

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. **WORKING END** – portion of rope used to make the bends to tie the knot. Also referred to as “running” or “loose” end.
6. **STANDING END** – portion of rope that is stationary when tying a knot. For example, the working end (end used to make the bends) in a “loop” crosses over the standing end (stationary portion). The standing end encompasses the area from the origin of the rope to the knot.

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 hitch will fall apart (Clove; Girth; Prusik Wrap).
3. **BENDS** – used to join ropes (Figure-8 Bend; Double Fisherman; Square Knot; Water Knot).

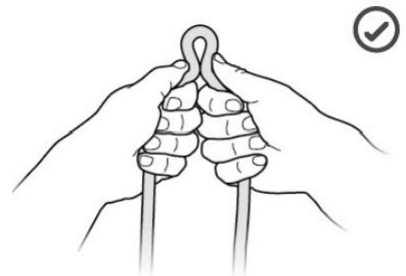
EFFICIENCY:

4-TO-1 RULE:

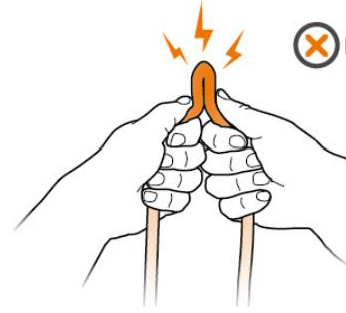
1. 4-to-1 rule refers to the efficiency of rope during bending. If a rope is bent around an object at least four (4) times its diameter, there will be **no** loss of efficiency due to bending. The “tightness of the bends” determines the efficiency ratings of knots. Note: Most rescue knots have a 20-to-28%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

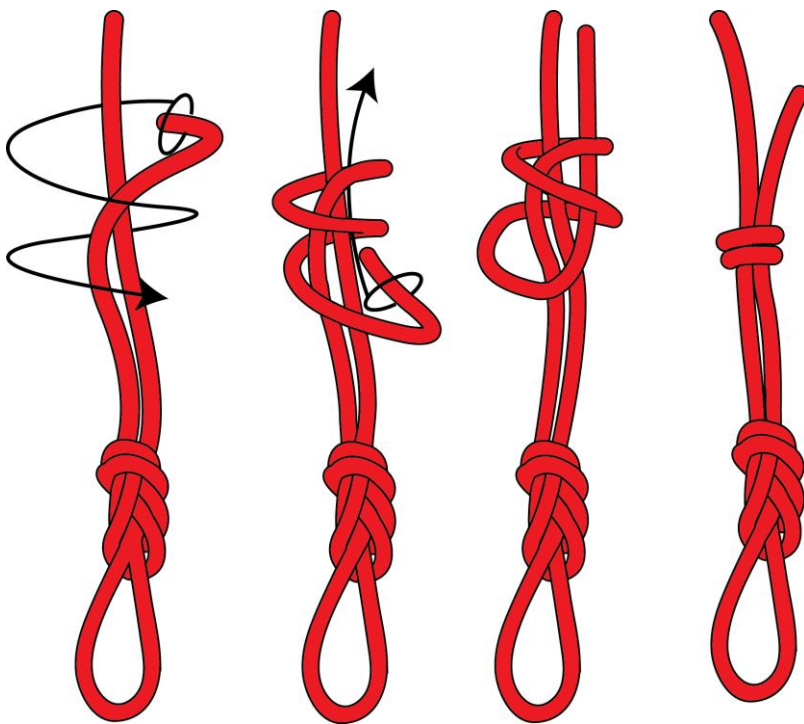
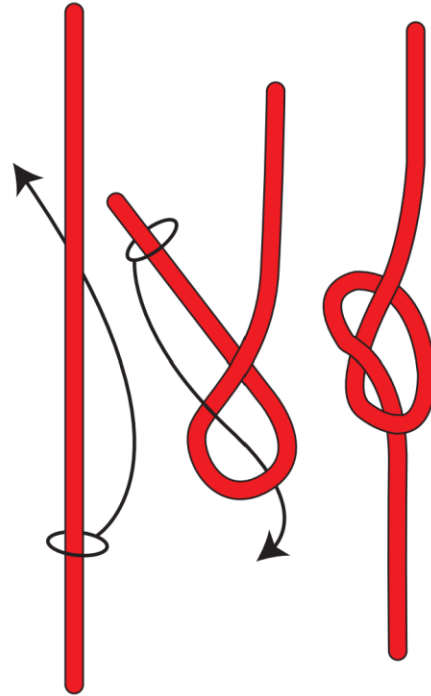


STEPS IN KNOT TYING:

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.



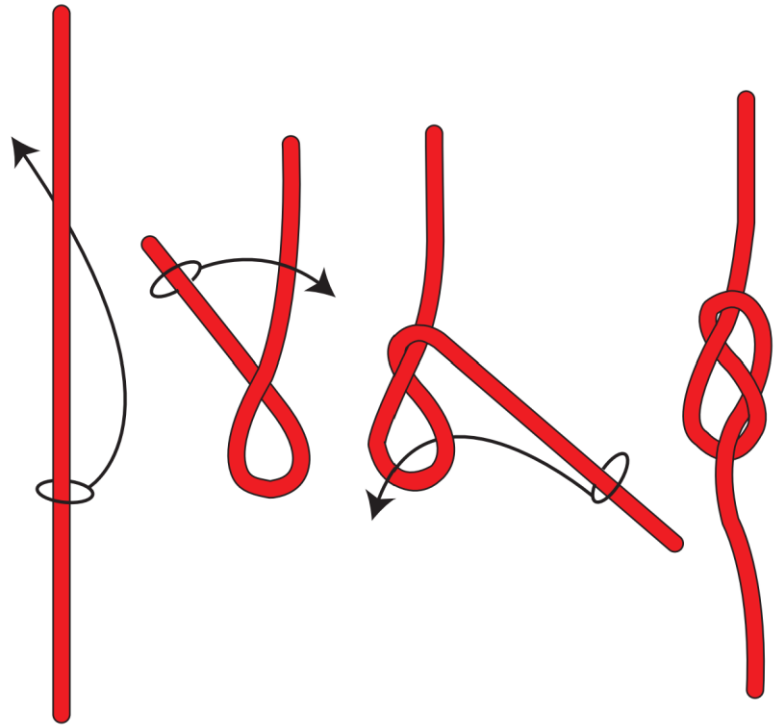
2. DOUBLE OVERHAND AS A SAFETY

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.

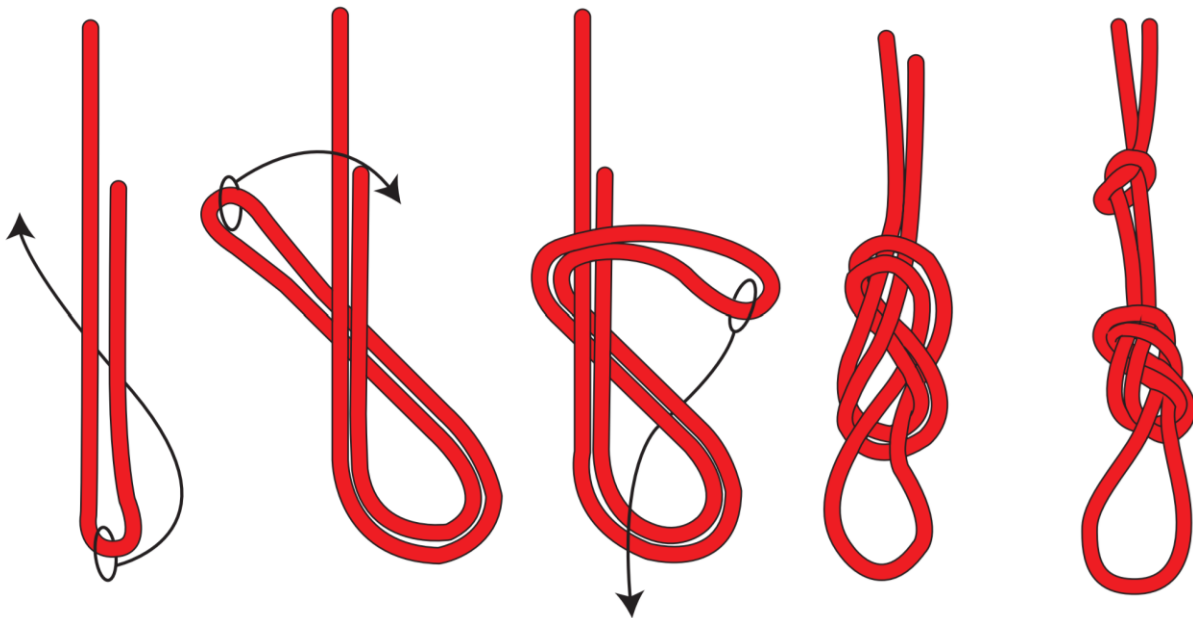
3. FIGURE-8 STOPPER KNOT

Purpose: A safety knot placed in the end of a line to prevent it from passing through a device.



