

RESCUE KNOTS FOR ROCO STUDENTS

While there are many knots available to rescuers, Roco encourages mastering a few knots that are applicable for most situations. These represent a “good cross section” of the most popular rescue knots. **Remember... practice, Practice, PRACTICE!**

TERMINOLOGY:

1. **KNOT** – fastening made by tying together pieces of rope or intertwining a rope.
2. **BIGHT** – U-shaped bend in a rope; the open loop in a rope formed when it is doubled back on itself.
3. **LOOP** – turn in a rope that crosses itself to create a closed loop.
4. **ROUND TURN** – full wrap of rope around an object so that both ends emerge from the same side.
5. **SHORT LEG (OR WORKING END)** – portion of rope used to make all of the bends to tie the knot. Also referred to as “running” or “loose” end.
6. **LONG LEG (OR STANDING END)** – portion of rope that is stationary when tying a knot. For example, the short leg (end used to make the bends) in a “loop” crosses over the long leg (stationary portion). The long leg encompasses the area from the origin of the rope to the knot; also called “standing end.”

TYPES OF KNOTS:

1. **LOOPS** – any knot that creates a closed loop for attachment (Figure-8; Double-8; Bowline).
2. **HITCHES** – used to attach a rope (or webbing) to an object. A hitch binds on the object – if object is removed, the knot will fall apart (Clove; Girth; Prusik Wrap).
3. **BENDS** – used to join ropes (Figure-8 Bend; Double Fisherman; Square Knot; Water Knot).

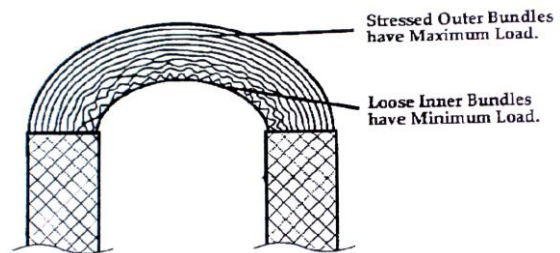
EFFICIENCY:

4-TO-1 RULE:

1. 4-to-1 rule refers to the efficiency of rope during bending. If a rope is bent around an object at least four (4) times its diameter, there will be **no** loss of efficiency due to bending. The “tightness of the bends” determines the efficiency ratings of knots. Note: Most rescue knots have a 20-to-28% efficiency loss.

Example: To prevent efficiency loss with ½ inch rope, the knot must have no bends smaller than 2-inches.

2. Although not possible when tying most knots, this rule must be followed as much as possible (ropes over square edges, ropes through pulleys, etc.)
3. **IMPORTANT:** In order to maintain maximum efficiency (strength) of ropes and rope systems, **AVOID ACUTE BENDS!** The sharper the bend, the greater the efficiency loss.



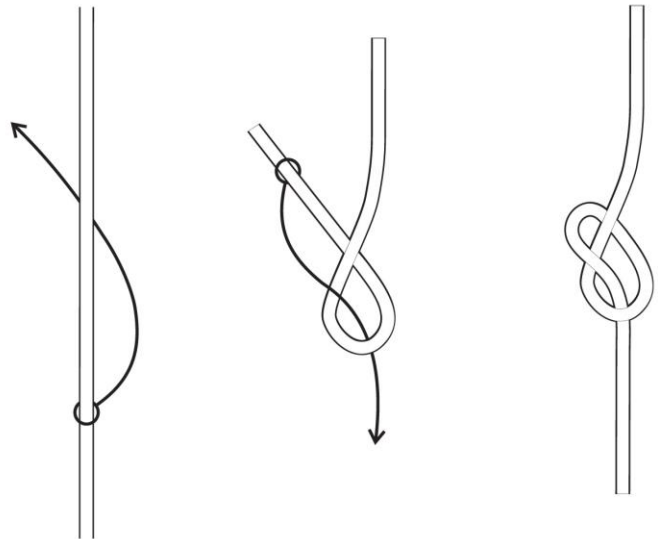
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STEPS IN KNOT TYING:

1. **DRESS...**Try to keep the ropes free of twists – with legs running side-by-side.
2. **LOAD...**Once tied, the knot should be pulled tight to avoid any accidental movement when line is loaded. **TEST LOAD** before life-loading!
3. **SAFETY...**Refers to securing any loose ends. If knot has a loose end (tail), it should be secured using another knot (a safety knot).
4. **PRACTICE...**Most important concept in tying knots... Practice!!

1. OVERHAND KNOT:

Purpose: Used as a Safety Knot to secure loose ends.

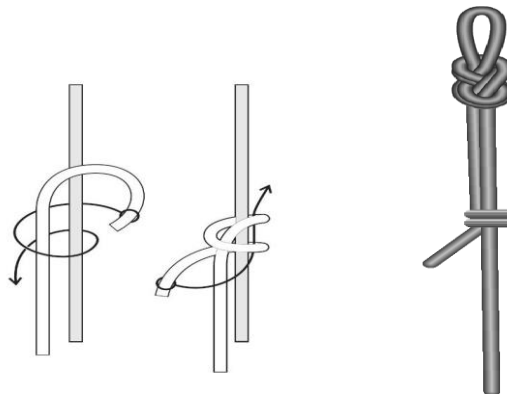


OPTIONAL KNOT

Barrel Knot as a safety

Purpose: Used as a safety knot to secure loose ends.

This knot, when used as a safety, is less likely to untie. It is used as a safety knot for hitches, when running a loaded knot over an edge or when the knot will see tensioning and slacking of the line repeatedly.



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2. FIGURE-8 STOPPER KNOT:

Purpose: Used to stop rope end from moving through a device (rappel rack, etc.).

