced as the most popular.

Texas Method

Connecting a knot from a seat harness to the main rope and another cord set from both feet up to the main rope we can achieve a pretty efficient sit-stand system.

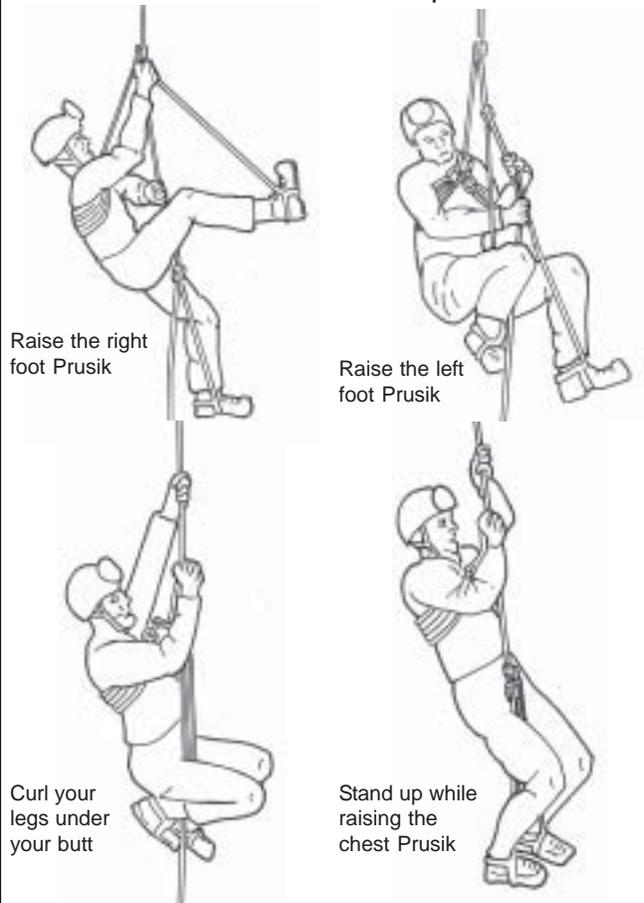
Knot Climbing Systems were among the very first ways that people were able to efficiently climb ropes. They have evolved and in their popular years (1950-1975) most of all the deep pits of the world were explored using Knot Climbing Systems.

Misconceptions

- The biggest misconception about knot climbing is that whenever everything else fails, knots will work.
- No prior planning has to take place to set in motion a knot climbing system that will work efficiently.
- Incorporating knots into a climbing system doesn't take that much planning and fore thought.
- Anyone can do it. This is intuitive, even easy.
- How much rope it takes to tie a knot. Tie knots and measure the rope when you're done. An 8 mm Prusik on 11 mm rope takes as much as 20 inches of 8 mm cordage to make a Prusik Hitch.

Classic Three Knot

This system requires a wide horse girth type of chest harness and three separate knots.



Rigging

Goals of the Rigging Unit

1. Can demonstrate the attributes of a safely rigged rope.
2. Pursues non-invasive rig points whenever possible.
3. Places a knot at the bottom of the rope and knows why.
4. Can deploy, coil or bag, and transport team gear to and from a rigging site.
5. Can set 3 bolts and hang from them.

Advice to the Student:

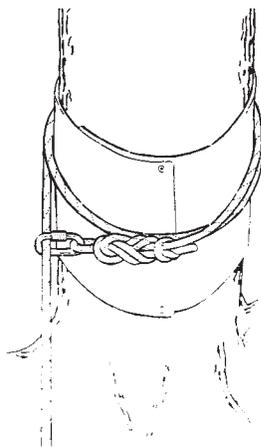
Seek several Mentors for this unit. Some people spend a lifetime pursuing and mastering this one single topic. Being a great rigger takes a lot of dedication and commitment. Be thorough with your quest to be a great rigger for as a leader your team will depend on you to provide safe passage.

Natural anchors are best. Seek non-invasive rig points whenever possible. Drilling holes in which to place bolts should be the last resort when looking for a suitable anchor. Setting the bolt causes it to expand in the hole. This exerts outward pressure on the rock, rendering it secure, but weakens the rock for several inches around the bolt placement.

“Ethically, bolts are only justified in the absence of a suitable alternative anchor...”
Montgomery

Read and research all you can find about bolt placement.

