ELEMENTS OF ROPE

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KNOTS & HITCHES

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Manual 1 of 10

EVOLUTION OF ROPE, KNOTS, & HITCHES

*This manual, nor any other manual in this eight-part series are to be considered an all-inclusive or standalone training aid. The manuals are designed to help guide you through an evolution of common topics and practices that can be found throughout the United States. Tree work is inherently dangerous, and you must be trained under the supervision and instruction of skilled workers before attempting to replicate any of these situations alone. *

Pre-Face

In this first manual in the series, you will be reading into the evolution of rope and rope construction from simple natural manila fiber into todays synthetic multiple braid ropes.

The tree care industry relies heavily upon ropes, ropes support your life and the lives of your peers as well as helping to keep you employed. There are many obstacles and challenges Line Clearance Tree Trimmers face, death is not the only possibility, a mistake could cost the climber or trimmer their career. Ropes can help prevent accidents and maintain control over all facets of the job/task at hand reducing and eliminating unnecessary accidents.

Also included in this manual is an in-depth review and instruction on knots and hitches used by most tree care professionals. Some knots are used for rigging while others are used for life support. Be sure to read the description of each knot, Tie Dress & Set (TDS) each knot, and test your knot or hitch before use.

Throughout your career, you will come to depend upon rope to save your life, complete a job without damaging property, make a dangerous situation safer, or use it to rescue a co-worker. Rope has countless uses within this industry but must be used properly and cared for.

In this manual you will become acquainted with rope types, rope construction, care and inspection, proper uses and the various knots/hitches used in the industry.

First, lets look at a brief timeline consisting of the evolution of rope from its humble beginnings to todays advancements.

Manila rope: natural fibers tightly twisted together then braided into a single line. Manila rope is named after the highest producer of its natural contents, Manila Philippines. This was a great rope in its day but since has been replaced with synthetic material offering smaller diameters, lighter weight, and higher breaking strengths.

Manila rope is a type of rope made from manila hemp.

Manila hemp is a type of fiber obtained from the leaves of the abacá. It is not actually hemp, but named so because hemp was long a major source of fiber, and other fibers were sometimes named after it. The name refers to the capital of the Philippines, one of the main producers of abacá. *Wikipedia*

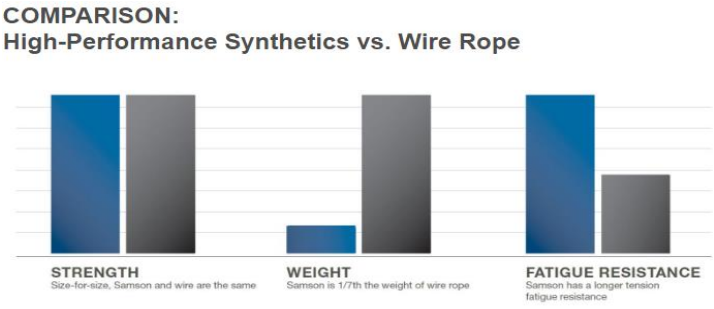
View these vintage photos from the pioneers of tree climbing. Using Manila flip lines and a "cat's paw" knot to adjust their rope.

Rope material started turning little fibers of plant material into bigger fibers, those bigger fibers get turned into even bigger fibers until you have one strand of a rope. Then one strand is added to another and another until they can be braided together by hand to create rope.

Now we have automated machines that can create thousands of uniform feet with specific colors, braiding, patterns, and application properties. Drums of synthetic material are loaded onto a platform of spinning rods that rotate around one another in a specific pattern, this rotation makes the braid.

Rope material and construction has gotten so much better ANSI actually states that no rope used as a climb line can be made of natural material. It has to be synthetic and man-made to ANSI/OSHA's specific requirements for its intended purpose. In some case synthetic rope can be stronger then braided steel, and lighter! For example, Samson Rope's "Amsteel" which is size for size equal or stronger then cable but light enough to float on water!

ANSI Z133-2017 8.2.4 "Arborist climbing lines used for moving rope systems shall have a minimum of ½ inch (12.7 mm) and be constructed from synthetic fiber, with a minimum breaking strength of 5,400 pounds (24.02 kilonewtons [kN]) without terminations when new. Maximum working elongation shall not exceed 7 percent at a load of 540 pounds (2.402 kN). Arborist climbing lines shall be identified by the manufacturer as suitable for tree climbing."



The ropes used in the industry of tree removal, tree trimming, powerline clearance, and arboriculture are categorized on the following page:

Static / Kernmantle: these ropes have little to no elongation and high abrasion resistance. They are typically used for Single Rope Technique (SRT) climbing due to the benefits of not having a rope that bounces while climbing as well as extra firmness and tough out core that resist damage or "picking" from toothed ascender devices.

Dynamic: rope that is used in Dynamic Doubled Rope Technique (DdRT) and is most commonly 16 or 24 strand rope. This rope has some elongation/stretch properties and works well with most hardware. The example below is a version of Samson "arbormaster" rope, a 16 strand climbing line that is very common in this industry.

Double Braid: Double braid ropes used in the arborist industries generally have an outer sheath with two carriers braided into 24 strands that house the core. These ropes are share the load between the core and the outer jacket. Core-Dependent Double Braid's differ because the core is where the strength is and the outer sheath is simply for protection, identification, and to hold the inner core together. A common double braid rope is the Samson "stable braid" ropes which range in size from ½" to 1" and have considerable breaking strength and low stretch. This family of ropes is the most desirable rigging applications.

Hollow Braid: hollow braids can be made of either 1 or 2 carrier strands. This rope has no core making it completely hollow, this construction makes it inherently easy to splice. Samson Tenex-tec and Tenex are very widely used in sling systems used for installing rigging blocks & Port-A-Wraps as well as slings used to wrap logs for lifting/lowering. This rope is extremely strong and an advantageous choice for rigging applications.

3 Strand: Todays three strand ropes are still made from synthetic fiber but follow the same construction principle as the original Manila rope. They are generally used for hand lines or pull lines. Some device such as the Masdam rope come along only work with 3 strand ropes. Rope advances have placed 3 strand construction types at the most basic level due to their low strengths and high weights.

Key terms:

Bend: referred to a type of knot that joins two ropes together
Bend Ratio: the size or diameter of device/limb a rope is placed over or through creates a bend ration
Bight: a long loop of rope -or- where a knot cinches down onto itself when loaded
Bulge: section of a rope where internal fibers are bent/twisted inside the core creating a bump
Coil: started at one rope end, making overhand turns in one's hand to coil and store a rope
Diameter: refers to ropes cross-sectional width
Double Braid: rope with braided outer sleeve and braided inner core
Dynamic: opposite of static, dynamic loading can either very in weight or unload then load again
Friction: heat caused by rubbing, causes damage and rope glazing
Flat Spot: area of rope where the internal fibers have broken or separated leaving a flat spot
Glazing: sections of a rope where it was exposed to excessive amounts of friction that melted fibers
Hockel: small twist within the rope
Hollow Braid: rope with 1 carrier strand or 2 but has no core
Kernmantle: type of rope with little stretch and high abrasion resistance
Overhand turn: a loop made in the rope by place the working end over the non-working end
Static: a load or applied weight that is constant, non-changing
Three strand: 3 separate ropes braided together
Climbing Line: a rope that is used only for life support
Rigging Line: rope reserved for lifting/lowering of wood and limbs
Hitch: knot consisting in wraps/braids that allows it to move in both directions when no weight is applied but then grips the rope and holds when weight is applied
Stopper Knot: knot at the end of a rope to prevent it from pulling through a device or hitch
Tie Dress & Set (TDS): after you tie a knot, perform TDS to get the knot ready for use

Ropes used for climbing:

The ropes you will be using for life support must be a minimum of ½ with a minimum breaking strength of 5,400 pounds and no more than 7% elongation with 540 pounds applied. ½ inch ropes are extremely common in most DdRT systems because of their overall knotability, breaking strength, ease of use, cost, and it is required by ANSI unless certain conditions have been met.

ANSI Z133-2017 8.2.4 EXCEPTION "In arboricultural not subject to regulations that supersede Z133, a line of not less than 7/16 inch (11 mm) diameter may be used, provided the employer can demonstrate it does not create a safety hazard for the arborist and the arborist has been instructed in its use. The line selected shall meet or exceed the standards for arborist climbing lines and shall be identified by the manufacturer as suitable for tree climbing."

This ANSI exception is most widely used to legally and safely utilize Kernmantle/Static Ropes because 90% of the Static/Kernmantle ropes on the market are not 12.7 mm, they are generally much smaller ranging from 8mm-12mm. SRT climbing systems should almost only be used with static rope, even though it is possible to use ascender equipment and SRT equipment on DdRT options previously mentioned, SRT works better and is safer on static rope. On the following page are examples of these two rope types, their sizes and differences.

DdRT Ropes:

New England "Tachyon" 11.7 mm

This rope is a hybrid rope that can be used for both DdRT and SRT systems. It has 24 tightly woven strands and a strong inner core. It is easy to see and distinguishable from other ropes or vegetation due to its bright color pattern. Its "knotability" rating is high as well as its breaking strength (6,000 pounds). Its features make it last long and even work well when wet.

Samson "Arbormaster" 12.5 mm

This red, white, and black is a variant of the ever common "blue streak" made by the same company. Low cost, good knotability and good overall value. It is a 16 strand DdRT climbing line offering a breaking strength of 6,500 pounds. It's braided inner core helps keep it firm and gives it great knot holding capability.

Yale XTC "Fire" 13 mm

XTC is a rope with 16 strands and a parallel inner core making it very tough and good at dissipating heat. It's multi-colored approach makes it one of the brightest ropes in the tree and easily visible. It is on the larger end of the scale for DdRT ropes, the extra .5 mm makes a noticeable difference when this rope is paired with eye-and-eye friction hitches. It has a spliced eye breaking strength of 6,200 pounds.

Of course, there are many versions, brands, and size of DdRT climbing ropes on the market today. The examples above are common place ropes with a good reputation in the industry.

SRT ROPES:

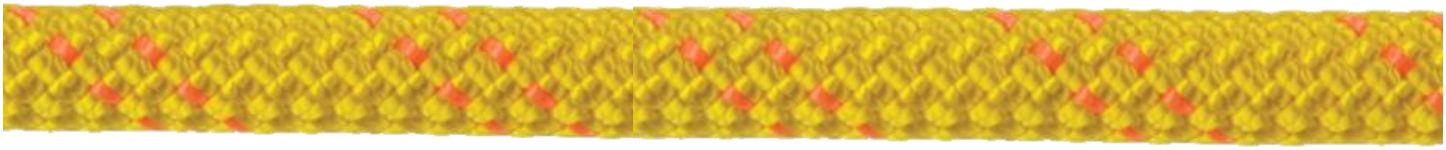
Sterling HTP "Snake Bite" 11 mm

Snake bite has been offered in a variety of sizes and colors since its inception. This construction of rope is one of the stiffest and longest lasting kernmantle ropes on the market. The above color scheme is extremely bright while still offering excellent knotability and stiffness the rope is known for. The outer jacket does not pick when using toothed cammed ascenders, you expect to get a lot of use from this rope choice. Being smaller than the DdRT ropes above doesn't stop this rope from producing 7,560 pounds of breaking strength.

Sterling “Work Pro” 12.5 mm

There are large 12.5 mm SRT ropes on the market today such as Sterling’s Work Pro & Tech 125 lineup. These ropes offer great size, strength, high melting points, and some of the best abrasion/cut resistance on the market. These ropes are expensive and generally used for industrial, or fire & rescue operations. This rope boasts an impressive 10,183 pounds of average breaking strength.

Samson “Stat Poly” 3/8,7/16,1/2,5/8



Another 12.5 mm version of static rope is this kernmantle rope constructed out of static polyester. This rope is excellent abrasion resistance and low stretch which makes it ideal for climbing or for zip-line systems where having elasticity in the transport line is not favorable. This rope ranges in average breaking strength from 5,700 pounds to 13,500 pounds.

Rigging Ropes:

3 Strand

Samson “Pro Master” 3/8,1/2,5/8,3/4,7/8,1

Samson rope offers one of the most cost effective and longest lasting three strand ropes on the market. It has low stretch which makes it ideal for use as a hand line or light-medium pull line when pair with a mechanical advantage system. Its breaking strength ranges from 3,200 pounds all the way up to 17,500 pounds. This 3 strand rope is the number one choice by local contractors and arborists.

