



Module 6 – Knots

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6.0 Introduction

Knots are the Catch 22 of ABSEILING. Before tying any knot in a line, the line has full strength but cannot be used for any practical purpose, but as soon as a knot is tied in the line, up to 90% of the strength of that line can be lost.

If a line is bent around a radius that is less than 10 times the diameter of the line, strength will be lost. This must be borne in mind when taking a line around an acute angled edge.

For every knot, there is a range of purposes and for every purpose, there is the ultimate knot. Although it is possible to join two abseiling lines with a reef knot, one would NEVER do it while abseiling.

This section will explore a range of knots and will give a guide to their approximate strengths and use. Every reference we consulted, gave a different figure for the strength of the knot. It must be remembered that if a life is at stake, always estimate on the safe side. Remember also that the SAFE WORKING LOAD of a line is 1/10th of the yield strength of a line after considering all the knots.

The SAFE WORKING LOAD (S.W.L.) of the Abseiling equipment set up MUST be known by the Abseiling Leader responsible for the activity. Unless you know the SAFE WORKING LOAD, you will not know when you have exceeded it.

UNDER NO CIRCUMSTANCES IS THE SAFE WORKING LOAD TO BE EXCEEDED.

A bend that is often overlooked is where the line goes through the figure "8" descender. More than 50% of the line strength may be lost at this point depending on the type of figure "8" descender being used.

NOTE: To be effective a knot must be set and dressed correctly. At least 80mm of line or tape must be left as the tail of all knots used in abseiling. It is preferable that this tail is tied back to the main line either with half a double Fishermans knot or with electrical tape.

For each knot there is a range of strengths quoted as a % strength of the line. For example a figure 8 loop knot is quoted as high as 90% in some publications and as low as 70% in others. In calculating the strength of the particular rig it is essential that the lowest known figure is used for the calculations as there is no way of knowing where in the range your particular knot lies.



6.1 Basic Knot terms

Here is a list of basic knot terms, even the most complex knot can be figured out if you remember these terms.