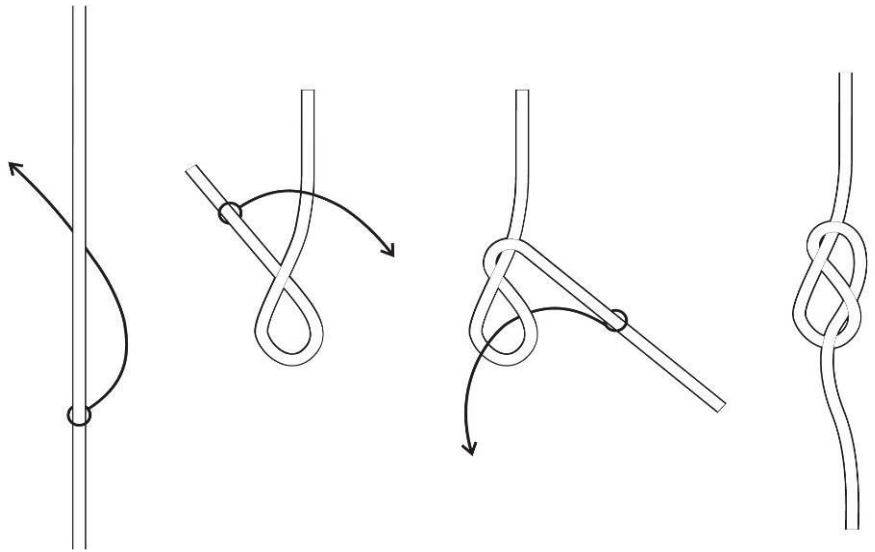


Figure-8 Stopper Knot

3. FIGURE-8 ON-A-BIGHT:

Purpose: Anchor knot that creates a single loop that will not slip. It can be attached to components of a rescue system with carabiners.

Efficiency loss: approximately 20%

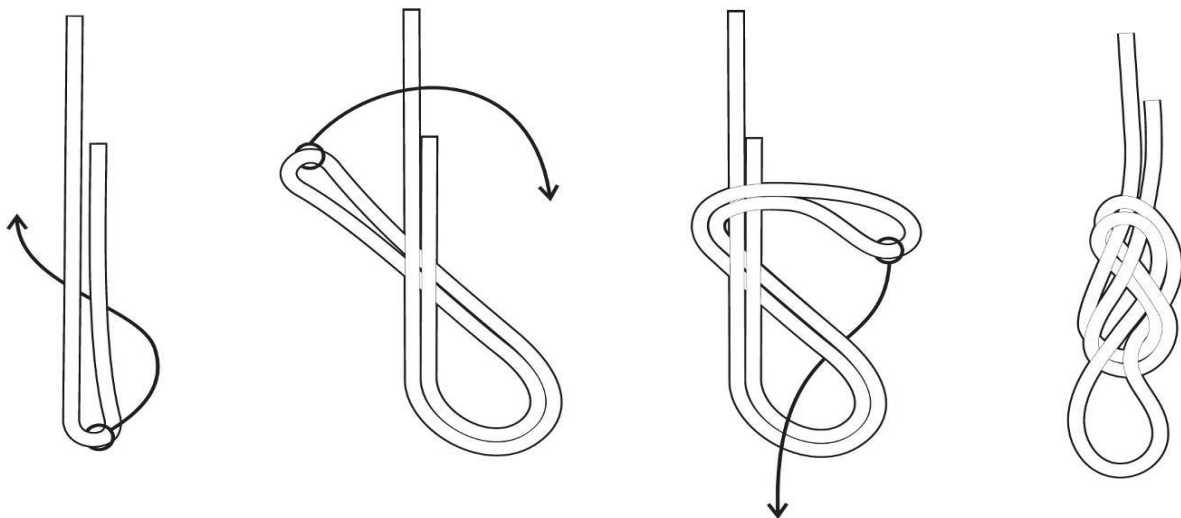


Figure-8 on-a-bight

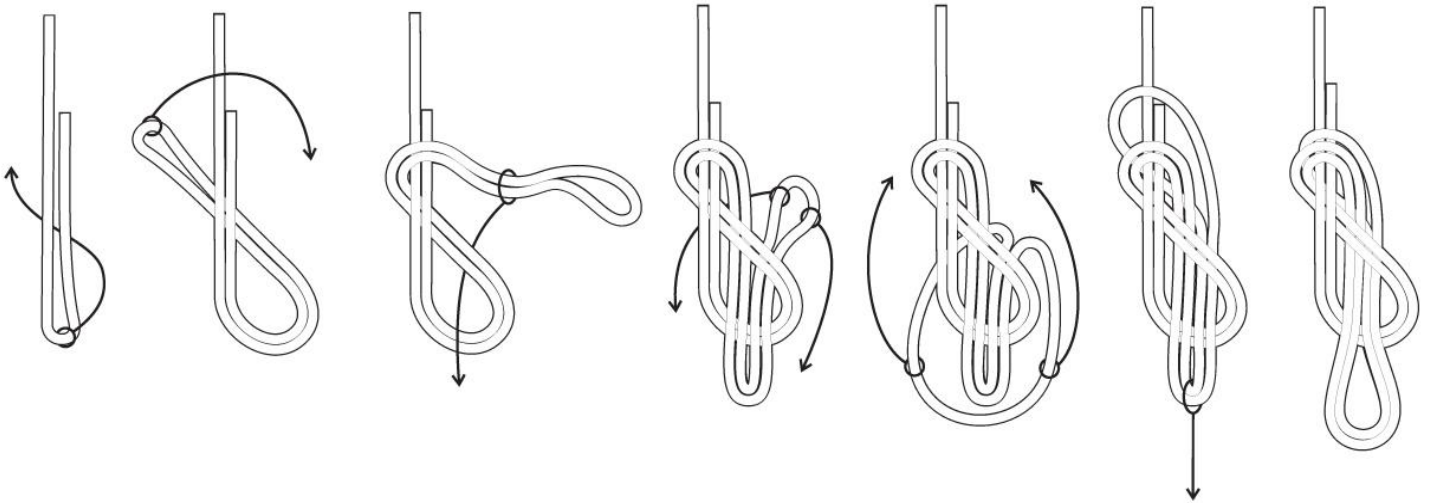
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4. DOUBLE-LOOP FIGURE-8:

Purpose: Anchor knot that provides more load-bearing surface area due to its two-loop configuration. It is slightly more efficient when you must tie around a tight object such as a carabiner.

Efficiency loss: approximately 18%

Double-Loop Figure-8



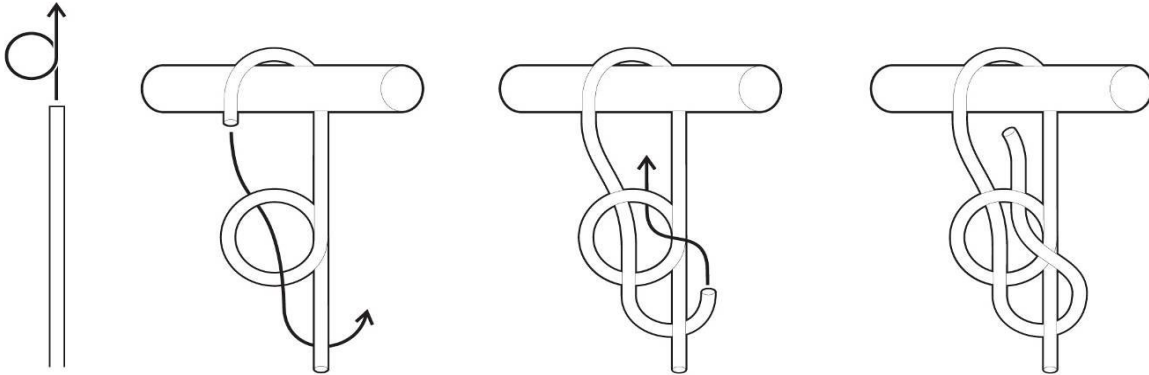
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5. BOWLINE KNOT:

Purpose: May be used as a static (non-moving) anchor knot.