Double Braid

Samson “Stable Braid”

Samson has offered their popular stable braid in sizes from ¼ inch up to a huge 5” in diameter with a maximum average breaking strength of 698,000 pounds! This rope has gained traction has the all around rigging rope due to its unique color code options, works well with rigging hardware, and is long lasting. It has an elongation rating of 2.7% of the ropes length at 30% load.

Yale "Dynasorb"/ "Polydyne" ¼ - 1-1/2"

Dynasorb rope by Yale is probably the most high-tech rope on the market today and is still relatively new. Dynasorb aims to have 3% more elongation then its double braid counterpart. That extra little bit of stretch helps arrest load easier. For example: drop 220 lbs. from 10 feet high on a static line and the overall shock weight on the rope is approximately 10 tons. Drop the same 220 lbs. from 10' on Dynasorb equates to only 3 tons of shock load because the core is made up of high tenacity fibers that offer strength and stretch. This rope is offered in ¼" diameter at 2,500 pounds up to 1-1/2" at 90,000 pounds average breaking strength.

Hollow Braid "Tenex" & "Tenex-Tec" ¼ - 1-1/4

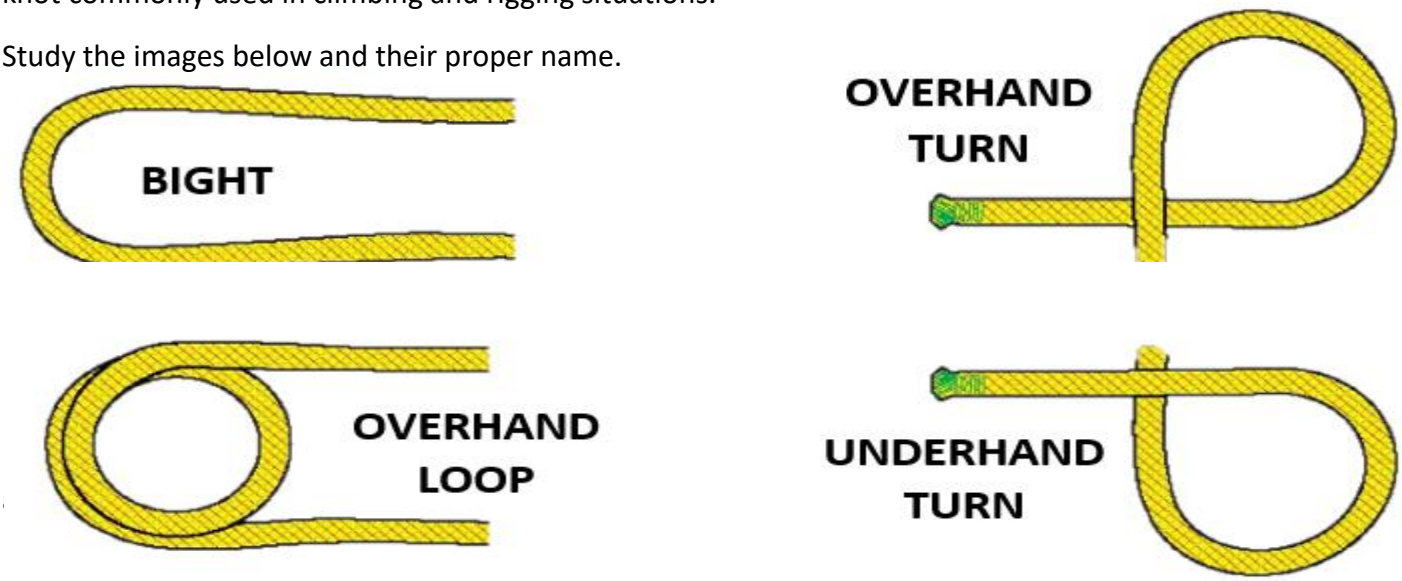
Tenex-tec & Tenex developed by Samson offers low stretch and a hollow construction. The hollow core allows for easy splicing, custom made slings, and is more pliable allowing a larger surface area to "squeeze" the tree/log preventing slipping. Note that this material is so strong that if a knot is tied using this material, the bight of the knot will actually cut through itself. This material should only be used with professional splices. The average breaking strength ranges from 3,400 pounds to 62,000 pounds.

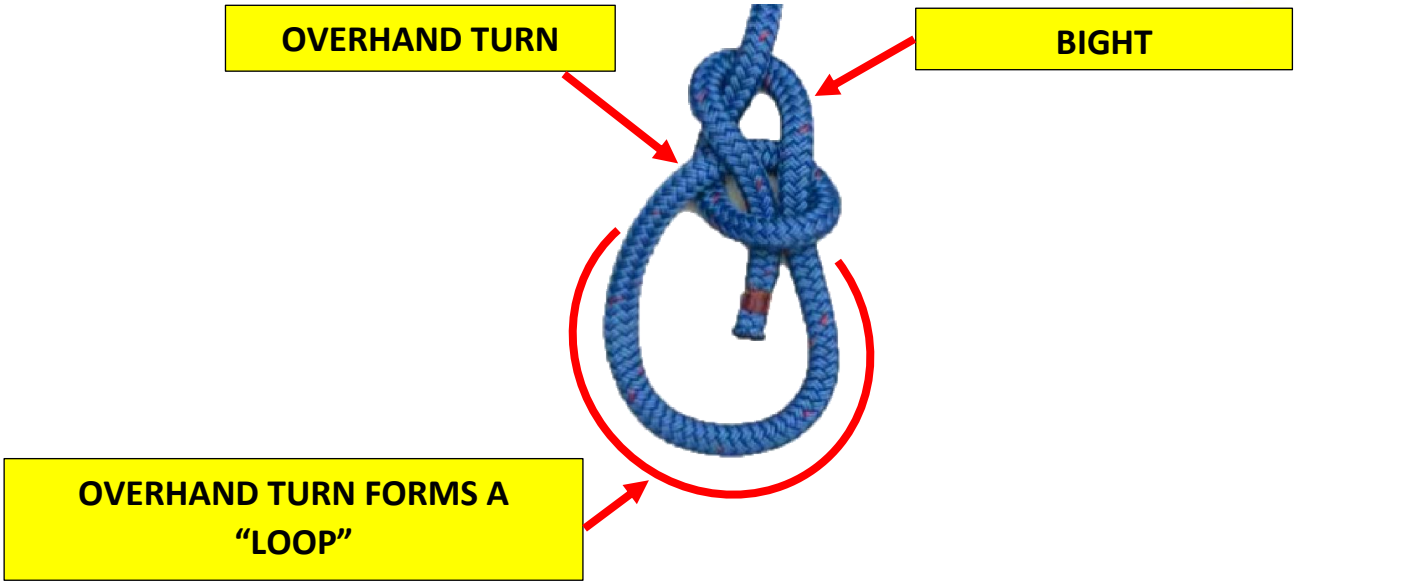
ROPE CONSTRUCTIONS		
3-STRAND		*Formed by taking 3 twisted strands and twisting them together, in the opposite direction*
8x3-STRAND		*8-strand plaited construction that uses 3-strand twisted sub-ropes*
8-STRAND		*8-strand, torque-free, balanced construction*
12-STRAND		*12-strand, torque-free, balanced construction*
16-STRAND		*16-strand cover often utilizing different types and orientations of core yarns to achieve specific performance attributes like rope firmness and elasticity.*
ROUND PLAIT		*12-strand single braid construction with an increased braid angle which results in a tighter braid, and generally firmer rope*
DOUBLE BRAID		*Load is carried by both cover and core (covers and cores with nearly equal elongation)* *Damage to either cover or core compromises rope strength*
CORE-DEPENDENT DOUBLE BRAID		*Load is carried by the core, cover protects the core from abrasion and damage* *Damage to the cover can typically be repaired without compromising the strength of the rope*

PARTS OF A ROPE/KNOT

The first step in tying knots/hitches is to learn what the rope terminology is and where to apply it. Below are several examples of ropes that are oriented differently with one side laying under another. You may be using an end of the rope or you may be tying a knot in the middle such as an Alpine Butterfly which is a mid-line knot commonly used in climbing and rigging situations.

Study the images below and their proper name.

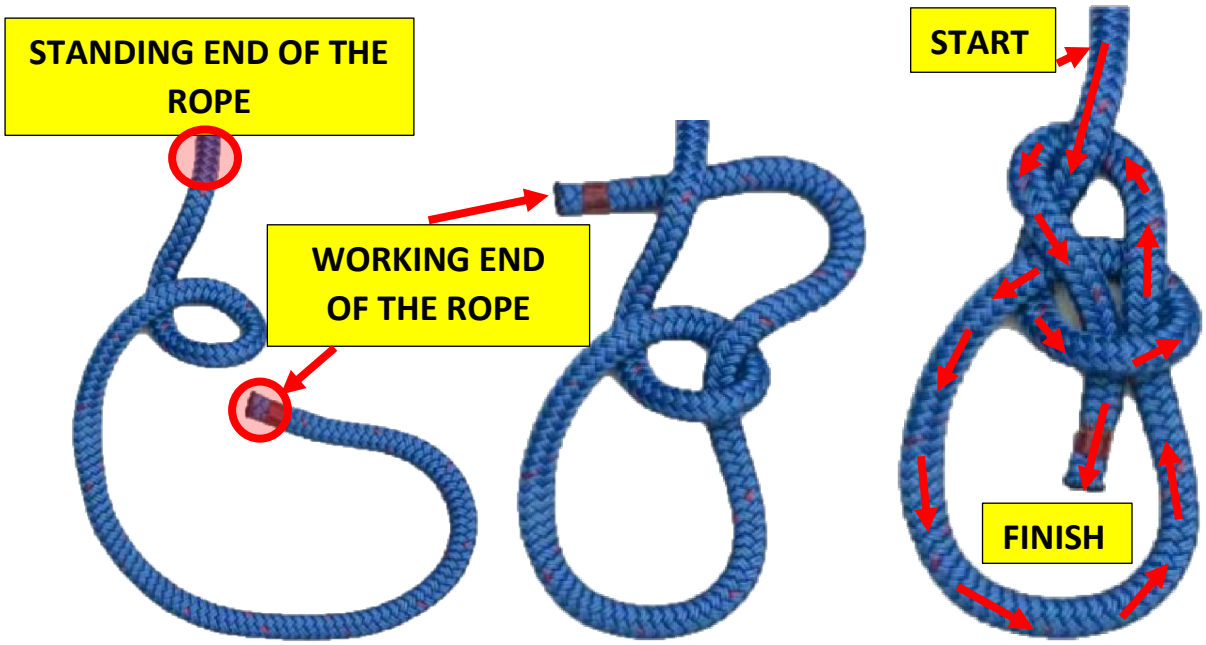




Now that you have been introduced to knot terminology and the different bends that can make up a knot, it is time to scale up. A rope may be in a tree, around a limb or other device and you must learn how to distinguish one end from another.

The **STANDING END** of the rope is also referred to as the **NON-WORKING END**. This is the end of the rope not currently in use.

The **WORKING END** of the rope is the portion you would be tying a knot with or anchoring to a tree to pull it over. Below is an illustration of a rope in several scenarios to give a clear example of what one rope with two ends looks like in use and how to distinguish the difference.



The same “standing end” and “working end” system used on the last page can be transposed into rigging applications. Below is an example of a rope place through a rigging block with the working end tied off to a chunk of wood, the standing end is installed in a portable friction device and held by hand.

