

Caving Knots



Nov 2001

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INTRODUCTION

1. This booklet provides information about knots used for caving. The "Basic knots" detailed within this booklet are taught to students attending the Cave Proficiency course, the "Advanced knots" are taught during the SRT and Leader training courses. This booklet may be used to be used as a guide for Local Cave Leaders and Cave Leader candidates in their preparation for assessment and can also be used as a reference for Cave Leaders and Instructors when running courses at Unit level.

2. The basic knots required for CVP and LCL are detailed below

- Figure of Eight
- Re-threaded figure of Eight
- Bowline
- Bowline on the Bight
- Double Bowline
- Butterfly
- Double Fisherman
- Clove hitch
- Tape Knot
- Italian hitch

3. All knots will weaken the rope, some considerably more than others. Peculiarly in the world of ropes, this weakening is known as the "Strength of the Knot". It is defined as the percentage of the strength of the rope without any knots. Therefore if a knot has the strength of 66% then the knotted rope is two thirds as strong as rope without the knot. It follows that lower the percentage the weaker the knot. The reduction in strength is many due to how tightly the rope twisted within the knot the tighter the turn the weaker the knot. Where the strength of the knot is known, it has been included.

4. There are sometimes a number of knots that can be used for the same job and it is personal preference as to which one is used. When using SRT, consideration has to be given to the ability and ease of untying a knot after use.

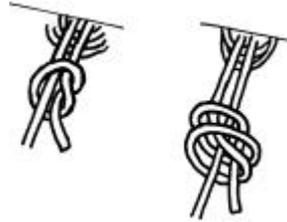
5. This booklet has been produced in consultation with JSMTW(Ripon) and is complimentary to the current Course Training Plan (CTP) for the CVP, CVT, SRT and CVR courses. Any questions or concerns about the contents of the booklet should be forwarded to the CSCA's Technical Training committee.

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BASIC KNOTS

Stopper Knots

6. Stopper Knots are used to prevent a knot working loose and to keep the knot "set", ie all areas of the knot load bearing or non load bearing, remain firmly held in the originally tied direction. Either an overhand or half a double fisherman knot is tied in the tail end of the rope.



End Loop Knots

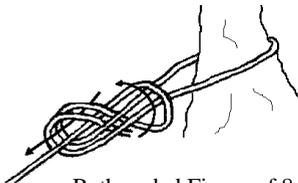
7. **Figure of 8** (*strength 70%*) The standard knot for tying a loop in the end of a rope. Normally used for attaching a life line to a harness with a karabiner or for attaching the end of a rope to an anchor. The tail end of the rope should be tied with a stopper knot or threaded back through the Figure of 8 to prevent the knot coming undone.

8. For greatest strength it is important that the loaded part of the rope is on the out side of the bend. If the loaded rope is on the inside it will result in a further 10 -15% strength reduction. A Figure of 8 which has been loaded can be difficult to untie, this is particularly the case when it is used as the main attachment point or rebelay during SRT.

Loaded rope
on the outside



9. **Rethreaded Figure of 8** This knot is identical to the standard Figure of 8 knot. It is used for tying into a thread belay, directly into an ECO anchor or when tying into a climbing harness.



Rethreaded Figure of 8

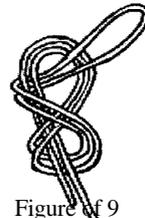
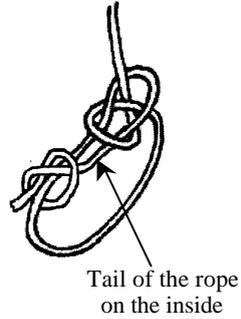


Figure of 9

10. **Figure of 9** A Figure of nine is similar to the Figure of eight but with an additional turn. This makes it a stronger knot and is normally used when maximum strength is required such as when using small diameter rope for SRT. The knot can be particularly difficult to untie.