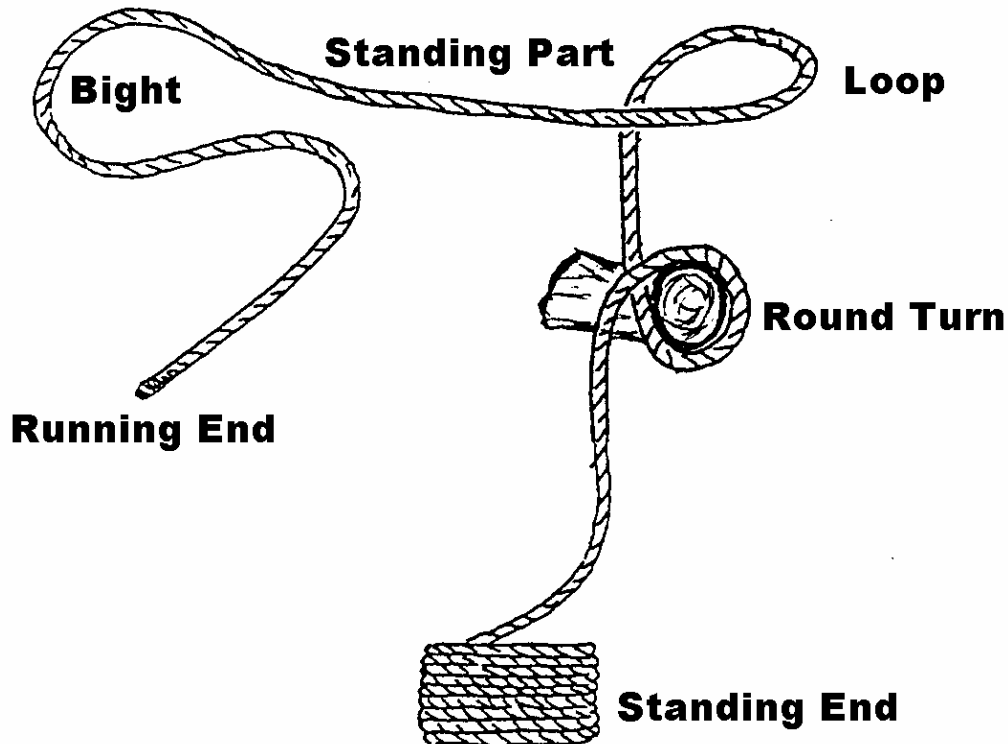


Figure 6-1 Basic knot terms

Bight.	A doubled section of rope usually taken from the centre of the rope that doesn't cross itself.
Standing end.	The end of the rope that is used to rig with or to tie off to something. eg. an Anchor point.
Running end.	The end of the rope that is not attached or free end.
Standing part.	Any part of the rope that is taking the load.
Loop.	Any part of the rope that crosses itself.
Round turn.	One complete turn around an object or another rope.
Knot.	A knot is the interweaving of parts of one or more ropes or tapes to fasten them together.
Hitch.	A simple fastening of a rope around some object by winding or crossing one turn so that one bites on the other. A hitch also requires constant tension to remain tight.
Setting.	Setting a knot involves the tightening of all parts of the knot so that all of the rope parts touch, grab and cause friction upon other parts of the knot so as to render it operational. The knot must not deform when tension is applied.
Dressing.	A knot is dressed by aligning all parts of the knot so that it looks exactly like the illustration in the book. Neglecting this may result in the loss of 50% of the total knot strength.



6.2 Knot Characteristics

A good knot has the following characteristics:

- easy to tie and untie, not too complex.
- easy to visually check if tied correctly.
- secure - remains tight after tying.
- strength - weakens rope to a minimum.
- versatility - can be used for different applications.
- does not apply tension upon itself.

6.3 Anchor point knots

6.3.1 Figure 8 on the bight or figure 8 loop

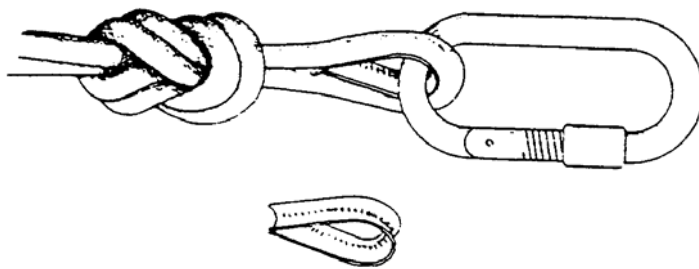


Figure 6-2 Figure 8 knot & thimble

The figure 8 on the bight makes a strong secure loop in either running end or the standing end and will hold in kernmantle rope where a bowline will slip.

Use: Tying a line onto an anchor point, when used with slings and thimbles.

Precautions:

- A. The standing part of the line must take the outer path through the knot, thus having the larger radius of the bend. (10% of strength can be lost otherwise) see 6.3.3
- B. It is advisable to fit a thimble into the bight of the knot, if it is attached to a small diameter object such as a karabiner. If this is not fitted, the weakest point will be the sharp bend in the bight around the karabiner, this may lose about 45% of the rope strength.
- C. The figure 8 on the bight knot is NOT suitable as mid line knot eg. dividing a rope in half for two abseiling lines. as the knot WILL undress under a three way pull.

Knot strength: 75%

6.3.2 Woven Figure 8 Knot

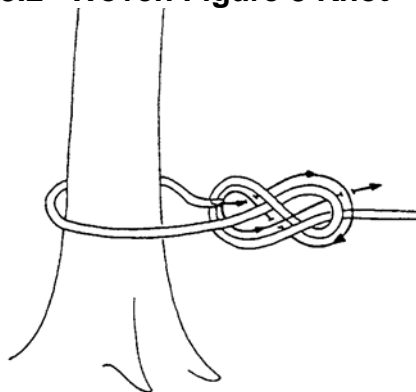


Figure 6-3 Woven figure 8 knot.

Use: For anchoring a rope around a large object. A double figure 8 knot should be tied in the bottom of a line bag as a stopper knot.

Precautions:

Ensure after tying the knot, that the woven figure 8 is set and dressed correctly as in Section 6.3.3.

Knot strength 75%



6.3.3 Dressing the Figure 8 Knot

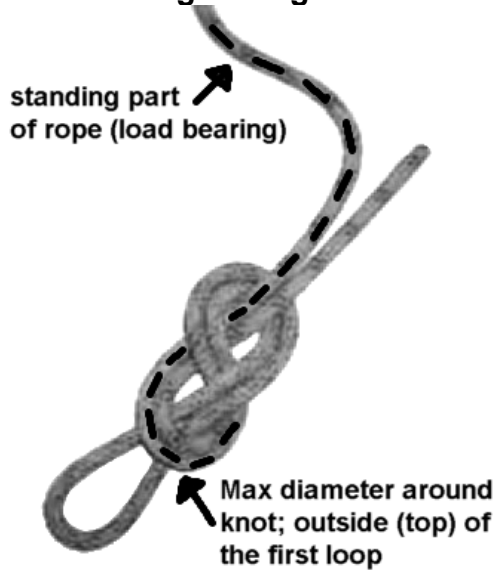


Figure 6-4 Woven figure 8 knot.