WORKING END OF THE ROPE

THE ROPE HAS BEEN TIED TO THE SECTION OF DEAD WOOD TO BE LOWERED. IT IS THE END OF THE ROPE DOING WORK

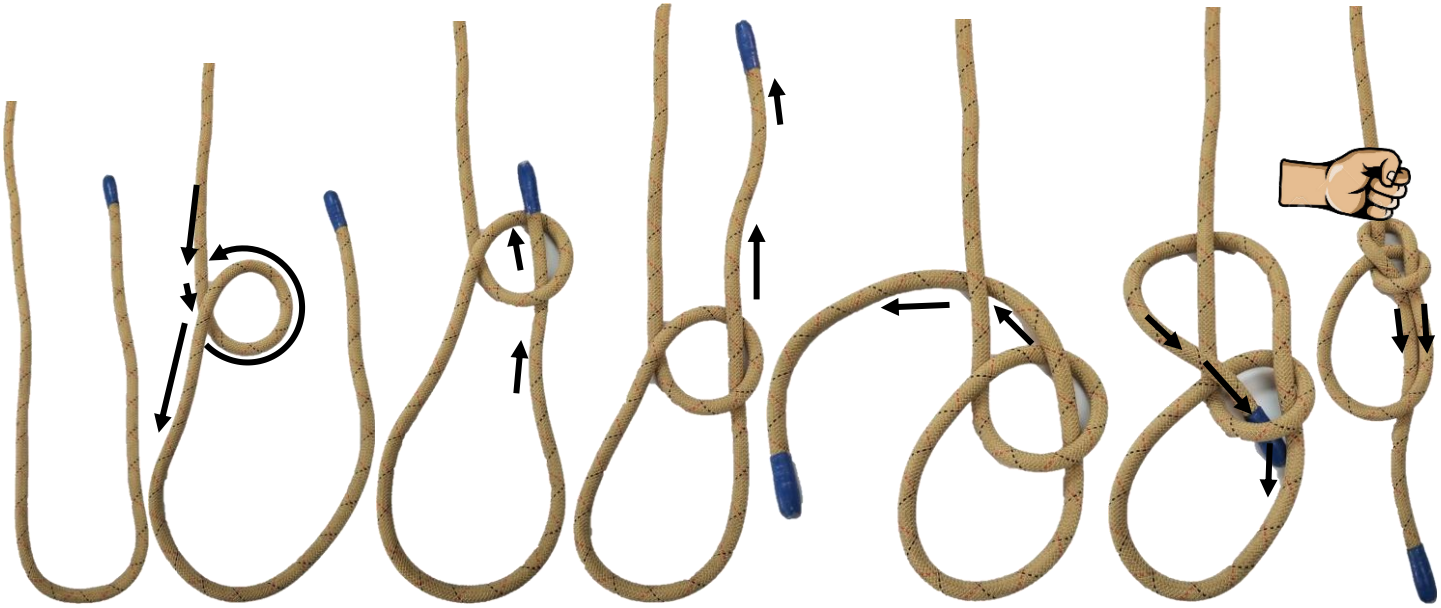
STANDING END OF THE ROPE

THE ROPE IS PLACED THROUGH A RIGGING POINT IN THE TREE AND COMES BACK DOWN INTO THE FRICTION DEVICE. THE STANDING END IS CONTROLLED BY HAND.

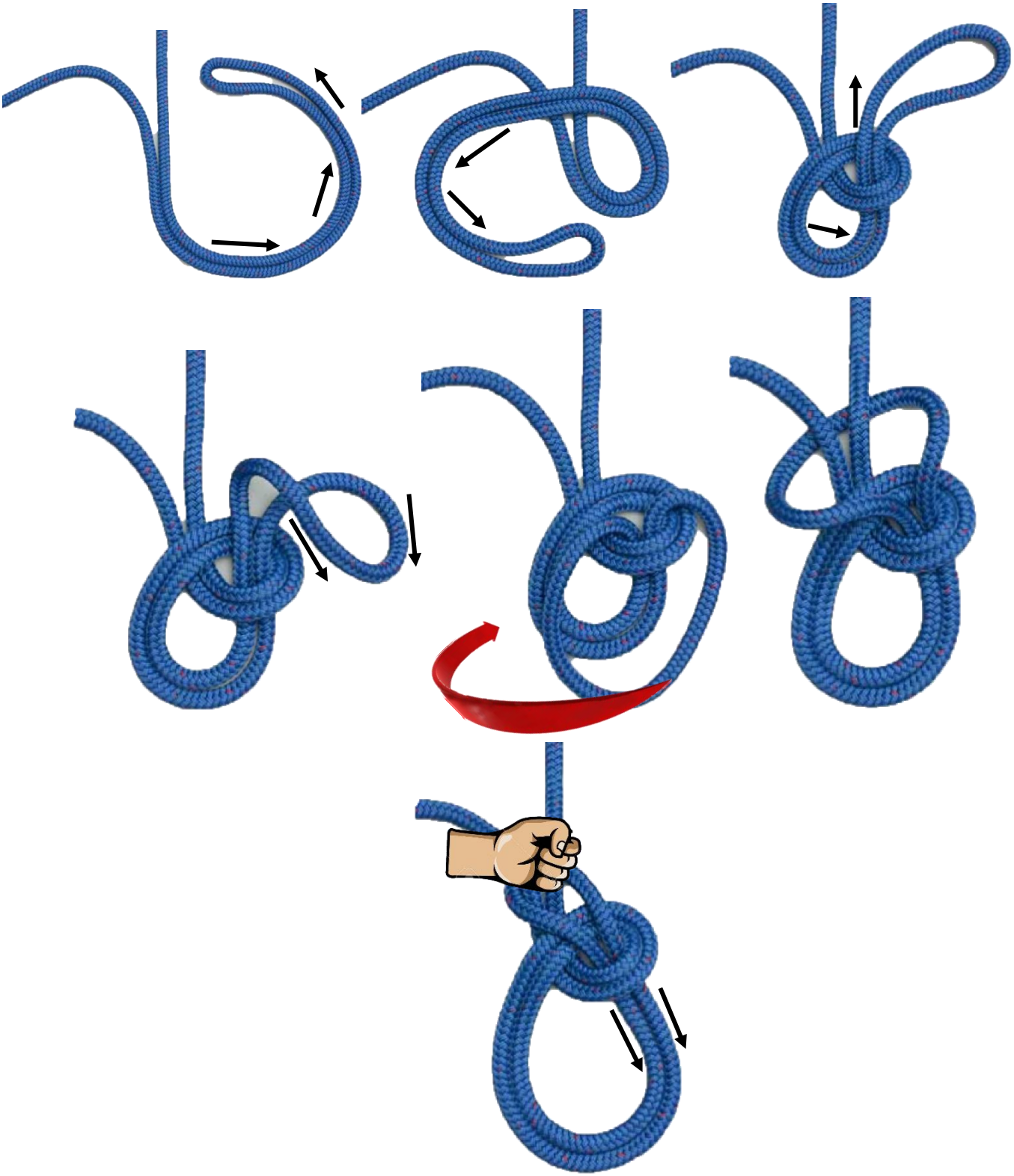
The following list covers the majority of the knots and hitches used in arboriculture today. Some require a lot of rope while others require very little. Some require two ropes, be sure to read each description to understand the elements of each knot/hitch and an example of its respective application.

1. Bowline
2. Bowline on a bight
3. Yosemite Bowline
4. Running Bowline
5. Large Eye Bowline
6. Clove Hitch end of line
7. Clove Hitch Mid-line
8. Girth Hitch
9. Bunt Line Hitch
10. Double fisherman's bend
11. Figure eight
12. Timber hitch
13. Cow hitch
14. Sheet Bend
15. Double Sheet Bend
16. Blake's Hitch
17. Taunt Line Hitch
18. Valdotain Tresse
19. Distel
20. Zeppelin Bend
21. Muntner
22. Schwabisch
23. Klemheist
24. Prusik
25. Alpine Butterfly
26. Anchor Hitch
27. Slippery Sheet Bend
28. Double Fisherman's Knot

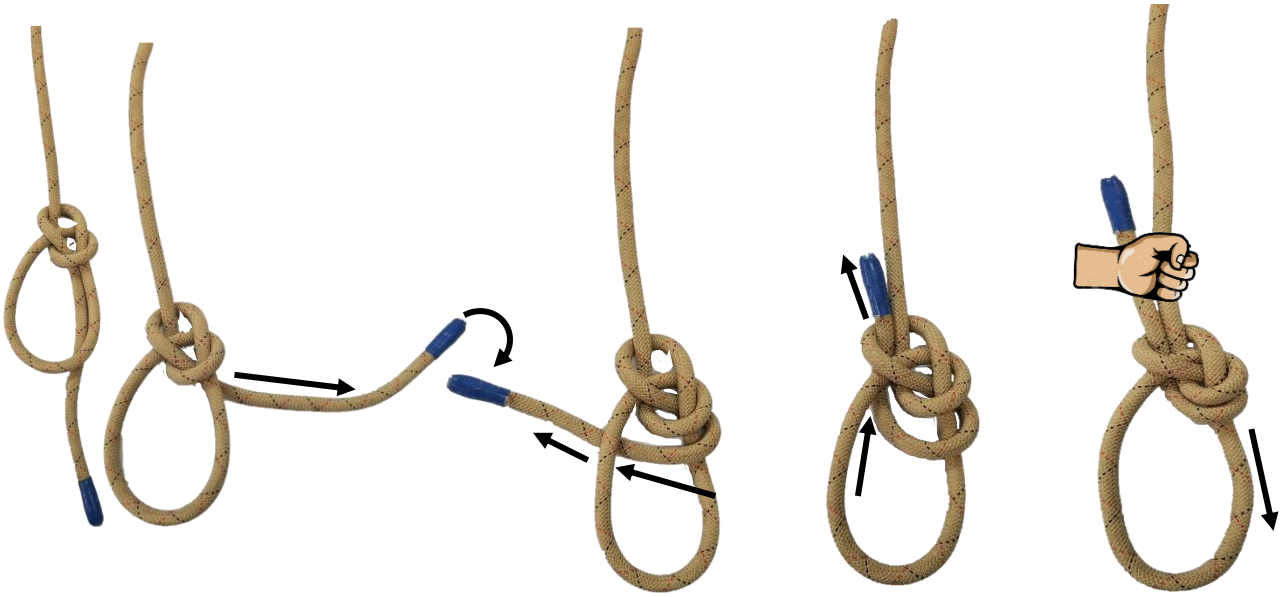
1. **Bowline:** this knot is the most common of knots used in arboriculture and has many variations. This knot can be used for lifting, lowering, pulling and tie-offs. It can be easily untied after considerable load has been applied.



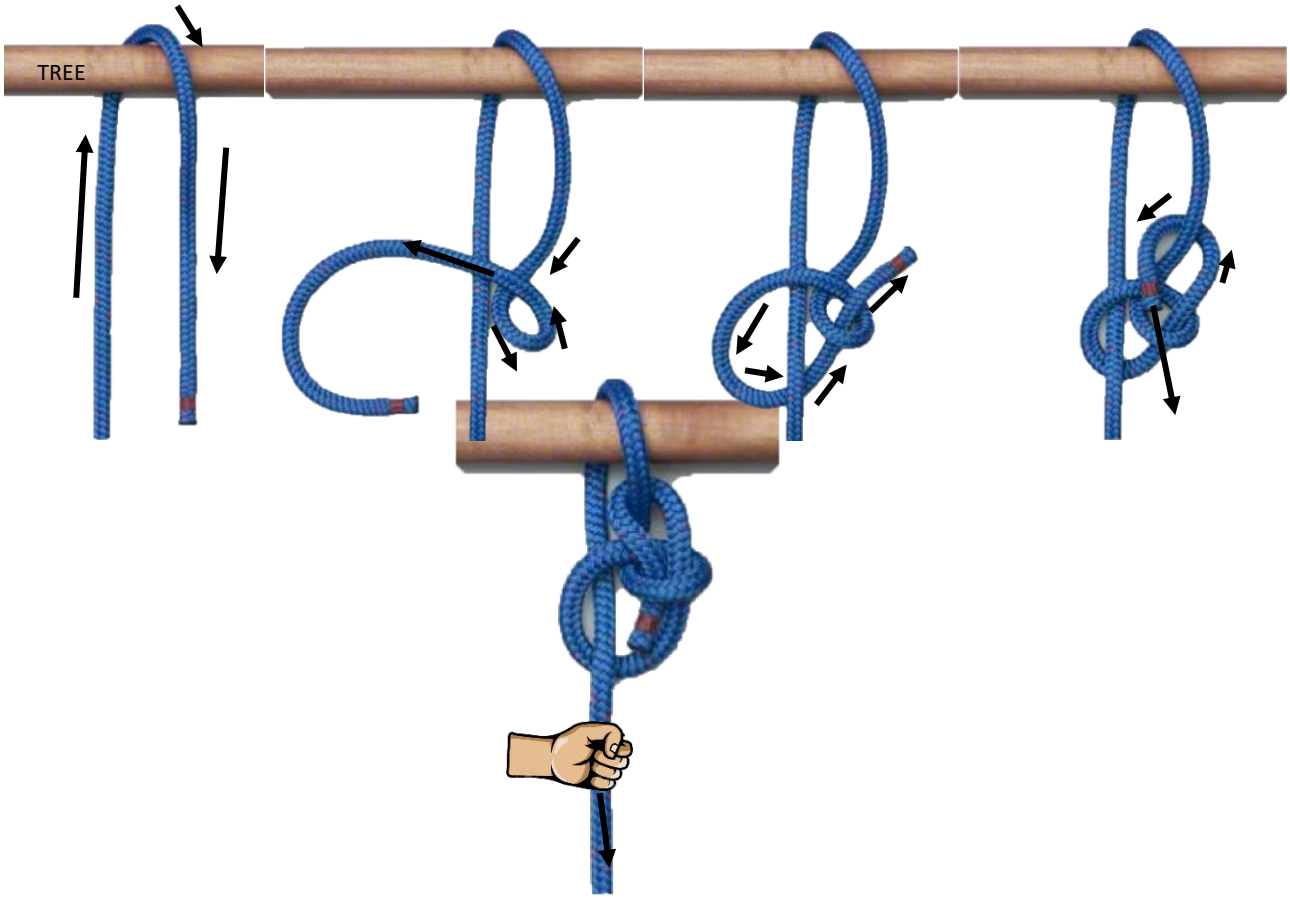
2. **Bowline on a Bight:** this knot is a mid-line knot and offers multiple anchor points because the finished product ends with two fixed eyes. This knot can be untied after heavy load and is excellent for pulling. The loop sizes can be adjusted for the desired task, they can be made very large to create a make-shift saddle in emergency situations.