Efficiency loss: approximately 27% to 33%

WARNING→ A bowline knot should NEVER be used in moving applications because it can untie when going over an edge. Always safety the loose end!



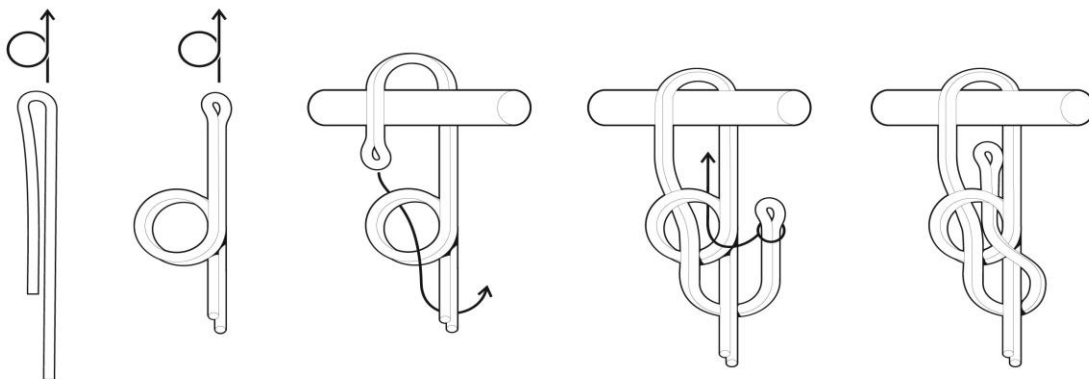
Bowline Knot

Always safety the loose end!

6. DOUBLED BOWLINE KNOT:

Purpose: May be used as a static (non-moving) anchor knot that can be tied in the middle of a line. It is a simple Bowline tied with a bight in the line.

WARNING→ The bowline knot is not recommended to be used in moving applications because it can untie when going over an edge. Always safety the loose end!



Doubled Bowline

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7. FIGURE-8 FOLLOW-THROUGH KNOT:

Purpose: Anchor knot that can be tied around an anchor or a “closed-end” object.

Efficiency loss: approximately 20%

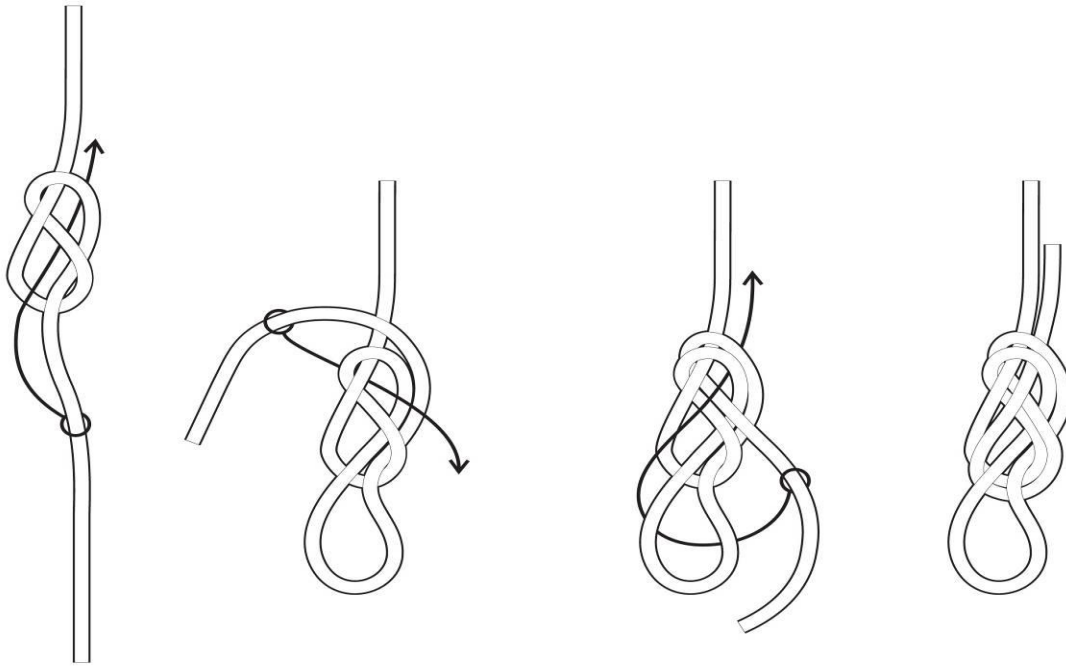


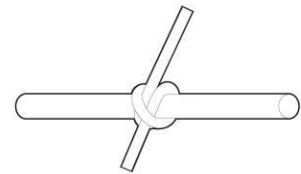
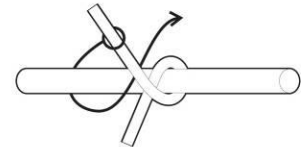
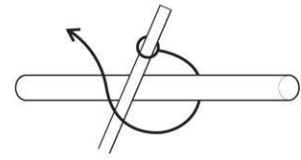
Figure-8 Follow-Through Knot

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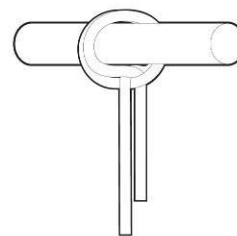
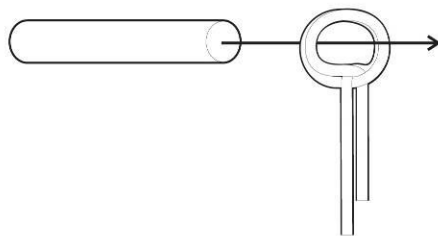
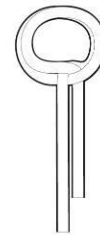
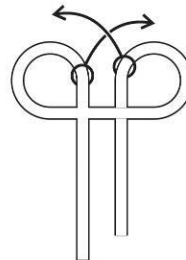
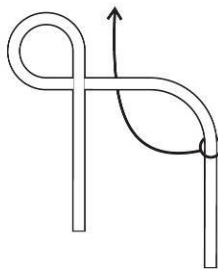
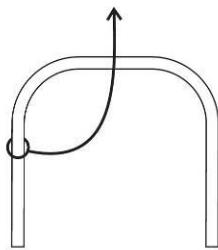
8. CLOVE HITCH:

Purpose: Adjustable anchor hitch often tied to round anchor points (horizontally or vertically). It may also be tied with webbing.

