This Trainee Trog is hereby dedicated to our favorite landowner, Mr. “Buddy” Penley. It's unfortunate that new VPI cavers will not have the opportunity to meet the man, but we should never forget him. The club still enjoys the fruits of our long standing relationship with him. All of our access in Skydusky Hollow has its roots in the club’s connection with Buddy and his family. He was the inspiration for the VAR Landowner Appreciation Award, which memorializes him. He was (and still is) our favorite landowner. Keep him in mind when you’re caving in Bland County.

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Fall 2002
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Vice President’s Message

Congratulations on becoming a prospective member of the VPI Cave Club!

Welcome to the VPI Cave Club, a student grotto of the National Speleological Society. You’ve just joined one of the oldest organizations at Virginia Tech, and the oldest student grotto of the NSS. We are one of the most active caving groups in the country. Our club was founded in 1943, making this fall our sixtieth anniversary. I am sure you will find our grotto a great group, not only to cave with and learn from, but a great group of people to become friends with. Caving is a unique activity, and everyone in our grotto has a love and respect for it.

You are now a prospective member, or “trainee.” You have paid your dues and received this special edition Tech Troglodyte dedicated to the essential information you will need to learn to be a safe and knowledgeable caver. Once you complete all the club membership requirements, you will be a full member of the club. Full members can lead their own trips, and, if they are a student, staff, or faculty member at Virginia Tech, may hold an office and vote at meetings.

One of the main purposes of our club is to promote interest in caving and to promote fellowship among those interested in caving. We are also very serious about cave conservation and safe caving practices. Our club is well known for our training program because we develop strong competent cavers who have explored caves around the world. We have also explored and mapped many of the caves in this area. There are an estimated five hundred or more caves within an hour’s drive from Blacksburg. Many of these caves are open to cavers because in the past, cavers have been very respectful of landowners. We work hard to make sure we keep a good relationship with cave landowners so we can continue to cave. There are many caves in the area that are closed now for various reasons. It is very important we respect these landowners’ decisions.

As vice president of the club my main job is to guide you through the training program. If you need any help getting your requirements signed off, let me know. And if I am busy (which I will be this fall), I will be sure to find someone to help you. If you enjoy caving, you have come to the right place! Cave smart, cave safely, and you will have a great time, and, you will have your membership before you know it.

Happy Caving,

Mike Cole, vp@vpicaveclub.org
Vice President
VPI 381, NSS 24606

Safety Chairman’s Message

If you are new to caving, you will find that people cave for a lot of different reasons. As you cave with different members of the club, you will get a taste of all the many forms of this sport. You will definitely learn that cavers have lots of opinions, but more importantly I hope you will learn how to think and be safe underground.

My job as safety chairman is to advocate safe caving. If you have an accident or close call underground, please report it to the vice president or me. All I am really interested in is making sure that the whole club learns from any individual mistakes so they will not be repeated.

Our tradition is that our own members train those who come after them. As a result, our club has constantly evolved with generations of cavers who are into surveying, vertical techniques, and just sport caving. You become the caver you want to be.

I hope you come to enjoy this sport as much as I have.

Cave Safely, and have a good year.

Mark H. Eisenbies, safety@vpicaveclub.org
Safety Chairman
VPI 313, NSS 32075
The VPI Cave Club Constitution

CONSTITUTION OF THE VPI CAVE CLUB
STUDENT GROTTO OF THE NATIONAL
SPELEOLOGICAL SOCIETY
(As amended April 5, 2002)
(Annotated Version)

The Constitution of our club contains all the basic rules for operation of the club as an organization. The Constitution also contains the guidelines we follow to remain safe underground and protect our fragile environment.

Below is an annotated version of the VPI Cave Club Constitution. The Constitution is in this font while the annotations are in the font you are reading now. The annotations will expand upon the basic ideas put forth in the Constitution, explaining why we follow certain rules in some cases and demonstrating concepts in other cases.

Article I
Name

The name of this organization shall be the VPI Cave Club, Student Grotto of the National Speleological Society (VPI is an acronym for Virginia Polytechnic Institute).

The National Speleological Society, or NSS, is the largest caving organization in the USA, and VPI is one of the original grottos of the NSS. Although regular members of the club are not required to be NSS members, it is highly encouraged. The NSS helps cavers and caving in general through funding of cave conservation and educational efforts, organization of a yearly convention where state of the art ideas and equipment are presented, and publishing a monthly magazine containing exploration and technology not only within the USA but also worldwide.

Article II
Purpose

The purpose of this club shall be to promote interest in, and to advance the science of speleology; to promote conservation of caves and safety in their exploration; and to encourage fellowship among those interested in caving.

New techniques and gear are constantly becoming available. Involvement with the club is an opportunity to see these in use, try them out, and find out what works best for you. In addition to new commercial products, cavers regularly innovate and modify their gear for specific cave tasks and difficult environments. Membership in the club is a great way to contribute to the caving community any new ideas of your own. The Cave Club is also a good place to meet people who share your interest in caving and many other non-caving activities.

Article III
Membership

Section 1: There shall be three classes of dues paying members: full, associate, and prospective. There shall be two qualifiers, inactive and life, as described in the By-Laws.

A. Full membership shall be restricted to students, faculty, or staff of VPI&SU who have completed membership requirements as stated in the By-Laws. Full members shall have access to club records and files and may use club equipment.
B. 1. Associate membership shall be reserved for those who have completed requirements for full membership but are not students, faculty or staff of VPI&SU. Associate members have all privileges of full membership except for the holding of an elected office and voting.

2. Faculty or staff who are full members may, for any semester for which dues have been paid, choose associate membership. Full membership may be reinstated upon written notification of the club treasurer during the first two weeks of any subsequent semester.

3. Students who are full members and who anticipate being absent from campus for a semester may choose associate membership for that semester.

By paying your Cave Club dues and getting this guide, you have already become a prospective member of the club, commonly called a trainee. You can cave with us, attend and speak at meetings, participate in any club activities, and generally hang out and have a good time with the club. While caving with us, you will be learning first-hand the things you need to know to be a safe, self-sufficient caver. That is what our Training Program, described in the By-Laws, is all about. Completion of the Training Program will result in full membership privileges such as access to the club gear and files, leadership of official club trips, and for students the ability to run for office.

C. Any individual may be invited verbally by the president and vice president to become a prospective member upon recommendation of a full or associate member. The prospective member must be willing to uphold the purposes and policies of the club. A prospective member may attend and address meetings, but may not vote or hold elected office.

Section 2: Honorary members may be recognized at the discretion of the club for their outstanding achievements or contributions to the club or the interests of the club. Honorary membership is a ceremonial title and holds no bearing on actual membership status.

Section 3: Dues shall be paid in a timely manner in an amount as stated in the By-Laws.

Section 4: Any prospective, associate, or full member may face disciplinary action, including possible loss of membership privileges, as defined in the By-Laws.

**Article IV**

**Officers**

Section 1: The elected officers of this club shall be: president, vice president, secretary, and treasurer. Election procedures are defined in the By-Laws.

Section 2: All elected officers must be full members and currently enrolled full-time students at VPI&SU at the time of the election and throughout the duration of their term. If an officer is not an NSS member, membership must be applied for within one month of the election.

*The VPI Cave Club is a Student Organization at the university, so our officers must be students. As an official grotto of the NSS, those officers must be members of the NSS. There are many older associate members (alumni and others) of the club that participate actively in the club, but ultimately this is a student group and is run by students.*

**Article V**

**Committees**

Section 1: Standing committees shall be the Equipment Committee, Safety and Techniques Committee, Publicity Committee, Project and Program Committee, Conservation Committee, Supplies Committee, and Executive Committee.

Section 2: Special and ad hoc committees may be established by the president or by action of the club by simple majority vote.
Article VI
Amendments

Section 1: Amendments to this Constitution may be submitted by motion of any full member and then tabled after passing with a simple majority of votes from full membership.

Section 2: An amendment must be voted on no later than three meetings subsequent to its proposal, and the full and associate members of the club must be specifically notified of the date of the vote and the nature of the amendment in writing.

Section 3: A 3/4 majority vote of the full membership shall be required for the adoption of any amendment.

Article VII
By-Laws

Section 1: The club shall establish a set of By-Laws for the purpose of amplifying and explaining in detail certain sections of the Constitution.

Section 2: The By-Laws may be amended as follows:

A. A motion to amend the By-Laws may be introduced by any full or associate member.
B. If the motion is “seconded” it is automatically tabled.
C. The secretary must notify the members of the amendment in writing.
D. Final action shall be taken at the next meeting by a 2/3 vote of the full membership.

By-Laws
Safety Code

Believe it or not, the VPI Cave Club is one of the most active caving organizations of its size in the world. We log several thousand caver-hours underground per year, and our safety record is very good. We have had our share of accidents and near misses, but as a whole this is a very good group of experienced cavers. However, caving is an inherently dangerous sport; you can get hurt and you can die. As a result, SAFETY should be on the forefront of every caver’s mind. It is very important that you learn to evaluate situations carefully and do your best to minimize the risks. Mother nature always sides with the hidden flaw, so it’s important to check and recheck the way you do things underground.

The rules below are simple, yet represent lessons learned the hard way by the cavers that have come before us. Following these rules on any club trip is a very serious matter, and violation of them will result in disciplinary action being taken by the club against you.

Section 1: General Safety

A. Never cave alone. It is recommended that at least three people be on any caving trip: at least one full or associate member on horizontal trips and at least two full or associate members on vertical trips.

Two full or associate members are needed on vertical trips. We like to have at least one experienced person at the top of a drop checking everyone’s gear as they get on rope, and at least one experienced person at the bottom to give a belay and to assist the rappeller if there is a problem on rope. Many common problems you might encounter on rope are more easily solved by an experienced caver below you. This item of the constitution is one of the foundations of our “members must be first and last of a group up or down the rope” policy.

B. Everyone participating in a trip should be physically and mentally capable of caving on that type of trip. Mind altering substances will not be used immediately prior to or during a cave trip.

Safety on a caving trip is EVERYONE’s responsibility. If you feel that something on a trip is unsafe, or you are unsure about your or someone else’s ability or physical condition, be confident that it is your right to bring this issue up with the trip leader. Safety concerns should be raised with the trip leader, and will be addressed on equal terms and with mutual respect no matter who brings up the issue.
C. No one should exert themselves or be forced to exert themselves beyond their limit of endurance.

On a club trip, you will never be compelled to do something you are not able to do, or that you do not want to do. If you are tired and need to turn back, or do not feel comfortable with a particular climb, tell the trip leader. It is better to shorten a trip than to cave to exhaustion and require assistance getting out.

D. If all lights fail, wait in place.

Caves are totally dark; without your light you will be unable to avoid dangerous situations such as pits or falls, and at the very least you will quickly become disoriented and lost if you start moving around. All club caving trips are signed out, which means others know where you are and when you are due back. If you wait patiently you will remain safe and others will come to find you within a reasonable time.

E. Avoid jumping.

The light cast from your headlamp underground is much different than regular room light or sunlight because it emanates from a single source. This makes it difficult for your eyes to determine the depth of drops and the slope of the ground at the bottom. Many broken or twisted ankles have resulted from cavers jumping down a small incline only to discover it is more slick than believed, or deeper than they thought. In addition to the danger of injury, you do not know the strength of the floor you are jumping on, and you do not know if you will be able to climb back out of what you have jumped into.

F. All equipment should be in working order and pass inspection before entering the cave.

For your own safety you should take care of your gear. You will also have a much better time on the trip if your equipment works correctly the whole time. And remember that you are an important part of the group: if you're having gear problems, everyone else’s safety and enjoyment will be affected also.