Reason: The Figure 8 Knot on a end-line load bearing knot which is commonly used in anchor systems, incorrectly dressing the knot and cross-overs of the rope on itself create points of stress and weakness. Always dress the knot then apply weight and redress before use to avoid the knot rolling over itself and ensure maximum strength.

Precautions:

Must not be used with the loop exceeding 90 degrees as it will roll-over itself until the rope feed all the way through under load. Do not use as a mid-line knot.

Knot strength variance up-to 10%

6.3.3 Figure 9 Loop Knot

The figure 9 loop gives greater security than the figure 8 loop, if subjected to a shock loading, the knot slips a little before gripping, thus absorbing the shock.

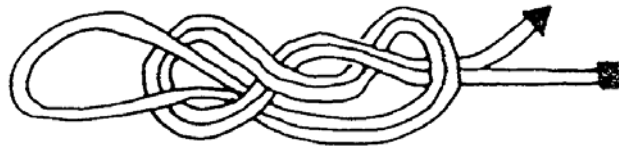


Figure 6-4 Figure 9 loop knot

Use: A variation of the Figure 8 knot. By adding another twist to the knot gains extra strength to the knot and is easier to undo.

Precautions:

Ensure the knot is set and dressed correctly. Not for mid line use.

Knot strength 80%

6.3.4 Round turn and 2 1/2 hitches



Figure 6-5 Round turn and 2 1/2 hitches

Use: For anchoring a rope around a round object as part of an anchor system and is only used to secure the non load bearing end of the rope.



Precautions:

- A. The round turn and 2 $\frac{1}{2}$ hitches is finished off with a lark's head knot, not a clove hitch, so no kink is placed in the rope. The knot should be offset from the centre of the tree.
- B. Knot strength is dependant upon the diameter of the object it is tied too.

Knot strength 60%

6.3.5 Alpine Butterfly

The Alpine butterfly is one of the strongest and most secure of the loop knots. It will withstand loads between any leg and the loop, as well as being able to handle a three way loading.

Use: A knot designed for mid rope usage, either as anchor point knot or as a knot mid way down to secure something. The Alpine butterfly will not undress under tension.

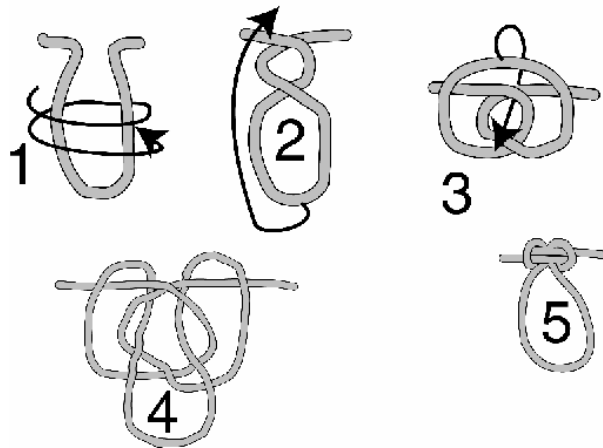


Figure 6-6 Alpine butterfly knot.

Precautions:

Ensure the knot is set and dressed correctly.

Knot strength - 80% End line, 75% Mid line.

6.4 Stopper Knots

6.4.1 Figure 8 Knot

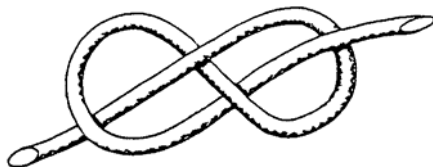


Figure 6-7 Figure 8 knot.

The figure 8 knot is a bit more bulky and less likely to jam tight than the overhand knot.

Use: As a stopper knot in ropes.

6.4.2 Overhand / Thumb knot

Use: A double thumb knot is used to attach a buckle to the end of a length of tape, for making a tape harness.

Precautions:

The knot must be set and dressed. Tails must be taped back onto the standing part for security.



Figure 6-8 Overhand knot

Knot strength: 30-60%



6.5 Joining Knots

6.5.1 Double Fisherman's Knot

Use: Tying two lines of equal thickness together to form a longer line or for joining two ends of a short rope to form a loop, for use as prusik cord or rope sling.

Precautions:
Knot must be well dressed and set.
Tails must be taped for security.
Check regularly that the knot has not come loose.



Figure 6-9 Double Fisherman's knot.

