

# **Army Mountain Warfare School**

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## **Military Mountaineer Course Knot Guide**

## 2 - Basic Knot Tying

071E9002

**INTRODUCTION:** There are many knots used in mountaineering. While some exotic knots show, a great deal of skill using such knots does not offset the safety margin gained when everyone is familiar with a simpler system. Media: Small Group Instruction (SGI)

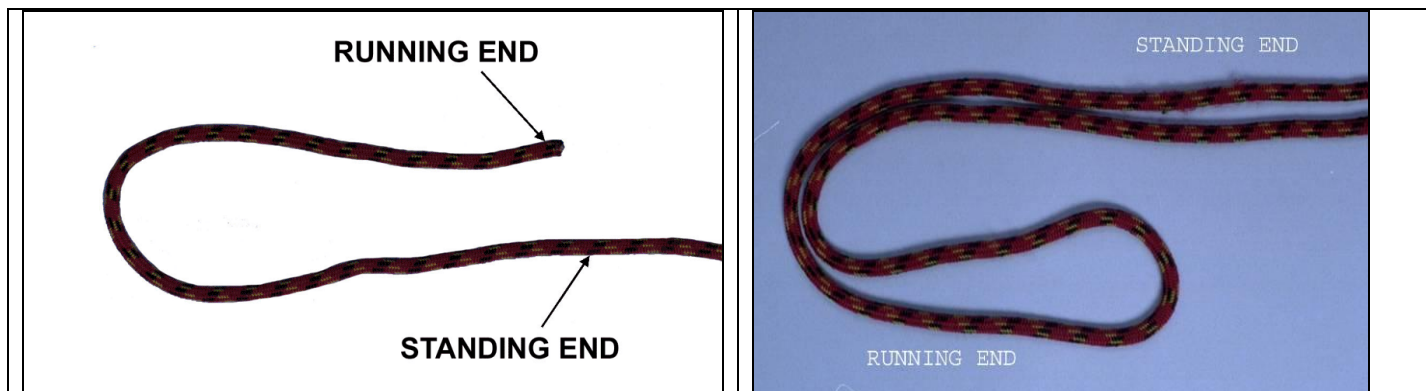
### a. Basic Knot Considerations.

- (1) Knot. A knot is a temporary condition in the rope. Knots have the ability to untie themselves over a period of time. A permanent knot would be desirable, but no such knot exists. All knots must be repeatedly checked and often re-tied.
- (2) Adverse Conditions. Often there is a need to tie a knot under adverse circumstances. You must know which knot is best for the purpose intended and how to tie the knot well. Repeated practice is recommended.
- (3) Selection. Strength should not be the sole basis of knot selection. Ease of tying, untying after loading, chances of working loose, and allowance for quick inspection are all factors.
- (4) Strength of Knots for Single Kernmantle Rope.

No Knot: 100%	Overhand: 60% to 65%
Clove Hitch: 60%to 65%	Bowline: 70% to 75%
Water Knot: 60% to 70%	Two Half Hitches: 60% to 70%
Figure Eight: 75% to 80%	

### b. Terms used in rope work.

- (1) Bight: A bend in the rope in which the rope does not cross itself.
- (2) Double Bight: A bend in a doubled rope in which the ropes do not cross themselves.
- (3) Loop: A bend in the rope in which the rope crosses itself.
  - (a) Overhand Loop: The running end over the standing end.
  - (b) Underhand Loop: The running end under the standing end
- (4) Half Hitch: A loop that runs around an object to lock or secure itself.
- (5) Girth Hitch: A bight around an object securing the standing ends.
- (6) Running End: Loose or working end of the rope.
- (7) Standing End: Stationary or non-working end of the rope.
- (8) Turn: A wrap of the rope around an object, providing 360-degree contact
- (9) Round Turn: A wrap of the rope around an object 1 1/2 times. You can use it around small diameter trees to prevent the rope from sliding up from the base.
- (10) Pigtail: The pigtail is the portion of the running end after the safety knot and the end of the rope. All pigtails will be a minimum of 4 inches long.



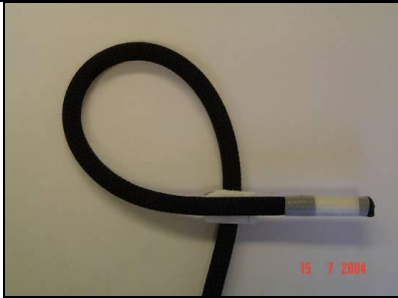


Figure 1  
Over Hand Loop



Figure 2  
Under Hand Loop



Figure 3  
Half Hitch

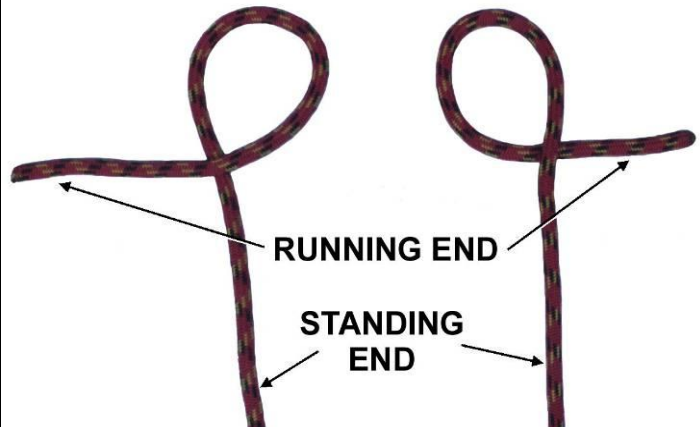


Figure 4  
Running and Standing Ends

Note: For standardization and ease of inspection, always tie right to left for horizontal anchors or top to bottom for vertical anchors.

## a. KNOTS

### (1) OVERHAND KNOT.

(a) Purpose: To be used as a safety knot.

(b) Tying the Knot:

- Take the running end of the rope and form a loop.
- Place the running end through the loop.
- Dress the overhand knot down to the knot that it is securing.

(c) Checkpoints:

- A locking bar that secures the running end to the standing end.
- Minimum 4-inch pigtail

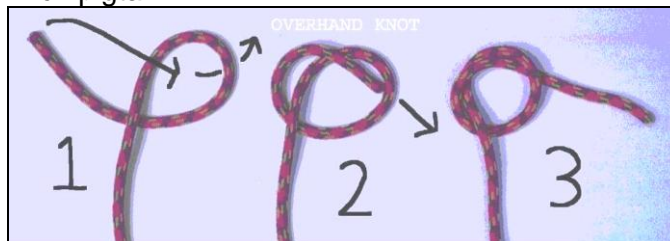


Figure 7  
Overhand

## (2) GIRTH HITCH.

(a) Purpose: To attach a piece of webbing or cord to an anchor or into a harness.

(b) Tying the knot:

- Take a pre-tied piece of tubular webbing and place a bight over the anchor or harness. The joining knot should be offset.
- Pass the knotted side of webbing through the bight.
- Dress the wraps and locking bar down ensuring the joining knot is offset and out of the girth hitch.

(c) Checkpoints

- Two turns around the object with a perpendicular locking bar.
- The joining knot is offset and out of the turns.

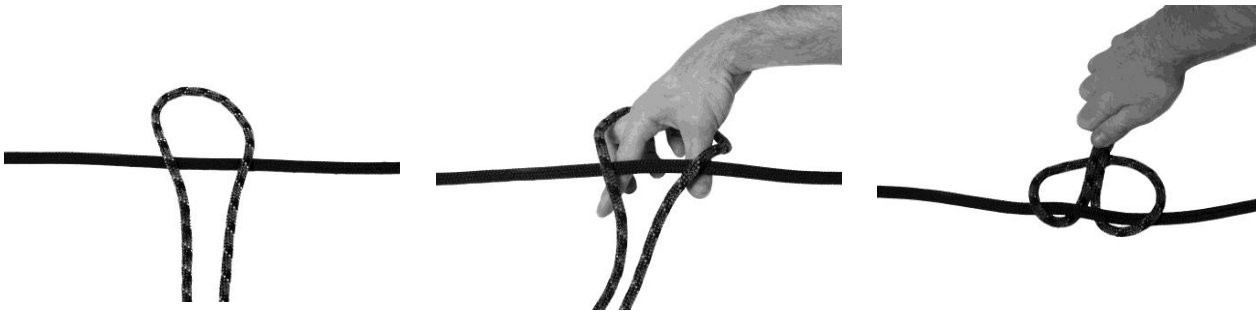


Figure 8  
Girth Hitch

## (3) SQUARE KNOT.

(a) Purpose: To join the ends of two ropes of equal diameter when they are under tension.