Section 2: Equipment

A. General equipment per person:

1. Hard hats with suspension, chin-straps, and a mounted light source are mandatory while caving.

   We strongly recommend a quality caving or climbing helmet with a four-point suspension and certification by CE and/or UIAA standards. Ask an experienced member for advice on a helmet purchase as this is one of the most important pieces of gear you will buy. A good, comfortable, and safe helmet will last you for many years. Wearing your light source on your helmet leaves both hands free to climb, crawl, and otherwise move safely about the cave. Use of a hand-held light risks losing or breaking your light if you drop it.

2. At least three (3) sources of light, each providing sufficient light to exit the cave under reasonable circumstances.

   Many VPI Cave Club members use carbide lamps as their primary light source. They are fairly inexpensive to fuel and can be used as a heat source. A helmet-mounted electric lamp is also commonly used both as a primary or secondary light source. The third source can be a flashlight (Mini Mags or simple LED lights work well) carried either on your person or in your pack.

3. Supplies for light sources.

   If you carry several electric lights, consider using lights that use the same spare parts and batteries. A multi-tool, such as the Leatherman, is great for in-cave repairs of many types of gear including both carbide and electric lights.


   Caves in our area are typically 52-54°F (11-12°C). If you are wet or need to sit for a long time underground, you will get dangerously cold in a short period of time. This is why so many VPI cavers still use carbide lights...they are warm! If you don’t use carbide, carry a candle or other suitable heat source.

5. Trash bag or space blanket.

   Believe it or not, a trash bag is a very important piece of emergency gear. If you become wet and cold while caving, cut a hole in the bottom of the bag for your head to fit through and pull it over your body. The bag serves as a vapor barrier that drastically slows evaporative cooling from your clothes and body. If you put your carbide lamp or a candle under the bag with you, it becomes a “heat tent” which will conserve your body heat and prevent hypothermia. Hypothermia is the most common and most serious danger faced while caving. Be sure to read and understand the article which details the symptoms and treatments for hypothermia.
6. Energy ration (candy bar, etc.).
   Everyone has their own preference of caving food, from candy bars to spaghetti. See what others bring along, try different things, and decide for yourself what works best. Pay attention to your own body and its energy needs. Be sure to include water with your “energy ration.” Cave water is not drinkable, and even slight dehydration will make you weaker.

7. Gloves, heavy boots or shoes, heavy clothing, or cave specific clothing are advisable.
   For your first trips, you will generally be fine wearing old blue jeans, a long sleeve shirt, and sturdy hiking boots with good soles and decent ankle support. Sneakers are not a very good choice. Your clothes will take a lot of abuse; don’t wear anything near or dear to your heart. If you are slight of build or tend to chill easily, wear a layer of polypropylene long underwear, or at least carry this with you. Wearing several layers is a very good technique for regulating your temperature underground. Cotton long underwear and sweatpants are not very good for caving as cotton soaks up a lot of mud and water and never dries out.

B. Appropriate type and quantity of equipment shall be taken on all caving trips.
   You should bring a pack to carry your stuff in. If you are going to a cave you haven’t been to before, ask some of the experienced members if there is anything specific you might need to bring on the trip such as vertical gear or extra clothes. Pay attention to what experienced members carry with them to each cave and think about why each item is included.

Section 3: Procedure

A. Always inform someone of the whereabouts of the caving trip, the expected time of return and appropriate phone numbers.
   Sign-out is the PROCESS of letting someone reliable know where you are going and what time to expect you back. If you are not signed back in by that time, a rescue party will come looking for you. Sign-out is NOT just signing a piece of paper at someone’s house. Someone must be watching over it for it to work properly. The VPI Cave Club provides a sign-out sheet posted at a local caver’s house. Your sign-out should always include the full names of participants, location of cave, date, time leaving town, estimated time of your return (ETA). When you get back, add a check indicating that you are back, the length of the trip, and comments.

B. Observe surroundings: respect landowners’ wishes and be considerate of their property.
   Most of the caves in this area are located on private property, which means it is a PRIVILEGE, not a right, to explore these fascinating places. For most of the caves, many cavers have invested countless hours in establishing a good relationship or friendship with the landowner. Some landowners do not have a preference for who visits the caves, others are very strict on their policy, and others are somewhere in between. Please be considerate of the landowners’ wishes, because one person can ruin the privilege for the entire caving community.

C. If possible, consult someone who is familiar with the cave.
   In addition to learning any special gear required in the cave, you will also learn if the cave has any seasonal closures and if there are specific places you should park, landowners to contact in advance, or permits to acquire.

D. All rigging is to be checked by a full or associate member. Ropes should be protected from fraying. All group members should be satisfied with rigging before it is used.
   The rigging techniques taught by VPI are very good and apply to a wide variety of situations. As a prospective member of our club, you will be expected to rig using the knots and techniques taught by our members. Once you have achieved membership, you can explore techniques which best suit your caving style.
   If you are concerned about the rigging on a cave trip, discuss it with the trip leader. The leader will evaluate the rig and either re-rig as needed or explain the rig to everyone’s satisfaction in order to dispel your concerns.
   Cavers from other grottos may rig using techniques different from “the VPI way.” Keep in mind that different does not necessarily mean wrong or unsafe. Learn as much as you can about knots and rigging techniques so you will be better equipped to evaluate the rigging of others.

E. Never leave a prospective member or other inexperienced caver alone.
   Basically, this means that VPI cave trips stick together. For example, don’t leave the group to explore on your own. No one should be left behind because they are slower than the rest of the group, or can’t fit through a tight space or make it up a climb. No one should leave the cave alone. If someone must leave the cave the trip should be split with full or associate members in each group, or the entire trip should turn back together.
F. A belay should be used on every person on a ladder. No belay shall be used when ascending a rope. Prospective members or other inexperienced cavers must accept a belay when requested to by a full or associate member. Anyone desiring a belay shall have one. The first person to descend a rope shall ensure that those following have a belay. The order of ascent and descent shall be determined by a full or associate member on the trip.

G. An appropriate loop knot should be tied on the lower end of any rope used for rappelling.

This is last, but it is among the most important safety rules in vertical caving. Rappelling off the end of a rope which did not reach the bottom of a drop is one of the most common fatal underground accidents. A knot in the end of the rope will prevent your rappel device (and thus you) from leaving the end of the rope, and also provide a handy loop to stand in while you turn around and climb back up to get a longer rope!

So what if you screw up and break the rules? Someone will speak with the safety chairman, an appointed officer who investigates accidents, near misses, and complaints of safety violations. The safety chairman will discuss the matter with you to find out what happened and to make sure you understand the reasons behind that particular safety rule. If the matter is especially important, the safety chairman may bring it up at a meeting so that everyone can evaluate the incident and learn something useful.

So what if you see someone else screw up and break the rules? During the cave trip you should bring it up to the trip leader. If for some reason you do not feel comfortable bringing it up during the trip, speak with the safety chairman afterwards. Do not worry about pointing the finger at someone else; you may be preventing future accidents by discussing the matter now. The safety chairman will then follow up as described above.

The safety chairman will in all cases be firm but fair. The purpose is not to punish or embarrass anyone, but to make sure everyone understands the importance of our safety rules so that we can all enjoy safe caving experiences. However if someone ignores the safety chairman when confronted on an issue or shows blatant or chronic disregard for safety, the cave club has recourse. See the section of the Constitution on Disciplinary Action for more information.

Membership

Section 1: Qualifiers

A. The qualifier “inactive” applied to any of the membership categories shall denote that said individual has not paid current dues and therefore retains only the privilege of attending and addressing regular meetings. Payment of dues shall result in automatic reinstatement of the membership previously held and all privileges thereof.

B. The qualifier “life” shall be applied to any full, associate, or prospective member of the VPI Cave Club upon receipt of life membership dues. Life members shall have any membership privileges for which they qualify, but are exempt from yearly dues.

Section 2: Training Program

The VPI Cave Club training program shall develop educated cavers consistent with Article II of the Constitution. The training program shall develop the basic skills to be safe and self-reliant underground. To be qualified as a full or associate member of the club, a prospective member must:

A. Read and understand the Constitution and By-Laws of the Cave Club.

B. Remain a prospective member for at least 10 weeks during which time he/she spends 40 hours underground on at least 6 trips on which at least one full or associate member is present.

New people of widely differing ability and previous experience are constantly getting involved in the VPI Cave Club. In order to maintain a high level of safety and experience, the club instituted a structured training program. No matter if you have never heard of a cave or have been caving for 50 years, in order to become a full or associate member of the club you must go through the training program. At first this seems intimidating, but realize that just by actively caving with us for a semester or two you will complete most of the requirements. The rest is knowledge which will serve you well caving and throughout life in general.

C. Demonstrate a working knowledge of a carbide lamp.

They may be antiques, but the carbide lamps are a very reliable light source and heat source. You do not need to use a carbide lamp on our trips, but this requirement is here because so many others use these lamps that you should learn how they work so you can help others.
D. Demonstrate elementary climbing skills in a cave.

*What this means varies from member to member, but ultimately it only means that you must safely and competently negotiate the types of climbs found in typical area caves. After a few trips with the club, most trainees can confidently display this skill.*

E. Demonstrate a working knowledge of belaying methods.

*You typically need to successfully belay a climber on a cable ladder and belay a rappeler using a bottom belay. Generally you will practice these after being shown the technique, and then take a skill test another day to demonstrate your working knowledge.*

F. Be able to tie a seat with webbing to the vice president’s satisfaction.

*The required seat is discussed separately in this guide.*

G. Demonstrate a working knowledge of change-over from descending to ascending and ascending to descending.

*You should take this test with gear you would typically use on a caving trip, not gear borrowed just for the test. Being able to change-over is an extremely important safety skill in vertical caving.*

H. Demonstrate a working knowledge of rappelling and prusiking, with knots, in a cave.

*You should take this test with gear you would typically use on a caving trip, not gear borrowed just for the test. Being able to change-over is an extremely important safety skill in vertical caving.*

I. Demonstrate how to rig and pad a rope correctly.

*This is done on a cave trip after you have been caving for a while. You will be asked to rig several drops; typically one of them is somewhere you have not seen rigged before.*

J. Know how to tie and explain the uses of: bowline, mountaineering bowline (double bowline), bowline on a bight, bowline on a coil, figure-8, figure-8 on a bight, alpine butterfly, square knot, overhand knot, Münter hitch, water knot, helical, prusik, double fisherman’s bend. (Knot names taken from *On Rope* by Alan Padgett.)

*The knot section in this guide covers each of these plus some other useful knots in detail.*

K. Complete satisfactorily a comprehensive general information quiz.

*This written test is usually given as you near the end of the training program, and includes a wide range of topics, among which are caving techniques, details about local caves and cavers, and club history. The best way to prepare for the quiz is to cove often, learn and understand the reasoning behind our rules, and attend club functions where old farts will be talking about “back in the day...”.*

L. Be endorsed by a full or associate member in good standing.

M. Submit to the editor a suitable article for publication in *The Tech Trogloidyte* allowing reasonable time for review and revision.

*The Trog editor will accept trip reports and many other kinds of articles. If you’re having trouble finding a suitable topic, check with the editor or officers for suggestions.*

N. Be approved by a 2/3 majority vote of the full membership.

**Disciplinary Action**

Section 1: Any prospective, associate, or full member who has allegedly committed an infraction of the VPI Cave Club Constitution, or By-Laws, or upon recommendation of the Safety and Techniques Committee, may face possible disciplinary action in the form of a reprimand, suspension, or expulsion, as defined below.