3. **Yosemite Bowline:** This is a version of the Bowline knot, the major difference that when dynamically loaded (loaded & un-loaded) this knot will not loosen up. If the Bowline is to be used for life support, it must be tied with a Yosemite Tie Off. Start it with a finished Bowline and then follow the steps below.

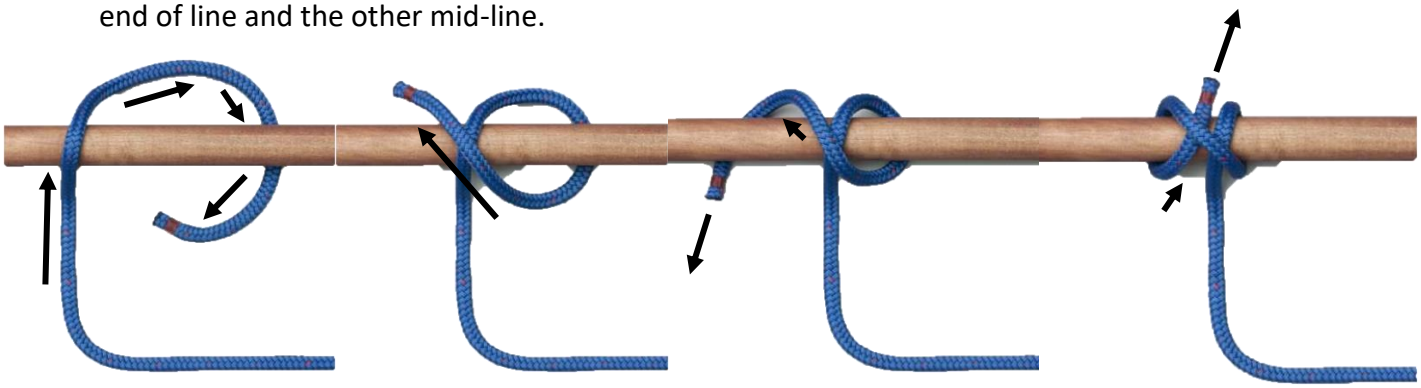


4. **Running Bowline:** The Running Bowline is a simple Bowline that is tied around the standing end of its own rope. When finished the standing end of the rope is pulled and the Bowline chokes itself around whatever your tying it to. This is common for setting ropes in trees for rigging.

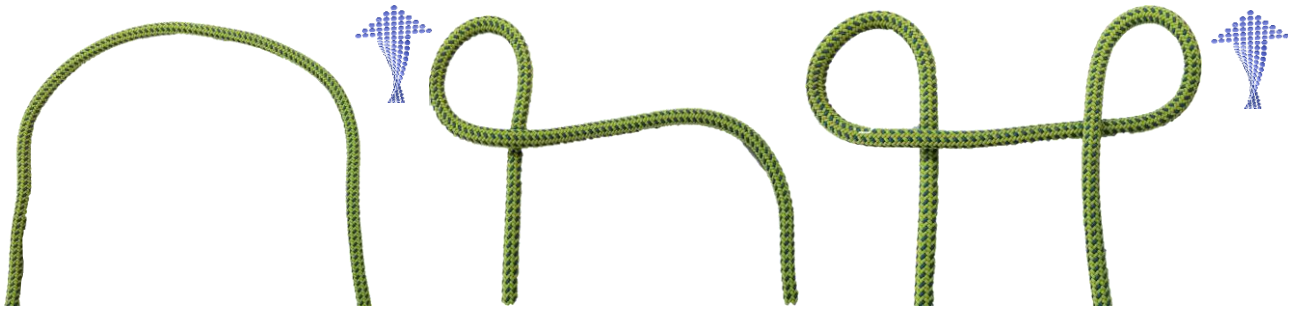


5. **Large Eye Bowline:** This version of a Bowline is tied exactly the same, the only difference is that the eye of the Bowline is kept extremely large. A situation for this is when you must tie a rope over something (limb) that is high off of the ground and need to apply pressure without the rope choking itself around the limb (running bowline) and then not being able to retrieve the knot to untie. Keeping the eye large allows you to untie it from the same location it was tied.

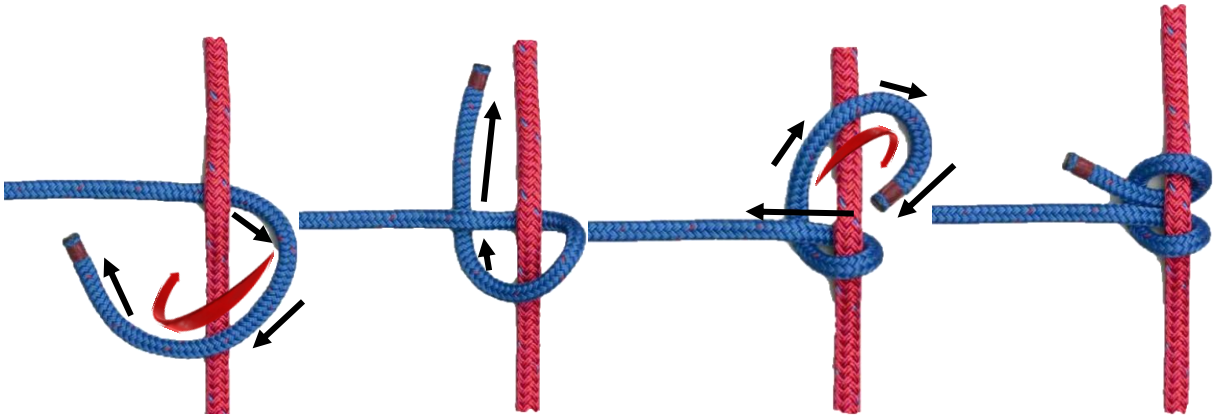
6. **Clove-Hitch End Of Line:** A Clove Hitch is a constrictor knot commonly used in rigging practices for installing blocks, equipment, or to tie off a limb. A Clove Hitch can be tied in two variations, one being end of line and the other mid-line.



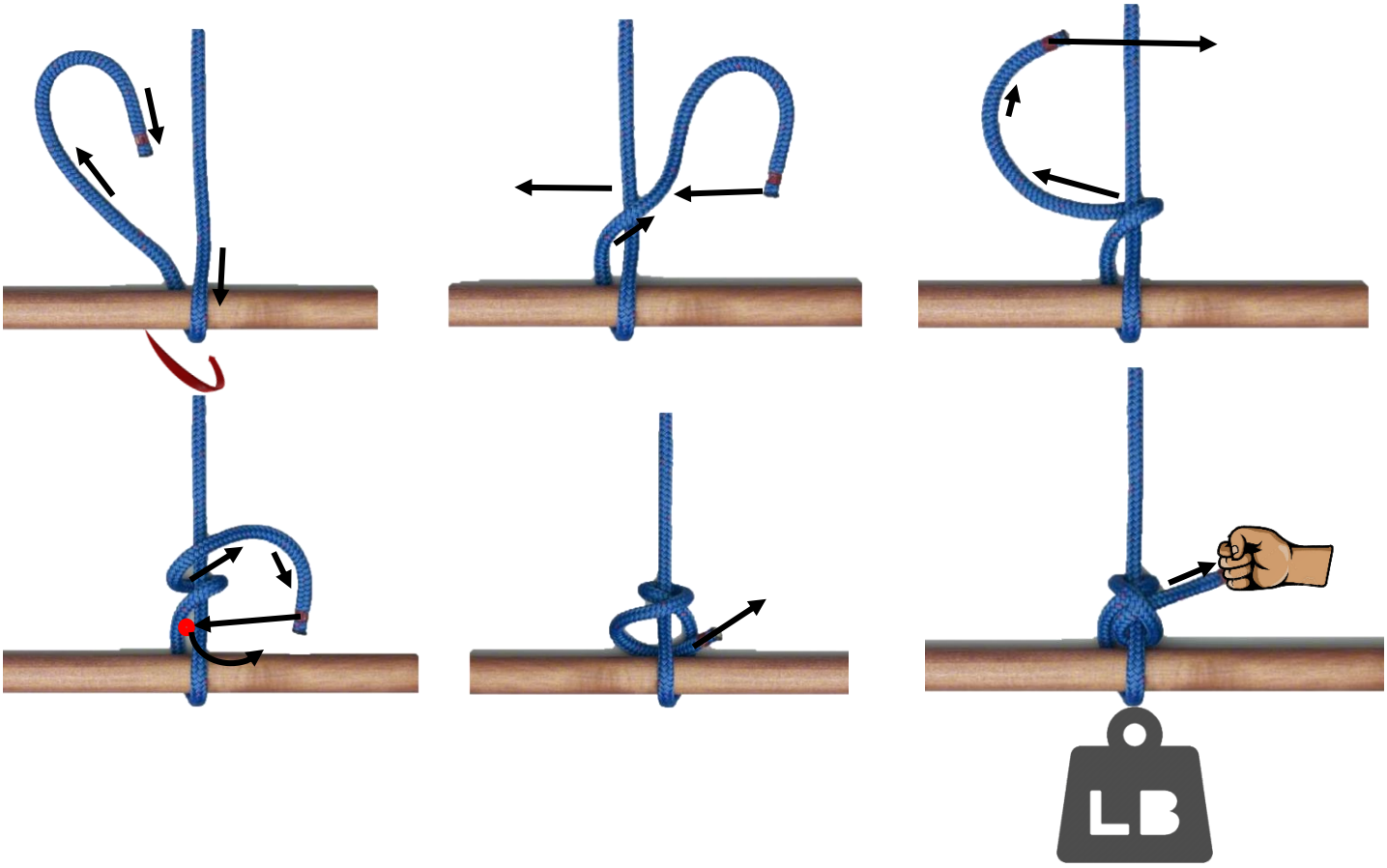
7. **Clove-Hitch Mid-line:** A mid-line Clove Hitch is the same knot just tied differently, instead of using one end of rope you are using a section of rope between the two ends. This is advantageous if the center of the rope needs to be tied off. In with rope in hand, twist one loop to form an underhand loop and the other twist to form and overhand loop. The left (underhand) loop is then laid over the right (overhand) loop. This creates a whole, while keeping the knot separated and in line place the knot over the object.