(b) Tying the Knot:

- Holding one running end in each hand, place the running end in your right hand over the one in your left hand.
- Pull it under and then back over the top of the rope in your left hand.
- Place the running end in your left hand over the one in your right hand and repeat as in Step 2.
- Dress the knot down and safety it with an overhand knot on each side of the square knot.

(c) Checkpoints:

- Two interlocking bights.
- The running ends are on opposite ends of the knot and on the same side of the standing ends.
- Minimum 4-inch pigtails after the overhand safety.

# Square Knot

**Right over Left**



**Left over Right**



Figure 8  
Square Knot

**(4) FIGURE EIGHT BEND.**

(a) Purpose: To join the ends of two ropes up to a 5-mm diameter difference.

(b) Tying the Knot:

- Grasp the top of a 2-foot bight.
- With the other hand grasp, the running end (short end) and make a 360-degree turn around the standing end.
- Place the running end through the loop you have just formed creating an in-line figure eight.
- Route the running end of the other rope back through the figure eight starting from the original rope's running end. Trace the original knot to the standing end.
- Remove all twists and crossovers. Dress the knot down.

(c) Checkpoints:

- Two ropes running side by side in the shape of a figure eight.
- The running ends are on opposite ends of the knot and on opposite sides of the standing ends.
- Minimum 4-inch pigtails.

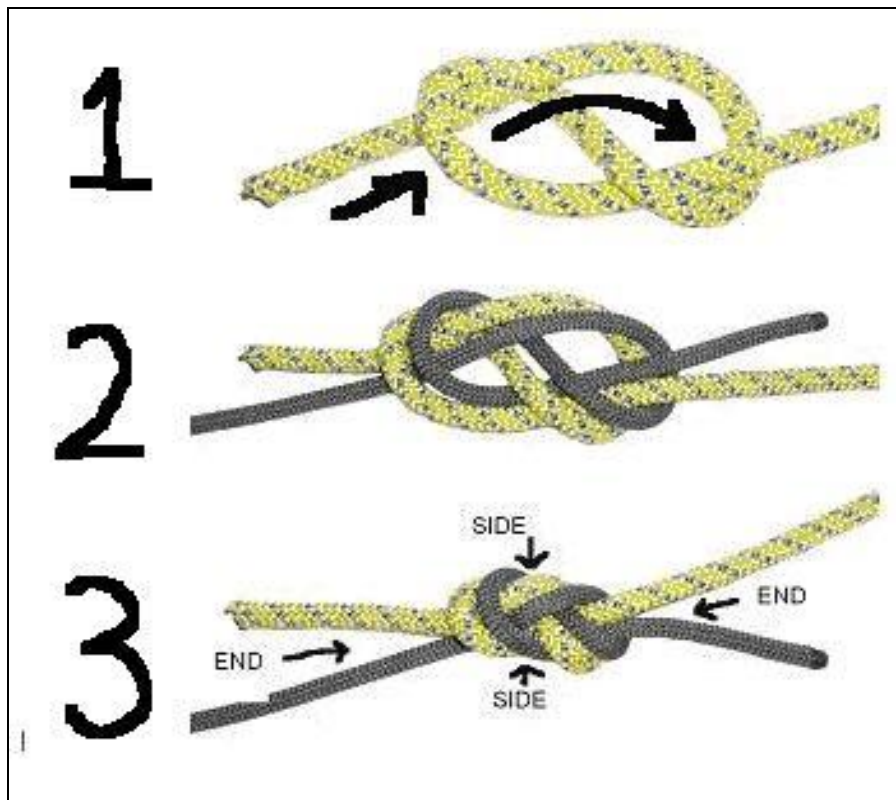


Figure 9  
Figure Eight Bend

**(5) WATER KNOT.**

(a) Purpose: To join the ends of tubular webbing.

(b) Tying the Knot:

- Tie an overhand knot in one end of the webbing.
- Route the other end of the webbing back through the overhand knot. Follow the course of the original overhand knot.
- Ensure all the webbing is laying flat within the knot.
- Dress the knot down.

(c) Checkpoints:

- Two pieces of webbing running side by side in the shape of an overhand.
- The running ends are on opposite ends of the knot and on the same side of the standing ends.
- There are no twists in the webbing.
- Minimum 4-inch pigtails.