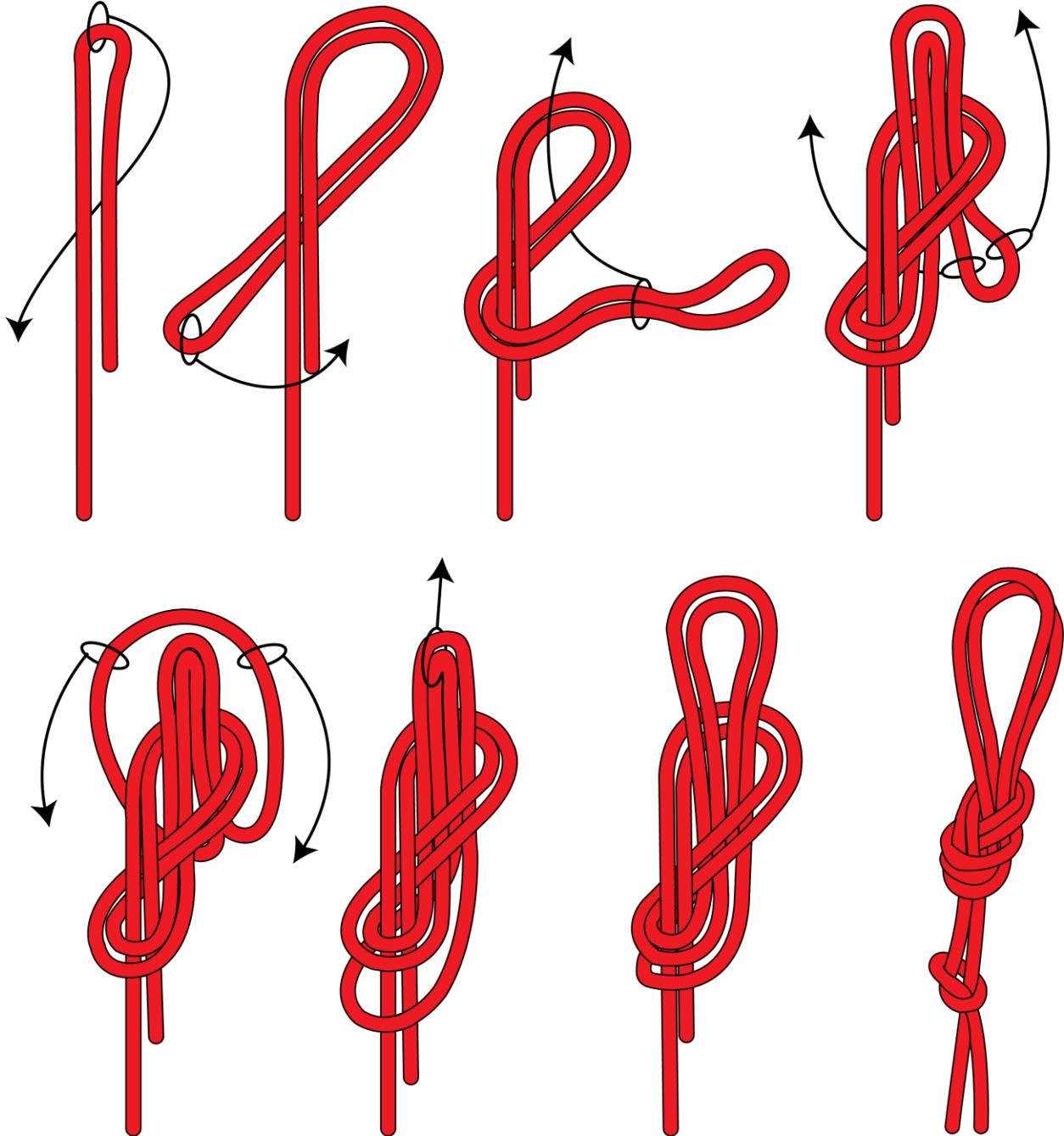
4. FIGURE-8 ON-A-BIGHT KNOT

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



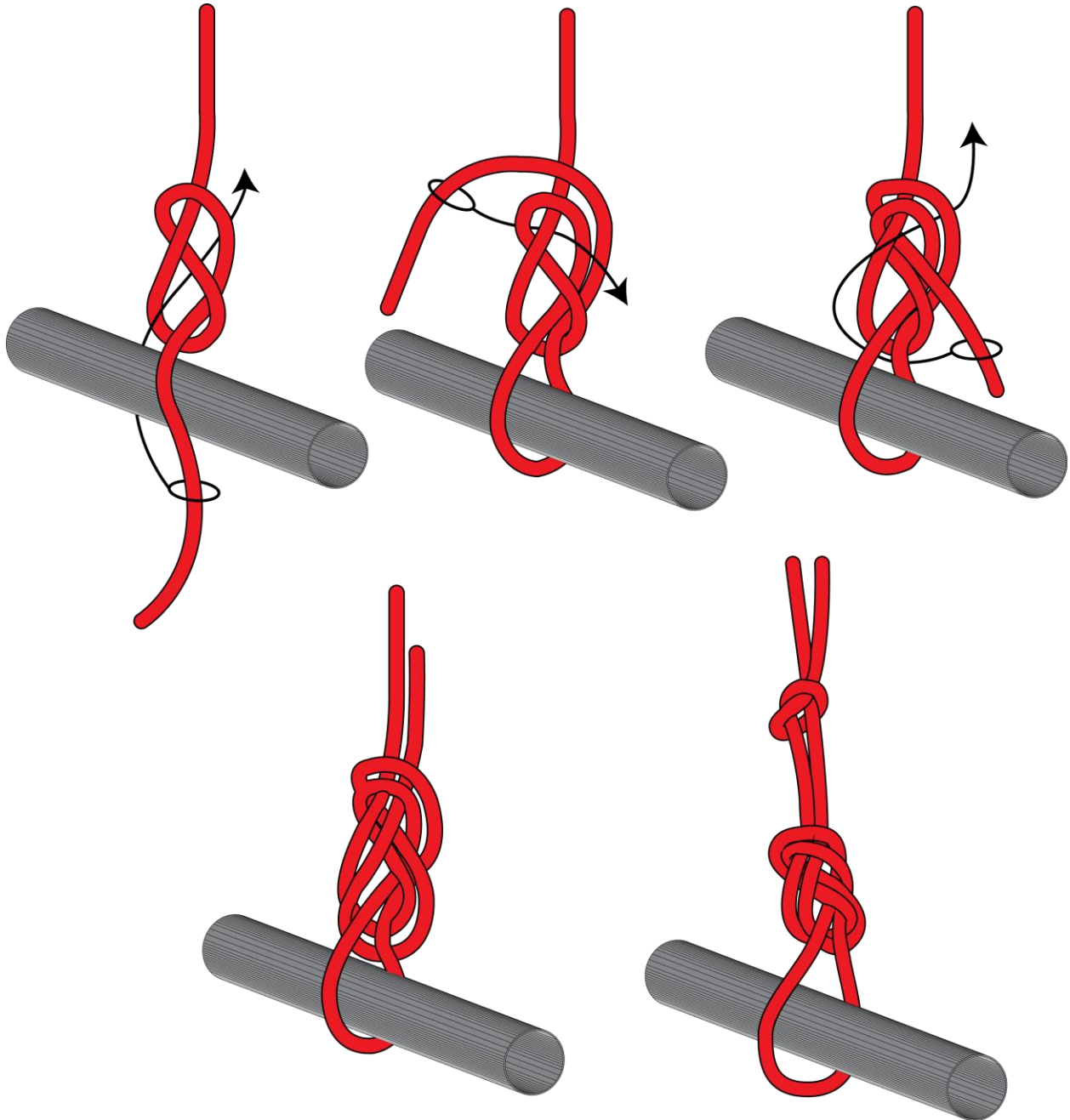
5. DOUBLE LOOP FIGURE-8

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.