Section 2: A. Levels of disciplinary action:

1. **Reprimand:** A reprimand shall be the lowest level of disciplinary action and shall be noted in the minutes.
2. **Suspension**: A suspension is the intermediate level of disciplinary action. A suspension shall be reduction of an associate or full member’s rights to those equivalent to prospective member status. A prospective member cannot complete any membership requirements while on suspension. The time period for a suspension shall be fifteen (15) weeks after which time the previous membership status is reinstated.

3. **Expulsion**: An expulsion is the highest and most severe level of disciplinary action. An expelled person is ejected from the club and all club functions and current dues are returned. Previously completed membership requirements are null and void. A person expelled from the club can only rejoin the club by being allowed to restart the training program by 2/3 majority vote by secret ballot.

B. **Procedure**:

1. A member of any class may bring a complaint for disciplinary action to the president.
2. The president shall convene the Executive Committee to evaluate the complaint.
3. Upon review, the Executive Committee shall bring the complaint to the club, within two regular meetings of the receipt of the complaint, with a recommendation for action.
4. The Executive Committee’s recommendation shall constitute a motion.
5. If the motion is to dismiss the complaint, upon a “second” it may be voted on at the current meeting and requires 2/3 majority vote to pass.
6. If the motion is for a level of disciplinary action, as defined above, upon a “second” the motion will be tabled until the next regular meeting.
7. The accused shall be given notice of the tabled motion at least three (3) days in advance of the meeting in which the final vote is to be taken and shall be given ample opportunity to present a defense before the club.
8. At the meeting following the tabled motion a discussion on the accused’s infractions will occur. At the close of the discussion a secret ballot shall be taken to determine whether or not action will be taken on the disciplinary measure.
9. A vote to take action must be passed by 2/3 majority of full members.

**Officers**

Section 1: The officers of the club shall be elected by ballot from candidates nominated from the floor. The order of election shall be president, vice president, treasurer and secretary. To be nominated, a member must meet the qualifications of Article IV, Section 2 of the Constitution. A separate ballot shall be voted for each office. A simple majority of the votes cast shall be necessary for election. In case there is no majority, the candidate with the lowest number of votes shall be dropped and a re-vote for the remaining candidates shall be taken. The election shall be held at the tenth regular meeting of the spring semester. The officers elected shall assume their duties at the end of the meeting during which elections were held and hold office until the elections of the following spring. A 2/3 vote of full members shall be necessary to invalidate the election.

Section 2: If the president and vice president are absent during the summer, the president shall appoint a president pro tem from among the full members available.

Section 3: In event of the resignation or release from office of an officer, a special election shall be held at the next regular meeting to elect a member to the office for the completion of the term of office.

Section 4: The duties of the president shall be:

A. To preside at all meetings and call special meetings.
B. To act as an ex-officio member of all committees.
C. To represent the club officially in all matters except those which require the cooperation of the treasurer.
D. To make appointments to special committees unless provision is made otherwise in the resolution establishing the committee with the approval of the majority of the committee members.
E. To make appointments to standing committees and to appoint committee chairmen and to remove appointees.
F. To make arrangements for the meeting room.
G. To appoint an editor for club publications.
H. To appoint a club parliamentarian.

Section 5: The duties of the **vice president** shall be:

A. To assume the president’s duties during the president’s absence.
B. To assist the president as the president shall require.
C. To countersign as authorizing officer vouchers for the expenditures that have been authorized by the club.
D. To be an active participant in the safety committee as director of the new member training program.

Section 6: The duties of the **treasurer** shall be:

A. To have charge of the finances of the club.
B. To keep an accurate record of the finances of the club, including balancing records weekly.
C. To collect any and all dues and fees which the club shall authorize.
D. To give a complete report on the financial status of the club at every regular meeting.
E. To keep a list of the club members and their status, and to make this available to all members, faculty advisors, and at all club meetings.
F. To make disbursements when authorized by motions passed by the club and only when so authorized.
G. To comply with regulations of the VPI Office of Student Affairs pertaining to finances.
H. To allow no transactions to occur without proper receipts.

Section 7: The duties of the **secretary** shall be:

A. To keep a record of all club proceedings of all meetings of the club and place a copy in the club files, within two academic weeks.
B. To keep a phone list of the members of the club and to make this available to all members and faculty advisors.
C. To conduct correspondence for the club as directed by the president.
D. To notify the NSS of changes in officers and other pertinent information.
E. To notify faculty advisors of proposed amendments to the Constitution or the By-Laws.
F. To make note of proxy votes.
G. To provide timely notification to club members of issues as specified by the Constitution or By-Laws.

Section 8: A. An officer may be impeached for specific and willful infractions of the Constitution, the By-Laws, or the policies of the club.

B. 1. A motion to impeach stating specific infractions shall be made by a member, committee, or other officer.
   2. The motion shall be automatically tabled upon a “second” to the next regular meeting.
   3. The officer shall be given notice of the motion at least three (3) days in advance of the meeting in which the vote is to be taken, and be given ample opportunity to present a defense before the club.
   4. Final action shall be by secret written ballot and will require a 2/3 majority vote of the full membership for removal from office.
Advisor

If desired, any person may be elected as an advisor to the club by a simple majority of votes from full membership.

Meeting and Quorum

Section 1: A. To constitute a meeting for the transaction of business, a quorum shall constitute one half (1/2) of the full membership either in person or represented by proxy.

B. The secretary shall be notified of each proxy before a vote. Blanket or continuous proxies shall not be held.

C. Meetings shall be held Fridays at 7:00 P.M. during the academic year.

D. Meetings shall comply with Robert's Rules of Order.

Dues

Dues for prospective members, full members and associate members shall be seven dollars and fifty cents ($7.50) per semester. Life membership shall be one hundred dollars ($100.00), payable in installments, to be paid in full within one year of the first installment.

The club gear is maintained primarily by money raised through dues. The club publications, including this one, are paid for by dues. Our dues are very low and paying them should be a high priority for even financially strapped members of the club. You must have paid dues to receive the Tech Troglodyte Prospective Member Guide and to complete the membership program.

Committees

Prospective members are truly welcome and encouraged to participate in the club’s committees. The Publicity, Conservation, and Project and Program Committees are always in need of new ideas and active participation. In addition, several ad-hoc committees form throughout the year for the organization of club events and parties. These committees are often led by trainees.

Section 1: It shall be the duty of the Safety and Techniques Committee to:

A. Supervise the new member training program.

B. Encourage safe caving practices and recommend disciplinary action where necessary.

C. Present periodic programs on current safety practices.

D. Submit a written report to the president upon request.

E. Oversee maintenance and inventory of club rescue gear.

F. The Safety and Techniques Committee shall consist of the safety chairman, the president, the vice president, former safety chairmen, former presidents, and vice presidents, and anyone that the president or safety chairman deems necessary.

Section 2: It shall be the duty of the Publicity Committee to:

A. Communicate with incoming freshmen and the student body on the availability and activities of the club.

B. Submit articles to the school newspaper, etc., on the club’s activities.

C. Publicize any activities which may be open to other groups.

D. Submit to the files such material that may be printed by or about the club.

E. Submit a written report to the president upon request.
Section 3: It shall be the duty of the **Conservation Committee** to:

A. The chairman of the Conservation Committee shall be a member of the National Conservation Committee of the NSS.

B. Encourage projects and better practices in cave conservation.

C. Instruct new members on the principles of cave conservation.

D. To bring to the attention of the club any violation of the club’s policy of conservation.

E. To scrutinize the mailbag for any material related to cave conservation.

F. Submit a written report to the president upon request.

Section 4: It shall be the duty of the **Project and Program Committee** to:

A. Plan and coordinate club projects, special activities, and social functions.

B. Plan and make arrangements for programs to be presented periodically at the regular meetings.

C. Submit a written report to the president upon request.

Section 5: It shall be the duty of the **Supplies Committee** to:

A. Buy equipment for sale to the club members and prospective members out of a special revolving fund established for this purpose.

B. Make equipment available for sale at all meetings to all dues paying individuals.

C. The fund shall be increased by semesterial appropriations until such time that it becomes self-sustaining. The fund shall be allowed to draw upon the club treasury in the form of loans when additional funds become necessary.

D. The Supplies Committee shall notify the treasurer of all transactions, and shall submit a report to him upon request.

Section 6: It shall be the duty of the **Executive Committee** to:

A. Preside over disciplinary proceedings.

B. Act for the club in emergency situations when it is not feasible for the club to meet.

C. The Executive Committee shall consist of the officers, the head of the Safety and Techniques Committee and other person(s) appointed by the president.

**Club Files**

Section 1: Maintenance: The president shall appoint a person to keep and maintain the files.

Section 2: Substance: The club files shall consist of cave maps, trip reports, meeting minutes, cave related publications, membership related material, and historical material.

Section 3: The file chairman shall submit a written report to the president upon request.

**Club Trips**

Club trips are caving trips which are recognized by the VPI Cave Club and which follow the spirit and intent of its Constitution and By-Laws. A caving trip is recognized if it has at least one full or associate member on it and it is properly signed out. (See By-Laws, Safety Code, Section 3.A for definition of a properly signed out trip.)
Club Savings

Section 1: The club shall establish a savings fund to be placed in an interest drawing savings account.

Section 2: The savings fund shall be drawn upon only for investments of long range importance to the club.

Section 3: The savings fund shall be increased by semesterly appropriations when possible.

Club Publications

Section 1: The grotto shall publish a periodic journal to advertise grotto projects, trips, and other activities. It shall further contain material of scientific and technical interest to the caving world.

Section 2: The title of this publication shall be: The Tech Troglodyte.

Section 3: The format and journalistic style shall be set by the editor.

Section 4: The circulation of this publication shall be to all members and prospective members who have paid current dues. In addition, the NSS library and all other grottoes which offer their publication in exchange shall receive this publication. An exchange editor will be appointed by the president for these duties, and he/she will cooperate with the mailbag person to keep an updated exchange file.
Basic Caving FAQ

The annotated Constitution and other articles in this guide cover the majority of the topics required for safe and responsible caving. This article provides more details on some of the topics not covered in depth elsewhere.

What is sign-out? What is the proper sign-out procedure?

Sign-out is the PROCESS of letting someone reliable know where you are going and what time to expect you back. If you are not signed back in by that time, a rescue party will come looking for you, thinking you are lost, injured, or something has gone terribly wrong. Sign-out is NOT just signing a piece of paper at someone’s house. Someone must be watching over it for it to work properly.

The VPI Cave Club provides a sign-out sheet posted at a local caver’s house. The sheet includes the names of participants, location of cave, date, time leaving town, estimated time of arrival (ETA), check back, length of trip and comments.

A. Be sure the sign-out sheet has all of the necessary information:
   - Full names of all participants.
   - Phone number of trip leader.
   - Cave name and location. Most caves are well known and there is little question about where they are. New or obscure caves (locations) present a problem. Leave a map at the sign-out if possible. If you want your cave to remain a secret, leave the map in an envelope.
   - ETA. This is the time you expect to arrive back into town. This includes travel time, getting organized, cleaned up, drinking a beer, getting lost, drinking a beer, and signing back in. If you miss your ETA, we assume the worst and call out a search party to come looking for you. We will attempt to contact you at your house first (sometimes people forget to sign back in). Do not be too liberal on your ETA because if something does happen, you may be miserable for some time.

B. Do not forget to sign back in AND return all borrowed gear (especially club gear). It is a good idea to get in the habit of doing this. All club gear should be returned cleaned and repaired. If a piece of equipment was damaged on your trip, please notify sign-out that it needs to be repaired.