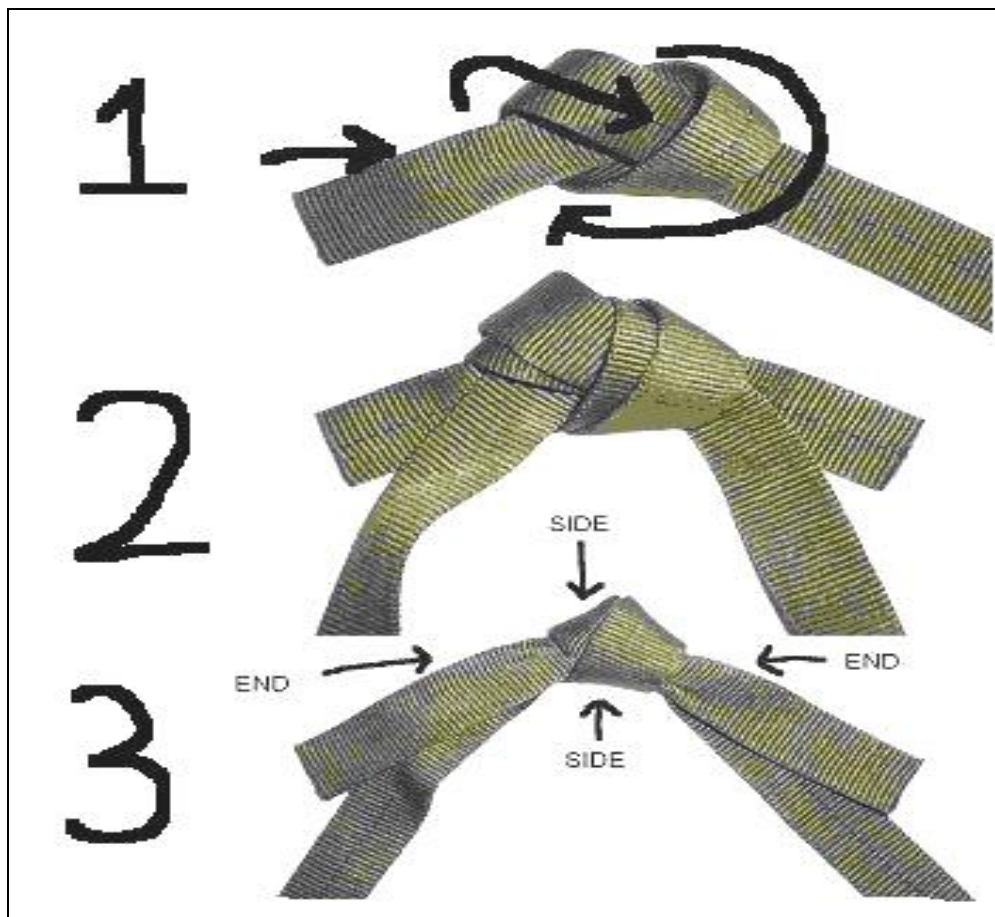


Figure 10  
Water Knot

(5) **BOWLINE.**

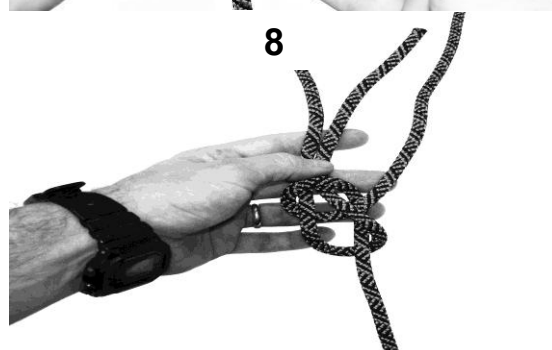
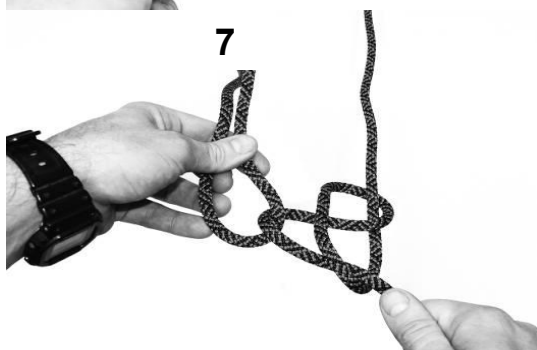
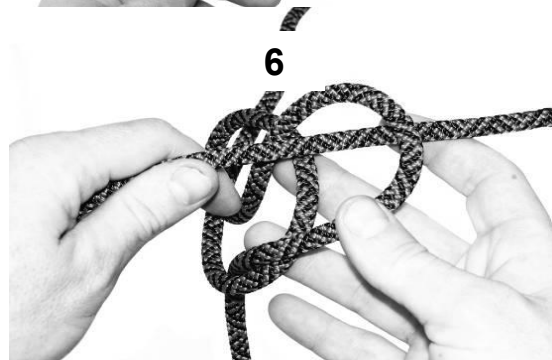
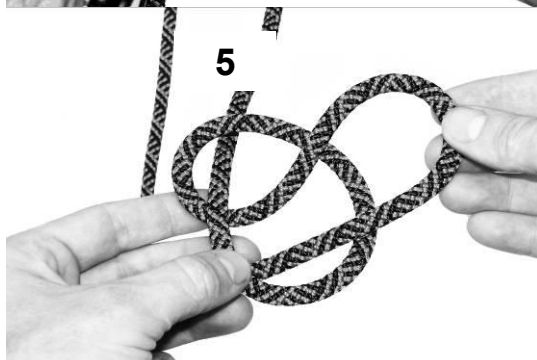
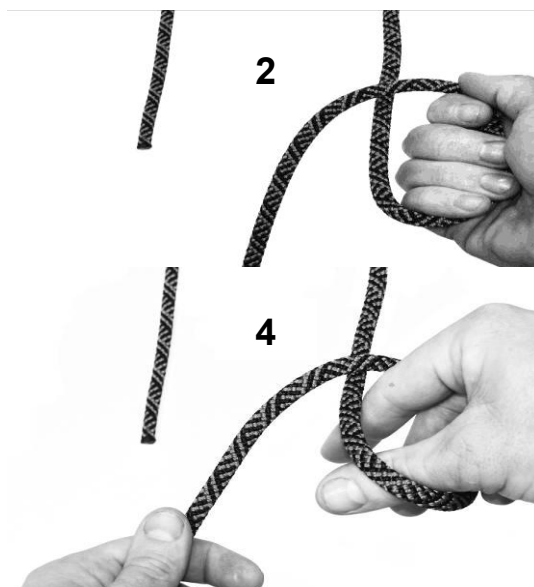
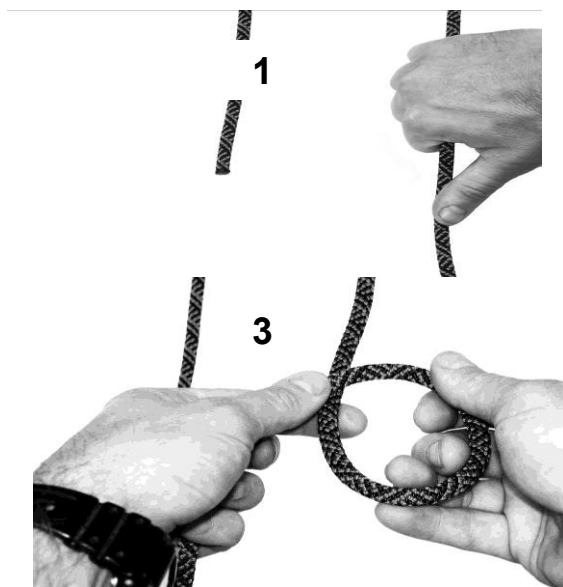
(a) Purpose: To anchor the end of a rope.

(b) Tying the Knot:

- Bring the running end of the rope around the anchor, from right to left, top to bottom.
- With your right thumb facing toward you, form a loop in the standing part by turning your wrist clockwise. Lay the loop to the right.
- Reach down through the loop with your right hand. Pull up a bight from the standing part of the rope. Ensure the standing part of the bight is facing toward you.
- Place the running end of the rope (on your left) through the bight from left to right and bring it back on itself. Hold the running end loosely and dress the knot down by pulling on the standing end.
- Dress the knot down and safety the bowline with an overhand knot.

(c) Checkpoints:

- A bight around the standing end, held in place by a loop.
- The running end of the bight is on the inside of the fixed loop.
- Minimum 4-inch pigtail after the overhand safety.





## (7)TRIPLE BOWLINE.

(a) Purpose: To anchor a bight of rope.

(b) Tying the Knot:

- Form a bight. Bring the running end of the rope around the anchor, from right to left top to bottom.
- With your right thumb facing toward you, form a doubled loop in the standing part by turning your wrist clockwise. Lay the loops to the right.
- With your right hand, reach down through the loops and pull up a doubled bight from the standing parts of the rope. Ensure that the standing parts are facing toward you.
- Place the running end (bight) of the rope (on your left) through the doubled bight from left to right and bring it back on itself. Hold the running end loosely and dress the knot down by pulling on the standing ends.
- Safety it off with a doubled overhand knot.

(c) Checkpoints:

- Two bights around the two standing ends, held in place by two loops.
- The running end of the double bight is on the inside of the fixed loops.
- Minimum 4-inch pigtail after the overhand safety.



Figure 29  
Triple Bowline

**(8) CLOVE HITCH: End of rope (EOR).**

(a) Purpose: To anchor the end of the rope under tension.

(b) Tying the Knot:

- Make a turn around the anchor, left to right.
- Bring the rope over the standing part and down continuing around the anchor forming a diagonal locking bar.
- Continue wrapping around the anchor.
- Pass the running end under the locking bar just formed.
- Dress the knot down.

(c) Checkpoints:

- Two turns around the anchor with the diagonal locking bar in the opposite direction of pull.
- The running and standing ends exit from the middle of the knot.