6. FIGURE-8 FOLLOW THROUGH KNOT

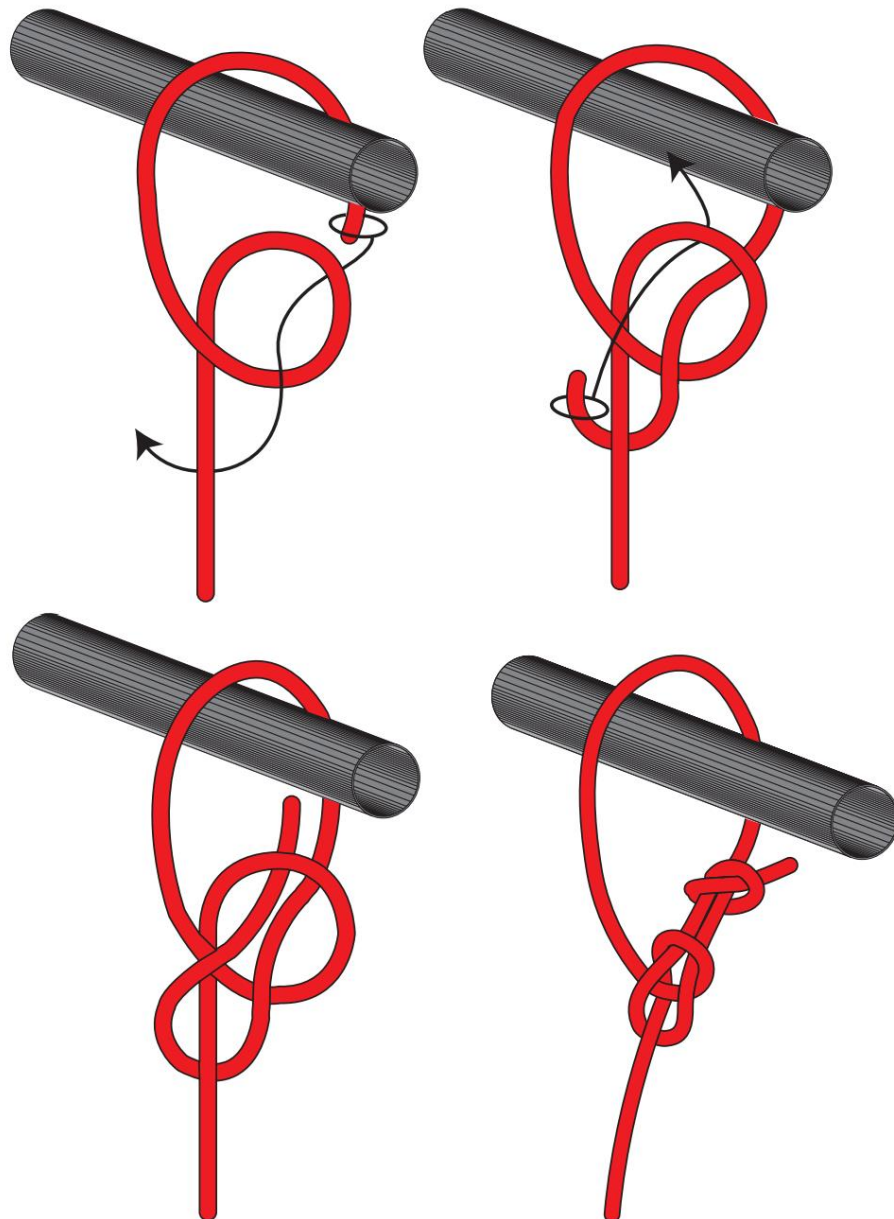
Purpose: Anchor knot that can be tied around an anchor or a “closed-end” object.



7. BOWLINE KNOT

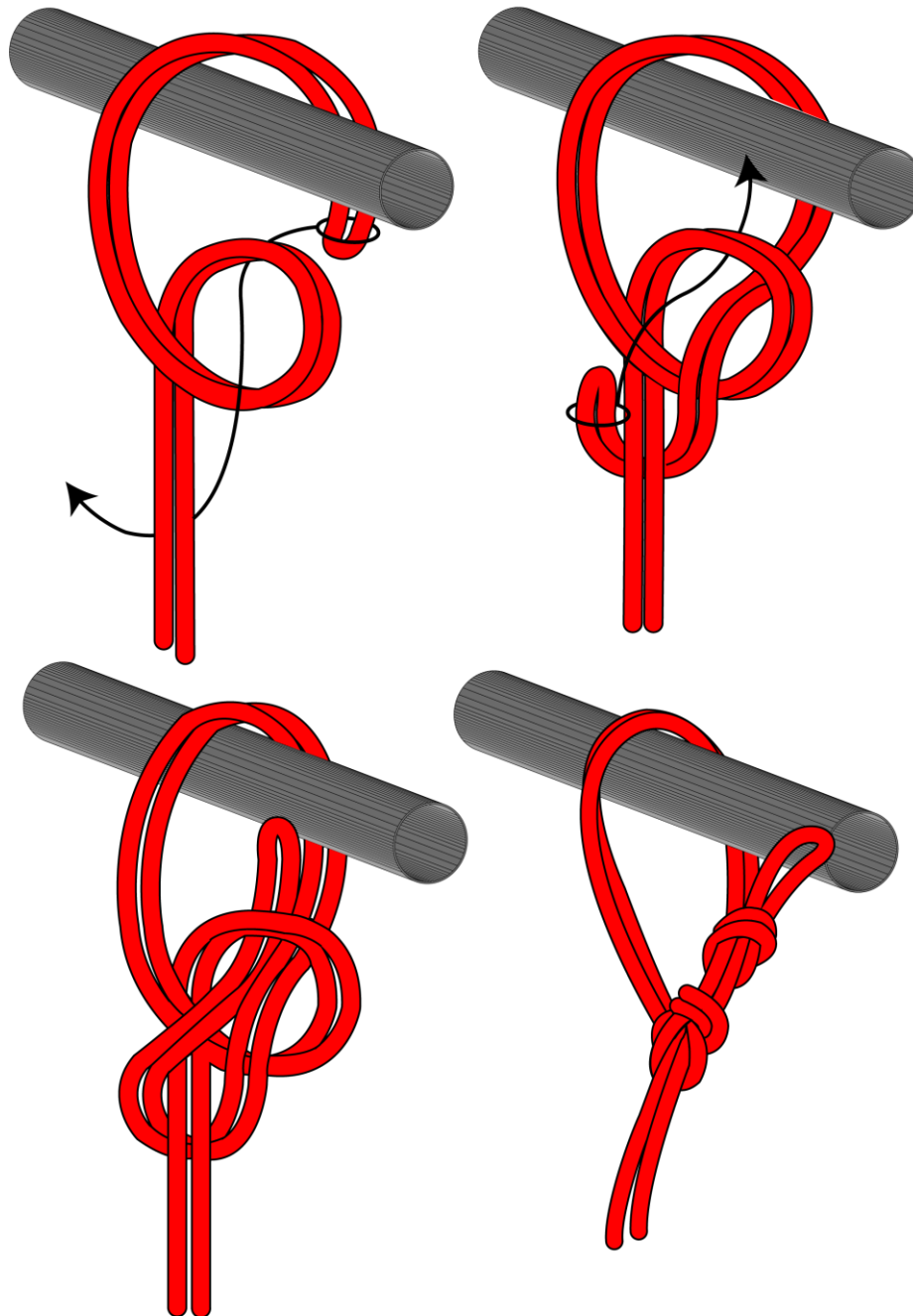
Purpose: Roco recommends use as a static (non-moving) anchor knot. The working end must end up inside of loop.