Efficiency loss: approximately 40%



Clove Hitch (end line)



Clove Hitch (mid-line)

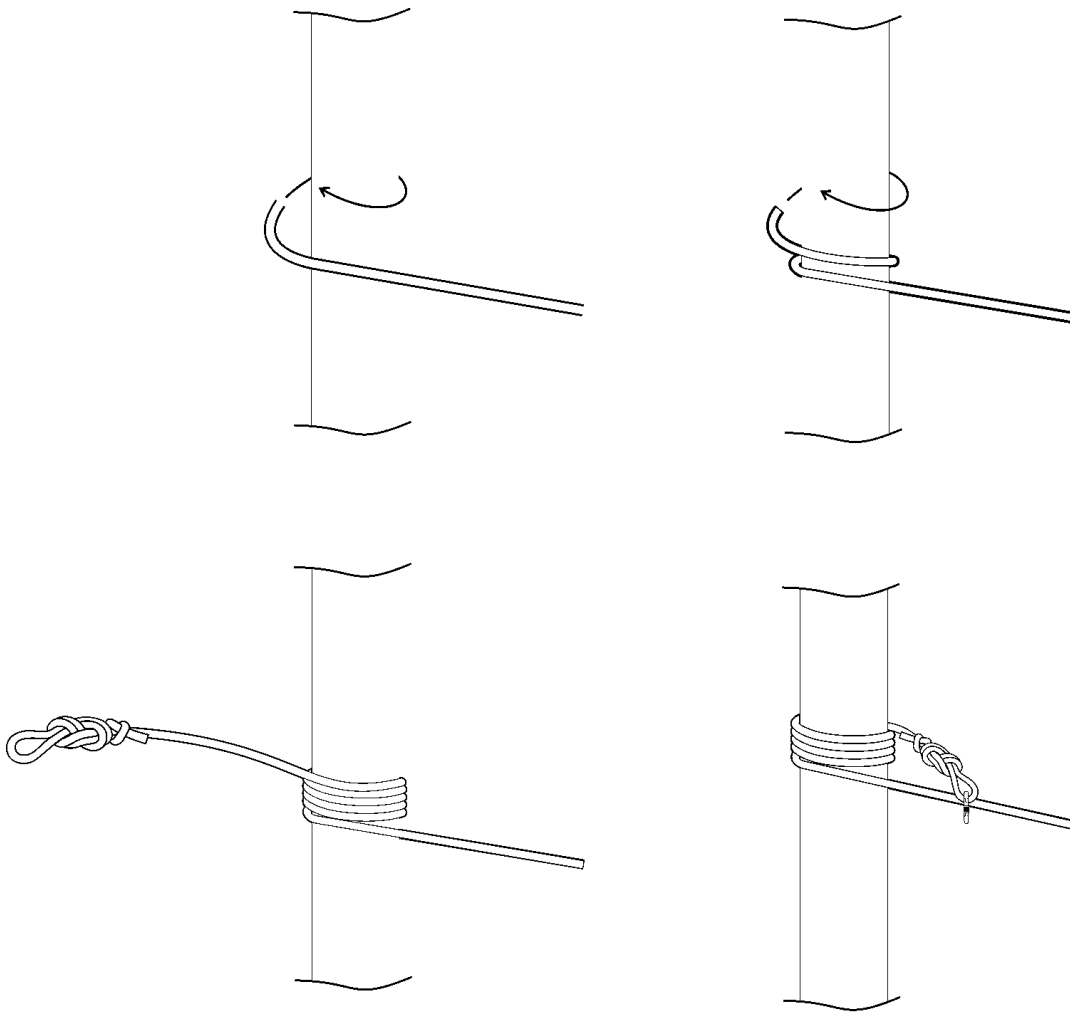
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9. TENSIONLESS ANCHOR (4-TO-1 WRAP):

Purpose: Most efficient means of anchoring a rope – as long as it's wrapped around a secure anchor at least 4 times the diameter of the rope.

1. Turns of the rope should not cross each other.
2. Minimum of three wraps.
3. Must be finished with a knot.
4. May roll on round, smooth anchors.

Efficiency loss: 0%



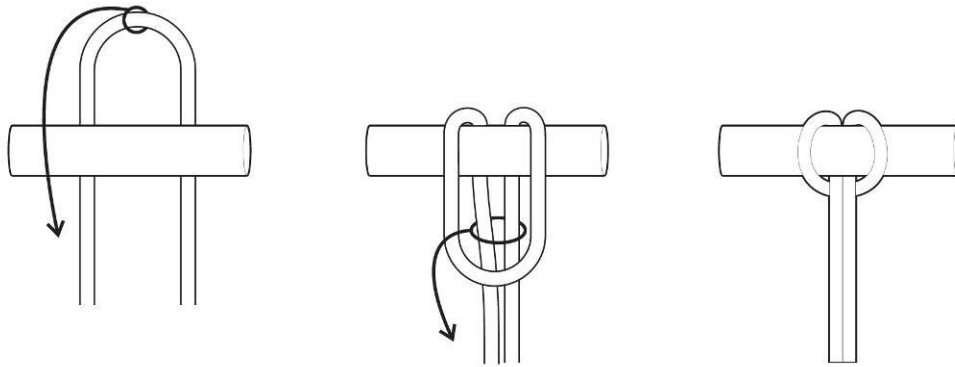
Tensionless Anchor (4-to-1 Wrap)

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10. GIRTH HITCH

Purpose: Used to anchor rope or webbing as a “choker.” It is the preferred method of attaching a piece of webbing to the foot-end of a backboard or metal litter when using a “Diamond Weave” to lash a patient.