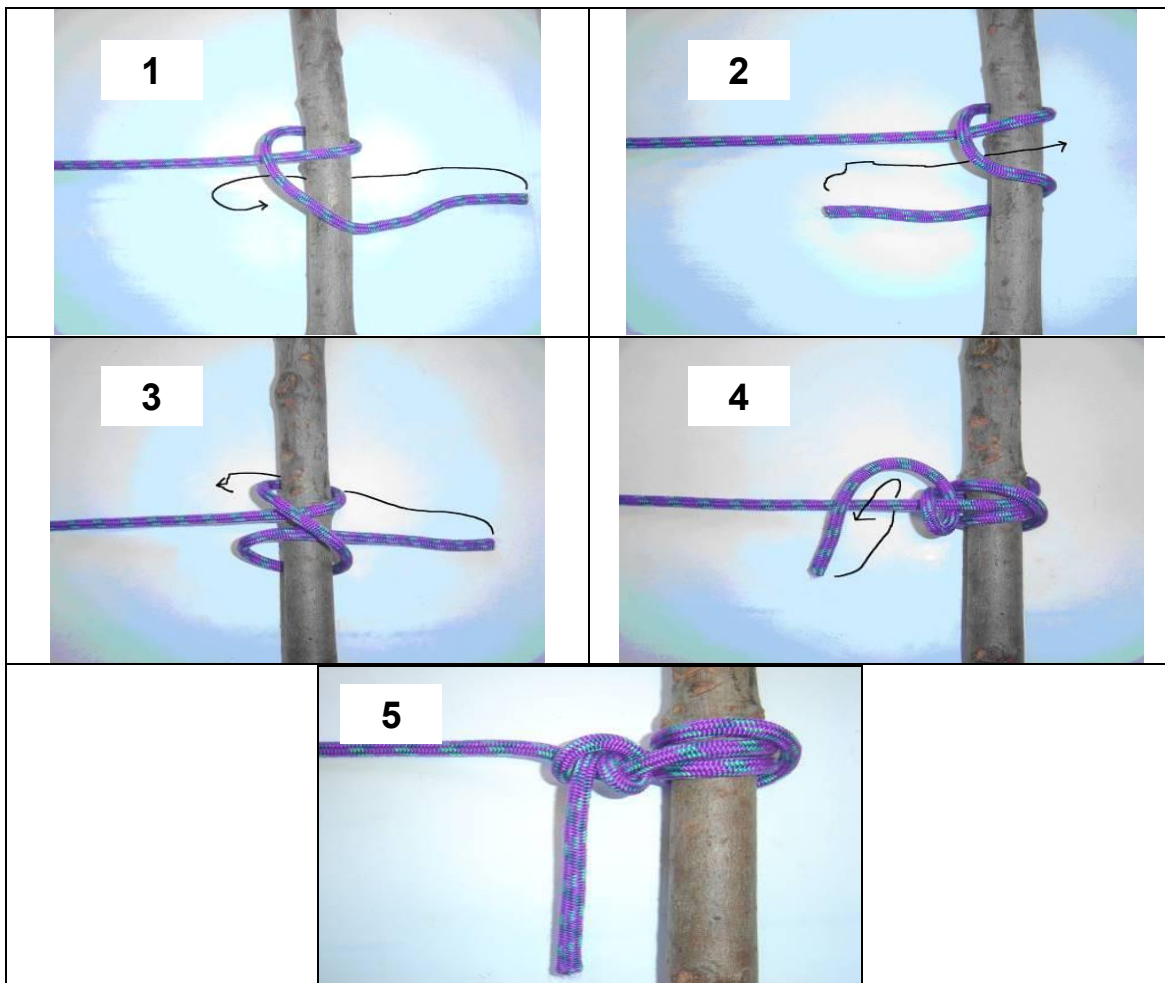


Figure 16  
EOR Clove Hitch

**(9) CLOVE HITCH: Middle of the rope (MOR).**

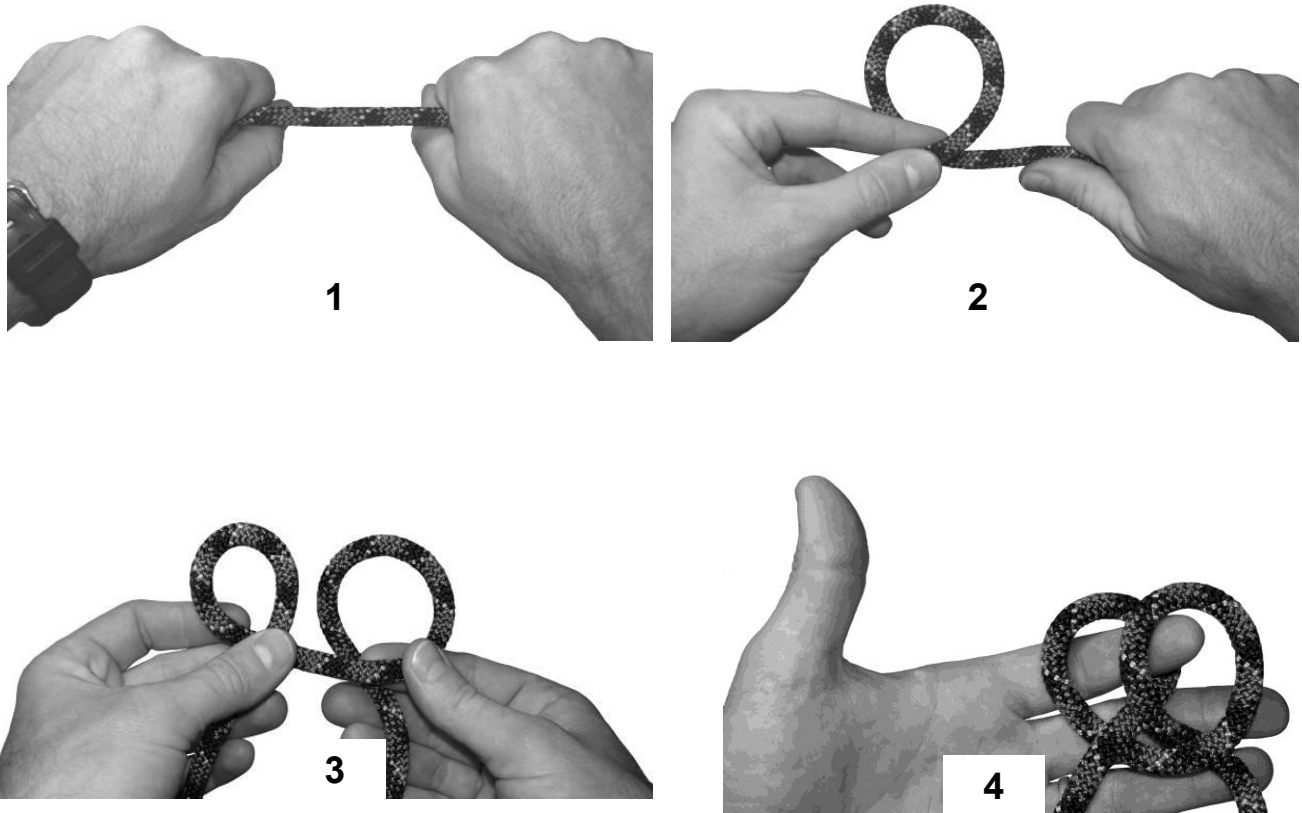
(a) Purpose: To form an anchor in the middle of a rope.

(b) Tying the Knot:

- Hold the rope in both hands, palms down about 12 inches apart.
- With the right hand, form a loop away from your body toward the left hand. Hold the loop with the left hand.
- Again, with the right hand, form a loop away from your body toward the left hand. Hold the loop with the right hand.
- Place the second loop on top of the first loop that you formed without flipping it.
- Place both loops over the anchor and pull both ends of the rope in opposite directions.

(c) Checkpoints:

- Two turns around the anchor with a diagonal locking bar.
- The running and standing ends exit from the middle of the knot.



Middle of the Rope Clove Hitch

**(10) DOUBLE FIGURE EIGHT.**

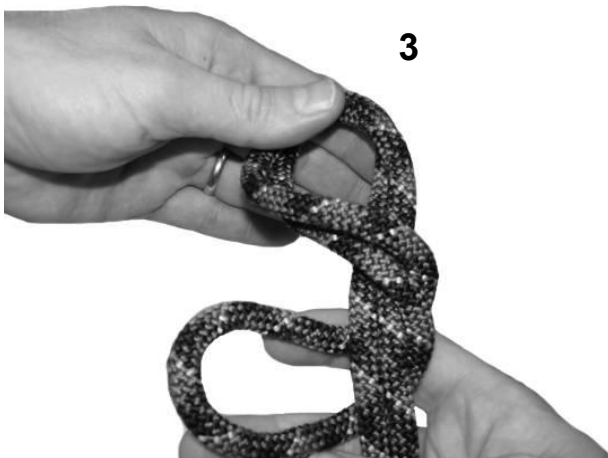
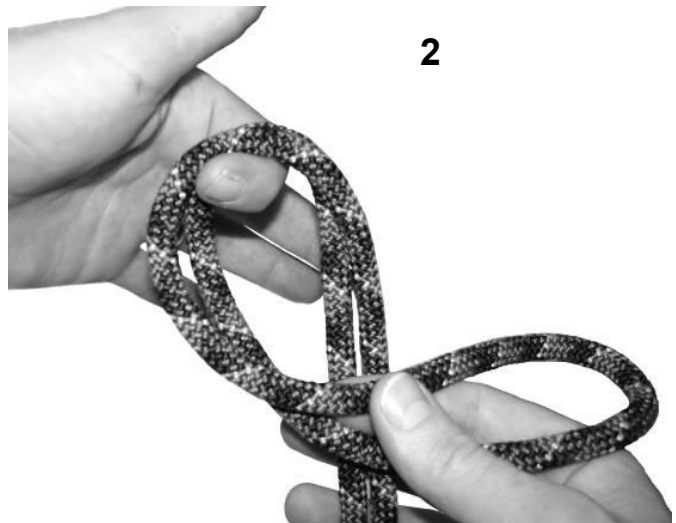
(a) Purpose: To form a fixed loop in a rope.