Note: Care should be taken when using a bowline. The bowline could untie when going over an edge.



8. DOUBLED BOWLINE KNOT

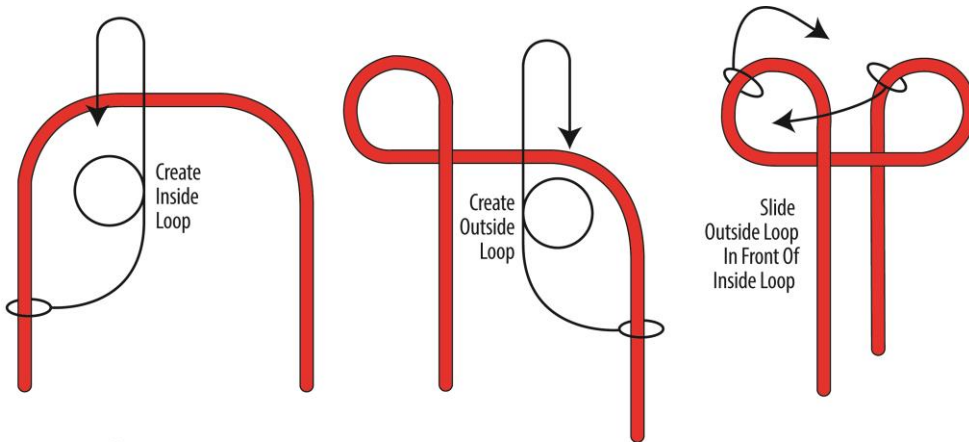
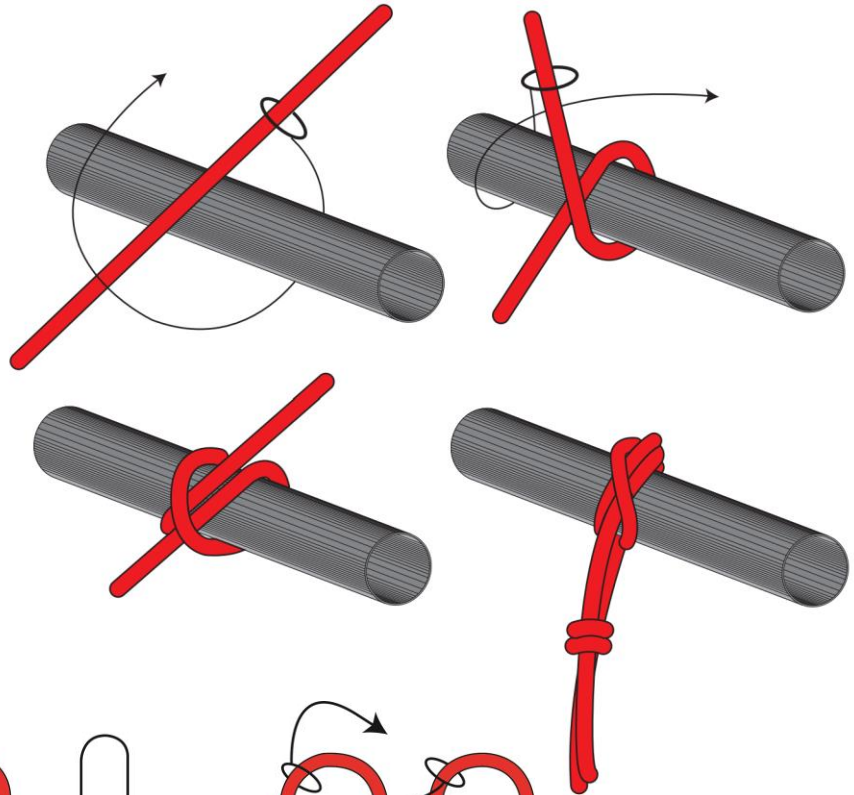
Purpose: Roco recommends use as a static (non-moving) anchor knot that can be tied in the middle of a line. It is a simple bowline tied with a bight in the line.



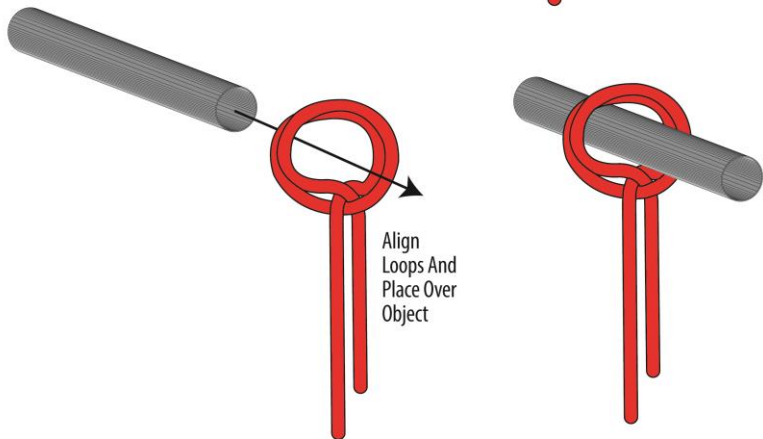
9. CLOVE HITCH

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

Note: Can be tied with the end of the line or midline



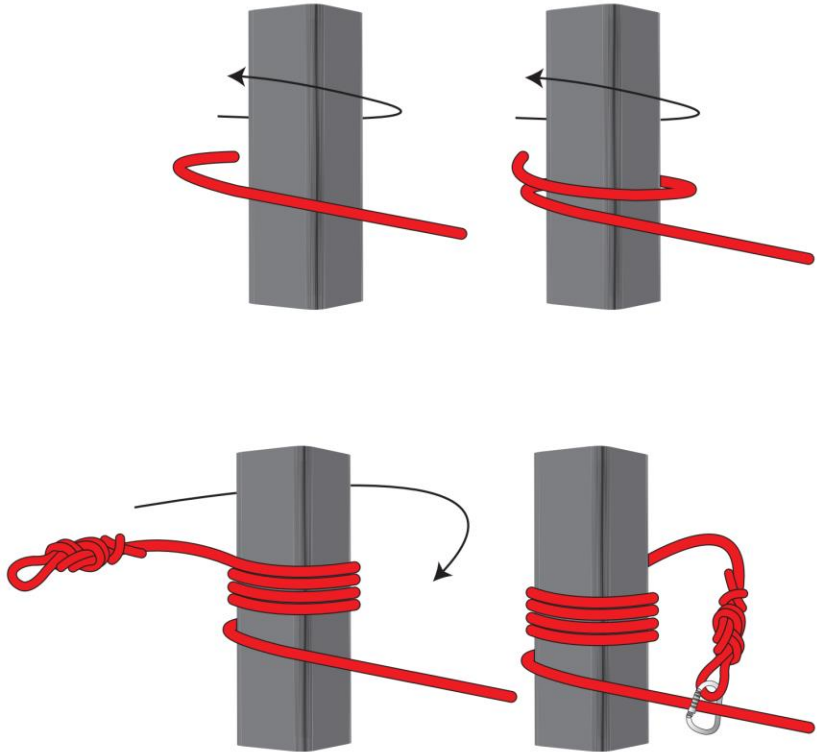
CLOVE HITCH (MID-LINE)



10. TENSIONLESS ANCHOR (4-TO-1 WRAP)

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

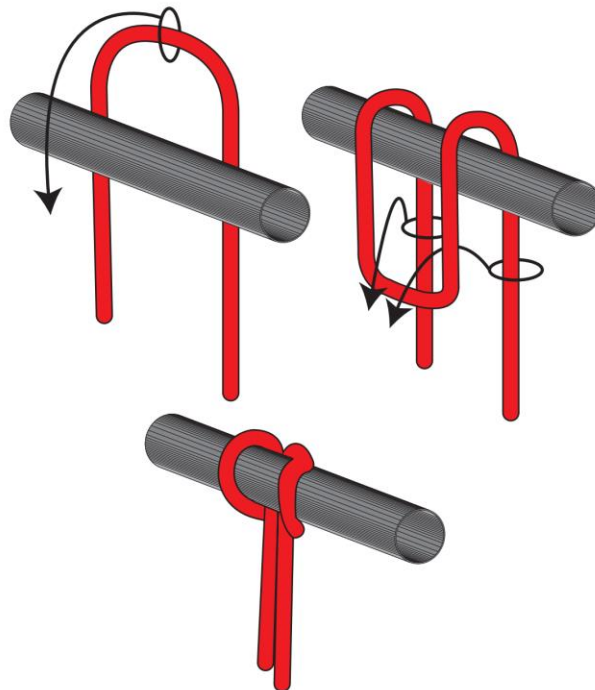
1. Turns of the rope should not cross each other.
2. Minimum of three complete wraps.
3. Must be finished with a knot (a figure 8 and carabiner or a barrel hitch).
4. May roll on round, smooth anchors.
5. Make sure there is slack between knot and standing end.