“Bolts can also remove one of cave exploring’s main technical challenges: that of constructing safe, well-positioned anchors using the natural features of the rock. The bolt-oriented caver may never see the hidden jug handle, or crack which only close scrutiny will reveal. Bolts are the easy way out....”
Montgomery



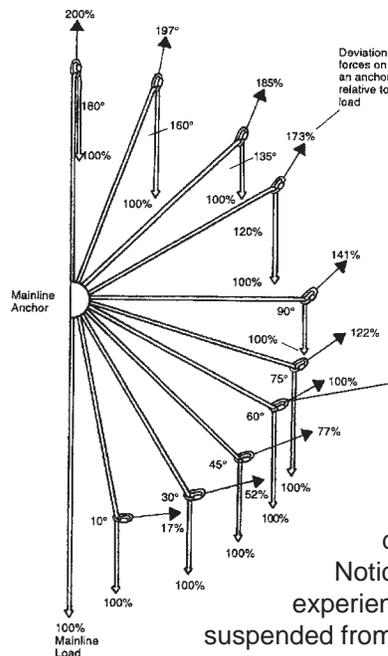
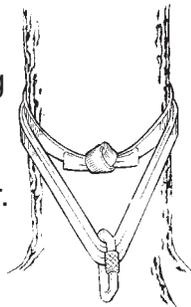
High Strength Tie-off

Two wraps around a tree with biner as shown provides almost 100% rope strength.

A rope pad can help to protect the cambrian of the tree’s bark.

Wrap 3-Pull 2

Webbing with a tied Ring Bend. This rigging has many applications and provides a strong anchor.

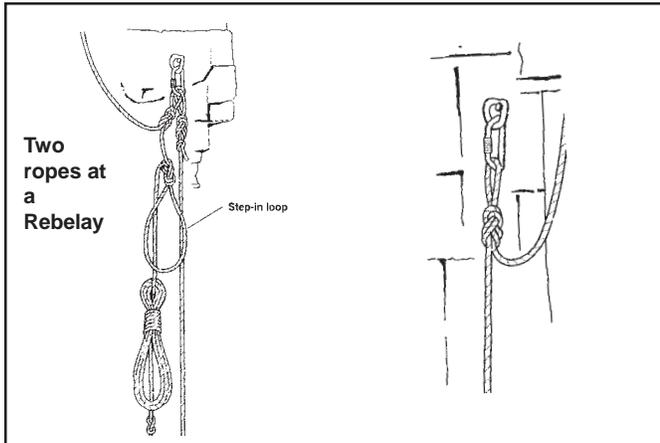


At this point. Forces on the Deviation equal the forces on the Anchor. Any deviation greater assumes more than the forces experienced by the load.

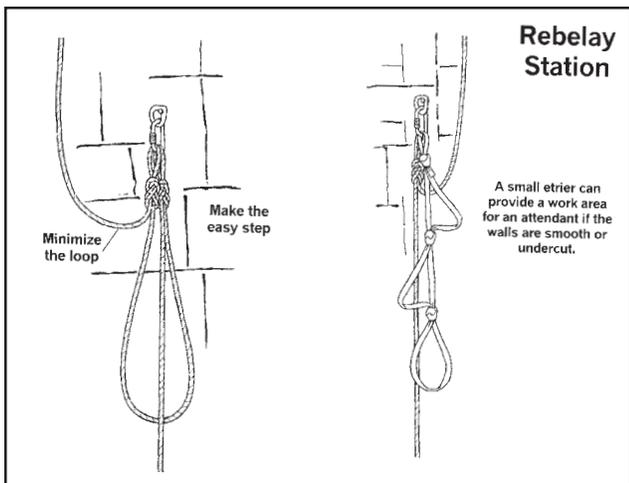
Know what forces the deviated anchor feels. Notice that a 90° deviation experiences 141% of the load suspended from the rope. What does a top roped climbing belay feel if the belay is secured at the bottom of the drop?

Rebelays

Be familiar with rigging a rebelay and become an expert at negotiating past them. Rebelay rigging techniques have become as common in North America as North American **one-long-rope** techniques. The primary advantage is that well placed rebelays can protect a rope from abrading itself on an exposed rock. The disadvantages stem from unsightly defacement to the pristine beauty of the cave.