(b) Tying the Knot:

- Form a 12-inch bight.
- With the bight, make a 360-degree turn around the standing end forming a doubled loop in your hand.
- Place the bight through the loop.
- Remove all unnecessary twists and crossovers. Dress the knot down.
- (VARIATION): A Doubled Double Figure Eight is tied the same, but with a doubled rope.

(c) Checkpoints:

- Two ropes running side by side in the shape of a figure eight.
- The knot forms a fixed loop.
- Minimum 4-inch pigtail when tied at the end of the rope.



**(11) FIGURE EIGHT SLIP KNOT.**

(a) Purpose: To form an adjustable bight in a rope.

(b) Tying the Knot:

- Take a bight in the rope. Holding the closed end, grasp the doubled rope below the bight with the opposite hand. Make two twists in the bight (360 degrees) with the top hand.
- Maintaining the two twists, reach through the loop and pull a bight through the loop in your hand.
- Dress down the knot.

(c) Checkpoints:

- The knot is in the shape of a figure eight.
- An adjustable bight passes through one loop of the figure eight.

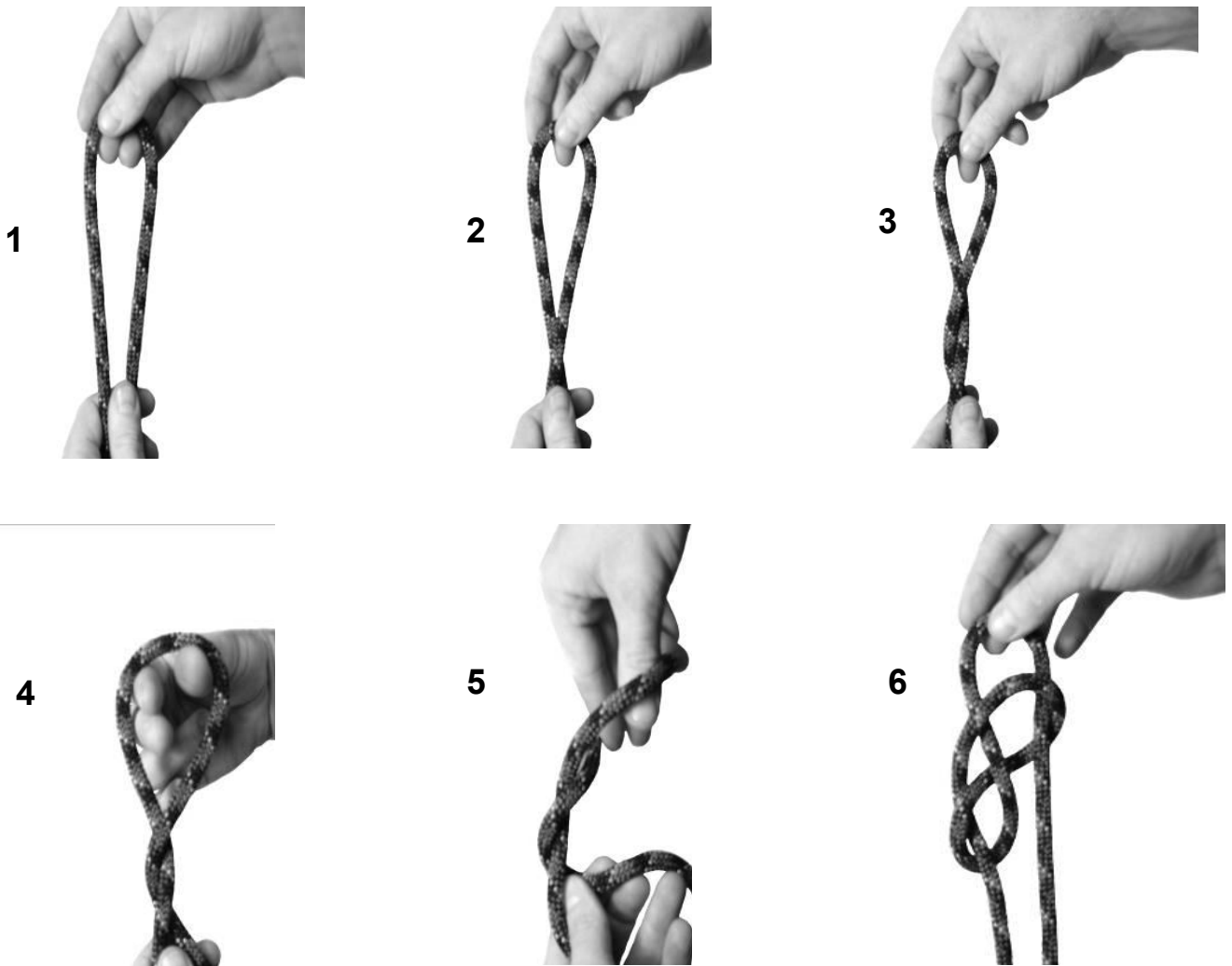


Figure 21  
MOR Figure Eight Slip

## (12) MIDDLE OF THE ROPE PRUSIK.

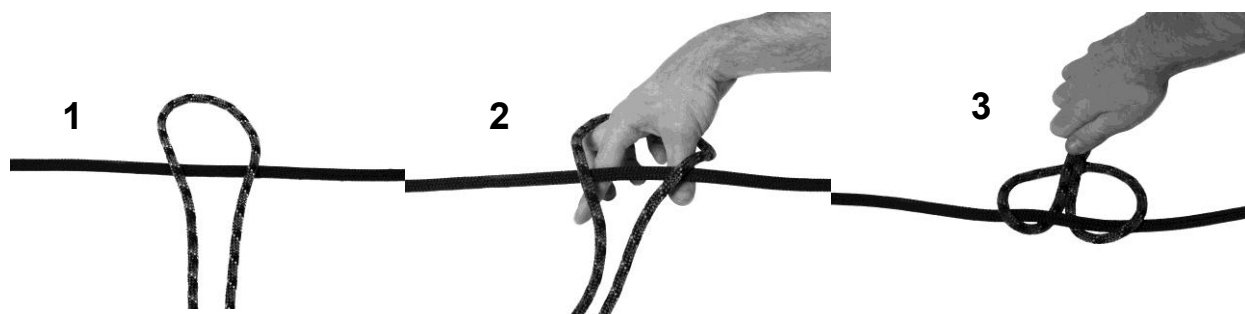
(a) Purpose: To attach a moveable rope to a fixed rope.

(b) Tying the Knot:

- Place a bight of rope over the fixed rope. The closed end of the bight is 4 to 6 inches below the fixed rope. The running ends are closest to you.
- Reach down through the bight pulling both running ends through the bight and continue around the anchor, repeat 2 more times. You will now have three round turns on the fixed rope and a locking bar running across them.
- Dress the wraps and locking bar down to make sure they are tight and not twisted.

(c) Checkpoints:

- Three round turns with a perpendicular locking bar.