Efficiency loss: 0%

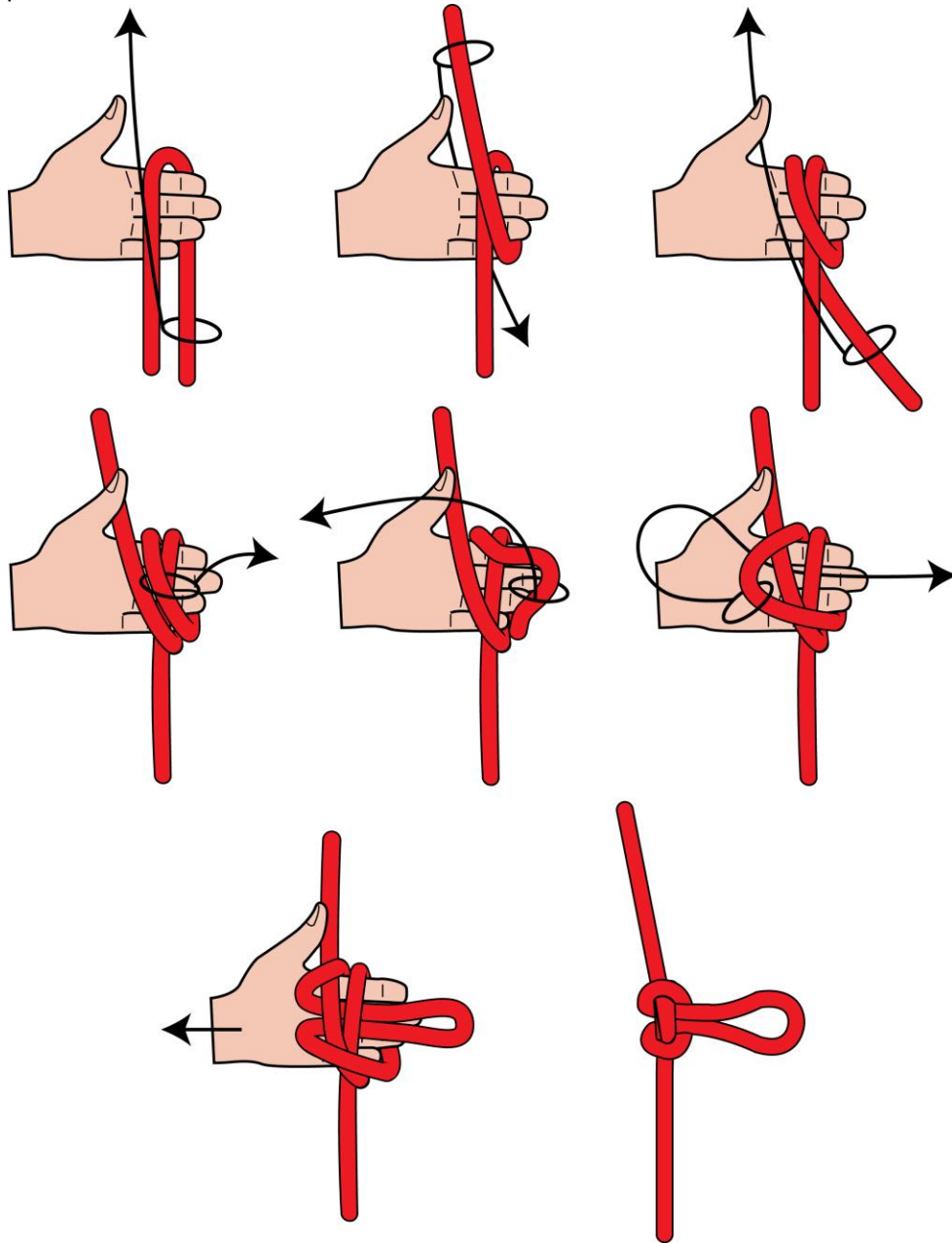
11. GIRTH HITCH

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.



12. BUTTERFLY KNOT

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



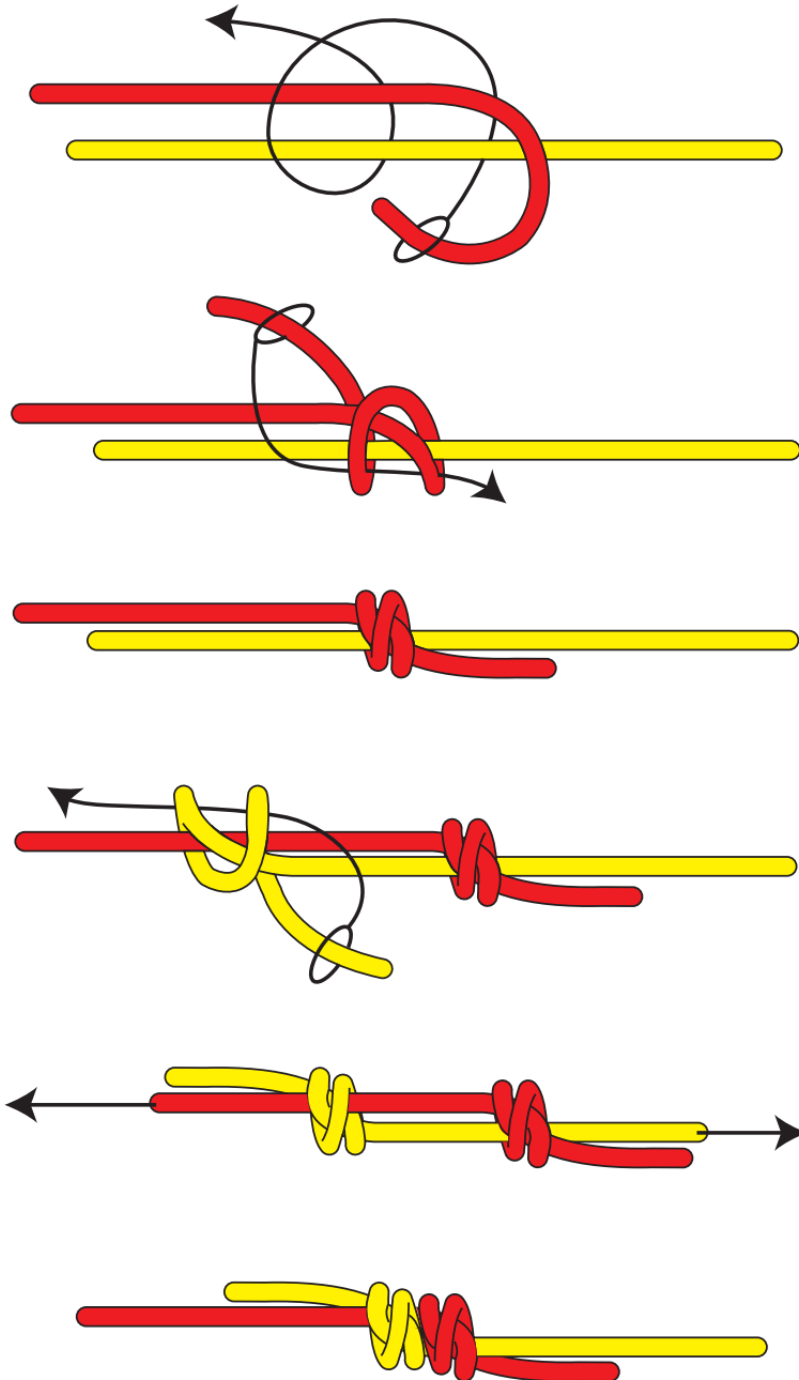
Butterfly Knot

Start with a bight of the rope hanging over fingertips. Now wrap the rope toward your thumb around your hand two times. Look for the center loop on the top of the hand and pick it up and move it toward your thumb over the other loop. Then slide it out toward the fingertip between the loops and your hand. Continue to pull that loop toward your fingertip and dress it. Pull the two rope legs until the knot flips and locks into place as a butterfly knot.