C. The sign-in and sign-out times should be reasonable. Do not have an ETA between midnight and 8 A.M., if possible. This causes a burden on the sign-out dwellers. To avoid confusion, please put “noon” or “midnight” instead of “12:00 A.M./P.M.”. Military time is good.

D. Once you get back into town, a simple “check” in the box is all that is necessary. It is always fun to leave the time of trip and a comment. Be creative!

E. A rescue callout is a very serious matter. People will drop whatever they are doing to join the rescue effort. They may risk their jobs or miss important activities. Talk of a rescue may cause the landowner to close the cave. If you miss your ETA for some reason other than a legitimate need for rescue, you will be very unpopular.

F. Be considerate of the sign-out residents. They provide a valuable service to the caving community. Consider inviting them along on your trip. Do not dump carbide or other trash at sign-out.

What are landowner relations?

Most of the caves in this area are located on private property, which means it is a PRIVILEGE, not a right, to explore these fascinating places. For most of the caves, many cavers have invested countless hours in establishing a relationship or friendship with the landowner. Some landowners do not have a preference for who visits the caves, others are very strict on their policy, and others are somewhere in between. Please be considerate of the landowner’s wishes, because one person can ruin the privilege for the entire caving community.
Here are a few tips:

A. **If you don’t know, don’t go!** Before you visit a cave, please ask a member about the proper policy for visiting the cave. These policies are constantly changing, almost to the point where it is hard to keep up with the latest information.

B. Leave gates as you find them. If it was closed and locked, open it, pass through, close and lock it behind you. If it was open, leave it open. The last thing a farmer wants to do is chase down his cattle on a Saturday night because of an open gate.

C. Respect the grass and crops. Some of the landowners make a living off of livestock, which feed on the grass. Do not destroy the grass. Do not spin your tires in the grass.

D. Some caves are listed as bat hibernatums by the state and are off-limits during the winter months.

E. Double check for litter just before you leave. Clean up after yourself and others who may have carelessly left some litter behind.

F. Do not dump spent carbide anywhere on the landowner’s property.

### Which Thermal Underwear Works Best?

Short answer: Polypropylene.

Longer answer: Air is the best insulator. The more air trapped in a material, the warmer you will be. This is the main reason that thicker clothing is warmer; more air is trapped against your body. The insulating value of a typical dry piece of clothing will be mostly a function of this trapped air, and a smaller function of the actual material. If your clothing is completely soaked, its insulating value is mostly a function of the trapped water, over 20 times worse than it was dry! The real advantages of modern fabrics are that they do not hold as much water, and they dry much faster.

The retained moisture percent is defined as the amount of water a completely dry fiber will absorb from the air at a standard condition of 22°C and 65% relative humidity. It is expressed as a percent of the dry fiber weight. If you get soaked and wring out your clothes, this is about the percentage by weight of the clothing which will still have the insulating value of water (over 20 times worse than before). The lower this number is, the warmer you will be. Although caves are not 22 °C and 65% relative humidity, the data below clearly show the superiority of modern fabrics over natural fibers with respect to retaining good insulating properties after getting wet.

These numbers are for heat conduction. Once you are wet, the convection of evaporating water will dramatically increase your rate of heat loss (unless you are wearing some kind of vapor barrier such as a plastic suit).

<table>
<thead>
<tr>
<th></th>
<th>Relative thermal conductivity of common clothing materials of equal thickness.</th>
<th>Retained moisture percent (22 °C, 65% relative humidity).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>1.0</td>
<td>Polypropylene 0.05</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>6.0</td>
<td>Polyester 0.40</td>
</tr>
<tr>
<td>Silk</td>
<td>7.0</td>
<td>Acrylic 1.30</td>
</tr>
<tr>
<td>Polyester</td>
<td>7.0</td>
<td>Polyamide 4.50</td>
</tr>
<tr>
<td>Wool</td>
<td>7.3</td>
<td>Cotton 8.00</td>
</tr>
<tr>
<td>Acrylic</td>
<td>8.0</td>
<td>Silk 11.00</td>
</tr>
<tr>
<td>Polyamide</td>
<td>10.0</td>
<td>Wool 16.00</td>
</tr>
<tr>
<td>Viscose</td>
<td>11.0</td>
<td></td>
</tr>
<tr>
<td>Cotton</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>26.0</td>
<td></td>
</tr>
</tbody>
</table>

Carbide Lamp Troubleshooting

• Initial checks for all problems.
  – Water – Be sure you have water.
  – Carbide – Be sure you have carbide.
  – Drip Rate – About one drip per second.
  – Tip – Check for clogged tip.

• Lamp will not light.
  1. Check for spark from striker assembly. Clean and dry if dirty or wet. Replace flint if needed.
  2. Check carbide and water. Replaced if needed.
  3. Check felt. Dry with shirt if wet. Replace if worn or brittle.
  4. Check tip for dirt or damage. Clean with tip cleaner or replace.
  5. Check water valve for proper dripping. If clogged blow through water door opening to unclog.
  6. Check for leaks around gasket between top and bottom of lamp. Clean gasket with water.
     Replace if cracked or worn. Clean threads and seating surfaces. Screw bottom onto top tightly.
  7. Check vent hole in water door. Clean if clogged.
  8. Check for holes in bottom of lamp around solder joints and edges.

• Lamp lights but burns irregularly or erratically.
  1. Check tip for dirt or damage. Clean with tip cleaner or replace.
  2. Check felt. Dry with shirt if wet. Replace if worn or brittle.
  3. Check carbide and water. Replaced if needed.
  4. Check for leaks around gasket between top and bottom of lamp. Clean gasket with water.
     Replace if cracked or worn. Clean threads and seating surfaces. Screw bottom onto top tightly.
  5. Check water valve for proper dripping. If clogged blow through water door opening to unclog.
  6. Check vent hole in water door. Clean if clogged.

• Flame around gasket between top and bottom.
  1. Clean gasket with water. Replace if cracked or worn.
  2. Clean threads and seating surfaces.
  3. Screw bottom onto top tightly.

• Flame burns around outside of tip.
  1. Check for dirt in tip seat. Re-seat tip.
  2. Dirt in tip. Clean with tip cleaner.
  3. Change tips or grind tip into seat to seal tightly.

• Water flow cannot be regulated.
  1. Move control lever to full on and blow through water door opening to remove any dirt.
  2. Check that lever is moving valve.
  3. Re-seat water valve. (Best done outside of cave with proper equipment.)

• Water spurts from water door vent hole.
  1. Decrease flow of water into carbide chamber.
  2. Check tip for dirt or damage. Clean with tip cleaner or replace.

• Lamp burns well, but light is poor.
  1. Dirty reflector. Clean it.
Conservation

Caves are a non-renewable resource. Caves and their inhabitants are extremely fragile and sensitive to changes in the environment. Human activity can easily upset the natural balance in a cave, causing far-reaching changes. For example, if loud, frequent traffic in a cave chases away a population of bats, other organisms that feed on the bat guano will perish.

Everyone who enters, be they frat boys, boy scouts, vandals, or highly skilled and responsible cavers, affects the cave in some way. Certain changes to the cave during exploration are unavoidable. We trample paths into the dirt floors, and we slowly polish the rocks in a pinch. It only takes one careless trip to drastically change a bright, untouched and beautiful passage into a dusty, tired, and worn-looking thoroughfare. The only absolute way to preserve a cave is to just not go there.

Cavers see the value of cave exploration and mapping. The best compromise is to go caving while keeping in mind a very basic understanding: even with the greatest of care, you WILL change the cave as you pass through it. Try to minimize your impact and preserve caves before the harm begins by following the guidelines below.

- Make sure that everyone on your trip, especially novices, understands the need to treat the cave gently, and has the skill and knowledge required to actually do so.
- Leave the bats in peace. Avoid waking them, especially in winter, by moving quietly through the rooms and not shining your light on them at close range. Repeatedly waking bats from hibernation depletes their energy reserves, severely decreasing their chances of surviving until spring.
- Stay out of streams unless it is unavoidable. Remember that crayfish, salamanders, and other critters are very difficult to see, especially after the water is muddied by the cavers in front of you.
- Avoid touching the formations, whether live or dead, whenever possible. The dust and mud on your clothes, and the oils on your skin, can halt or change the growth of live formations and may ruin the looks of any formation. Studies suggest that it takes an average of 120 years for one cubic inch of a speleothem to form.
- Do not remove any wildlife or formations from a cave, and do not intentionally break any formations. Not only does this damage the cave and ecosystem, but it is also illegal! Many states, including Virginia, have laws against this and enforce it by severe fines or jail time.
- Stay on the main trail where others have gone before you, especially in sensitive or fragile sections of the cave. Most of the caves you will visit have been traveled many times before by other cavers; look for “elephant tracks” to guide you.
- Clean up any trash you generate, and pack out any trash you find along the way. If it isn’t your trash, carry it out anyway. Others are less likely to leave trash lying around an already clean passage.
- Be careful not to spill carbide rocks and dump, and clean up anything you do spill. Always pack out your carbide dump.
- Take care of all bodily functions before you enter the cave, and pack out what you cannot hold until later.

Hypothermia

Hypothermia is a general cooling of the body core when more heat is lost than is produced (this is known as exposure). The most common causes are wet clothing (they lose much of their insulating value), wind (it cools the body by evaporating moisture from the clothes), inadequate clothing, caving to exhaustion, and combinations of these situations. As your body temperature gradually lowers, your cognitive ability diminishes, and you may not realize you are in danger. Without treatment, hypothermia leads to death. Cavers in this area are especially susceptible to hypothermia since cave temperatures are low and many caves are wet and muddy. Keep an eye on your fellow trip members; if someone is displaying any of the warning signs below, take immediate action. Remember that the hypothermic person is not thinking clearly, so you must decide what treatment steps are necessary.

The best way to prevent hypothermia is to minimize exposure. Don’t sit for too long on the cave floor; if you start to feel cold or begin to shiver, get up and move around. Sitting on your pack or gloves adds a barrier between you and the
heat-sucking cave. Eat something to provide your body with extra energy to generate heat; drink enough water to stay hydrated. When getting wet in a cave is unavoidable, plan in advance by wearing appropriate clothing and bringing extra clothes in a sealed bag. In stream crawls, keep your chest out of the water. In short, keep yourself as warm and dry as possible, and give your body every advantage to staying energetic.

**Warning Signs of Mild to Moderate Hypothermia**

- uncontrollable fits of shivering
- vague, slow, slurred speech
- memory lapses; incoherence
- immobile or fumbling hands
- frequent stumbling; lurching gait
- drowsiness
- apparent exhaustion; inability to get up after a rest

**Treating Mildly Hypothermic Cavers**

- encourage more activity
- get the patient away from the wind and water
- strip off all wet clothes and get the patient into dry clothes
- give the patient warm drinks, but do NOT give alcohol, caffeine, or nicotine
- be sure the patient eats so he can recover his energy
- protect the patient from heat loss to the cave floor using packs, rope or other available material
- use a heat tent to limit exposure
- if exposure cannot be reduced and/or the patient is not warming up, leave the cave!