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**(13) END OF THE ROPE PRUSIK.**

(a) Purpose: To attach a moveable rope to a fixed rope at the end of a rope.

(b) Tying the Knot:

- With the running end, make three turns around the fixed rope, working to your right and top to bottom.
- With the running end, come back over the standing part and under the fixed rope.
- Come over the fixed rope and make three turns working toward the right, bringing the running end under the locking bar.
- Dress the knot down and stabilize with a bowline.

(c) Checkpoints:

- Three round turns with a perpendicular locking bar.
- Stabilized with a bowline within six inches.
- Both ropes between the Prusik and bowline have equal tension.
- Minimum 4-inch pigtail.



Figure 30  
EOR Prusik

**(14) REROUTED FIGURE OF EIGHT.**

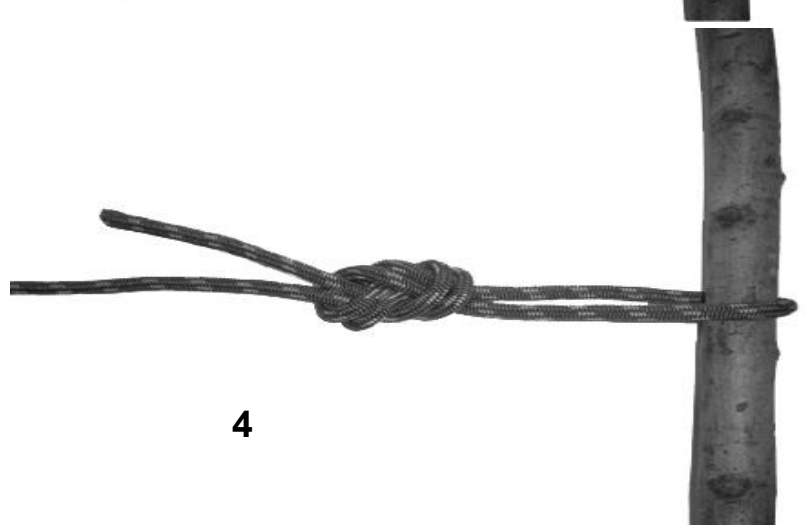
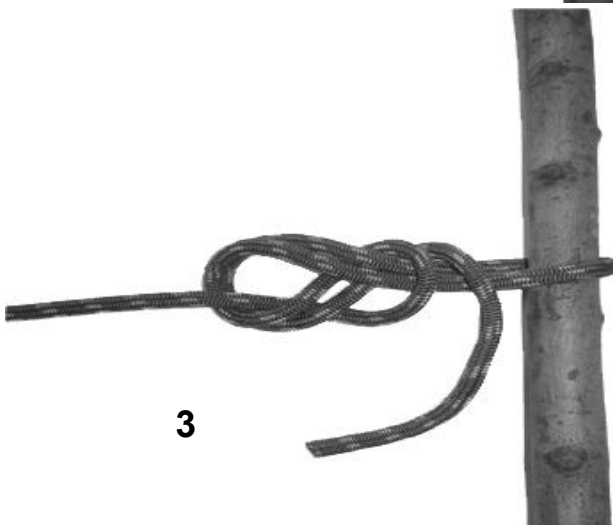
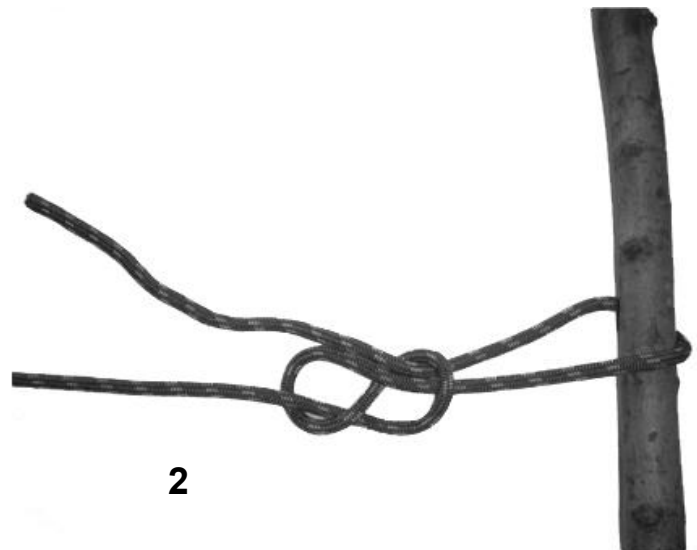
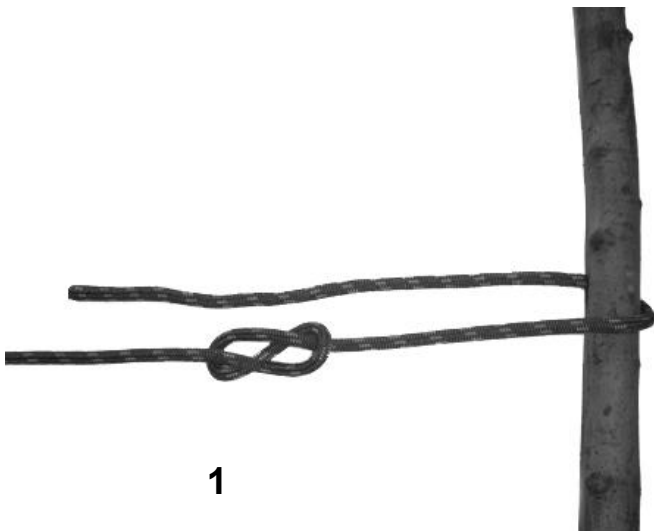
(a) Purpose: To tie the climbing rope around a fixed object or into a harness.

(b) Tying the Knot:

- Grasp the top of a 2-foot bight.
- With the other hand grasp, the running end (short end) and make a 360-degree turn around the standing end.
- Place the running end through the loop you have just formed.
- Place the running end around the anchor (or into the harness).
- Route the running end back through the figure eight tracing the original knot to the standing end.
- Remove all unnecessary twists and crossovers. Dress the knot down.

(c) Checkpoints:

- Two ropes running side by side in the shape of a figure eight.
- The knot will form a fixed loop around a fixed object or harness.
- Minimum 4-inch pigtail.





**(15) MUNTER HITCH.**

(a) Purpose: To form a mechanical belay.

(b) Tying the Knot:

- Hold the rope in both hands, palms down about 12 inches apart.
- With the right hand, form a loop away from your body toward the left hand. Hold the loop with the left hand.
- With the right hand, place the rope that comes from the bottom of the loop over the top of the loop.
- Place the bight that you have formed around the rope into the pearabiner. Lock the pearabiner.

(c) Checkpoints:

- A bight passing through a locked carabiner.
- The closed end of the bight is around either the running or standing end.



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# **(16) SUPER MUNTER HITCH.**

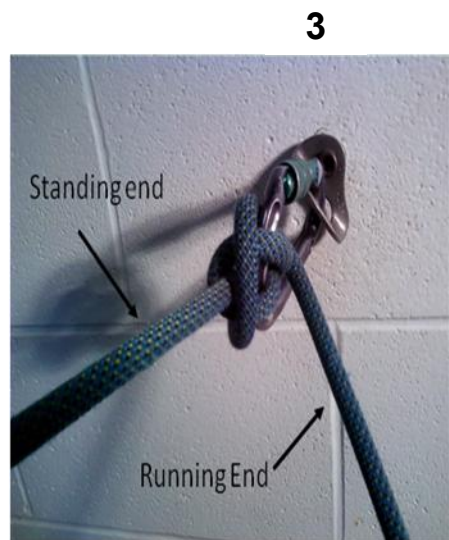
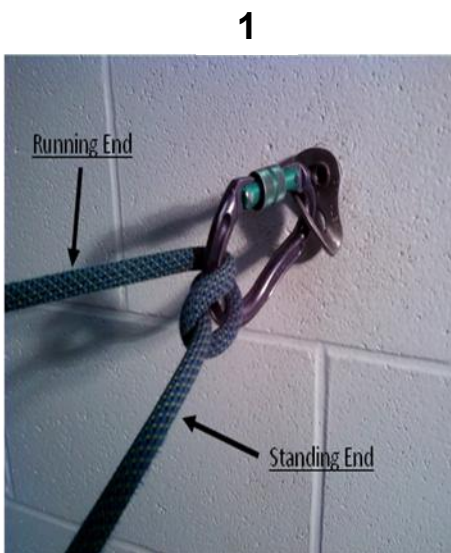
(a) Purpose: To create a high friction mechanical belay.