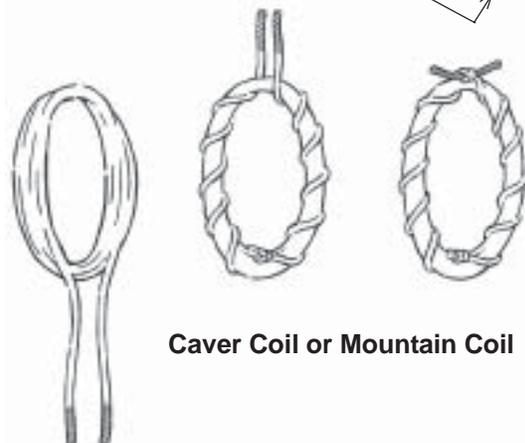
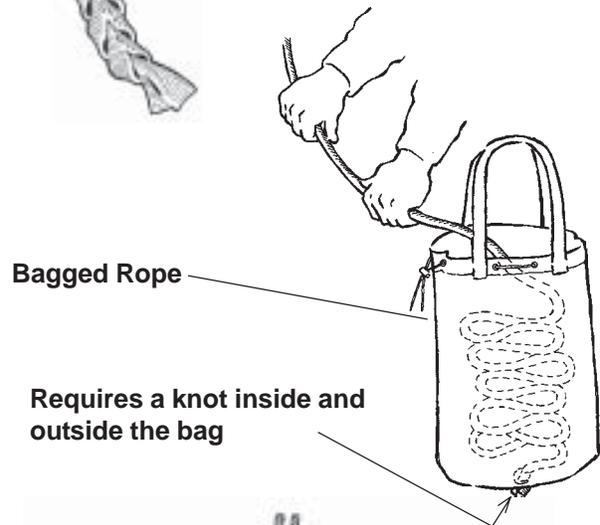
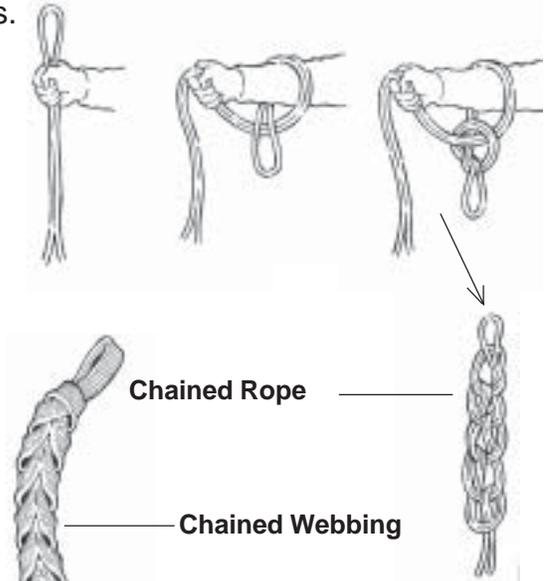


A **Rebelay** should be placed on or just below a rub point. The step-in loop must be kept small in case of anchor failure. There should be about 1 meter from the top of the metal anchor to the bottom of the loop. Turn your rope over to counteract sheath milking. Pictured here are several options that can provide rigging stations on a wall.



Rope Care

Know and practice the necessary care that a rope requires. If ropes get wet, they must be dry prior to bag storage or mildew will result. There are advantages and drawbacks about all the ways to transport rope. Know and understand the “whys” of all the ways.



Rescue Skills

Goals for this Unit

1. Student can safely build and operate a haul system.
2. Student can safely pick-off an injured climber from a rope and bring them to the ground.
3. Student can ascend/descend to an injured climber and rappel them to the ground.

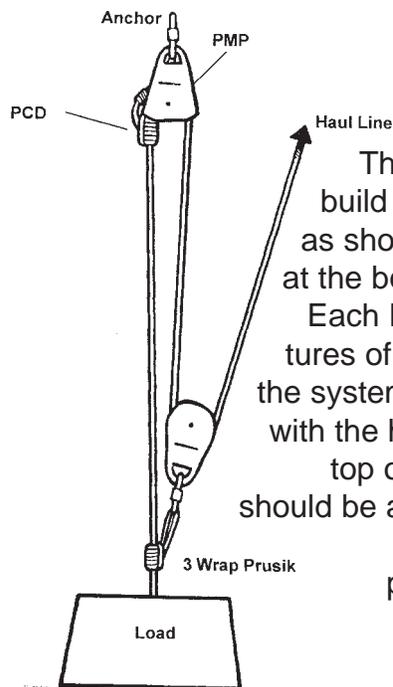
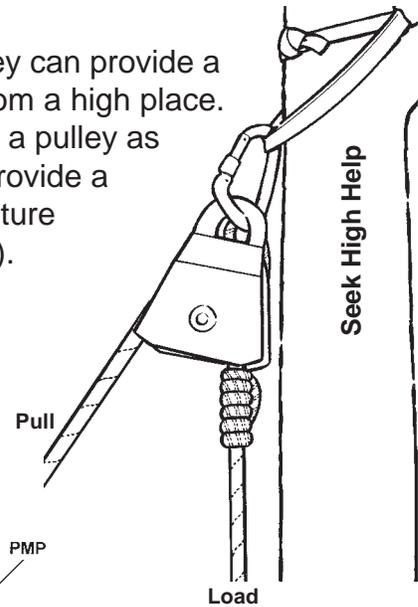
Rescue It is not uncommon that during the evolution of new caver's instruction problems may occur that they are unable to cope with. It may become necessary to haul them out of a pit that may have been too aggressive for them or challenged their skills to a point beyond their capabilities. Perhaps the training was thorough, but an unfortunate collapse has injured a member of the party and raising them out of a vertical challenge has become necessary.