13. DOUBLE FISHERMAN'S BEND

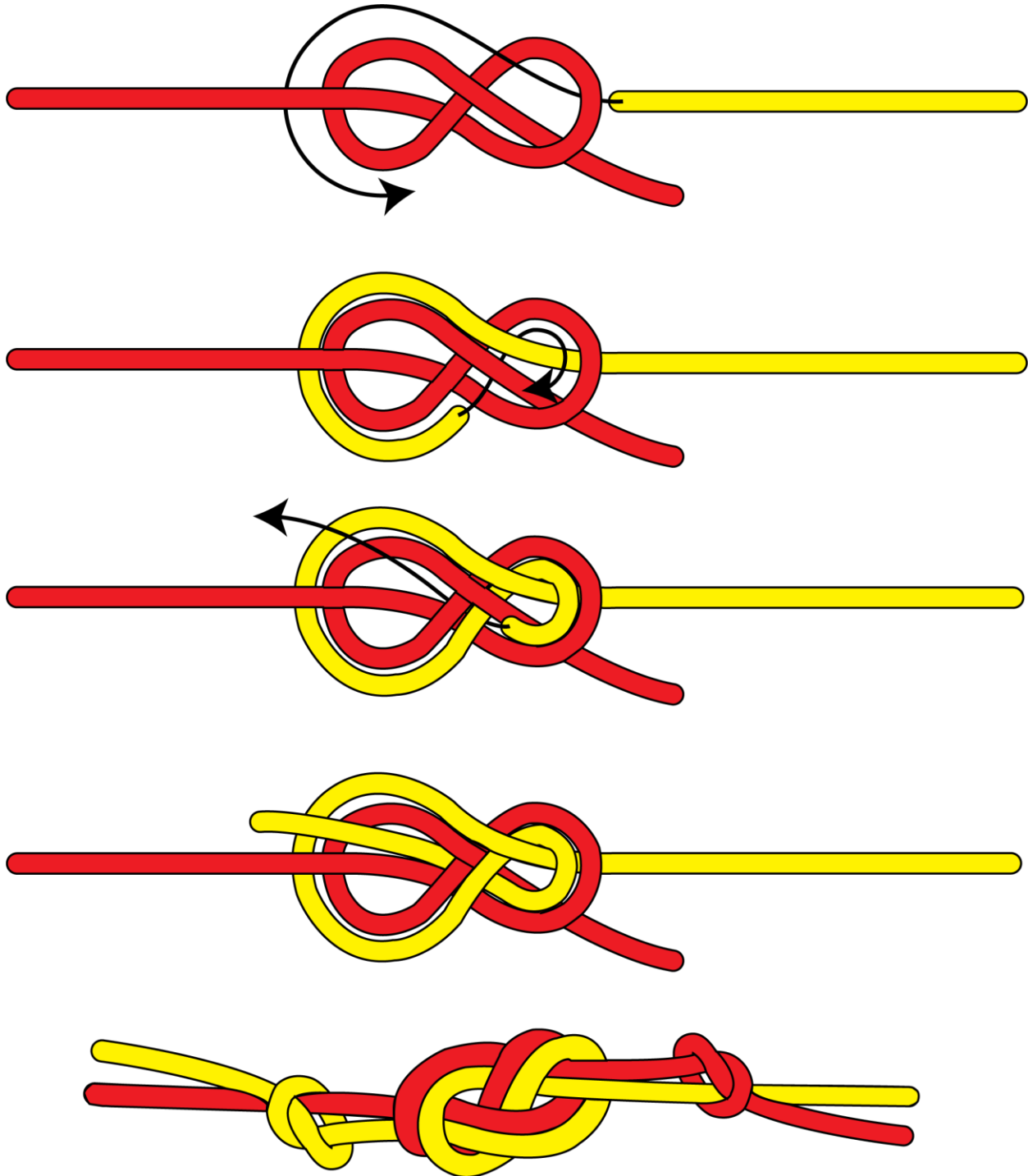
Purpose: Used to join two ropes of equal diameter together for load-bearing applications. (Usually used to form prusik loops.)

Note: Barrels and Crosses must be on same side.



14. FIGURE-8 BEND:

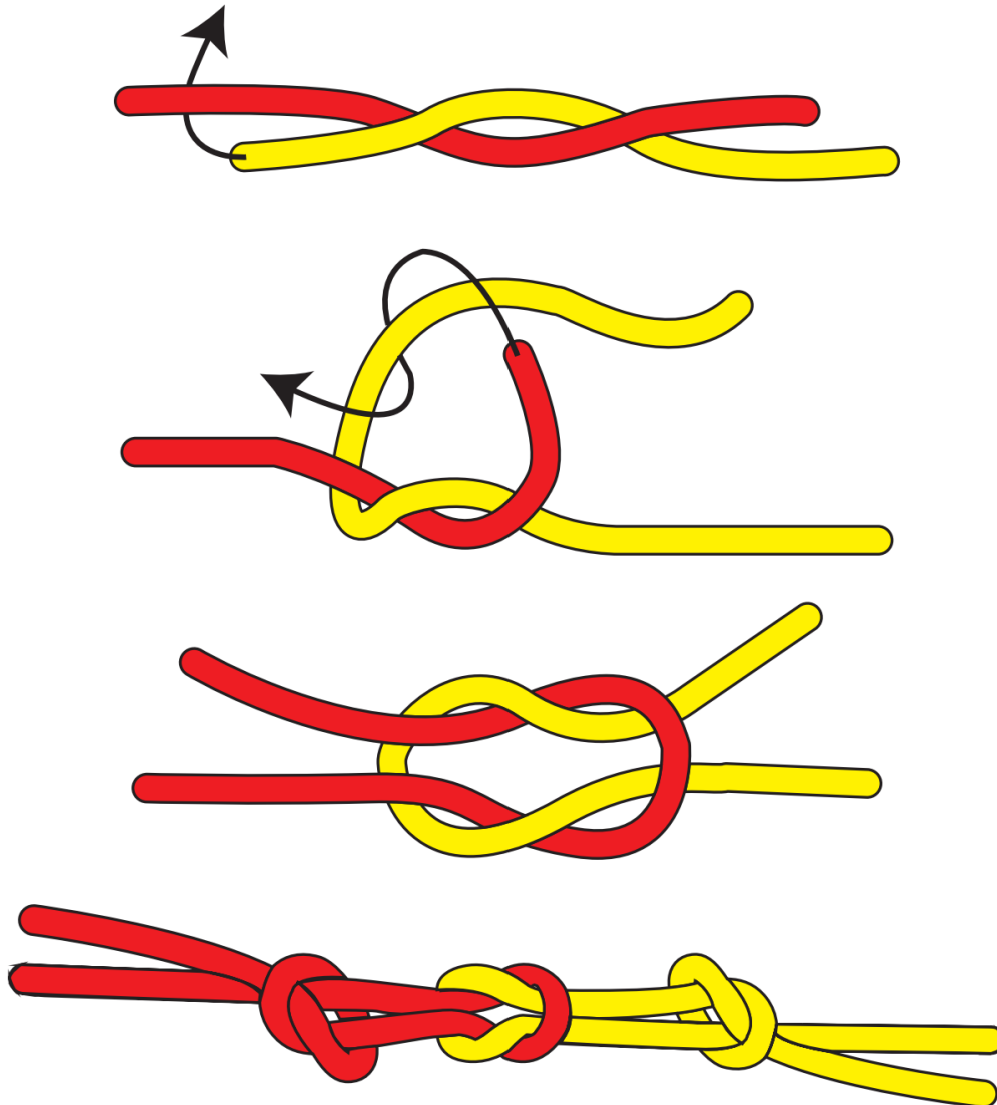
Purpose: To join two ropes together for load bearing purposes.