**Treating Moderately Hypothermic Cavers**

- if patient is having difficulty moving safely through the cave or has become exhausted, get him into a sleeping bag or heat tent
- add heat to the head, neck, chest, and groin for most effective warming (spent carbine containers make good heat packs)
- leave the cave after the patient has warmed and recovered enough energy to cave safely

**Warning Signs of Severe Hypothermia**

- disorientation and confusion
- physical activity is uncoordinated
- shivering has stopped
- stupor or unconsciousness leading to coma

**Treating Severely Hypothermic Cavers**

- evacuation - call a rescue
- keep the patient awake
- you may help the patient drink warm drinks, but due to the risk of choking, give nothing by mouth if the patient is extremely disoriented or uncoordinated, or semi-conscious
- place the patient in dry clothes (or naked if all clothes are wet) in a sleeping bag or heat tent and add heat packs to his head, neck, armpits, and/or groin
- protect the patient from heat loss to the cave floor using packs, rope or other available material
- the use of “skin-to-skin” heating by a warm caver is not recommended. The warm caver will soon become a second hypothermic patient.
A Few Good Knots

Rope is simple, ubiquitous, ancient. A creature of tension, it exists to be stretched between opposing forces. It is a highly evolved tool which, in its myriad sizes, materials, and constructions, can meet every sort of rigging need. Limitations are likely to be on the part of the user; it is for us to develop skill appropriate to the tool. [Tos98, p 1]

Only fourteen knots are required for your membership test. They have been selected to provide a common set of tools for all members, and these tools will be sufficient for most rigging. You should be able to tie all of these knots as easily as you tie your shoes; lives may depend on your ability to tie them when you’re tired, hungry, cold, confused, and in darkness. Learn, practice, and master these knots.

Learning to tie knots from printed material is not easy; get personal instruction from a member with vertical experience if you can. Animated images on the Internet are also helpful.

Terms and Functions

A few terms are used to describe knots and rigging.

- The working end of the rope is what you tie to the anchor.
- The standing line is the part of the rope between the anchor and load. It is the part you rappel or climb.
- The running end or free end is the end of the rope that is not attached to the anchor. It is the part of the rope you are not supposed to rappel off.
- A bight is formed when the rope is doubled back but does not cross itself.
- A loop is formed when the rope is doubled back and crosses itself.
- A knot or true knot is formed when a rope is tied to itself. Fixed loops, mid-line loops, and stopper knots are true knots.
- A hitch is used to fasten a rope some object or another rope. The rope or object you are hitching to is not part of the knot; a hitch will fall apart if the rope or object is removed.
- A bend is used to fasten one rope to another.
- Knots, hitches, and bends are all ties, but it is usual to call all of them knots.

Selection and Characteristics

Here are some things to consider when selecting which knot you will use for a particular job.

- Is the knot suitable for the type of material you are using? Different types of material may require different knots. Knots that work in webbing may not work in rope. Many of the knots seen in typical knot references do not work well in the stiff and slick synthetic ropes used for caving.
- How secure is the knot? Security of a knot refers to how well the knot maintains its shape under load. Many knots that are very secure under constant tension will fail in situations where the rigging is alternately loaded and unloaded. An additional overhand knot is often added to secure the primary knot.
- How strong is the knot? Bending or twisting a rope reduces its strength. Most sources will give figures of 20-50% strength reduction with a typical knot.
- Is the knot suitable for the load?
- How likely is the knot to capsize? Capsizing refers to a failure of a knot where its structure changes under load. The best example of this is what happens when the free end of a square knot is pulled.
- Does the knot jam? Some knots will jam after heavy loading. The difficulty of removing a particular knot may require the use of tools that damage the rope (requiring the damaged section of rope to be discarded).
- Can the knot be tied under tension?
- How compact is the knot?
• How much rope does the knot require?
• How hard is it to examine the knot and tell if it is tied correctly? It is important that each person who will use some rigging be able to examine it and confirm that it is rigged correctly.

Tying 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. This is not the impossibly high standard of the idealist, it is a mere fact for the realist to face. In a knot of eight crossings, which is about the average-size knot, there are 256 “over-and-under” arrangements possible. Make only one change in this “over-and-under” sequence and either an entirely different knot is made or no knot at all may result. — [Ash44, #77,78,79]

Tying a knot is more complicated than just arranging the rope like one of the illustrations. Here are some steps to follow.

• Select knot that is suitable for the job and material.
• Tie the knot.
• Dress the knot by arranging all parts of the knot in the correct orientation. When tying a knot with webbing, try to keep the webbing as flat (not twisted) as possible. Re-traced (re-threaded) knots (like the re-traced figure-8) also require special care.
• Set the knot by taking up the slack on all parts of the knot. Be sure to maintain the correct orientation.
• Secure (backoff, backup) with an overhand loop, double overhand loop, or specialized method. Knots used to secure another knot should be as close as possible to the main knot and oriented to fit tightly against it. (Sometimes the backoff is part of the knot and must be done prior to setting, e.g. bowline with Yosemite finish.)
• Inspect the finished knot and securing knot. Do not leave unsecured or incorrect knots in the rigging. It may not be obvious to others that it is not ready to use.

Once you learn to identify and tie the required knots, spend some time learning different techniques of tying them. The references section of this document lists several good places to learn specialized techniques that will help you tie the knots quickly and correctly in a variety of situations.

Required Knots

Little is known about the mechanics of knots, and friction itself is still a scientific mystery. Under the circumstances, it behooves the laymen to speak skeptically rather than dogmatically about why knots behave the way they do. [Day86, p 16]

Notes on the Illustrations

To provide the clearest information for learning to recognize and tie the selected knots, some of the illustrations show knots that are not complete or are not quite in the form that they should be used. In particular, knots are shown before being set, without the required backoff, or with tails and loops of incorrect size.

Overhand Knot

The overhand knot (or thumb knot) is the simplest of all knots. Its most common use is to secure (or backup) a more complicated knot. Of the fourteen required knots, four are based on the overhand knot (overhand knot, water knot, square knot, double fisherman’s bend), and four are secured with overhand knots (bowline, mountaineering bowline, bowline on a coil, and helical).
• When used to secure a knot, two forms of the overhand knot are possible: the inside form and the outside form. The inside form is preferred since it is more compact and symmetric, and the two ropes lay parallel to each other.
• There are two possible orientations for the inside form of the overhand knot depending on which way the turn is taken around the standing part. Viewed from the side, the knots slope in opposite directions. Choose the one that puts the backup knot closest to the main knot.
• Two turns can be taken around the standing rope to form the double overhand knot.
• The overhand knot can be used as a stopper knot (e.g. to keep a line from running through an opening), but it is prone to jamming. A figure-8 is a better choice.
• When tied with the ends of two ropes, this knot is more properly called a half knot.

![Overhand knot](image)

**Figure 1: The overhand knot**

**Water Knot**

The water knot (or ring bend) is most often used to bend two lengths of webbing together. It is easily tied by tying an overhand knot in the end of one length of webbing and then re-tracing the knot with the end of the other length of webbing. This technique is called a “re-trace” and is also useful with the figure-8.

• Only retains 50-60% of the webbing’s strength.[SP96, p51]
• Does not require overhand backups in webbing. Be sure to leave the tails several inches long though.
• Dress knots in webbing carefully so the two strands remain flat and parallel to each other.

**Double Fisherman’s Bend**

The double fisherman’s bend (or grapevine knot) is a very secure knot that can be used to bend two similar pieces of rope. It is prone to jamming with heavy loads and can be difficult to remove. With three turns on each overhand, it is called a triple fisherman’s bend or barrel knot. The triple fisherman’s bend is as strong as the rope and is the only bend that should be used with Spectra[SP96, p52].

The double or triple fisherman’s bend is often used to bend two lengths of rope that will be used for a rappel.
Water knot (This knot is usually tied in webbing, but rope is shown for clarity.)

Figure 2: The water knot and the double fisherman’s bend

Square Knot

But employed as a bend [...], the reef knot is probably responsible for more deaths and injuries than have been caused by the failure of all other knots combined. — [Ash44, #75]

The square knot (or reef knot) is a binding knot. It’s easy to tie, compact, and can be tied while maintaining some tension in the line. If the tail and standing part of one of the ropes get pulled, the knot will capsize with one rope forming a girth hitch around the other. If this knot is used as a bend and something snags one of the ends, the knot can capsize easily. The problem is worse if the materials used are of different size or stiffness.

- The most common way to tie a square knot is to take the two ends of the ropes and tie a half knot right-over-left and then another left-over-right.
- The tails of the square knot should be parallel to the standing parts of the ropes and on the same side of the knot.
- Use the square knot to tie the free ends of a coil of rope.
- Use square knots to tie a seat harness with webbing.

The Wrong Way

There are three incorrect knots you can end up with when you attempt to tie a square knot. Which one you have is determined by the orientation of the tails with respect to which side of the knot they are on and if they come out of the knot along side of the standing part.

- **Granny Knot** – This is probably the most common error. The tails are on the same side of the knot, but do not follow the standing part out of the knot. If you intended to tie a square knot with the right-over-left left-over-right method, you got one of them backwards. This is the only one of the three incorrect knots you can end up with when using that method of tying. This knot is not secure and will pull out of most materials. Don’t use it for anything.
  Look down at your shoes. Are the loops of the bow knot extended across your shoe or along its length? If the loops go along the length, you have the granny form of the bow knot. Fix your shoes before someone notices.

- **Thief’s Knot** – This knot has free ends that come out of the knot parallel with the standing part of the rope, but on opposite sides of the knot. It will not support much of a load and should not be used in rigging.

- **What Knot** – This knot has free ends that do not follow the standing parts out of the knot and the tails are on opposite sides.
Bowl line

The bowl line is the King of knots because it is strong, secure, and versatile, as kings should be. And simple, as kings generally are. — [Tos98, p 62]

The bowl line creates a fixed loop on the end of a rope. Four of the required knots are based on the bowl line (bowl line, mountaineering bowl line, bowl line on a coil, bowl line on a bight) and knot texts will show many more variations. This knot is easy to tie, easy to inspect, and not prone to jamming. After you learned to tie your shoes, you should have learned this knot. If you didn’t, learn it now.

- The free end must have a backup knot. The most common choice is the overhand knot. An even more secure choice is the double overhand knot. A Yosemite tie-off will put the free end of the rope outside of the loop.
- The single bowl line can be re-traced to form a knot with the same structure as the bowl line on a bight.
- The free end should be inside of the major loop (except with the Yosemite tie-off). Although the “left-handed” form of the bowl line is thought to be just as strong as the properly tied version, the free end is more likely to snag on something and capsize the knot into a slip knot.
- When a bowl line is tied around something, it is easy to tie if you start with an overhand knot. See the section on the helical knot for an example of this method of tying.
- The bowl line is not suggested as a main rigging knot. Use the mountaineering bowl line instead.

Mountaineering Bowl line  The mountaineering bowl line (double-loop bowl line or double bowl line) is identical to the single bowl line except that it has two minor loops. It is stronger and more secure than the single bowl line. One of the backoff methods used for the single bowl line should be used with the mountaineering bowl line.

Bowl line on a Coil  The bowl line on a coil is used to attach a person to a belay line if a harness is not available. The use of multiple major loops (usually three) helps distribute the load and is more comfortable for the person on belay.

- A rope in not a harness. Use this knot only in cases where a harness is not available and no webbing is available to tie a harness.
- This is not a knot to be used in equalizing rigs. All of the coils must be around the same object.
- The orientation of the minor loop and the way the end of the rope passes through it are the same as a regular bowl line.
- The bowl line on a coil should be secured with an overhand knot around all of the major loops[GH97, p123].
**Bowline on a Bight**  The *bowline on a bight* is a mid-line knot used to create a fixed loop.

- You can tie this knot around something by tying a single bowline with a long free end around the object first, then re-trace the free end through the knot.
- The relative size of the two major loops can be adjusted.
- This knot may be used in an equalizing rig and it is the only one of the required knots that can be.