If 2 or 3 people bring small pulleys in their packs to share the weight, it would be easy to set up a number of haul systems that can pull an injured person to safety.

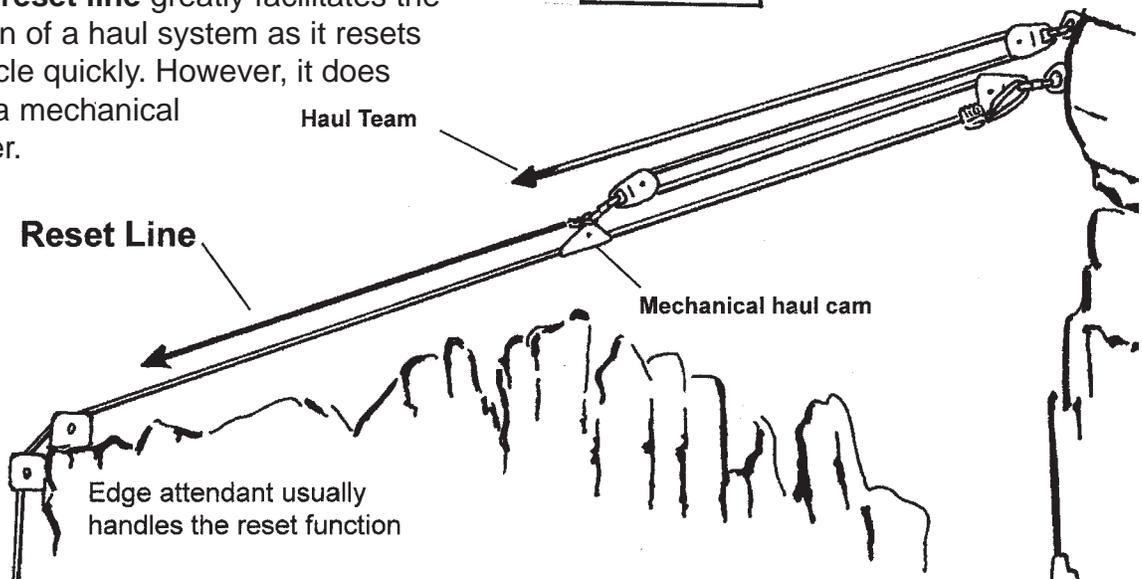
The study and understanding of haul systems requires dedication and substantial study. What is presented here is only a small taste.

Using a **reset line** greatly facilitates the operation of a haul system as it resets each cycle quickly. However, it does require a mechanical ascender.

A single pulley can provide a directional from a high place. A Prusik with a pulley as shown can provide a progress capture device (PCD).



The next option is to build a 3:1 haul system as shown on the left and at the bottom of the page. Each have different features of complexity. Build the system as shown below with the haul system at the top of the drop. There should be a haul line extending down to the person who needs assistance.



Rescue Skills

Pick Offs

1. When is a pick-off needed?

Hair or clothing entrapped
Stranded person on an exposed ledge
Fouled equipment
Injury or exhaustion
Typically, it will be an emergency.

2. Work through a logical thought process to ensure the most efficient process is used.
 - a. Placing a rescuer in harm's way by going to the individual should be the last option considered.
 - b. Every effort should be made to get the individual to complete the rappel or climb and allow them to self rescue
 - c. If necessary, carefully consider the following options.
3. Talk the participant through the problem from a distance.
4. Assume the participant has no second line (belay line) and is on a single line; a two rope pick-off is one option.

**Perform a scene survey first!
Don't let whatever got the
person in trouble get you!**

Perform an Assist

An "Assist" is the lowering or introduction of another rope to help the stranded person.