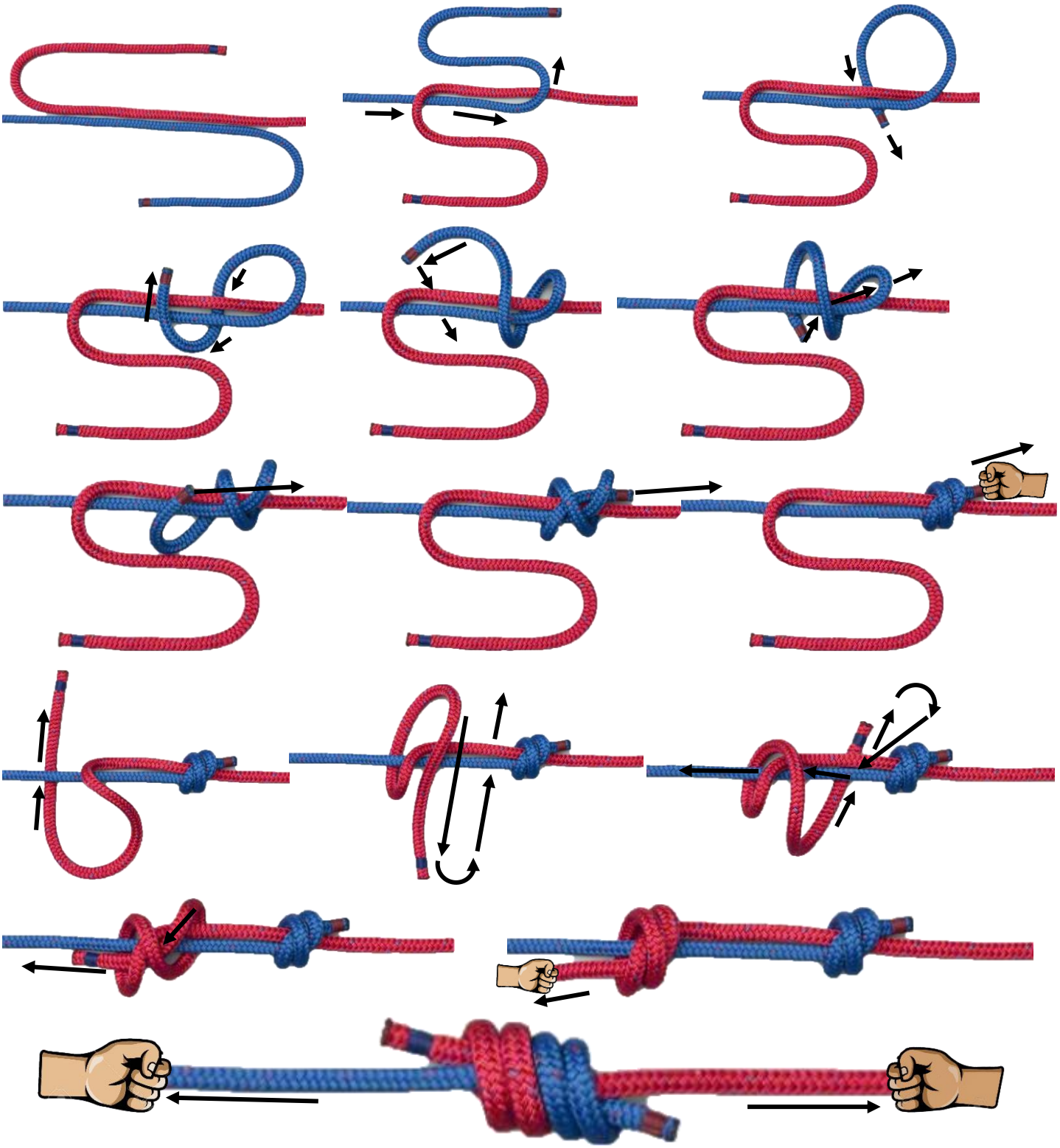
8. **Girth Hitch / Cow Hitch:** these two hitches are the same, names decipher the application. A Girth Hitch term is reserved for an endless loop (circle of rope) that is placed over and object and pulled back through itself. A Cow Hitch is the same hitch, just tied with an end of the rope which will be its majority of use such as tying a Cow Hitch around the bottom of a tree to install a friction device.



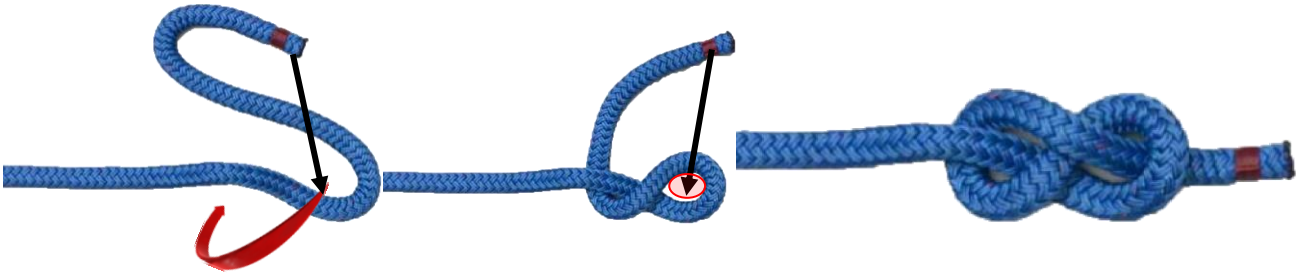
9. **Bunt Line Hitch:** The Bunt line hitch is an acceptable life support knot, it is a constrictor knot and once the knot has been Tied, Dressed, & Set this knot can become hard to untie. One large benefit of this knot is the direction the tail is facing when the knot is tied properly, this benefit allows the tail to be oriented in a more favorable position when tying a friction hitch in a close system.



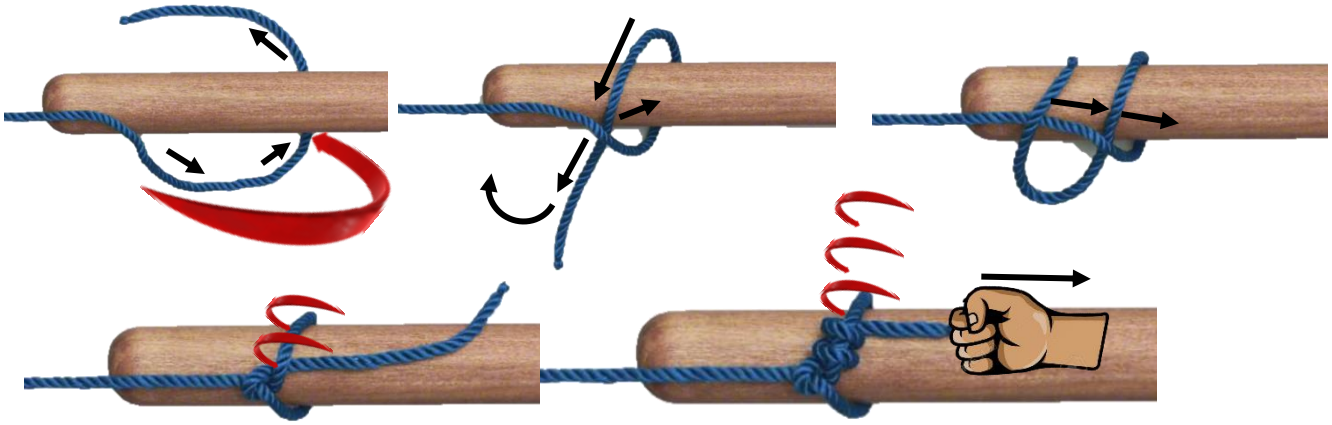
10. **Double Fisherman's Bend:** This bend is used to join two ropes of the same diameter together. The most common application for this bend is to join two ends of the same small piece of cord together forming an endless loop, these endless loops can be used for rigging prusiks or foot-locking.



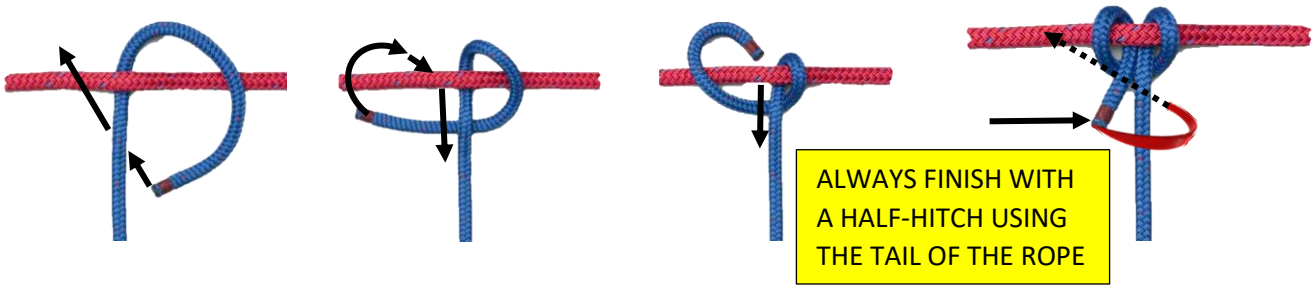
11. **Figure Eight:** This knot is a simple yet effective knot. It is most commonly used as a stopper knot at the end of your climb line to ensure it does not slip through your friction hitch in case you didn't have enough rope to make it to the ground. It is also a common stopper knot to use at the end of your split tail or friction hitch so it does not unravel.



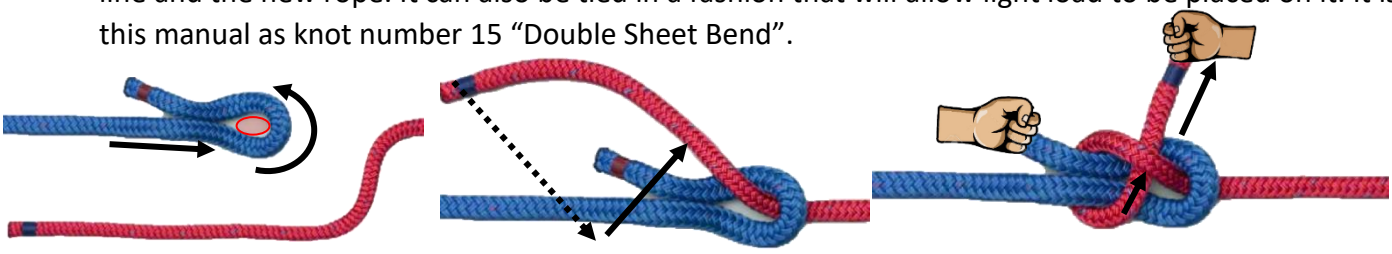
12. **Timber Hitch:** This is an excellent hitch that can be used to secure the end of a rope to a tree as a tie off, or it can be used to anchor a block to a tree during rigging scenarios. It is made by wrapping one tail end of the rope around the tree, then taking the same tail end and crossing above or below the rope where they meet and simply tucking wraps behind the rope, against the tree in the opposite direction. This hitch can also be used to secure a tree from barber chairing during felling operations. In the pictures below, the hitch directions have been scaled down for training purposes, in reality the wraps to secure the rope should always be at least 1/3 of the tree and include a minimum of 5 tucks.



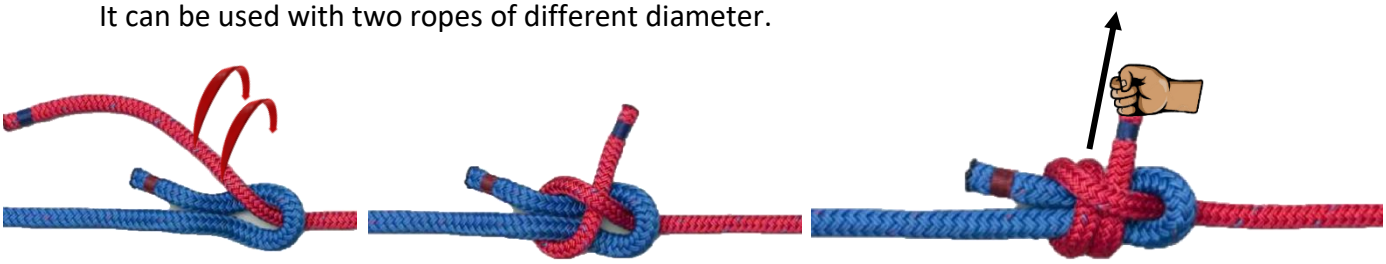
13. **Cow Hitch:** The Cow Hitch can serve the same purpose as the Timber Hitch but takes more rope to complete. When the hitch is finished properly it will look just like a Girth Hitch, this should always be finished with a half-hitch over the standing end of rope to secure it. It is excellent for securely installing a rigging block to a tree if enough rope is available.