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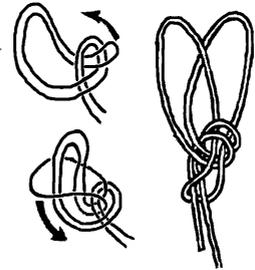
11. **Bowline** (strength 63%) Knot which is usually used for tying around a thread belay. The main advantage of the bowline over the Figure of 8 is that it is easy to adjust and can also be easily untied after heavy loading. The tail of the rope must be on the inside of the loop. The bowline can easily work loose and therefore a stopper knot **MUST** be tied in the tail end of the rope.



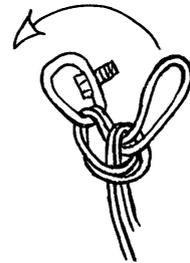
12. A load should not be applied to the loop without loading the main rope, this can cause the knot to invert and then slip.

Double Loop Knots (for Y hangs)

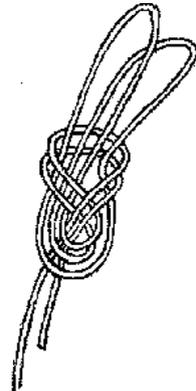
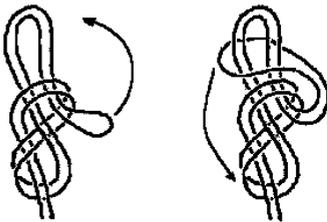
13. **Bowline on the Bight** Very useful knot for attaching maillons or karabiners into two anchors, which are close together, to create a Y hang. The knot is easily adjusted to allow equal load sharing between the two anchors and can be easily untied after being heavily loaded.



14. The bowline on the bight can be used for attaching to a single point rebelay on an SRT pitch. Using this knot rather than a Figure of 8 overcomes the problem of trying to untie a tight knot after use. The bowline can be either tied directly to a ring hanger before it is bolted to the rock or tied then attached to a plate/twist hanger with a maillon or karabiner.

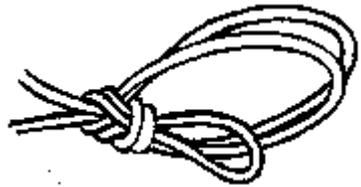


15. **Double Figure of 8 on the Bight (Rabbit's Ears)** Similar to Bowline on the Bight, but a lot more bulky. Knot can be easily adjusted for load sharing.



Mid Rope Knots (used on traverse lines)

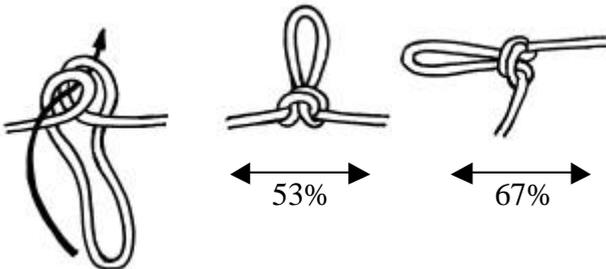
16. **Double Bowline** This knot is often referred to as a Triple Bowline because it produces three loops. Used for attaching the middle of a rope to a thread belay when either a sling and karabiner is not available or suitable. The end of the rope should be tied with a stopper knot (not shown). It can also be used for an improvised harness.



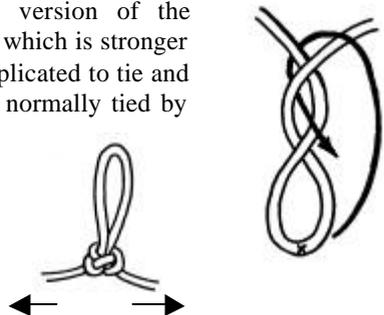
17. **Overhand Knot** (strength 33%) Often used on traverse lines as a convenient attachment point and to form loops in a handline. The over hand knot is a relatively weak knot and is very difficult to untie after loading.



18. **Butterfly Knot.** (strength 53% both ropes loaded, 67% loop loaded) The Butterfly knot is used to form a loop in the middle of a rope, where the knot will be subjected to loading in any direction. It is used extensively for SRT rigging and advanced ladder and lifeline techniques for traverse lines and pitch head Y hangs. The knot can be easily adjusted and undone after use.