Knot strength 70%



6.5.2 Tape knot

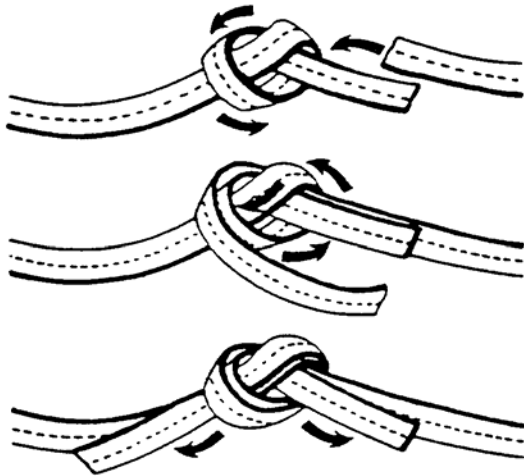


Figure 6-10 The Tape Knot

Use: Joining two (2) ends of a length of tape to make a sling.

Precautions:
Correct dressing and setting is essential. Tails (80mm) may be taped to standing part for security.

Knot strength: 80%

6.5.3 Surgeons Knot

Use: For securing the tails / ends of a Tape Harness.

Precautions:

- May tend to slowly creep undone under certain conditions. Always check after every couple of jumps, if necessary retie. Tails to be 80mm.
- Not to be used for Slings.

Knot strength: 70%

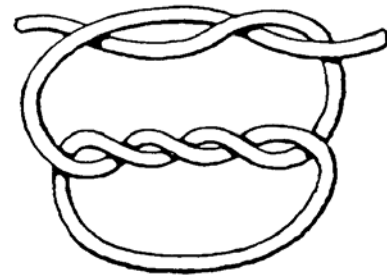


Figure 6-11 Surgeons Knot.

6.6 Sliding friction Knots

6.6.1 Prusik Knot

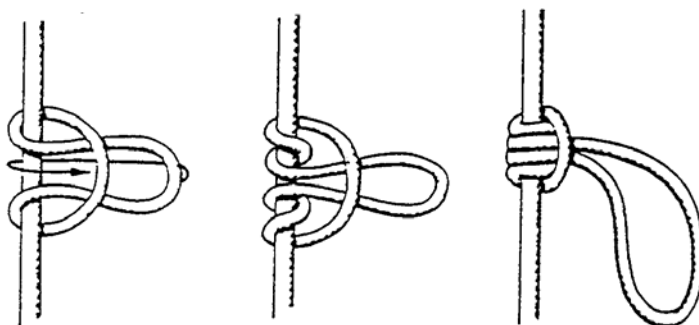


Figure 6-12 Prusik knot.

Use: A rope or cord is wrapped around the abseiling rope in such a way that the prusik cord grips the main rope and will not slide under tension. When there is no tension on the knot, it slides freely up or down.

Can be used to ascend a line or as a self belay safety knot.

Precautions:

- Can slip on wet or icy rope. Must be tied with a cord much thinner than the main line, usually 7mm cord.
- If silage occurs, additional turns may be added to increase friction



6.6.2 French Prusik

The French Prusik is a variation of the basic prusik knot and is somewhat similar to the Klemheist. The primary use is in circumstances where the basic prusik would slip, wet, muddy or icy conditions.

As with the Klemheist, simply wrap around the main line until both tails are roughly equal and connect with a carabiner.

Precautions:

See precautions for prusik.

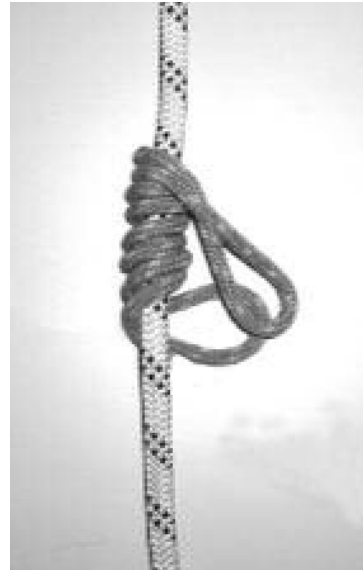


Figure 6-13 French Prusik.

6.6.3 Klemheist Knot

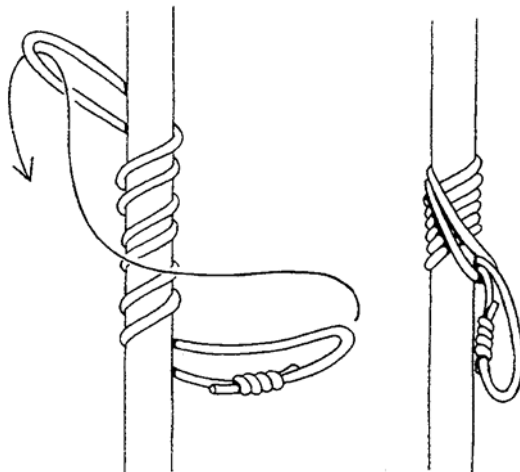


Figure 6-14 Klemheist knot.