15. SQUARE KNOT:

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

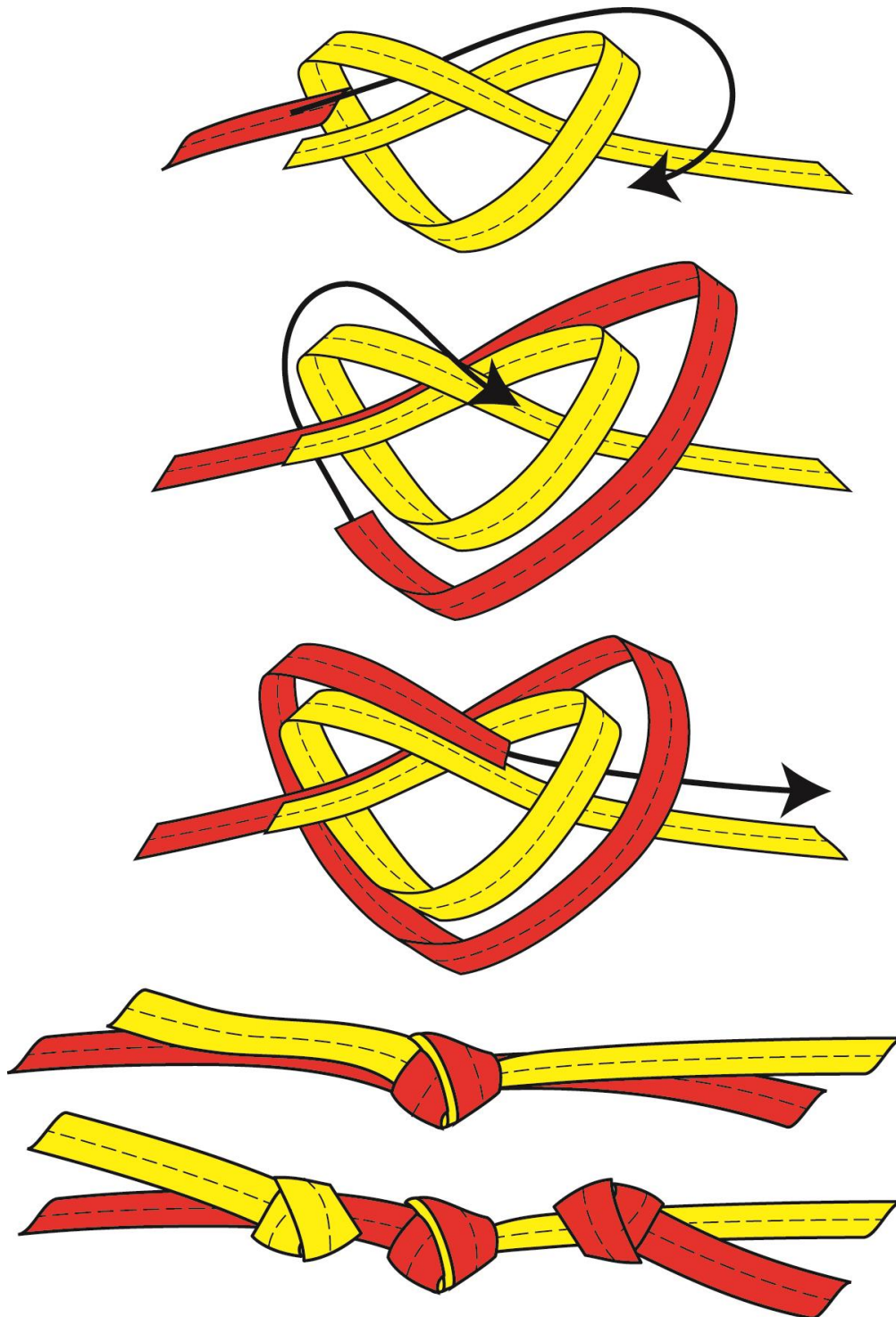
WARNING → Square knots should not be used in load-bearing applications or to support human loads! Always safety the loose ends. When finished, both tail ends must emerge from the same side of knot. If the rope ends emerge from opposite sides (one top, one bottom), it is not a square knot and will slip more easily when a force is applied.



Square Knot
Always safety loose ends!

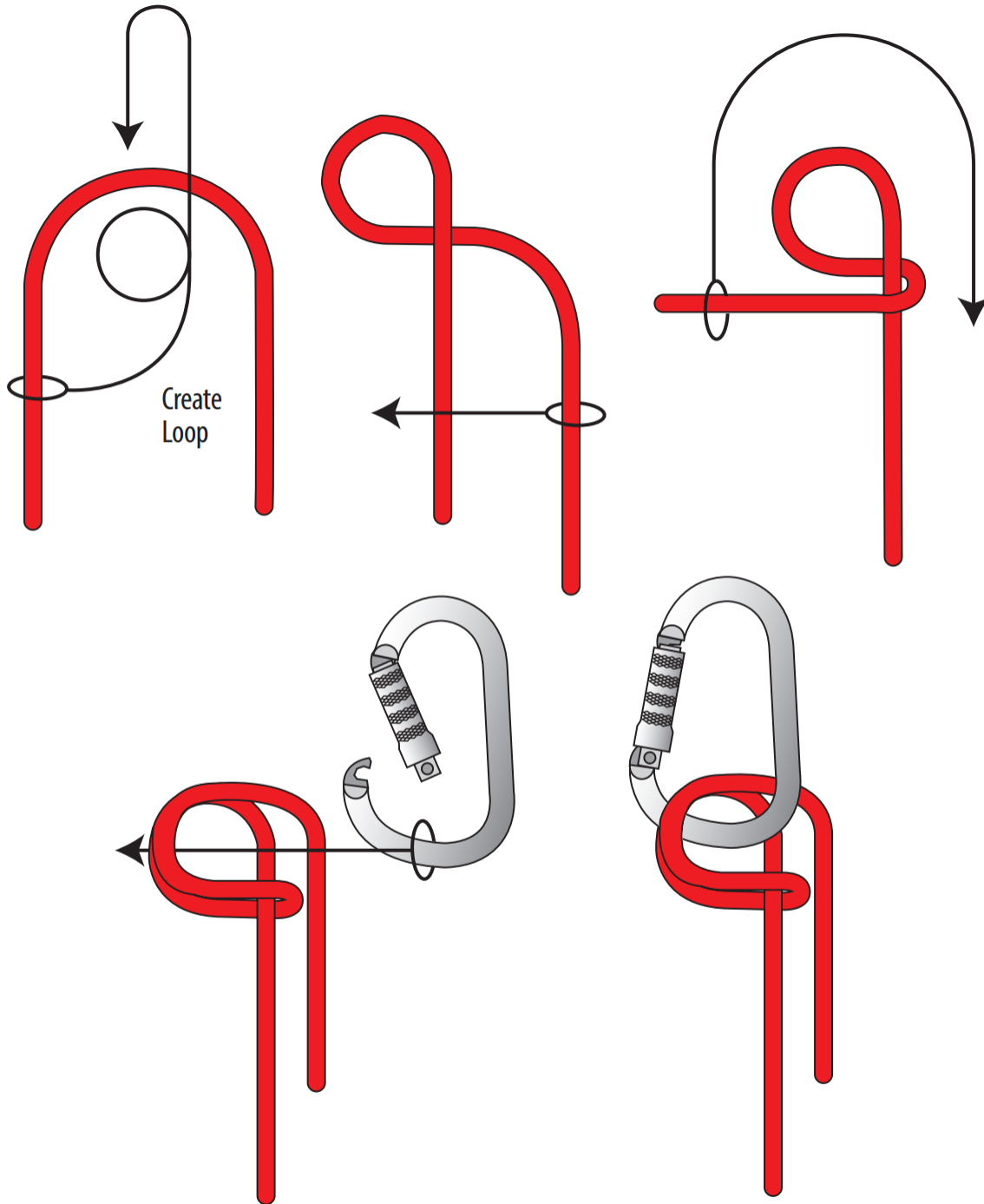
16. WATER KNOT:

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



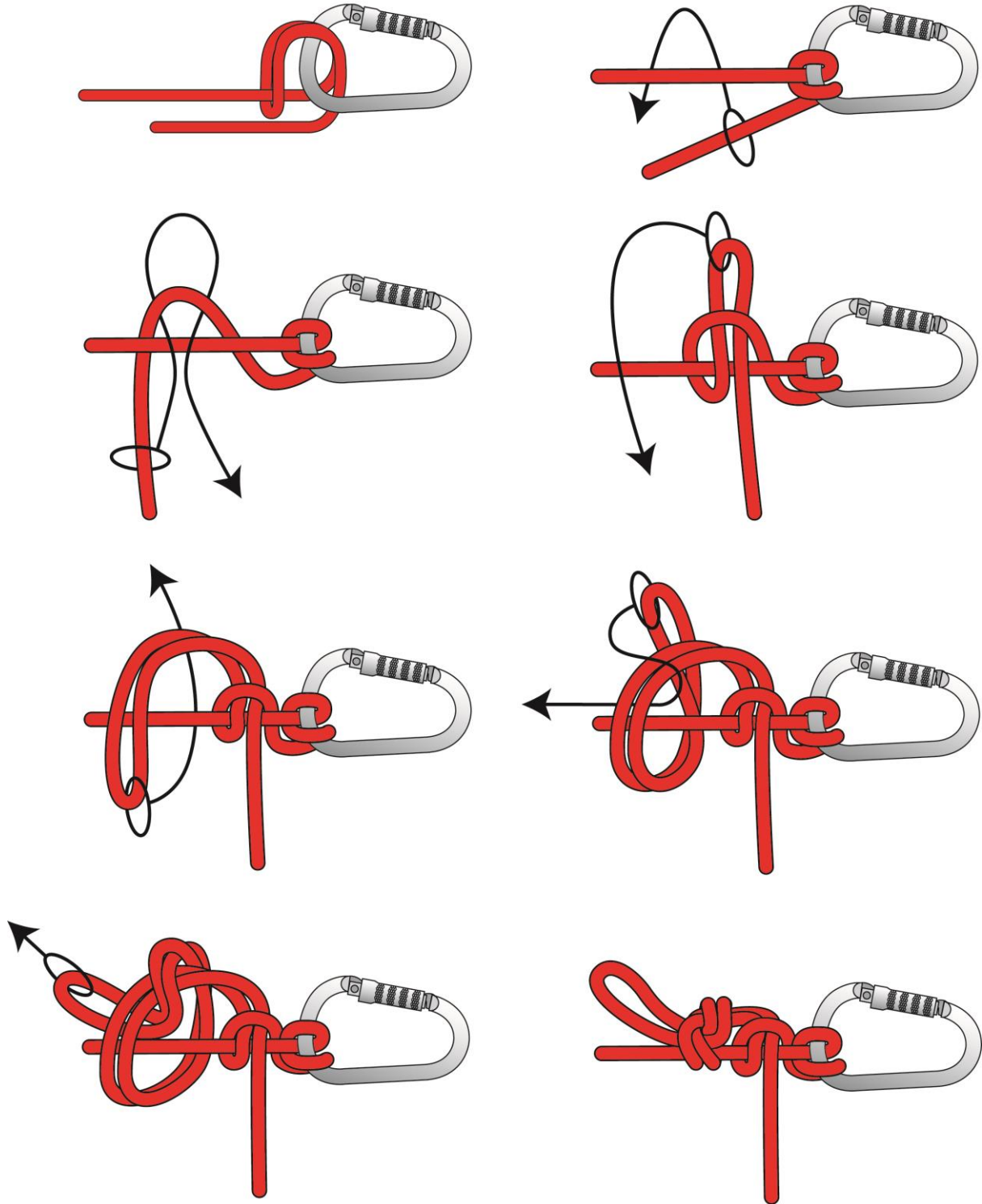
17. MUNTER HITCH:

Purpose: Used primarily as a “belay hitch” – allows belayer to catch a falling load when properly operated. Predominantly used for Technical Use loads. If used for General Use loads, it is recommended that another rescuer assist as a body belay.



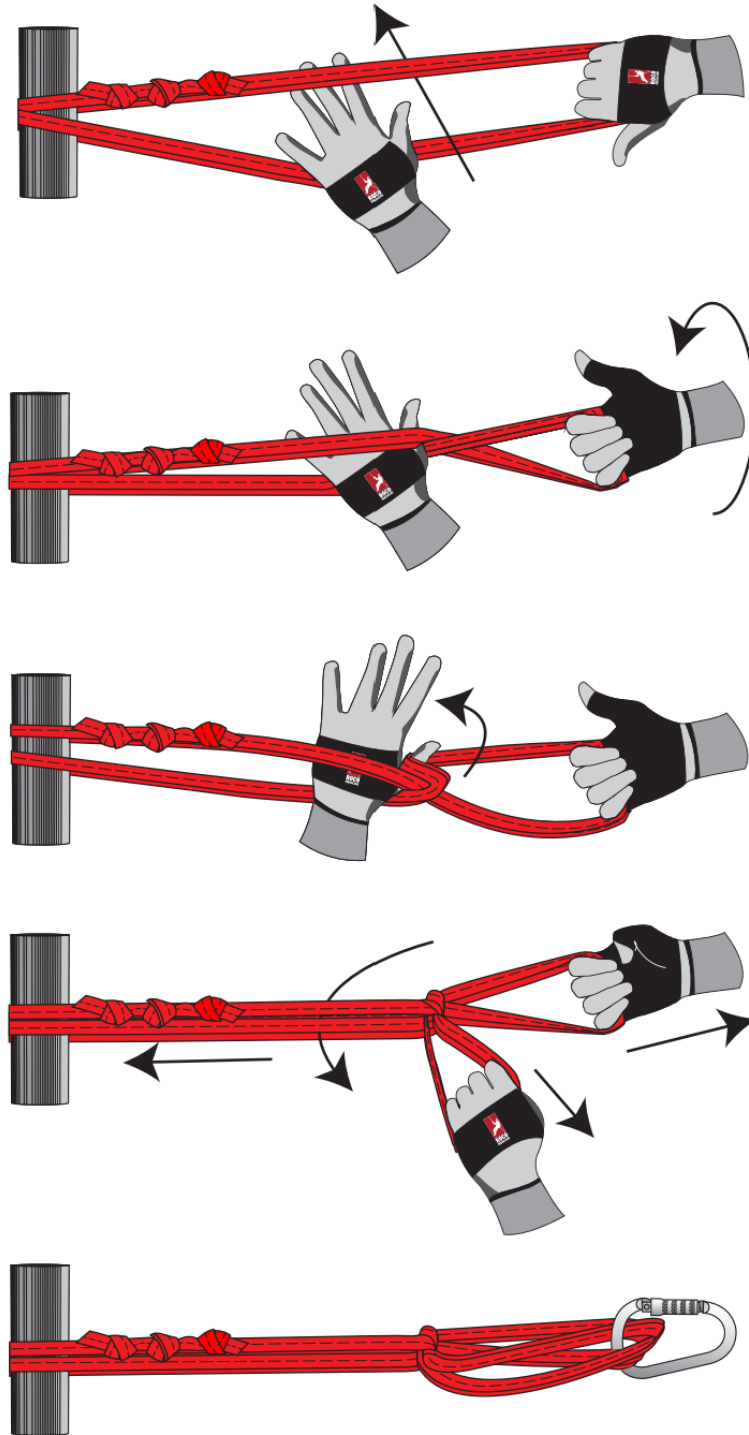
18. MULE KNOT:

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



19. WEBBING ADJUSTMENT

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



20. 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.