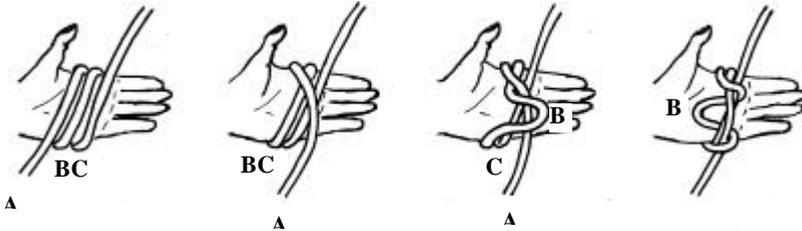


19. **Alpine Butterfly.** A more secure version of the standard butterfly. It is a symmetrical knot which is stronger than the standard butterfly but is more complicated to tie and harder to adjust and untie after load. It is normally tied by putting two twists into the rope and then passing the end of the loop back through the middle twist as shown. It is important to pull both ends of the rope to form the knot.



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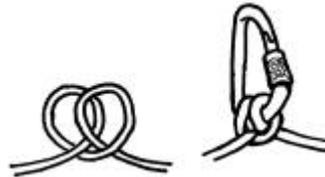
20. An alternative method of tying an Alpine Butterfly, which is useful when a small bop is required for connecting to anchors on a traverse line is shown below:



- Rap the rope loosely around the hand twice.
- Pass **A** over both **B&C**
- Pass **B** over **A&C**.
- Pass **B** back underneath both **A&C**.
- Hold loop **B** with the other hand, remove knot.
- Pull both ends of the rope to form the knot.

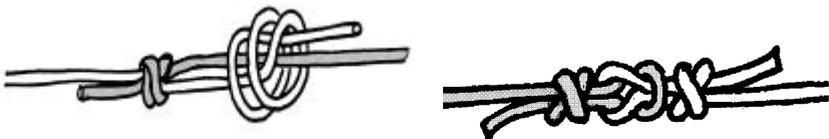


21. **Clove Hitch** (strength 35%) A quick and easily adjusted knot for attaching to a karabiner mid rope. It is occasionally used when rigging ladder and lifeline. It is a weak knot which is prone to creeping. A Clove hitch is not suitable for SRT.



Joining Ropes

22. **Double Fisherman** (strength 65%) Used for joining two ropes or for making rope slings. It is a very secure knot, but is difficult to undo after heavy use. The tail ends of the rope should be a minimum of 8 times the rope diameter. (10mm rope tails to be minimum of 80mm).



23. To make it easier to untie, a reef knot can be tied in the middle with a double fisherman's either side.

24. **Reversed Figure of Eight** A Figure of 8 is tied in the end of one rope and the other rope is carefully threaded through the knot following the same route as the first rope. A stopper knot must be tied in the end of both ropes.



Tape Knot

25. Used for tying a tape sling. At least 100mm of tape tails should be left for security. Spectra tape should not be tied as the knot can slip, it should only be used as a pre-sewn sling. Although a very strong material, spectra has a very low surface friction coefficient which makes it particularly slippery.

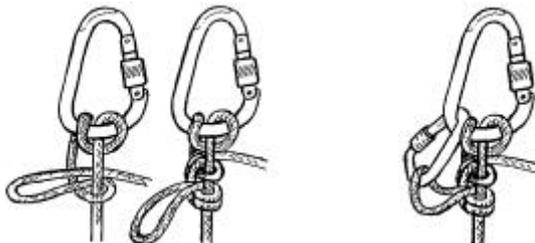
Belay Knot

26. **Italian Hitch** The Italian hitch is a quick simple and very effective belay method that requires the minimum of equipment. The knot works by the friction generated by the rope running around a karabiner and back around itself. Because the point of friction is constantly moving, insufficient heat is generated to cause damage to the rope.



27. It is essential that a large karabiner is used because the knot only functions properly if it can reverse itself by swinging through the karabiner. HMS or Pear shaped karabiners are ideal. If using the Italian hitch frequently, particularly in muddy caves, consider using a steel karabiner. Alloy karabiners will wear significantly at the point of moving rope contact and worn karabiners are weak.