(b) Tying the Knot:

- Tie a Munter hitch with the closed end of the bight on the standing end of the rope.
- Bring the running end of the rope under the standing end and form a bight around the standing end.
- Clip the running end of the bight into the pearabiner and lock.

(c) Checkpoints:

- Two bights passing through a locked pearabiner.
- The closed ends of both bights are on the standing end of the rope.



### (17) AUTO BLOCK.

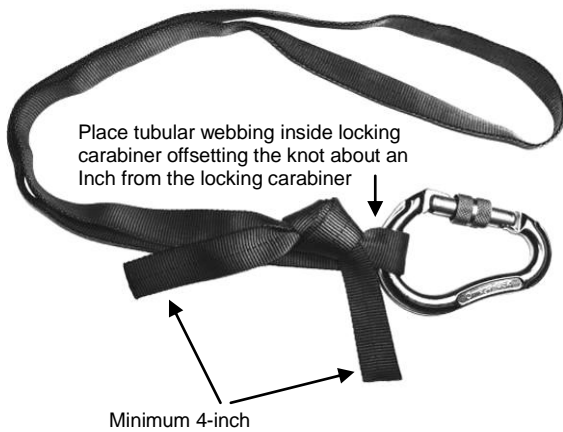
(a) Purpose: To attach a moveable piece of rope or webbing to a fixed rope that is easy to release under tension.

(b) Tying the Knot:

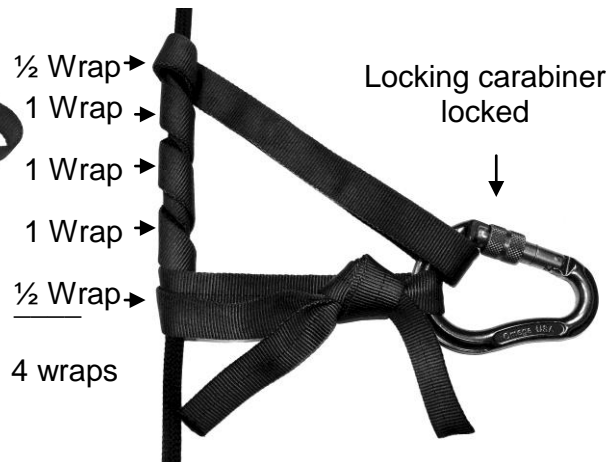
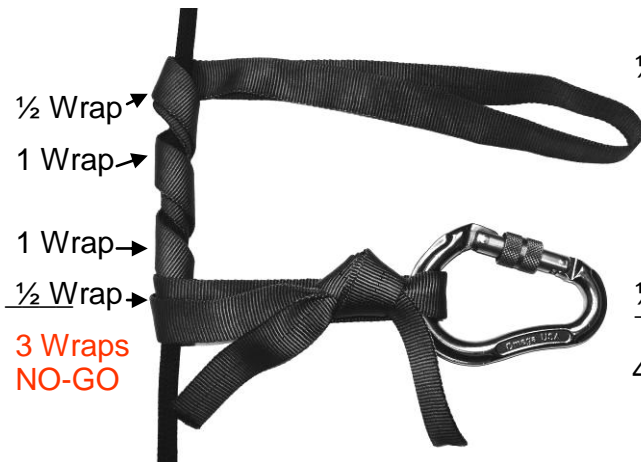
- Join a utility rope to form an endless loop, about 24 inches. You may use a standard length sewn runner or tubular webbing.
- Offset the joining knot. Wrap the clean portion of the endless loop around the rope a minimum of 4 times.
- Place both bights into a locking carabiner and lock.

(c) Checkpoints:

- Minimum of four turns around the rope.
- Both bights in a locked carabiner.
- The joining knot is offset and out of the turns.

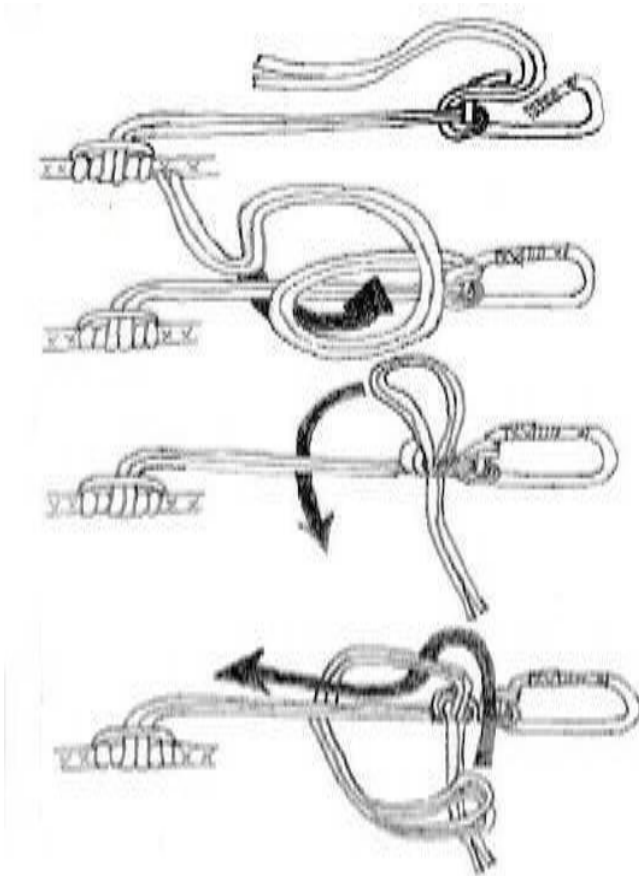


Do Not Use Sewn Webbing  
Made of spectra



## (18) MUNTER MULE KNOT

- (a) Purpose: To create a releasable anchor knot.
- (b) Tying the Knot:
- Place a Munter hitch into a locking carabiner.
  - With the brake strand(s) of the Munter, create an overhand loop and place onto the load strand(s) of the Munter hitch.
  - Bring a bight through the overhand loop capturing the load strand(s) creating a slipknot.
  - Dress the slipknot down against the Munter hitch.
  - Tie an overhand knot around the load strand(s).
  - Dress the knot down.
- (c) Checkpoints:
- A bight passing through a locked carabiner.
  - The closed end of the bight is around the load strand(s).
  - Bight up through an over hand slipknot capturing the load strands.
  - Overhand knot around the load strand(s) with a minimum of 4" pigtails.



**(19) BUTTERFLY COIL WITH FARMER'S TIE OFF.**

(a) Purpose: To prepare a climbing rope for carrying on the body.

(b) Tying the Knot:

- Backfeed the doubled rope until you have the approximate center bight.
- Place the center bight over your head and drape it in front, over your shoulder so it hangs no lower than your waist.
- With the rest of the doubled rope in front of you make doubled bights placing them over your head in the same manner as the first bite, ensuring you alternate from side to side (right to left, left to right etc.) while maintaining equal length bights.
- Continue coiling until you have approximately two arms lengths of rope left. Carefully remove the coils from your neck/shoulders holding the center in one hand.
- With the two ends, wrap the coils a minimum of three times ensuring the first wrap locks on itself.
- Pass a doubled bight from the two loose ends up through the apex of the coils, pull the two loose ends through the doubled bight and dress it down.
- Place the Butterfly Coil on your back.

(c) Farmer's Tie Off:

- Place the Butterfly Coil on your back.
- Separate the two loose ends.
- Bring one over your right shoulder and one over left shoulder.
- Continue down under your arms and across your back.
- Ensure the rope crosses over the coils.
- Secure the two ends in front with a square knot without overhand safeties.