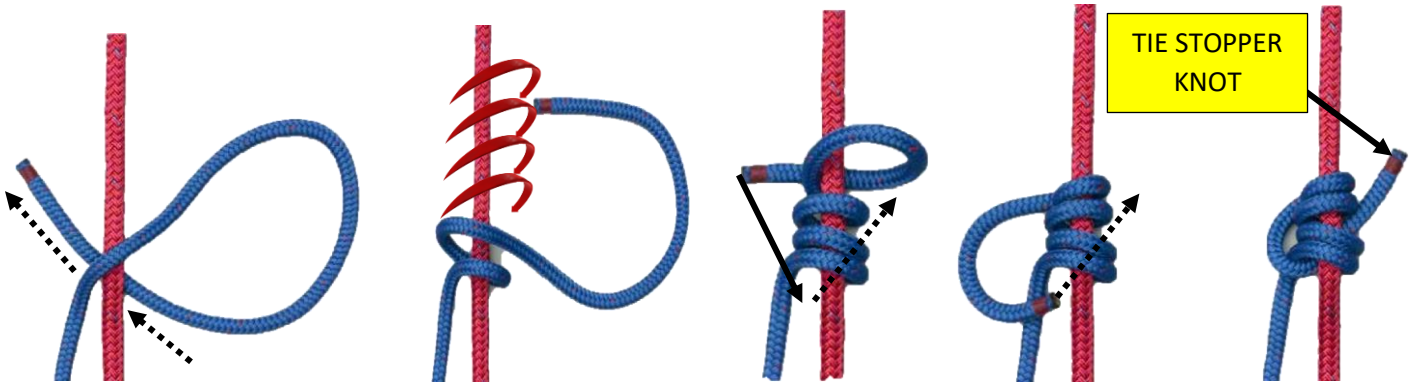
14. **Sheet Bend:** This is a very effective and quick bend to tie one rope onto another rope. The most common application is sending a rope up to the climber by using this bend between the climbers climb line and the new rope. It can also be tied in a fashion that will allow light load to be placed on it. It is in this manual as knot number 15 “Double Sheet Bend”.



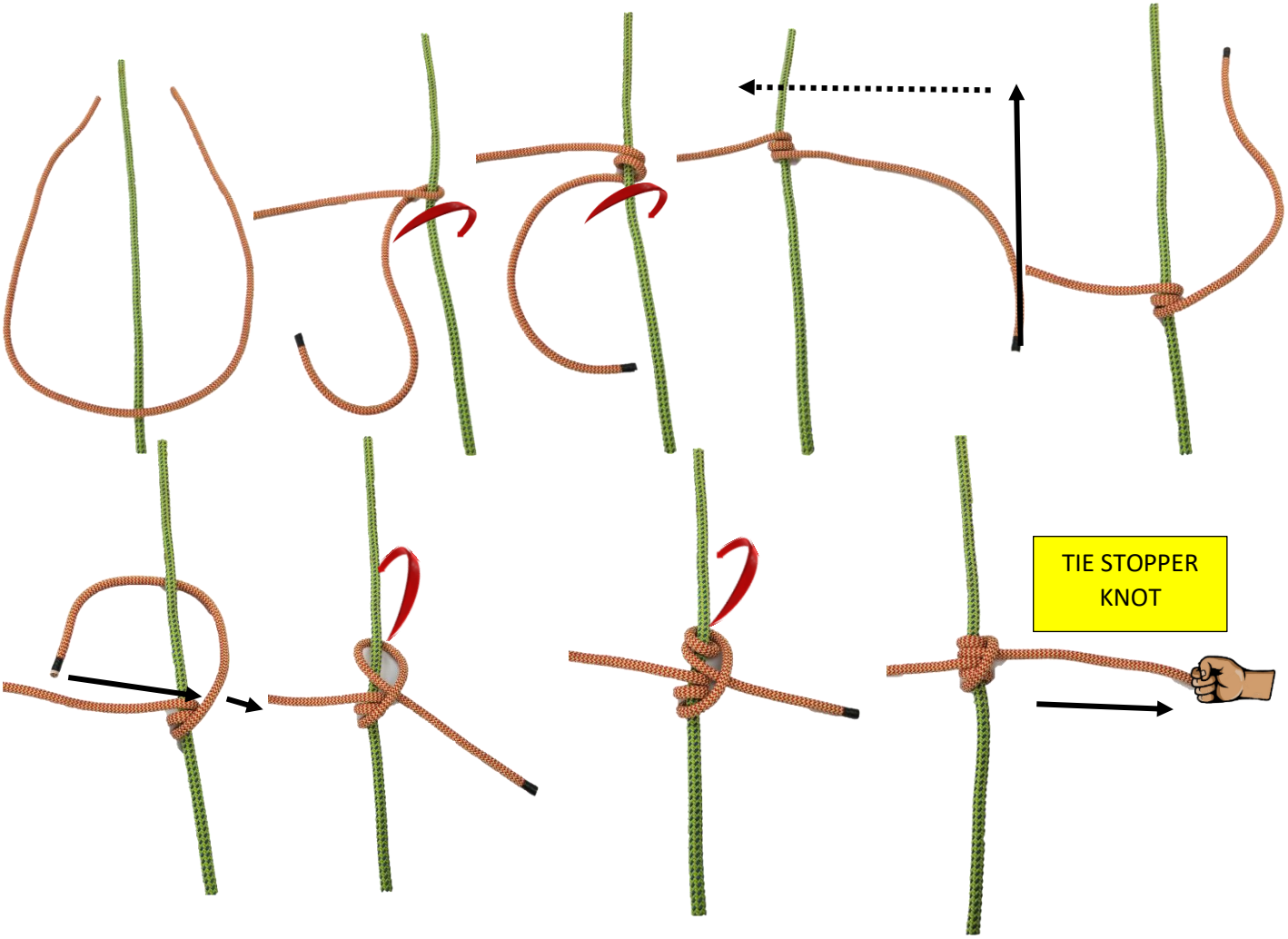
15. **Double Sheet Bend:** This bend is formed the same way as the original Sheet Bend but has one extra wrap. This is more secure than the first version and can be used to apply light load in pulling situations. It can be used with two ropes of different diameter.



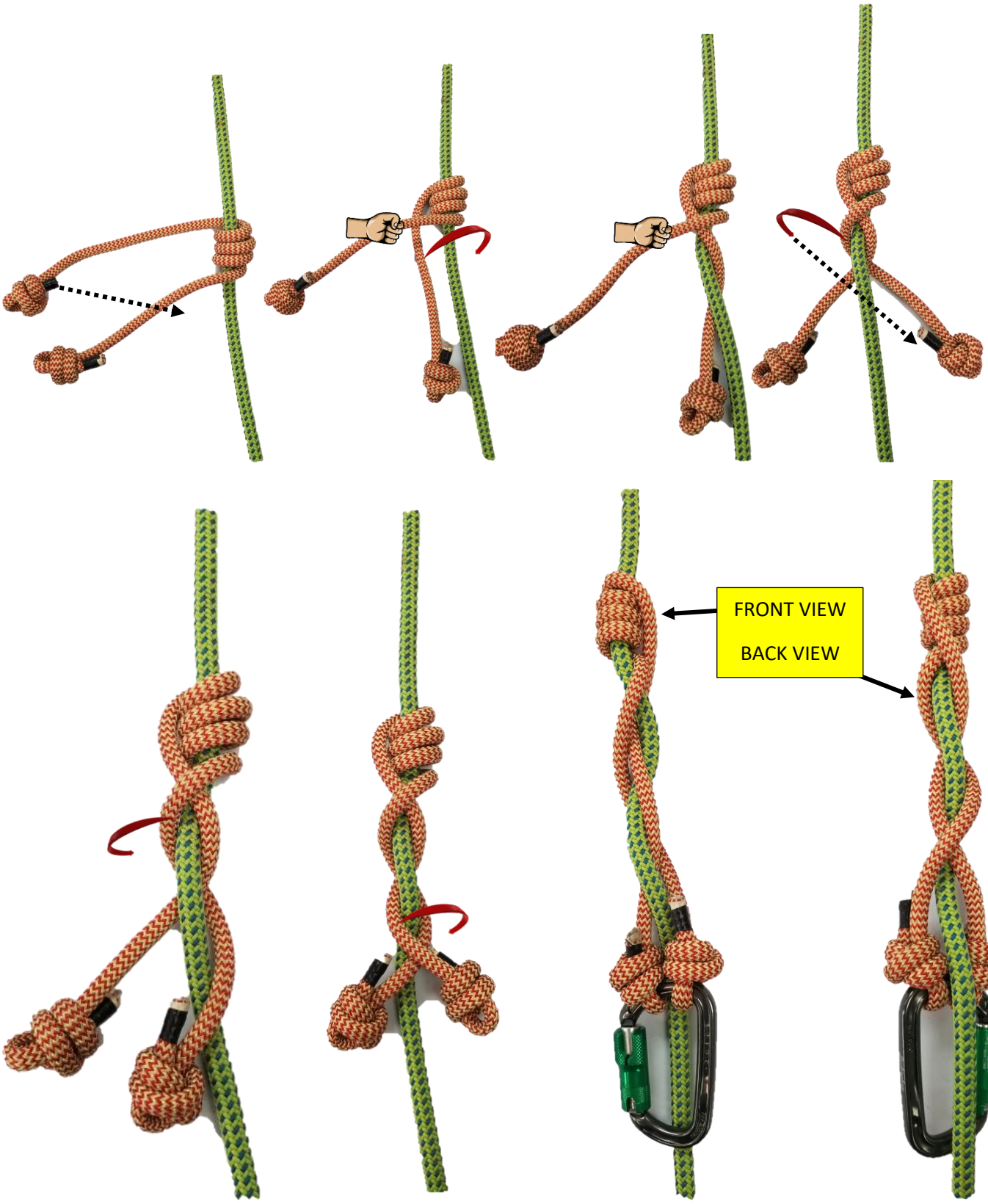
16. **Blake’s Hitch:** The Blake’s Hitch is a series of 4 wraps using the tail of the same rope it is being wrapped around or by using a short section of another rope (split-tail) to tie a friction hitch used in climbing. This hitch sometimes works better for others than the traditional Taunt Line Hitch. Remember to always TDS (Tie Dress & Set) each knot before application and the tail end of the knot should always have a stopper knot tied before use. After the last wrap the tail comes in front of the standing blue line, is tucked behind the red line and poked up through the bottom of the first two wraps. Tie a stopper knot.