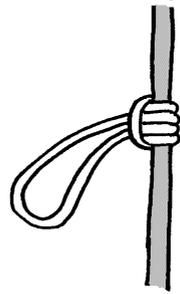
28. The Italian hitch can be locked off with a half hitch tied beneath the knot, a second half hitch must then be tied. For additional security the loop can be clipped back into the karabiner. The knot can be easily released when under load, but it is important that a firm grip is maintained on the rope at all times when releasing the locked off hitch and that it is released smoothly to prevent a sudden drop



ADVANCED KNOTS

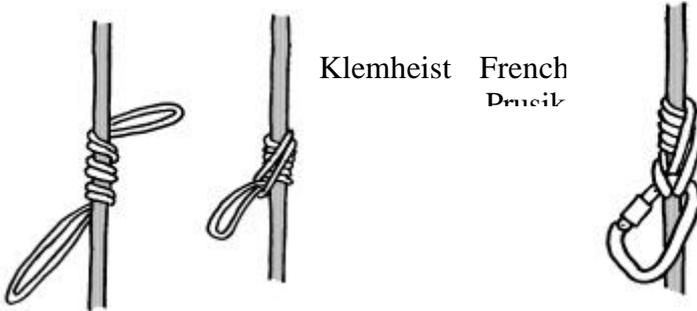
Prusik Knots (for climbing and improvised rescue)

29. **Prusik knot** The traditional prussic knot is tied by simply winding a rope sling "prusik loop" around the rope twice and back through itself. Keep the knot symmetrical and do not overlap the turns. The traditional prusik has the advantage that it can be tied single handed. Its disadvantage is that it cannot be released when under load and is prone to jamming particularly when wet or when tied with too small a diameter rope.



30. The best diameter rope for the prusik loop is $\frac{2}{3}$ the diameter of the main rope. For general caving 10-10.5mm rope is used and therefore 6-7mm accessory cord is ideal.

31. **Klemheist.** This is an extremely useful knot which does not jam. It is tied by winding the sling around the rope at least 3 times and passing the bottom loop through the shorter top loop. The klemheist can be tied equally well using a tape sling but is important that the tape is laid flat against the rope when the knot is tied.

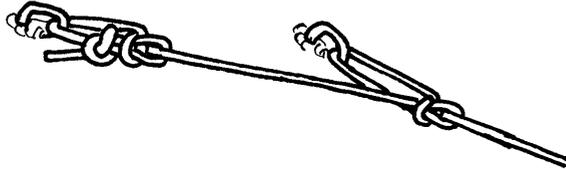


32. **French Prusik** This is very similar to the klemheist but uses a short sling with both ends clipped into a karabiner. It is advisable to use a screw gate karabiner. The knot can be released under load by placing your hand around the top of the knot and sliding the whole knot down.

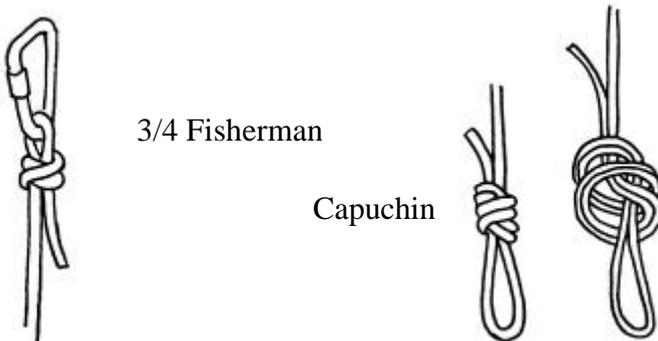
WARNING

33. If climbing using two prusik knots the French Prusik **must not** be used for the lower knot. If it is used and the upper knot slips down onto the top of the French Prusik it will release the French Prusik and both knots will slip. (Climber often use a French as the top knot and a klemheist as the lower knot.)

34. **Continuous Bowline..** This is used to tie directly into two or more Eco hangers. It is particularly useful when running short of maillon or karabiners. The problem with the knot is that the anchor nearest the pitch/traverse has to be tied into first and only the anchors that can safely be reached can be used, this will normally limit the number which can be tied into in this way to two or three. The furthest anchor is tied into with a normal Bowline with an extra long tail. This tail is then tied into the next anchor with a bowline and even a third could be tied onto in the same way. The final bowline is tied with a stopper knot.