(d) Checkpoints:

- Coils uniform and even, within 6 inches.
- A minimum of three turns around the coils, with the first one locking on itself.
- A double bight through the top of the coils, securing the standing ends.
- A minimum of one wrap around the body and the coils tied off with an unsafetied square knot.
- Minimum 4-inch pigtails.



Butterfly Coil

Figure 37



Butterfly Coil with  
Farmer's Tie Off

Figure 38

**(20) FIELD EXPEDIENT SEAT HARNESS.**

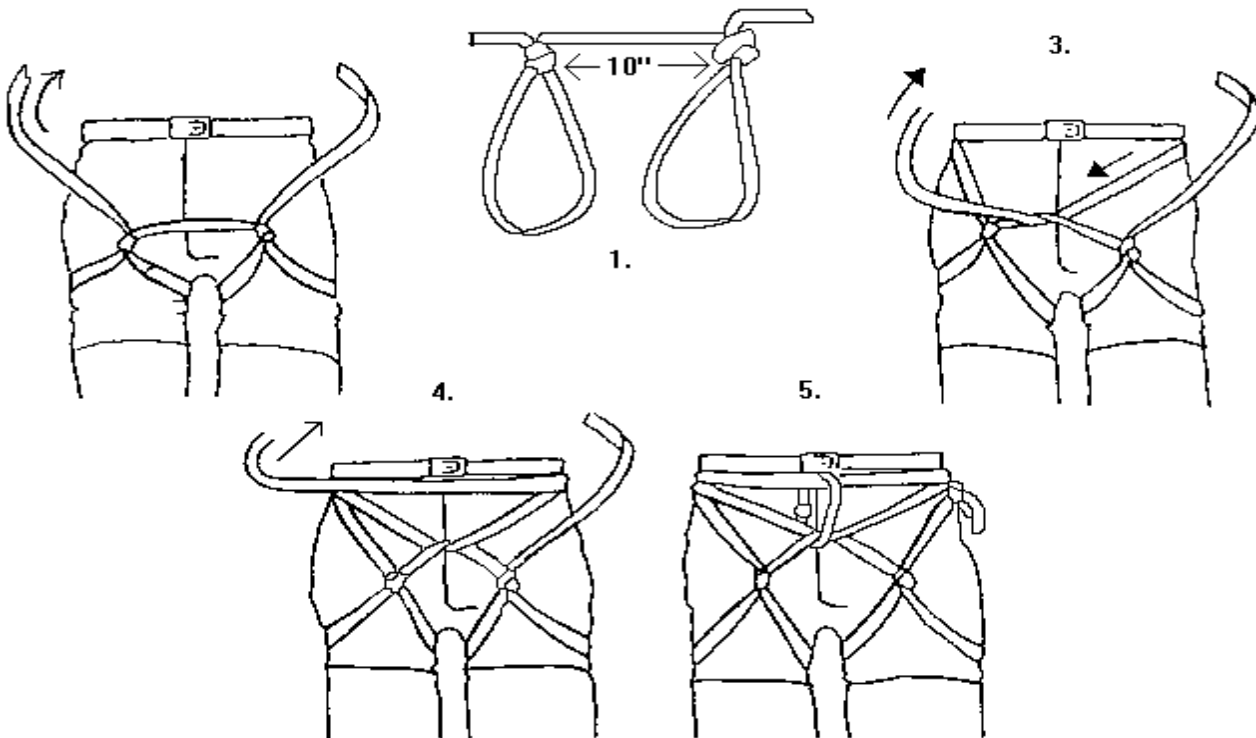
(a) Purpose: To form a seat harness out of tubular webbing for rappelling or climbing.

(b) Tying the Knot:

- Take a piece of tubular webbing 22 feet long.
- Leave about 24 inches of tail. Tie an overhand on a bight to form a fixed loop. Make this loop slightly larger than your left thigh.
- Move 10 inches on the webbing and tie a second loop. Tie an overhand on a bight to form another fixed loop. Make this loop slightly larger than your right thigh.
- Step into each loop and bring it up around your thighs, with the 24-inch tail on the non-brake hand side. The 10-inch piece is in front and the long portion on the brake hand side.
- Take the long end and run it around the back and just above the hipbone to the front.
- Run this end under and through the 10-inch section at the front and pull everything snug.
- Bring the end around the back again, to the guide hand side and tie it together with a water knot (If enough webbing is left over run the long end around the waist an additional time before tying off).

(c) Checkpoints:

- Two overhand knots on the front of the legs, 10 inches apart.
- Leg loops snug on the legs and above cargo pockets.
- A minimum of two turns around the body, snug and above the hips, the first wrap around the body running through the webbing between the overhand knots.
- Minimum 4-inch pigtail after the water knot.



You can use an expedient seat harness with or without a chest harness. Construct the harness from 22 feet of 1 or 2 inch tubular webbing. Inspect the webbing before and after each use. Use the field expedient seat harness when falls are very likely or you will be operating on steep terrain for long period.



## (21) RAPPEL SEAT.

(a) Purpose: To form a rope harness for rappelling.

(b) Tying the Knot:

- Find the middle of a sling rope, and make a bight.
- Decide which hand you will use as your brake hand and place the bight on the opposite hip.
- Reach around behind you and grab a single strand of rope. Bring it around to your front and tie two overhands on the other strand of rope, creating a loop around your waist.
- Pass the two ends between your legs, ensuring they do not cross.
- Pass the two ends up under the loop around your waist, bisecting your pocket flaps. Pull up on the ropes, tightening the seat.
- From rear to front, pass the two ends through the leg loops creating a half hitch on both hips.
- Bring the longer of the two ends across your front to your non-brake hand hip and secure the two ends with a safetied square knot.

(c) Checkpoints:

- Two overhands around the body, above the hips.
- Ropes not crossed between the legs.
- Half hitch on each hip.



## EVALUATION GUIDE

### 071E9002

### Basic Knot Tying

**Action:** Tie Basic Mountaineering Knots.

**Condition:** In a classroom environment given (1) 11mm x 50 meter rope, (1) 11mm x 18 ft sling rope, (1) locking pearabiner, (1) 1 x 60 inch tubular webbing, (1) 7mm x 18ft cord and (1) 24 ft x 1 inch tubular webbing.

**Standard:** The knot must be correctly tied and purpose stated during the time allowed. The student must score a minimum of 240 points out of a possible 300 points to achieve a “go” on this test.

#### Performance Measures:

		PURPOSE		KNOT		
		4 POINTS		16 POINTS		
Tied the:		GO	NOGO	GO	NOGO	POINTS
1. Clove Hitch	30 seconds					
2. Munter Hitch	30 seconds					
3. Super Munter Hitch	30 seconds					
4. Girth Hitch	30 seconds					
5. Prusik	30 seconds					
6. Bowline	30 seconds					
7. Double Figure Eight	30 seconds					
8. Autoblock	30 seconds					
9. Water Knot	1 minute					
10. Figure Eight Bend	1minute					
11. Munter Mule	1minute					
12. Rerouted Figure Eight	1minute					
13. Rappel Seat	1 minute					
14. Field Expedient Harness	3 minute					
15. Butterfly Coil w/Farmers Tie Off	2 minute					
		TOTAL POINTS/TOTAL POINTS POSSIBLE				/300
		Circle One:                      GO                      NOGO				

#### FEEDBACK

Score the soldier a GO if the Total Score is 240 points or higher.

Score the soldier a NOGO if the Total Score is less than 240 points.

If the soldier fails any of the steps, show what was done wrong and how to do it correctly.

STUDENT'S RANK/LAST NAME: \_\_\_\_\_

INSTRUCTOR'S RANK/NAME \_\_\_\_\_ DATE: \_\_\_\_\_



# We also have Knot videos on you tube.

Cut and paste the link below.

[www.youtube.com/user/mountainschoolvt](http://www.youtube.com/user/mountainschoolvt)

You can also do a youtube search for mountainschoolvt all one word.

When you find this click on mountainschoolvt and it will take you to our youtube channel.