Efficiency loss: approximately 30%



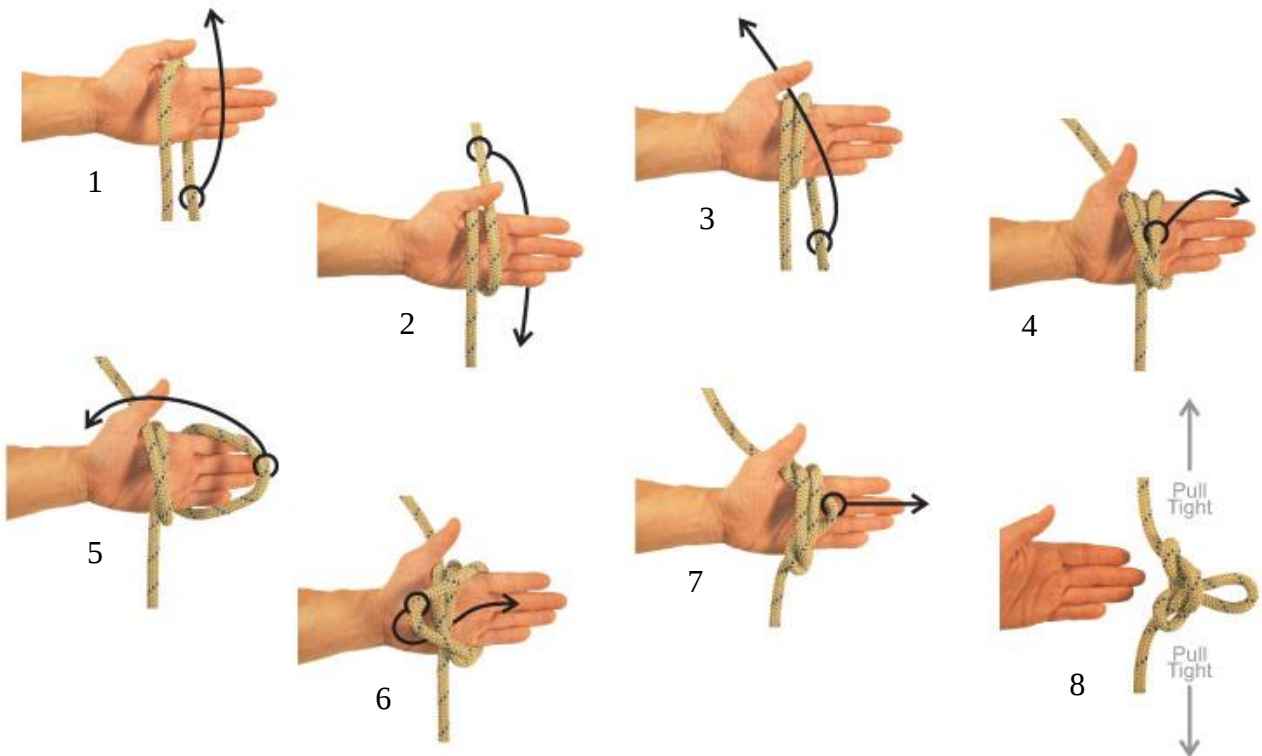
Girth Hitch

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11. BUTTERFLY KNOT:

Purpose: Bridle knot that provides a mid-line attachment point and is designed to take a three-directional pull.

Efficiency loss: approximately 25%



Butterfly Knot

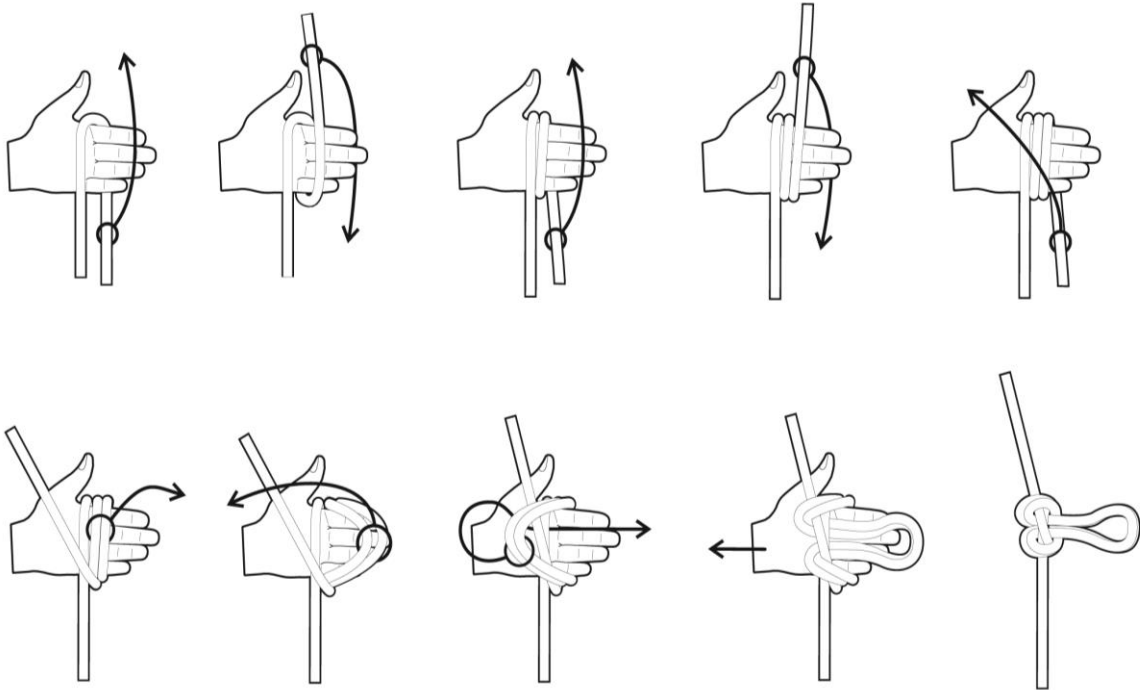
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Optional Knot

12. DOUBLE BUTTERFLY KNOT:

Purpose: provides more surface area round attachment hasp by forming a double loop much like the double loop -8

The knot is tied by forming four loops around your hand instead of three. Then picking up the center two loops instead of the center one and pulling both center loops back toward the thumb and out under the remaining two loops. Finish knot as usual.