35. **3/4 Fisherman.** (Strength 67%) also known as a Barrel Knot. This knot is frequently used for attaching the karabiners to the end of cowstails. It is only slightly weaker than a Figure of 8. It has the advantage over the Figure of 8, in that it is less bulky, it holds the karabiner captive preventing the inadvertent loss of the karabiner and it has the ability to absorb shock load as the knot tightens. The knot is simply tied by passing the rope through the karabiner and tying it back around itself with half a double fisherman knot.



36. **Capuchin.** This is basically half a double fisherman knot tied in a bight of rope. This knot can be used to produce a particularly large knot in the end of a rope that will not pull through a karabiner or ring when doing a "Pull Through" trip. It can also be tied into the bottom of a rope to prevent someone abseiling off the bottom and a new rope can easily be attached without undoing the knot (see Joining SRT ropes).

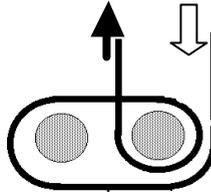
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37. **Alpine Clutch.** In the event of the loss of a chest jammer this knot can be used to climb a rope. Two identical D shaped karabiners must be used. The knot can not be released under load, so a caver may go up the rope but cannot slide back down.



Rope passes through

karabiners in this

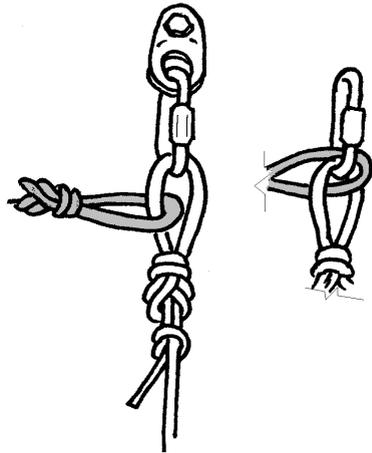


38. **Sheet bend.** The only use this knot has underground is when making a improvised chest harness out of a 2.4m tape sling, called a Parisian Baudrier.

Joining SRT Ropes

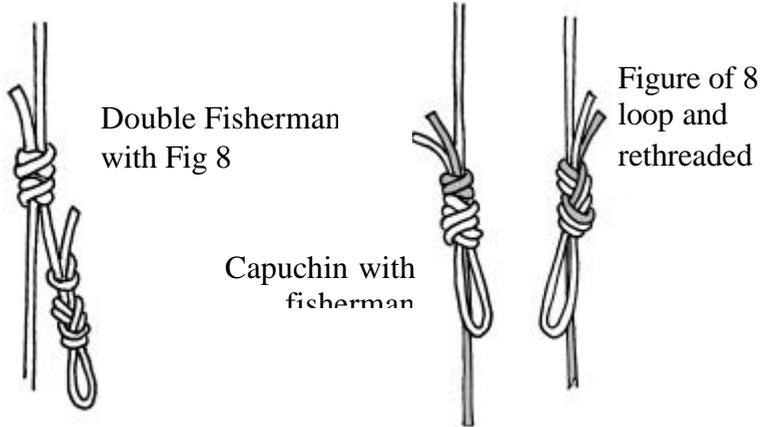


39. If practical SRT ropes should be joined at an intermediate anchor or rebelay. The two ropes must be tied together as shown and not connected by clipping both loops into a karabiner or maillon. Any spare rope not used for SRT progression at the join, should be neatly coiled and tied in such a way that it cannot be inadvertently used.



40. There will be occasions when a rope must be joined midway down a pitch. In order to safely pass the knot a loop must be available to clip a cowstail into. There are a number of ways to tie the two ropes together. The normal knot to use is a Double Fisherman with a Figure of 8 tied in an extra long tail.

41. Alternative knots are a normal Figure of 8 loop tied in the bottom of the first rope and the next rope threaded up through the knot in the same way as a Reversed Figure of 8.



42. A very secure knot is a Capuchin tied in the bottom of the first rope and the new rope being passed up through the middle of the knot and tied with half a double fisherman above the Capuchin