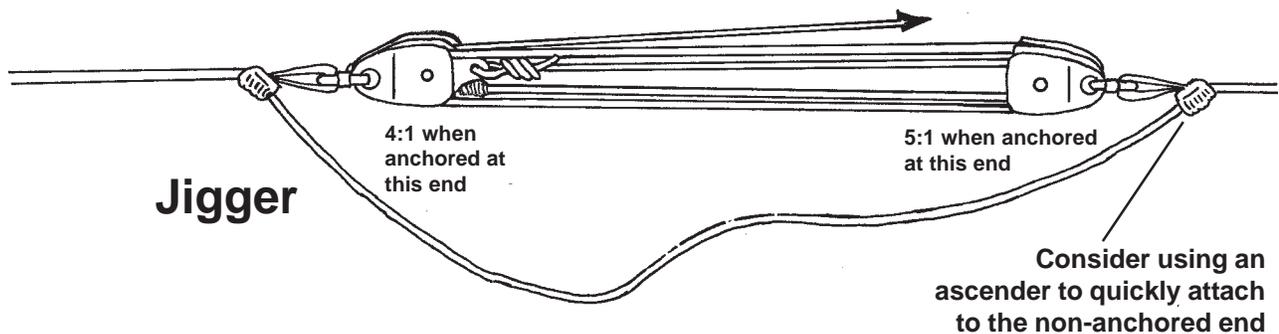
One Rope Conscious Pick-off (small party rescue with limited resources)

Research ways that this can be done.

Note: Advanced training is needed. These require extensive personal rope skills, changeover skills, and many hours of focused training.

Become an expert with a Jigger

The use of a **Jigger** to release tension from a loaded line can be one of the best tools in a rescuer's tool box. Other options are possible, but in the end, a **Jigger works best** by providing tensioning and slacking capabilities.



Important: It is best when rescuing a stranded person to lower them to the ground! Feed and warm them. Re-establish good blood circulation. Then raise them to safety. There are exceptions, but typically let gravity be your friend and get everyone out of harm's way as fast as possible. Fumbling with an ineffective raising system could kill your patient if it takes too long.

The long Prusik method provides only holding options and does not provide tensioning or slacking capabilities. Ask any experienced rigger. The versatile **Jigger** will be their tool of choice in their tool box. Jiggers can be used as the engine to enable a traveling haul system.

Caving

Goals of this Unit

1. Safely lead at least 3 multi-drop cave trips--taking change of rigging and the welfare of the participants.

The seven sections before this should have helped to prepare you for this last unit. Did it cover every skill you needed? Probably not. But hopefully it moved you ahead of the learning curve to ready yourself for the many challenges that remain underground. Just completing this intermediate course is the springboard to higher adventure and more fulfilling experiences that you were only teased by the in the Basic Vertical Course.

Through it all, cave softly. Cave responsibly. Use good judgment. Use prudence. Leave the cave when someone gets hurt. Leave the cave when indications of exhaustion start affecting the first party member. Leave the cave when half your primary light sources are gone. Reach a telephone within the time you told someone you would be out and safely. Monitor weather reports.

“To me the simple act of tying a knot is an adventure in unlimited space. A bit of string affords a dimensional latitude that is unique among the entities. For an uncomplicated strand is a palpable object that, for all practical purposes possesses one dimension only. If we move a single strand in a plane, interlacing it at will, actual objects of beauty and utility can result in what is practically two dimensions; and if we choose to direct our strand out of this one plane another dimension is added which provides opportunity for an excursion that is limited only by the scope of our own imagery and the length of the ropemaker’s coil.”

Clifford Ashley

Take every opportunity to ask your mentors key questions that will make you a better caver. As a leader, your bullet proof days are over. You are the designated driver. You are the one that cannot get hurt. You are the one who should not take chances. Caution should be your watchword. Side with conservatism.

Never put any of your team members at risk. Cater to the weakest member of your team. As a leader it is important to grow up quickly, but never forget the joys that caving and discovery gave you during your early years. Let your team lead the way now and then with your sage guidance always nearby. Carry your knowledge and experience softly, but always nearby for the unknowing to sip from. Let your team glow in the thrills of their own successfully lead trips and let them take pride in their achievements.

Take nothing but pictures.

Leave nothing but footprints, (and leave them in the right places).

Kill nothing but time.

NSS Motto



Return completed documents to the Vertical Section Training Coordinator. For questions, call
Bruce W. Smith 423-344-4716 work
6313 Jan Lane Drive 423-344-2345 home
Harrison, TN 37341 423-838-2626 cell