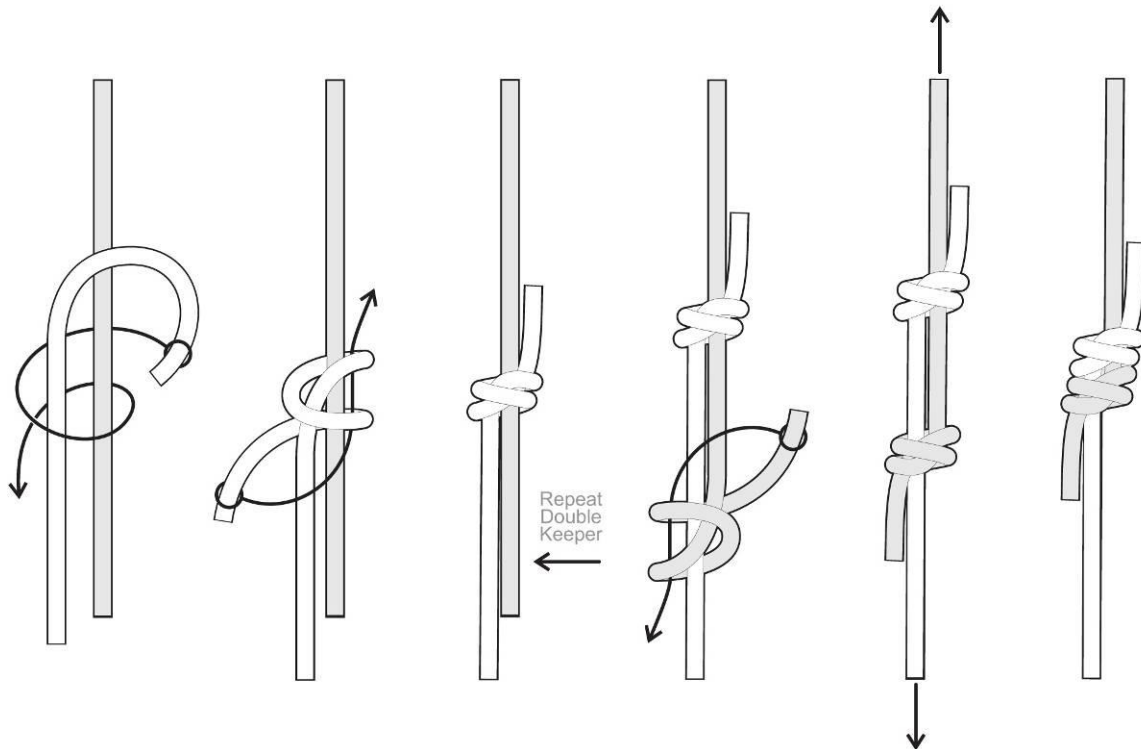
Double Butterfly

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13. DOUBLE FISHERMAN'S BEND:

Purpose: Used to join two ropes of equal (or slightly unequal) diameter together for load-bearing applications. (Usually used to form prusik loops)

Efficiency loss: approximately 21%

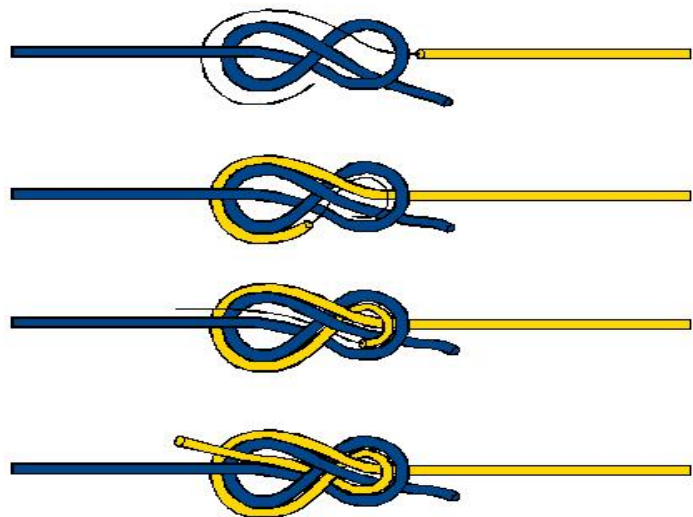


Double Fisherman's Bend

14. FIGURE-8 BEND KNOT:

Purpose: To join two ropes together for load bearing purposes.

Efficiency loss: approximately 19%



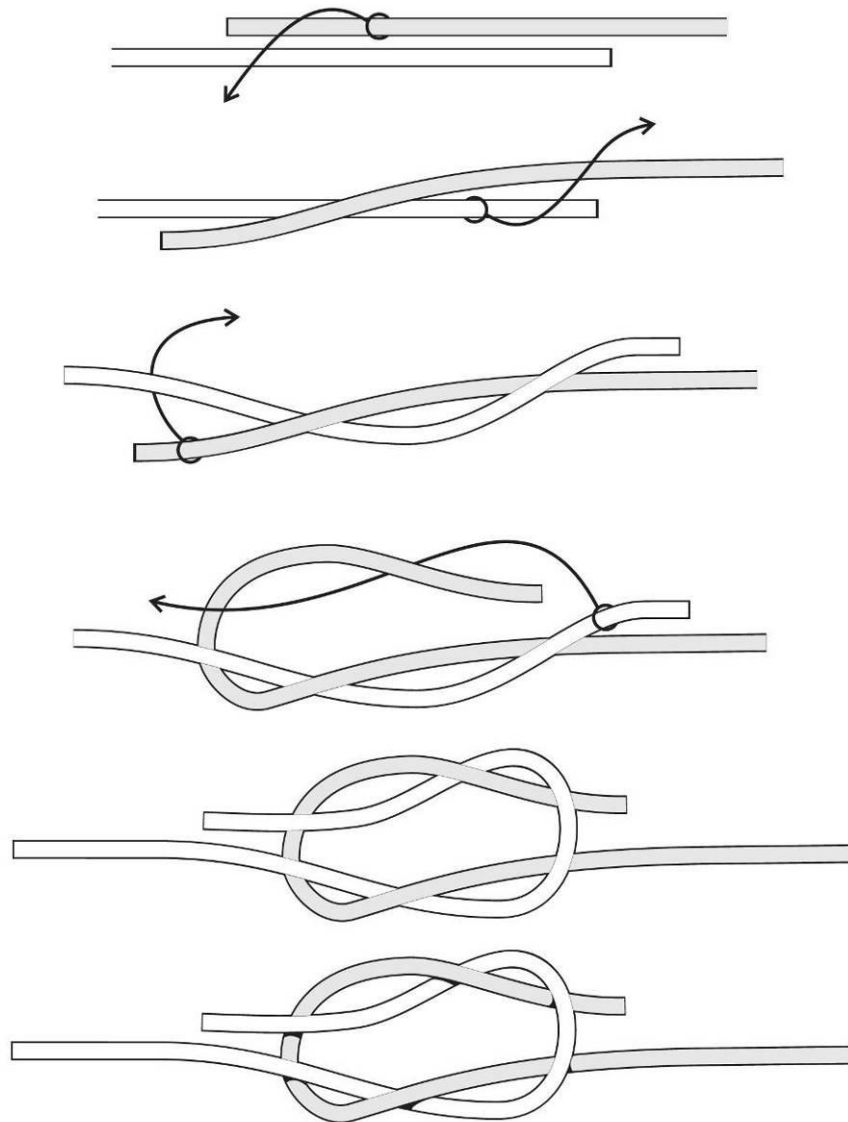
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15. SQUARE KNOT:

Purpose: Used to “bind” two ropes of the same diameter together.