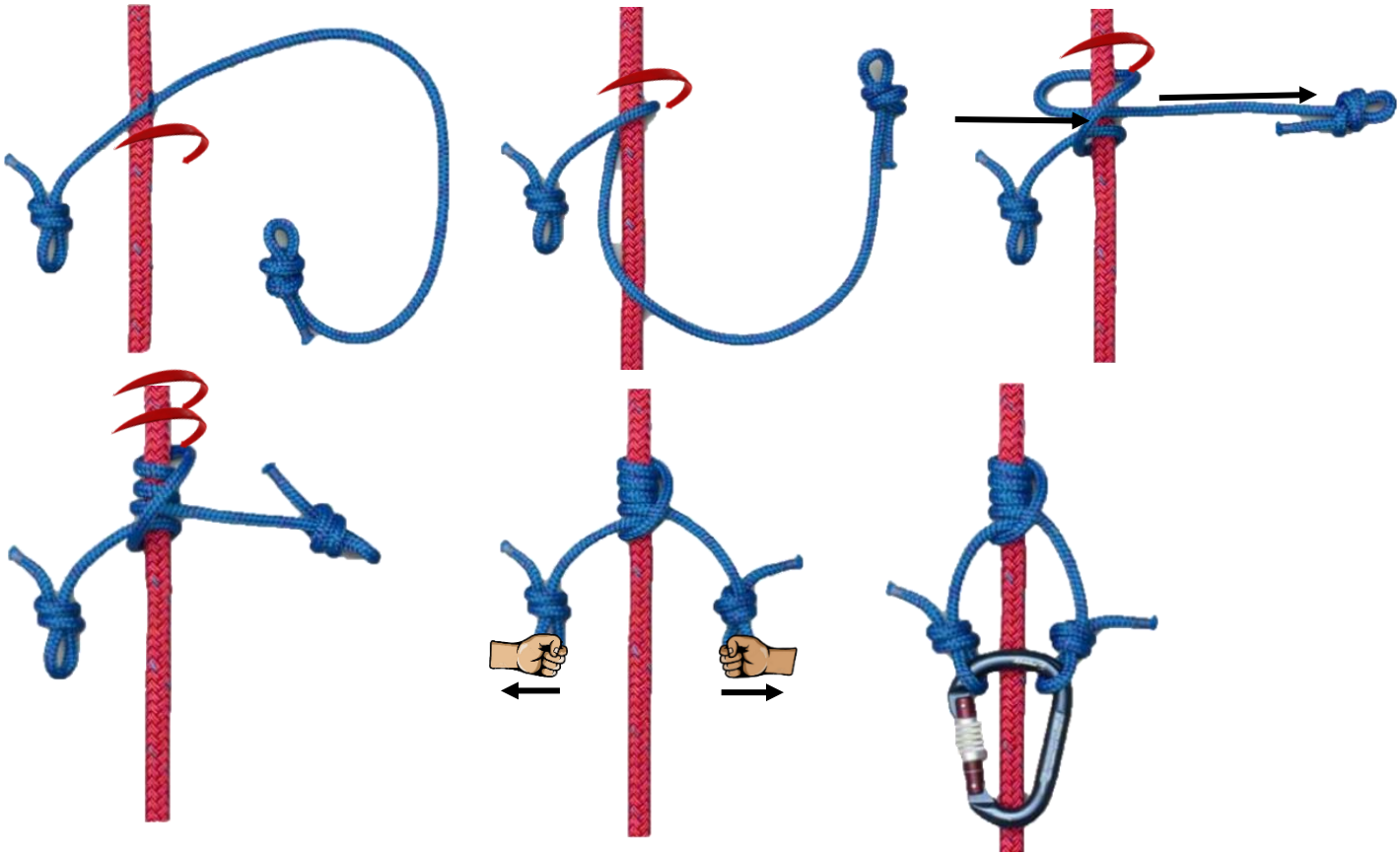
17. **Taunt Line Hitch:** This hitch is the foundation hitch most people have learned to climb with. It works well but after continued use it may become to tight and will need re-worked for it to function properly. It is tie very similarly to the "Distel Hitch" you will tie later on as knot . It is formed by using the tail end of a rope or using a short section (split tail) and forming two underhand wraps around the climbing line then two over overhand wraps above the first two and in the same direction. Then the tail is tucked underneath the "bridge" that is created. TDS & install a stopper knot.



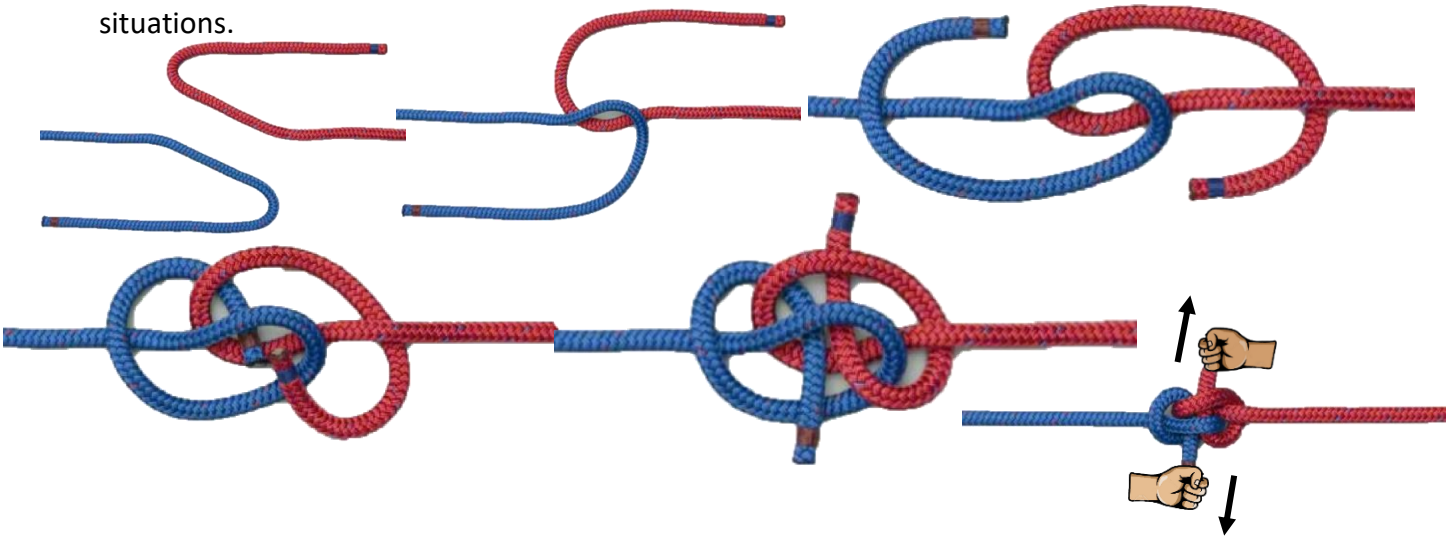
18. **VALDOTAIN TRESSE (VT):** The VT is an advanced friction hitch that can be used for DdRT & SRT (with rope wrench) climbing. It is formed with 4 wraps and three braids. This hitch takes practice to both tie and master, it should always be set before any weight is applied. This hitch works better with longer eye-to-eyes as opposed to short ones (28"-). This hitch is complex with several steps and is continued onto the next page.


FRONT VIEW
BACK VIEW

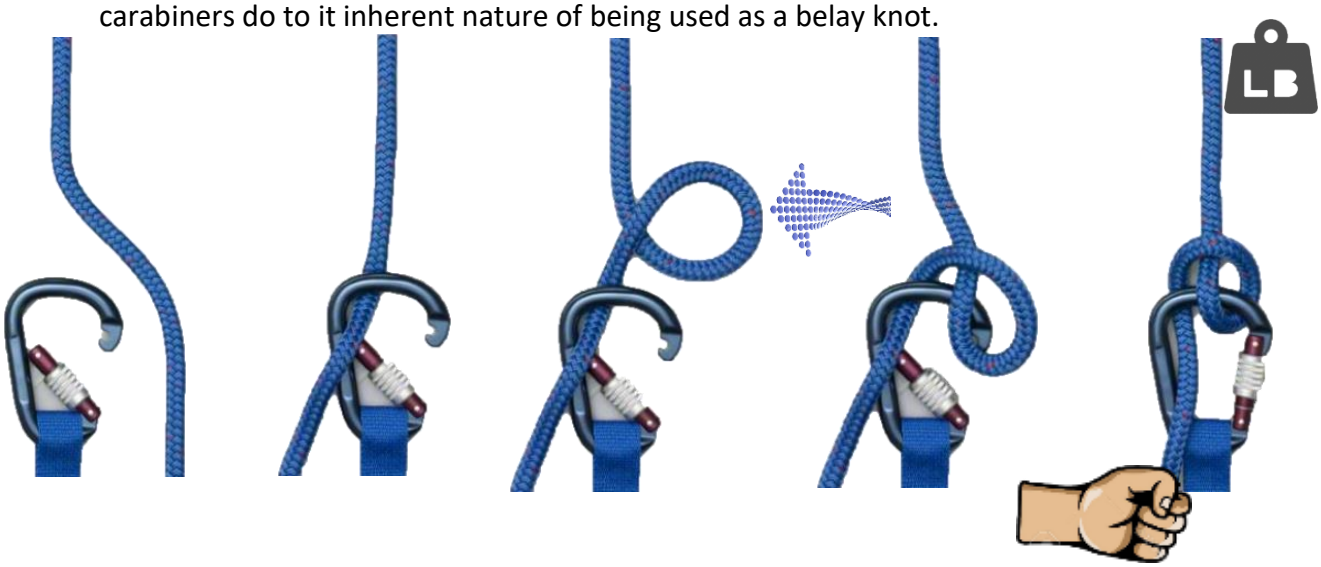
19. **Distel:** The Distel Hitch is tied with an eye-to-eye just like the VT. It is important to know how to tie at least both the VT and the Distel because every hitch acts different depending upon the climb line diameter, the hitch cord diameter, and the condition of both. If on hitch does not bite as it should then you should tie the other.



20. **Zeppelin Bend:** This bend can be used to join two ropes of the same diameter together. This bend can take tremendous load and still be untied. It is quick to accomplish and can be adapted to many situations.

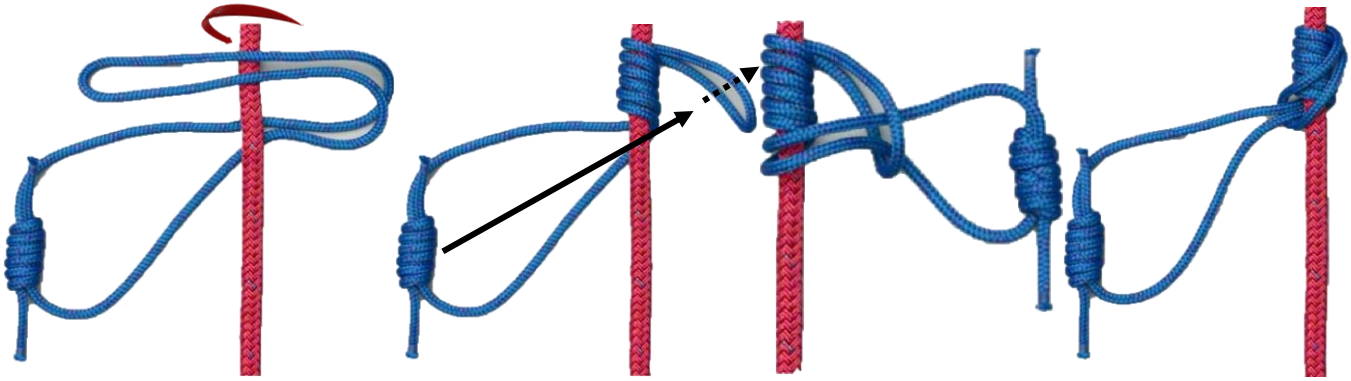


21. **Muntner:** The Muntner is a knot that can be used to hold or control load. This knot is common during belaying where slack can be taken from one side of the knot but if weight is applied the knot will lock onto itself providing enough friction for a person to hold onto it easier. It is mostly applied to carabiners do to it inherent nature of being used as a belay knot.

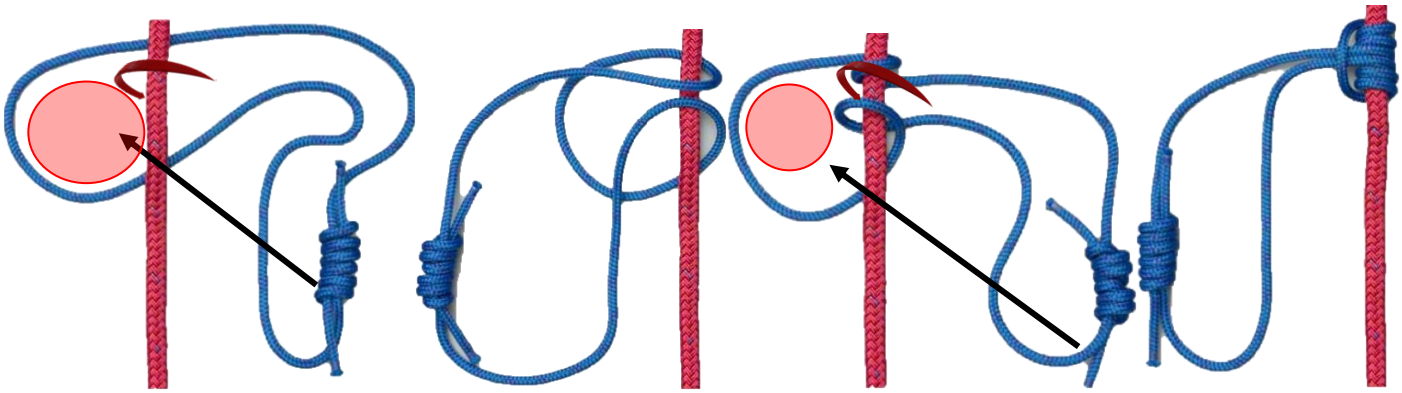


22. **Schwabisch:** This is another climbing hitch that is less common than the VT or Distel. It acts very much like a Prussik and is tied with an eye-to-eye hitch cord. This hitch provides a lot of friction and can burn a rope or the hitch cord quickly if not cared for.