**Figure-8**

The *figure-8 knot* can be used as a stopper knot (e.g. to prevent a rope from passing through a pulley). Its more common uses are in the forms tied in the bight or re-traced. No securing knot is required, but many people prefer to add an overhand backup.
A Few Good Knots

Starting position.
The coil that makes up the major loops would be around your waist.

Before setting

Set and secured.
Note that the backup knot goes around all of the loops.

Figure 6: The bowline on a coil

High Angle Rescue Techniques [VH99, p 62] lists the following as reasons the figure-8 family is preferable to the bowline family:

• more likely to be tied correctly
• more likely to be remembered
• a lot easier to tell if it is tied correctly
• remains stable if loading comes from a direction different from what was intended
• more likely to remain tied after repeated loading and unloading
• less likely to invert and become untied when pulled across an obstruction or when the tail of the knot is pulled
• tends to weaken the rope less

I still prefer the bowline in a lot of situations. The bowline is a lot less likely to jam and it consumes much less rope than a figure-8.

Figure-8 on a Bight A figure-8 knot can also be tied in a bight to form a fixed loop. This knot is usually tied near the end of a rope and used as a main rigging knot. The same knot can be tied by tying a figure-8 in the rope, passing the free end around something, and re-traced the knot. Re-threading a figure-8 with another line will form a figure-8 bend, a very secure knot.

• Use as a main rigging knot.
• Use to form fixed loops on climbing slings.
• Use to form a fixed loop in the end of a rope being lowered down a drop for rappelling.
• Requires some attention to dressing.
• Does not require an extra knot to secure.
• Use an alpine butterfly or an inline figure-8 if the knot is to be loaded in opposite directions on both tails.
Start by forming the minor loop in the bight. Pass the end of the bight through the minor loop. Spread the end of the bight to form a loop and fold it back over the knot.

**Figure 7: The bowline on a bight**

![Bowline on a bight](image1)

**Completed knot.**

**Figure 8: The Figure-8**

![Figure-8](image2)

**Figure-8 on a bight before setting.**

**Completed knot.**

**Re-traced Figure-8 on a bight used as a bend.**

**Münter Hitch**

The *Münter hitch* (or *Italian hitch*) is a friction hitch formed from a rope and locking carabiner. It can be used to belay single-person sized loads and can serve as an emergency rappel method.

- The Münter hitch will automatically reverse directions depending on if you are letting out or taking up rope. You should set the knot in the direction you are going to use it to avoid several inches of slack when the knot reverses.
- The carabiner must be the locking type, and it must be large enough for the knot to pass through when changing directions. A pear-shaped locking carabiner is the preferred type.
- The Münter hitch provides good friction no matter what the angle between the ropes and carabiner. (Some belay methods using devices like a figure-8 are quite sensitive to the angle of the ropes.)
- When used as a rappel method, the Münter hitch kinks the rope more than other methods.
- The Münter hitch may be used to provide extra friction to the rope feeding into another rappel device.
- The Münter hitch is commonly used as part of a load releasing hitch.
- The Münter hitch may be locked off with a *mule knot.*
Form a bight in the rope.

Grab the end of the bight and twist it once.

Grab the end of the bight and twist it again.

Attach a locking carabiner.

Set the knot by pulling the end of the rope that will be attached to the load.

Figure 9: The Münter hitch

Alpine Butterfly

The *alpine butterfly* (or *lineman’s loop*) is a mid-line fixed loop. It can support a load in either direction along the main line.

- Use to bypass a damaged section of rope. Two alpine butterflies and a carabiner can be used to bypass a longer section of rope.

Figure 10: The alpine butterfly
Helical

The helical knot (or, ascender knot) is a friction knot used with rope climbing systems to attach a smaller sling (7-8mm) to the main line (11mm). When there is no tension on the sling, the knot slides freely. When the sling is loaded (parallel to the main line), the knot grips the rope and will not slide.

- This knot is usually tied with four or five turns around the main line.
- The figures show the knot joined with a bowline. This is the most common way to tie the Helical knot, but careful attention must be paid to securing the bowline with an overhand knot, or better yet, a double overhand or Yosemite finish.
- A figure-8 tie can also be used.
- The helical knot may be adjusted without detaching the other end of the sling from your harness.
- The helical knot is a bit harder to tie than a prusik, but moves easier and grips the main line more securely.
- If necessary, this knot can be used to attach a flat webbing sling to the main line.
- It is best to tie this knot with a minimum of slack. It will stretch when loaded.
- Never apply any downward pressure on the top coils of a loaded helical knot. This may cause it to slip. If it slips far enough to press down on the top of another knot, disaster may result.
- Slide a helical knot up the main line by pushing it up from the bottom, not by gripping the knot.
- Tie the top knot first and remove it last. That way you will not end up hanging by your heels if you slip.

![Diagram of the helical knot](image)

Figure 11: The helical

Prusik

The prusik knot is a friction knot similar to the helical.

- Once set, the prusik knot must be loosened before it will move freely. It is this property that makes the helical knot more popular for ascending.
- The prusik knot may be loaded in either direction.
- The prusik knot is often used to attach rope pads.
- The prusik knot is used as a safety in hauling systems.
- If necessary, this knot can be used to attach a flat webbing sling to the main line.
- Tie the top knot first and remove it last. That way you will not end up hanging by your heels if you slip.
A Few Good Knots

Begin with a figure-8 on a bight. Pass the sling and knot around the main line and through the loop. The finished prusik.

Figure 12: The prusik

A Few More Good Knots

In addition to the required knots, there are a few more knots which are being used frequently by cavers and worth learning or at least recognizing.

Mule Knot

The mule knot can be used to tie off a Münter hitch.

Form a loop in the free end close to the main knot. Pass a bight from the free end around the standing line and through the loop. Set the knot and pull a long loop through. Secure the loop to the standing line with an overhand knot.

Figure 13: Locking off the Münter hitch with a mule knot

Doubled Tucked Sheet Bend

The sheet bend is a knot used to bend two ropes of unequal thickness or stiffness. The thicker or stiffer rope is used to form a bight, and the thinner or more flexible rope is passed through and around the bight. This is a knot subject to some controversy. Depending on which reference you use, the standard sheet bend will be shown with the tails on the same or opposite sides of the knot. Some references show both and call one “left handed” and claim it is inferior to
the other. The references that the author trusts the most ([Ash44, #66][Day86, #31][Tos98, p68]) all show the proper knot with the tails on the same side.

An examination of the knot offers some insight into the controversy. Ashley explains:

The so-called oft-quoted “principle of the knot,” that “no two parts which would move in the same direction, if the rope were to slip, should lie alongside of and touching each other,” plausible though it may appear, does not seem important. — [Ash44, #64-65]

An excellent example of this is the sheet bend. The sheet bend (#66) violates the alleged “principle” at every point where it can, but it has good nip and does not slip easily. The Left-Hand Sheet Bend (#67) conforms to the so-called “principle” to a remarkable extent, but has poor nip and is unreliable. — [Ash44, #66-67]

- Can be used to bend ropes that are not the same diameter or even to attach webbing to a rope. The smaller or more flexible rope should be tied around a bight of the larger rope. In the pictures, the bottom (light-colored) rope would be the smaller or more flexible one.
- Securing this knot is required.

![Figure 14: The doubled, tucked sheet bend](image)

**Double Figure-8**

The double figure-8 is similar to the figure-8 on a bight, but it provides two loops (which may be of different sizes). This is the knot of choice for equalizing rigs. (See [SP96, p 46].)

**Figure-9**

The figure-9 knot is similar to the figure-8 on a bight. It is used for the same things as the figure-8, but is claimed to be stronger and less likely to jam. The strength factor may be significant in rigging using rope of 9mm or less. (See [SP96, p 46].)

**Load Releasing Hitch**

The load releasing hitch is used to attach a load to an anchor when it may be necessary to release the load in a controlled manner, such as moving the load to another anchor. (See [SP96, p 226].)
Inline Figure-8

The inline figure-8 is used to form a mid-line loop where the tension on the loop is in the same direction as the tension on one of the tails (such as to a backup anchor). (See [SP96, p 49].)

Additional Information

Books

- *On Rope* [SP96] – Considered the best reference on North American rope techniques. Knots, rigging, safety, equipment, and many other subjects are covered. The illustrations are good for learning to tie knots. I think every vertical caver should read this book.
- *The Handbook of Knots* [Paw98] – This is the book I recommend if you want a good general-purpose knot reference. The book covers a fair number of climbing knots and has very good color photographs. Amazon.com has some sample pages you can preview.
- *Art of Knotting and Splicing* [Day86] – My favorite general-purpose knot book prior to Pawson. The book uses black-and-white photographs to show the knots and has some discussion on techniques of tying them.
- *The Klutz Book of Knots* [Cas85] – This is a small and inexpensive book that covers 25 of the most useful knots. It comes with cord and has die-cut cardboard pages so the knots can be practiced next to their illustrations. It is an ideal book to get people started with tying knots that are useful for everyday life.
- *The Morrow Guide to Knots* [BR82] – This is one of the most popular books on knots. It has step-by-step color photographs and shows multiple techniques for tying knots. I find Day to be a better reference since this book is lacking several of my favorite knots (alpine butterfly, Ashley’s bend, buntline hitch, and a few others) and it is not as thorough in its text.
- *Vertical* [War94] – Knots, rigging, safety, equipment, and many other subjects with a focus on European (or Alpine) techniques. This book is a great companion to On Rope.
- *CMC Rope Rescue Manual* [Fra98] – Another general-coverage book. The focus is on rescue rigging and not caving.
- *The Ashley Book of Knots* [Ash44] – Probably the most complete collection of knots ever assembled. 3800 knots and variations are described. Ashley is referenced in almost every other knot book. This book is fairly old and it does not account for caving/climbing applications. The illustrations are not all that good for learning to tie the knots.
- *The Complete Rigger’s Apprentice* [Tos98] – This book focuses on rigging for sailing. The chapters on knots, tricks and puzzles, and “sheer ingenuity” are probably the most useful. If you are blessed with a need to work with wire rope, there is also a lot of material on its splicing and use. Toss is expected to release a new book called *Working Knots* sometime in the summer of 2000.

Internet

- [http://www.earlham.edu/~peters/knotlink.htm](http://www.earlham.edu/~peters/knotlink.htm) - Knots on the web
- [http://www.mistral.co.uk/42brghtn/knots/42ktmenu.html](http://www.mistral.co.uk/42brghtn/knots/42ktmenu.html) - Animated Knots for Scouts and Guides (Please respect the owner’s wishes not to copy these images).

References


VPI Tied Seat Harness

The seat harness illustrated here was perfected in the mid 1980’s by Jim Washington and has since become required knowledge for all VPI members. It uses a single length of webbing to provide a safe and effective seat harness. There are many other ways to tie a seat harness. Some are easier, but they do not have the redundancy that this one provides; if you cut any one piece of webbing on this harness it will not fail completely. Some are more complicated, and while usually more comfortable and just as safe as the VPI seat, they are usually more time-consuming to tie. Even if you know and prefer another type of tied seat, you will still need to learn how to use this one as part of your membership requirements. Since many cavers around you will be using this design, you should be familiar with it anyway.

To tie this harness you will need 20-30 feet of one inch tubular webbing, depending on your size. Using a longer piece is not recommended as it only makes tying and untying more complicated.

Step 1: Find the center of the webbing (some people mark the center with a Sharpie or tape) and place it in the middle of your back just above your hips. Bring the ends around to your front and tie a square knot. It should be tied reasonably snug as the harness will tend to loosen while being worn.