WARNING → Square knots should not be used in load-bearing applications or to support a human load! Always safety the loose ends.

When finished, both tail ends must emerge from the same side of knot. If the rope ends emerge from opposite sides (one top, one bottom), it is not a square knot and will slip more easily when a force is applied.



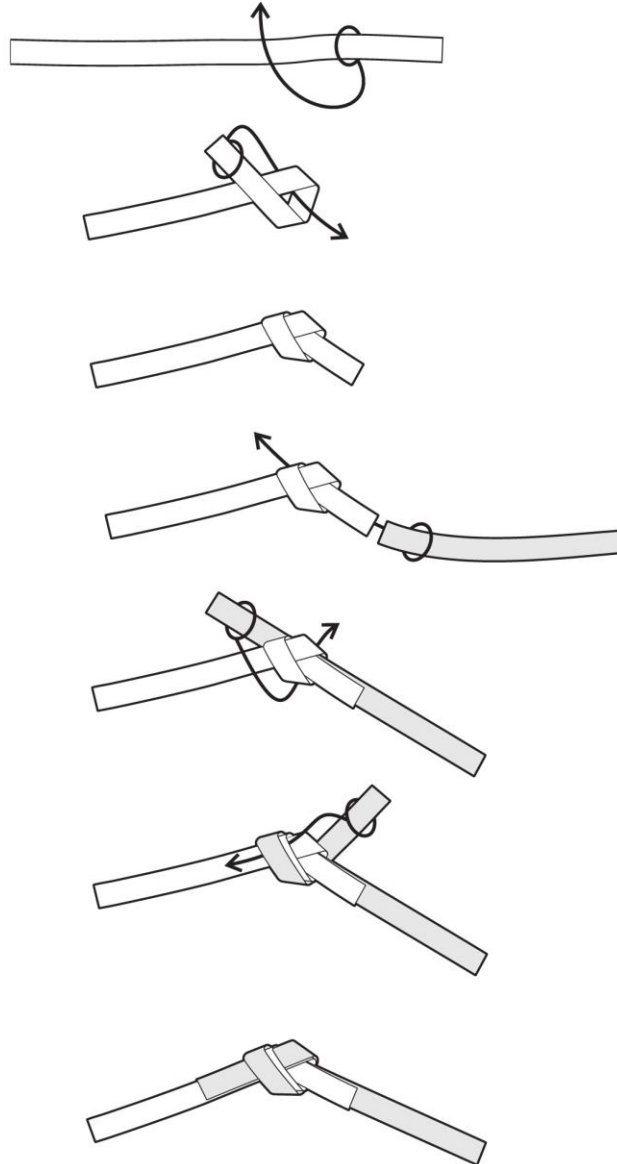
Square Knot
Always safety loose ends!

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16. WATER KNOT:

Purpose: Preferred method for joining two pieces of webbing for load-bearing applications.

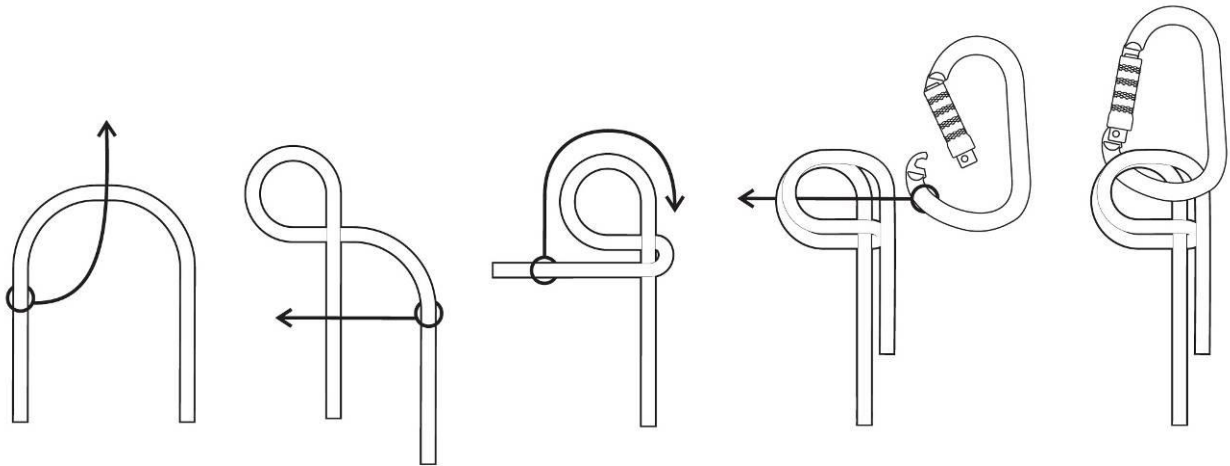
Efficiency loss: approximately 35%



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17. MUNTER HITCH:

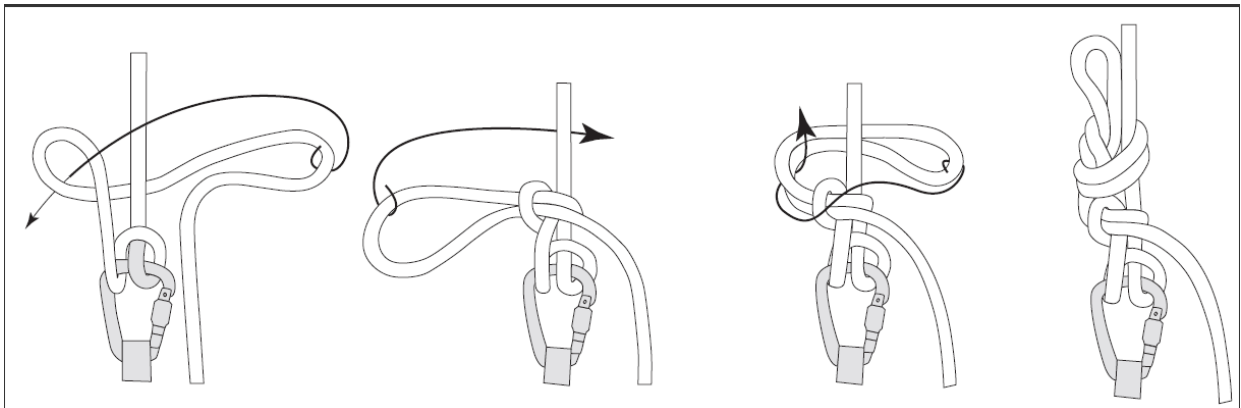
Purpose: Used primarily as a “belay hitch” – allows belayer to catch a falling load when properly operated. Predominantly used for Technical use loads and recommended if using for General use loads that another rescuer assist as a body belay.