The Klemheist knot is a variation of the prusik and french prusik knot. This knot is also known as the Machand. Note that the French Prusik is also used in it's true form with both loops being connected through the carabiner.

Use: Same use as prusik knot but but can only be used for ascending.

Precautions:

Will tend to slip on laid rope, if tied the opposite way to the twist in laid rope.

6.6.4 Bachmann Knot

The Bachmann knot involves the use of a karabiner and is a similar to the prusik knot.

Use: The knot is useful in pulley systems used for hoisting casualties.

Precautions:

Has the same problem as the Klemheist knot on laid rope.

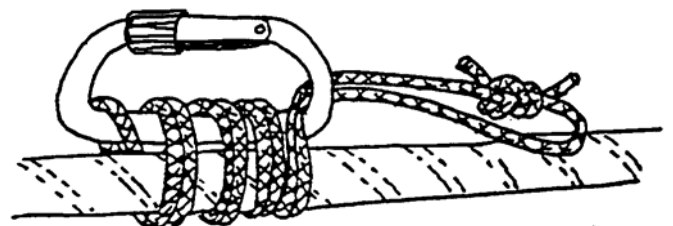


Figure 6-15 Bachmann knot.



6.6.4 Munter Hitch

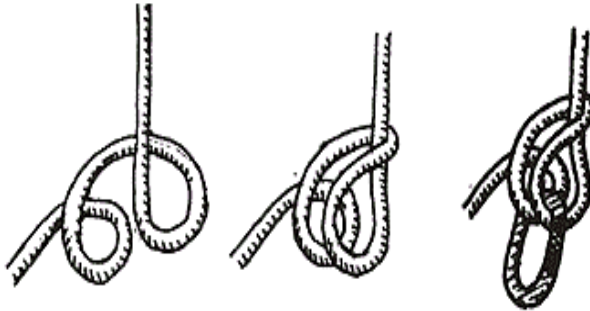
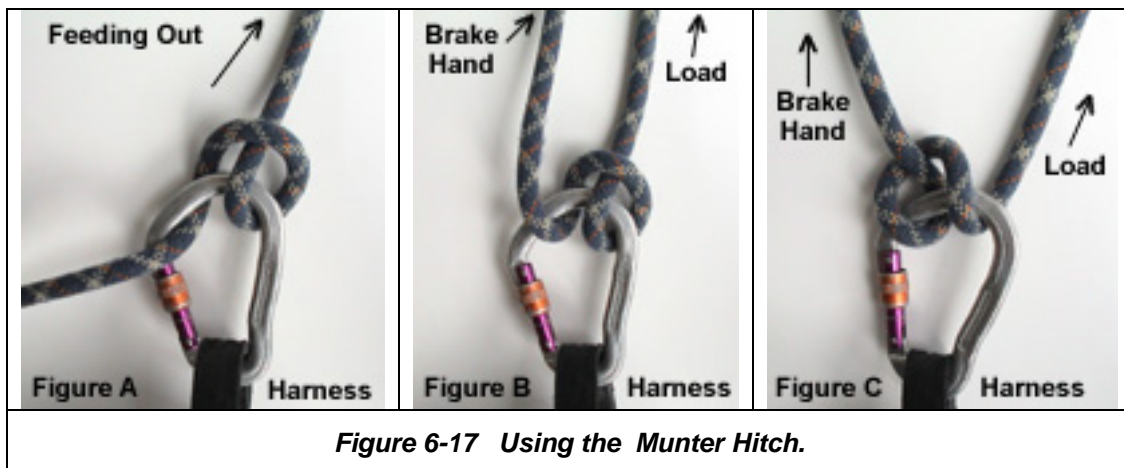


Figure 6-16 Munter Hitch.

The Munter Hitch is useful for both abseiling and belaying. It's advisable to use a pear-shaped carabiner, and try to avoid cross-loading it. The knot will "flip" as opposite strands of the rope are pulled, this is normal. To lock the knot, apply the braking hand by moving the slack line parallel with the loaded line. This knot is also known as the Italian Hitch.



Use: *Figure A*: Here you're feeding out slack when belaying, or you're abseiling down. *Figure B*: To lock the Munter Hitch draw your brake hand up parallel with the load line. *Figure C*: The knot will correctly "flip" into this position as you take in slack when belaying.

Precautions:

The rope is in direct contact with the carabiner and this is where the friction will occur. Heat dissipation is very minimal and 'glassing' of the rope due to excessive heat is a real issue. The speed limit to reduce this must be borne in mind.