Step 2: Bring one end around the back of your leg, up between your legs, and behind the waist strap and leg strap.

Step 3: Bring the webbing down in front of the waist strap and leg strap, then underneath the leg strap (toward your crotch), leaving a bit of loop.
Step 4: Feed the end back through this loop to create an overhand knot.

Step 5: Repeat steps 3–4 to complete your other leg loop.

Step 6: Squat down and make sure the leg loops are snug against your crotch and butt. Work the webbing through the overhand knot until the leg loops are snug (but not cutting off the circulation). When you stand up, the leg loops will be tight. Watch out (men especially). The leg loops must be snug at the top of your leg or the harness will become very uncomfortable to climb in as it loosens up.

Step 7: Take one end of the webbing and pass it behind your back. Tie a square knot at your side with the other end, forming another loop around your waist.

Step 8: Loop the webbing around your waist and finish each loop with a square knot until all of the webbing has been used. You should have at least enough for two waist wraps.

Step 9: Secure each tail of the last square knot with an overhand knot. Use extra overhands to take up any left over webbing. Most cavers place these last knots on the opposite side of the body from where the rope will run while rappelling. This keeps knots and extra webbing safely out of your way.

Step 10: Place your carabiner, or other point of attachment, around ALL of the pieces of webbing at the front of the harness.
Vertical Caving Tips and Etiquette

General Information

- Never step on rope or climbing equipment.
- Practice with new equipment or systems above ground before trusting them underground.
- Have someone check your personal rig (seat, knots, locked biners) before climbing or rappelling.
- Always check and understand the rigging.
- Don’t weight any carabiners across the gate.
- If you drop something or kick off a loose rock yell “ROCK!” even if it isn’t a rock.
- If someone yells “ROCK!” don’t look up; your helmet does a poor job of protecting your face.

Rappelling

- Make absolutely certain to tie a figure-8 knot in the bottom of the rope so no one rappels off the end.
- Never take your controlling (brake) hand away from the rope.
- Don’t jump away from the wall while rappelling; walk smoothly down the wall.
- If you use a rack, know what the dangerous “idiot” or “zipper” rig looks like. Get a member to describe or show it to you so you can recognize and avoid it.
- When rappelling past a lip, make sure the rope is correctly contacting the rope pads.
- Learn how to lock off your rappel device.
- Learn how to change-over from rappel to ascending.

Climbing

- Climbing systems should contain three points of contact or two points with attachments directly to the seat.
- Carry a spare prusik or mechanical ascender with you.
- Technique is an important part of climbing rope. Every system gets maximum efficiency if you use your legs. Keep your feet under you, and keep your torso close to the rope.
- After ascending a rope, find a safe place away from the lip to remove your gear.
- When getting off rope, remove your seat safety or top knot last.

Belays – General

- Anyone who wants a belay gets a belay.
- If a member asks you to take a belay, you must accept it.
- Always wear gloves.
- Both the belayer and climber must be careful to not allow too much slack in the belay line.

Belays – Top

- Always be sure you are solidly anchored before starting the belay.
- Have enough rope or webbing to lower the climber to the floor or other safe location in case of emergency.
- Keep the belay tight as communication may be poor between the climber and the belayer.

Belays – Bottom

- Stay out of rockfall.
- Concentrate on the rappeler; do not talk or be distracted by other cavers.
Self-Belay

Self-belaying is a technique that is employed on climbs or cable ladders where a fixed rope has been rigged alongside a relatively easy climb or cable ladder. A self-belay utilizes a mechanical ascender that the climber moves up the rope as he climbs.

- ASCENDERS ARE NOT DESIGNED TO TAKE SHOCK LOAD. Do not employ this technique if you cannot maintain tension between yourself and the ascender on the rope.
- Bring a spare ascender or prusik so that you can switch to ascending the fixed line if you need to.

Gear

Always inspect all gear prior to a trip. Obvious cracks, bends, deep scratches, and excessive wear in your gear mean it should be replaced immediately. Ropes and other “soft” components should be visually checked before the trip, and inspected by hand during rigging, derigging, and cleaning. “By hand” means that as the rope goes through your hands, feel for sections which bend differently or change diameter as well as visible external damage. Any discontinuity or damage to a rope or sling should be cut out or the piece replaced.

Recommended equipment list for the aspiring vertical caver:

- two locking carabiners
- a descender (figure-8’s are cheap, racks are best)
- 30 feet of one inch webbing
- a set of prusik or helical knots (25-30 feet of 7-8mm cord)
- a mechanical ascender (Petzl jammer)
  - replaces top knot
  - use in self-belay situations
  - easy to clip into a safety line
  - use for hauling
  - easily incorporated into a wide variety of mechanical climbing systems as you advance

Color Codes

Color codes are unique two or three color bands that identify personal equipment. Once you have been in the club awhile or have amassed some gear, it is a good idea to pick one out. Before you buy your tape, check on the Listserv and phone list to see whether any local cavers are using that combination.
Rigging

There are many things to consider when rigging a drop and every drop will present its own unique set of obstacles that need to be overcome. By keeping in mind a few simple guidelines, you can make rigging safe and effective.

If the guidelines can be met, a natural anchor is preferred over a bolt or other man-made anchor.

Rigging Guidelines

- The rigging should allow the caver to easily and safely get on and off rope.
- The rig should avoid hazards which may damage the rope or injure the caver.
- The rigging should be as strong as the rope.
- The rigging should be as simple as possible and easily inspected for damage or wear.

Selecting the appropriate rigging point for a drop can be confusing. Often, the best rig point won’t be obvious from the top of the pit, and what looks like a great rigging point may place the caver in a dangerous situation further down the drop. Whenever possible, consult with other cavers who may be more familiar with how the cave you will be visiting should be rigged.

The first person to descend should always be experienced and prepared to change-over and return to the top if the rigging turns out to be unsuitable for any reason. Sometimes it will take several tries to rig an unknown drop correctly.

When working near the edge of a drop, always put on your harness and clip into a safety line. The edges of pits are often steep and slippery.

The Friction Wrap (Tensionless Anchor)

The friction wrap or tensionless anchor is one of the most commonly used methods of rigging a rope around an object such as a tree. Friction wraps maintain most of the rope strength by avoiding sharp bends and tensioned knots. This method uses the rope’s friction around the rig point to hold the rope in place. The end of the rope is loosely tied back to the main line with a figure-8 on a bight or bowline producing a tensionless tie off.
• Generally, three to five wraps around a tree will provide enough friction to prevent the rope from slipping and tensioning the knot. Smaller trees require more wraps than larger trees or rocks.
• When properly rigged and loaded, the mainline should pass straight through the tie off without deviating. The tie off should not put any tension on it when the main line is loaded.
• When wrapping the tree, the mainline should come off the bottom of the coil and the knot off the top. This will prevent the loaded part of the rope from crossing itself causing nylon on nylon abrasion (a dangerous situation in any rigging).
• If a safety line is to be made from the tail end of the rope, as shown in figure 15, an inline knot such as an inline figure-8 or alpine butterfly should be used instead.

Whenever a rope is wrapped around a tree, a pad should be used. Without this protection, abrasion to the bark of the tree can cause it to die and eliminate a good rig point and accelerate erosion around the pit. It will also protect your rope from sap on pine trees

Fixed Loops

Breakdown blocks, formations, and other natural anchors can be awkward to rig due to their size, shape, and many sharp edges. A fixed loop such as a figure-8 on a bight or mountaineering bowline may be a better choice than a friction wrap for rigging to such objects. A bowline on a coil may prove better in some situations because the tension will be distributed over several loops.

Formations used for rigging should be inspected very carefully.

• Check for cracks or fractures.
• Be sure the rig point is attached to solid rock.
• Don’t use friction wraps on stalagmites, the wraps may slide up and jump off.
• Never rig to a stalagmite if there is the possibility of tension being applied in any direction other then downward.
• Pad all sharp edges.
Rigging With Webbing

When using webbing to wrap around an object, a good method to use is the wrap 3-pull 2 method shown in figure 17.

- Wrap the webbing three times around the object and tie off with a water knot.
- Place the knot at the point of least tension by pulling and loading the two loops without the knot.
- Keep the total angle of the webbing at the carabiner less than or equal to 30°.

The method shown, using 1-inch tubular webbing, has a strength exceeding that of 11mm static rope.
Load Distribution

The tension in a line between two anchors is \( \frac{\text{Load}}{2 \cos \frac{\Theta}{2}} \) where \( \Theta \) is the total angle of the rope, as shown in figure 18. \( \Theta \) should not exceed 120° in typical rigging. At 120°, the tension at your anchors will equal the load. At 150°, the tension at the anchors is twice the load. Never use angles greater than 150° because the tension in the rope very quickly becomes much higher, and will lead to rope or anchor failure. A 150° angle will result in a sag in the line of 15°, or about three inches sag per foot of line.

![Figure 19: Technical rigging: Hauling systems and load-sharing rigging.](image)

Pulleys, Bolts, and Other Technical Rigging

*Mechanical advantage*, using pulleys, reduces the strength required to lift a load. For example, in a *two-to-one system*, the pulling strength required is about half the weight of the load. However, you must pull twice the distance that the load will move. In a *three-to-one system* such as the Z-rig, the strength required to lift is one third the load weight, but you must pull three times the distance that the load will move.

In all *hauling systems*, a *safety cam* should be used to hold the load. In many cases prusiks or helical knots will work as well as cams. Typically a person must tend the cams or knots in order to keep them set at the proper location and orientation.

In areas with heavy traffic you may find two or more bolts or other anchors for rigging. Sometimes using two anchors will be for strength and redundancy, and sometimes to re-direct the main line into a better position than either anchor can achieve alone.

The double figure-8 or the bowline on a bight are typically used when rigging to two anchors. The alpine butterfly can also be used. Be sure to adjust the knot so that the rope hangs comfortably between the two anchors when weighted.

A *load distributing system*, shown in figure 19, can be used to evenly distribute the load among many anchors, especially if the angle at which the anchors will be loaded changes significantly as a caver climbs or rappels. However, this system is more complicated and will lead to higher shock loading of remaining anchors should any component fail.
### Table of Rope/Webbing/Hardware Strength

<table>
<thead>
<tr>
<th>Gear</th>
<th>Failure Strength (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PMI Static Rope</strong></td>
<td></td>
</tr>
<tr>
<td>11mm</td>
<td>6050</td>
</tr>
<tr>
<td>10mm</td>
<td>5200</td>
</tr>
<tr>
<td>8mm</td>
<td>4350</td>
</tr>
<tr>
<td><strong>PMI Accessory Cord</strong></td>
<td></td>
</tr>
<tr>
<td>9mm</td>
<td>3650</td>
</tr>
<tr>
<td>8mm</td>
<td>3150</td>
</tr>
<tr>
<td>7mm</td>
<td>2100</td>
</tr>
<tr>
<td>6mm</td>
<td>1550</td>
</tr>
<tr>
<td><strong>Tubular Webbing</strong></td>
<td></td>
</tr>
<tr>
<td>1in</td>
<td>4000</td>
</tr>
<tr>
<td><strong>Petzl Croll</strong></td>
<td></td>
</tr>
<tr>
<td>Shell Failure</td>
<td>2250</td>
</tr>
<tr>
<td>Rope Sheath Damage begins</td>
<td></td>
</tr>
<tr>
<td>11mm static</td>
<td>1370</td>
</tr>
<tr>
<td>9mm static</td>
<td>1040</td>
</tr>
<tr>
<td><strong>Petzl Basic</strong></td>
<td></td>
</tr>
<tr>
<td>Shell Failure</td>
<td>3877</td>
</tr>
<tr>
<td>Rope Sheath Damage begins</td>
<td></td>
</tr>
<tr>
<td>11mm static</td>
<td>1370</td>
</tr>
<tr>
<td>9mm static</td>
<td>1040</td>
</tr>
<tr>
<td><strong>Oval Mallion</strong></td>
<td></td>
</tr>
<tr>
<td>10mm</td>
<td>11020</td>
</tr>
<tr>
<td>7mm</td>
<td>6060</td>
</tr>
<tr>
<td><strong>SMC D-Ring Carabiner</strong></td>
<td></td>
</tr>
<tr>
<td>gate closed</td>
<td>6070</td>
</tr>
<tr>
<td>gate open</td>
<td>1574</td>
</tr>
</tbody>
</table>
Belay and Climbing Calls

Communication between members of a caving trip is critical for safety. Factors such as echo, noise from running water, and absorption of sound can make communication very difficult. In order to minimize confusion, a set of standard signals is used. Other talking and noise should be kept to a minimum.