Munter Hitch

18. MULE KNOT:

Purpose: Used as a secure, easy to release “tie-off” to prevent rope from feeding through a device, munter hitch or carabiner wrap.



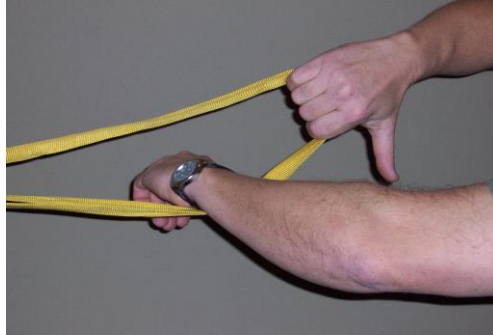
Mule Knot

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19.WEBBING ADJUSTMENT TECHNIQUE

Purpose: Used to adjust the length of tubular webbing once it has been looped and doubled around an anchor.

- a. Place webbing looped with a water knot around an anchor.
- b. Grab both loops with your right hand in the thumbs down position.
- c. Place left hand through both loops.



- d. Rotate right hand from thumbs down to thumbs up position.
- e. Hook loop leg on left thumb and pull leg back out with left arm.



- f. Work both loops out as you move closer to anchor.



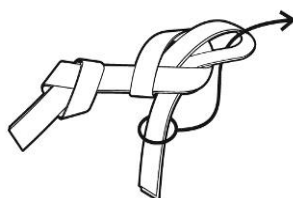
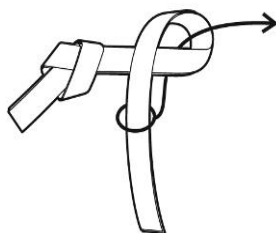
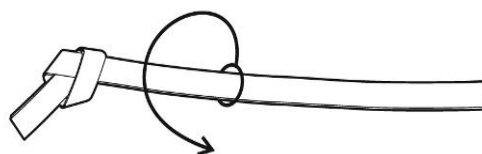
- g. This will allow you to adjust the webbing up to half the distance to the anchor.
- h. Once webbing is at desired length, place a carabiner through all loops.

Note: These steps can be repeated to half the webbing again.

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20. DAISY CHAIN →

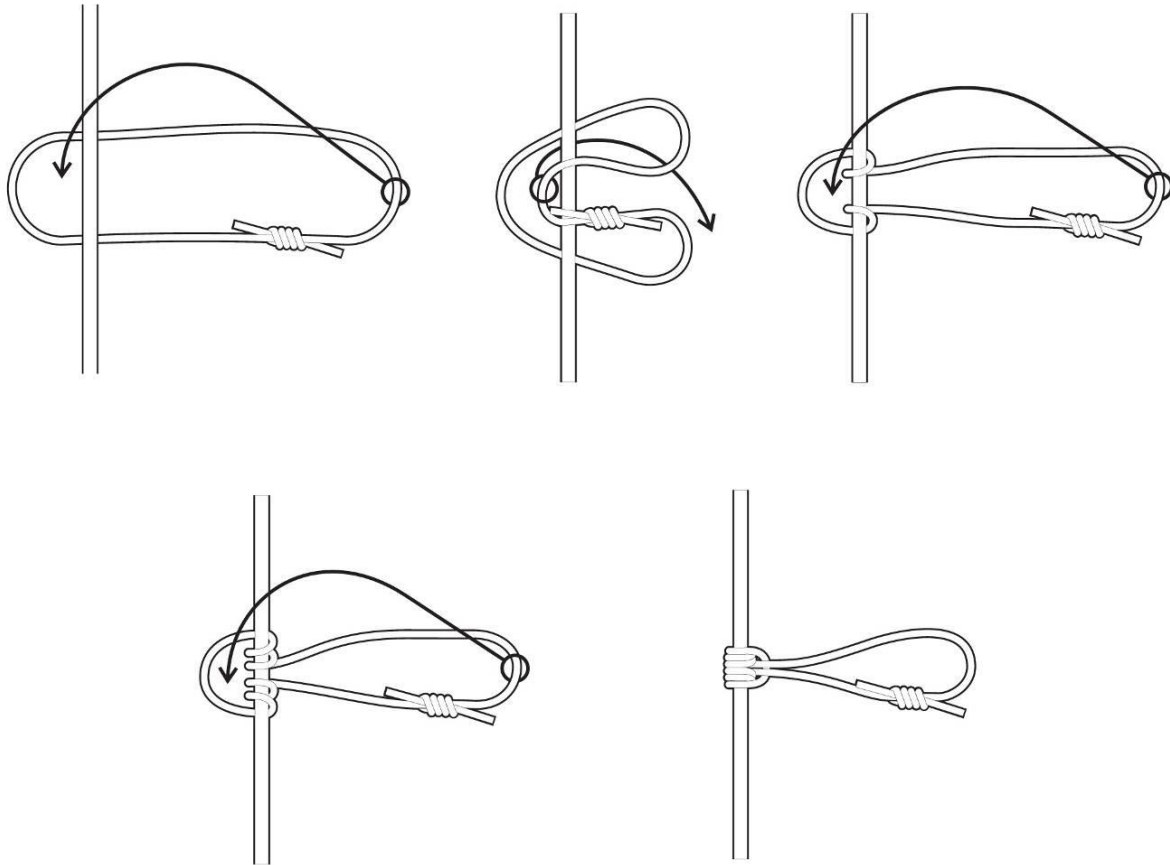
Purpose: Storing or transporting rope or webbing.



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21. DOUBLE-WRAP PRUSIK HITCH:

Purpose: Used for hauling, ascending and self-rescue. It is formed using a “prusik” loop of a smaller diameter accessory cord wrapped around a larger diameter rope. The prusik acts as a “rope grab” on the larger rope. The accessory cord should be about 4mm smaller than the rope (or about one-half to three-quarters the size of the rope).



Double-Wrap Prusik Hitch