- If a call requires a reply, make sure you hear it or repeat the call.
- Before signaling “Off Rope” or “Clear,” make sure everyone and all equipment (including excess rope) are out of the rockfall area, and that the next belayer is in position with the rope in his hand.
- Under difficult communication conditions, a request for a repeat may be taken as “OK” or whatever answer is expected.
- Use appropriate volume when signaling (e.g. loud near waterfalls, quiet near the landowner’s house).

Note that other organizations may use a different set of calls. Review climbing calls with the trip leaders before you get on rope if you are unsure.

When Lowering a Rope or Equipment

The following signals are used when lowering rope or equipment down a drop. In cases where it is expected that there is no one at the bottom, you should still make the calls and give time for a reply.

<table>
<thead>
<tr>
<th>Top</th>
<th>Bottom</th>
<th>Top</th>
<th>Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rope</td>
<td>OK</td>
<td>Equipment</td>
<td>STOP!</td>
</tr>
<tr>
<td>Top</td>
<td>Bottom</td>
<td>OK</td>
<td>STOP!</td>
</tr>
<tr>
<td>Top</td>
<td>Bottom</td>
<td>STOP!</td>
<td>OK</td>
</tr>
<tr>
<td>Bottom</td>
<td>Top</td>
<td>OK</td>
<td>STOP!</td>
</tr>
</tbody>
</table>

Rappelling

<table>
<thead>
<tr>
<th>Rappeller</th>
<th>Belayer</th>
<th>Rappeller</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready to rappel.</td>
<td>Belay on.</td>
<td>Rappeller is ready to begin rappel.</td>
</tr>
<tr>
<td>Rappeling</td>
<td>Rappelling</td>
<td>Belayer is ready for climber to start.</td>
</tr>
<tr>
<td>Rappeller</td>
<td>Rappeller</td>
<td>Rappeller has started to rappel.</td>
</tr>
<tr>
<td>Rappeller</td>
<td>Rappeller</td>
<td>Belayer understands climber has started to rappel.</td>
</tr>
<tr>
<td>Rappeller</td>
<td>Rappeller</td>
<td>Rappeller is at the bottom and the belay is no longer needed. (This is a message to the belayer and is unnecessary in many cases where the belayer has a clear view of the rappeler.)</td>
</tr>
<tr>
<td>Rappeller</td>
<td>Next</td>
<td>Off Rope</td>
</tr>
<tr>
<td>Next</td>
<td>OK</td>
<td>Rappeller is off rope and out of rockfall. The next person may rig in.</td>
</tr>
<tr>
<td>Next</td>
<td>OK</td>
<td>Message was understood at the top of the drop.</td>
</tr>
</tbody>
</table>

Ascending

<table>
<thead>
<tr>
<th>Climber</th>
<th>Next</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climbing.</td>
<td>OK</td>
</tr>
<tr>
<td>Off Rope</td>
<td>OK</td>
</tr>
<tr>
<td>Climber</td>
<td>OK</td>
</tr>
<tr>
<td>Climber</td>
<td>OK</td>
</tr>
</tbody>
</table>

Climber is rigging in to rope. Climber has reached the top and is away from the edge and rigging. The next climber may rig in. Message was understood at the bottom of the drop.
Climbing With Belay

<table>
<thead>
<tr>
<th>Climber</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climber</td>
<td>Ready to climb.</td>
<td>Climber is ready to start.</td>
</tr>
<tr>
<td>Belayer</td>
<td>Belay on.</td>
<td>Belayer is ready for climber to start.</td>
</tr>
<tr>
<td>Climber</td>
<td>Climbing</td>
<td>Climber is starting climb.</td>
</tr>
<tr>
<td>Belayer</td>
<td>Climb away</td>
<td>Belayer understands that climber is started to climb.</td>
</tr>
<tr>
<td>Climber</td>
<td>Off Belay</td>
<td>Climber no longer needs belay.</td>
</tr>
<tr>
<td>Belayer</td>
<td>Belay off</td>
<td>The belayer no longer assumes responsibility for the climber.</td>
</tr>
<tr>
<td>Climber</td>
<td>Off rope</td>
<td>Climber is no longer rigged to the rope and is away from the edge or rockfall zone. The next climber may rig in.</td>
</tr>
<tr>
<td>Belayer</td>
<td>OK</td>
<td>Message was understood.</td>
</tr>
</tbody>
</table>

Instructions to Belayer

<table>
<thead>
<tr>
<th>Climber</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climber</td>
<td>Tension</td>
<td>Climber wants support from belayer for a maneuver he thinks he might fall or there is too much slack.</td>
</tr>
<tr>
<td>Climber</td>
<td>Slack</td>
<td>Climber wants more slack.</td>
</tr>
<tr>
<td>Climber</td>
<td>Falling</td>
<td>Climber is falling and belayer should lock off the belay.</td>
</tr>
</tbody>
</table>

Others

<table>
<thead>
<tr>
<th>Anyone</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anyone</td>
<td>ROCK!</td>
<td>A rock or other object is falling. The term “rock” is used no matter what is falling. Do not look up.</td>
</tr>
<tr>
<td>Climber</td>
<td>Clear</td>
<td>Some obstacles are passed one person at a time. This is an indication that you have passed and are the next person may begin. It is used by some people to indicate that they are off rope and out of rock fall.</td>
</tr>
<tr>
<td>Anyone</td>
<td>STOP!</td>
<td>Do not rig in, begin climbing, or whatever you just indicated. Wait for additional communication.</td>
</tr>
<tr>
<td>Anyone</td>
<td>Say Again</td>
<td>Repeat the last call. As stated above, it is usually better to just wait for the call to be repeated.</td>
</tr>
<tr>
<td>Anyone</td>
<td>OK</td>
<td>Acknowledgment of last message.</td>
</tr>
</tbody>
</table>
Acronyms

BFR  large rock suitable to use as an anchor
BOG  Board of Governors (Governing Board of the NSS)
CHUD Cannibalistic Humanoid Underground Dwellers
CE  Conformité aux Exigences (Mark indicating a particular piece of equipment conforms to the European Community safety standards. Similar to the UL mark in the US.)
COG Congress of Grottos
DTC committee chaired by Doug Perkins
ELMT With locations all over the world!
ETA Expected Time of Arrival back from the cave
ETD Expected Time of Departure from town
GCCS Giles County Cave Survey
GORP Good Ol’ Rasins and Peanuts
IMO Inner Mountain Outfitters (Caving and outdoor equipment vendor.)
KISS Keep It Simple, Stupid (Not to be confused with Keep It Stupid, Simple)
MAR Mid-Atlantic Region
MSA Mine Safety Appliance
NCRC National Cave Rescue Commission
NSS National Speleological Society
OTR Old Timer’s Reunion
PSC Potomac Speleological Club
RASS Richmond Area Speleological Society
SCC Southeast Cave Conservancy
SIVTAC Some Individual Virginia Tech Associated Cavers
TAG Tennessee Alabama Georgia
TRA The Robertson Association
UIAA International Union of Alpinist Associations (Sets standards for equipment.)
VAR Virginia Region
VSS Virginia Speleological Survey
WVACS  West Virginia Association for Cave Studies
WVASS  West Virginia Speleological Survey
WVCC  West Virginia Cave Conservancy
YTR  Young Timer’s Reunion

Definitions

A.I. Cartwright  our mascot, go visit him in Clover Hollow Cave
air rappel  do not do this, you will die
arm-chair caver  old fart who caves with his mouth, not his body
B&C Wunderwear  vendor who makes caving suits; owned by Cecile James
banquet  annual event to officially recognize landowners and outstanding achievements by VPI cavers
bat ranch  a cool caver hangout
belay  safety line preventing a climber from falling
biner  carabiner
biner pop  it sucks!
Bob & Bob  vendor whose motto says it all, “cavers serving cavers”
bolt  artificial rigging point or anchor
Brunton  survey instrument maker, now owned by SPAB of Sweden
Buddy Penley  our favorite landowner
Captain Ed  lesbian trapped in a very large burly manly-man’s body
cave boogers  those nasty ones you get after a dry cave like Bone Cave
caver tan  1. ghost white skin with blotchy black and blue spots; 2. something that looks like a tan, but washes off
Cecile  see B&C Wunderwear
Chummer  Dave Warren
club files  contains the history of the club, along with maps and much good literature
cow’s tail  safety line connecting your harness to an ascender or an anchor
Dave  Take your pick.
dump  spent carbide
Elvis Grotto  1. world’s largest; 2. “Caving is dangerous. Don’t go.”
Evelyn Bradshaw  everyone should know who she is
float trip  floating down the New River in homemade rafts
frog system  a type of ascending system
gypsum flowers  prettiest of them all
litter  see “stokes”

nerd caver  unprepared, inexperienced, or untrained thrill seeker lacking helmet, boots, and three sources of light

nuisance drop  short (less than 20 feet) vertical drop

Octoberfest  annual party held in October, “Alarm!”

old fart  Has that caver been caving longer than you have been alive?

picnic  annual campout in April at the Penley pasture

quarry  place near the Bat Ranch where the club teaches new people how to rappel and climb rope

RASShole  Eric Stanley

rebelay  a bolt, knot, or redirection in the middle of a rope

rescue roster  list of cavers to be called in the event of a rescue

ridge walking  hiking in strategic locations in search of caves

Rock!  DO NOT look up

scaling pole  contact Ray Sira for additional information.

scooping  caving in virgin passage without surveying it

Silva  survey instrument maker.

speleopolitician  similar to armchair caver, but more opinionated

speleoseminar  a gathering of cavers after the Friday night meeting. Must attend for more information.

spelunker  nerd caver (origin: The sound nerd cavers make when they hit the ground.)

squeezbox  known to cause many people to take their clothes off and curse

Steve  1. Anti-Steve; 2. Steve

Stokes  a stretcher used to transport an injured person out of a cave

Suunto  survey instrument maker.

The Bastard  Wil Orndorff

The Ton  the Ton-80 Club located in downtown Blacksburg

to Carl  to drop your lamp down a pit such that is recoverable and usable.

to Rance  to drop your lamp down a pit such that it iw not recoverable or will never work again.

troglogyte  1. a member of a primitive people dwelling in caves; 2. a person resembling a troglogyte

virgin passage  unexplored underground terrain
The *Tech Troglodyte Prospective Member Guide* is a group effort by the VPI Cave Club community. Numerous people have contributed their time and knowledge to make it what it is. We hope this document has provided you with most of the basic information you need to cave safely and responsibly. Your comments will help us improve it. Did you find errors? Are there other things you think need to be covered? Is there too much information on some subjects? Let us know.

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