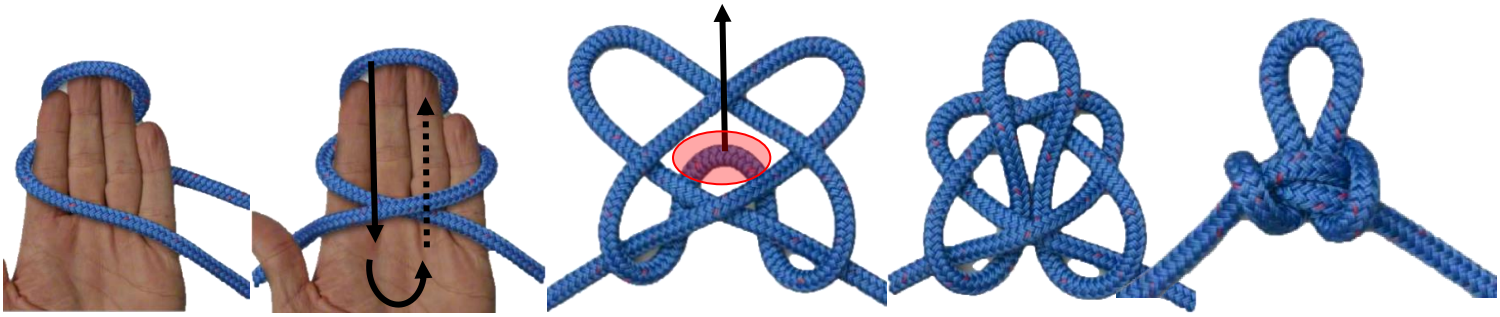
23. **Klemheist:** The Klemheist is a sliding & gripping knot. When it is not under load the hitch slides freely but once weight is applied it locks up. This is a very common hitch used in place of a Prussik during foot-locking and used to attach a spider leg balancer to a rope during rigging. It is easily adjustable and holds well under tension. It is tied by using an endless loop, wrapping the loop around the standing rope upwards to complete 4 wraps then the large loop is placed through the small one.



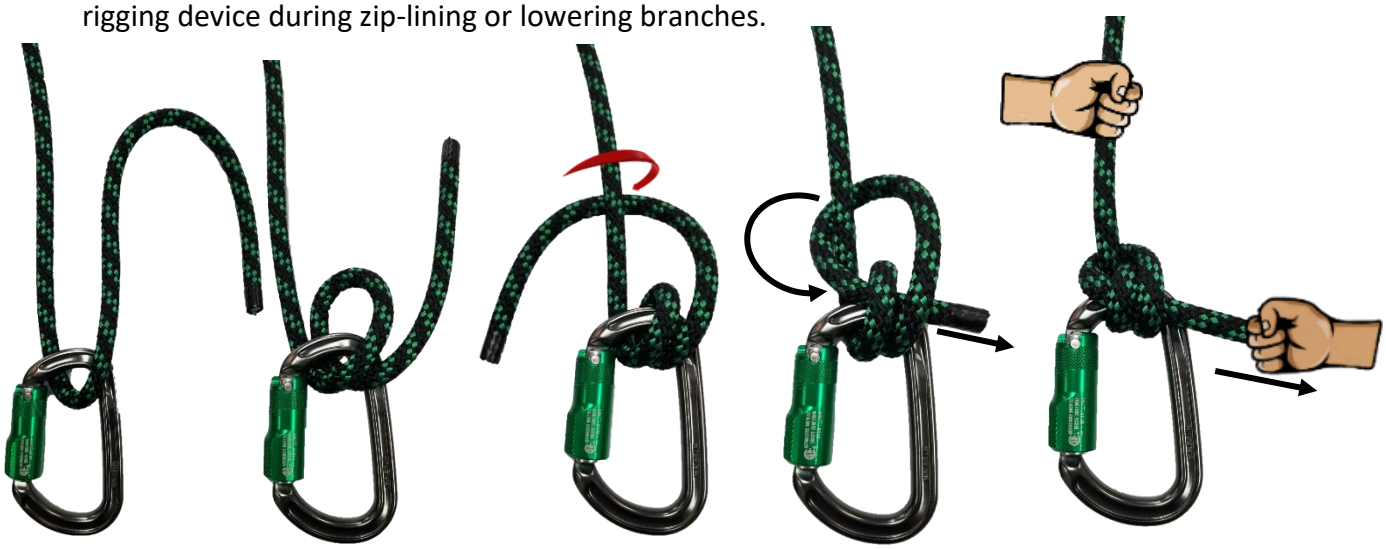
24. **Prussik:** The traditional 6 wrap (3 wraps with two sections of rope) prusik is used for foot-locking as well as a mid-line attachment for floating crotches. It is a sliding & grip hitch that can be hard to untie if to much load is applied without adjustment. A bite of rope is placed behind the standing leg of rope, then the other bight is placed through the loop and wrapped around the standing leg of line 3 times, going through the loop each time.



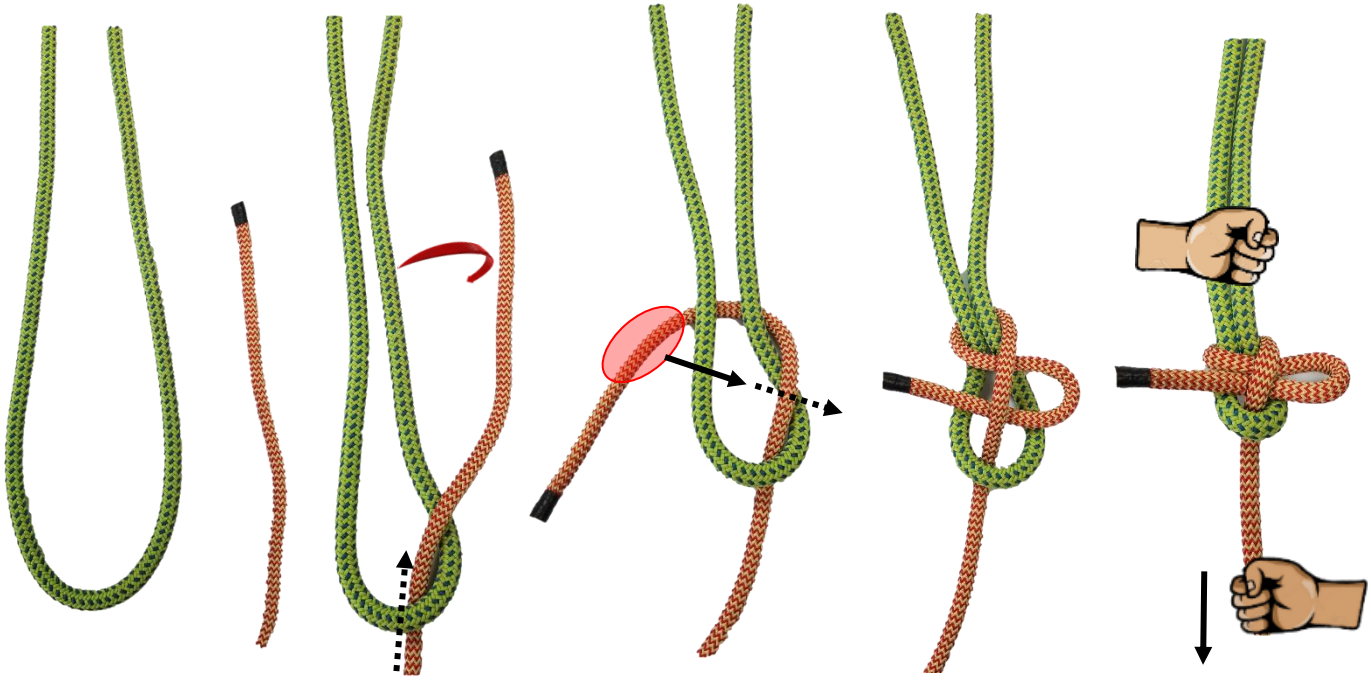
25. **Alpine Butterfly:** This is a favorite amongst climbers for use as a mid-line knot. This knot is used to secure long sections of rope, used to "spike" the line in floating crotch's, or used to anchor something via mid-line. To set this knot, you must pull on each standing end of rope opposite of one another.



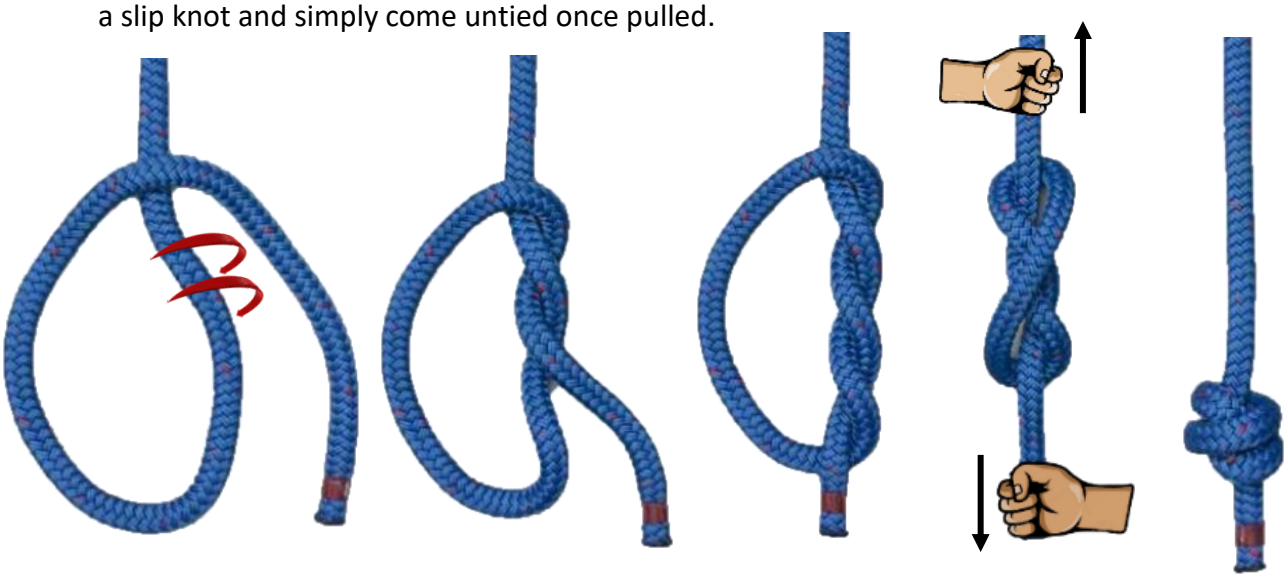
26. **Anchor Hitch:** This hitch is used to secure an end of line to an object. It is a constrictor knot so the more weight applied the tighter it becomes. Used commonly for tying an end of rope to a carabiner or rigging device during zip-lining or lowering branches.



27. **Slippery Sheet Bend:** Slippery when used in conjunction with knots or hitches relates to it being easy to untie. The Slippery Sheet Bend is tied the same as the traditional, however at the finish, instead of pulling the tail through you are actually pulling a bite of rope through then setting the knot. This leaves a tail sticking out that can be pulled to quickly untie the knot, much like a shoelace.



28. **Double Fisherman's Knot:** This is a cinching knot that can be tied either at the end of a line in a twisting fashion to form a stopper knot (commonly used on replaceable rope bridges) or around it self to form a cinching life support knot. This knot must be TD&S before use, if tied incorrectly it will act as a slip knot and simply come untied once pulled.



Hitch Cord

Throughout your career you will inevitably use many different brands, sizes, and types of hitch cord. A few important things to always consider and look for when selecting hitch cord is a high melting point and that it is approximately 2mm smaller in diameter then the rope it is being tied to.

Tying your friction hitch out of material that is designed for this purpose have high melting points because essentially the hitch is your break, the weight that is applied during use causes friction which can create enough heat to melt ropes and even burn through.

Ensuring the hitch cord is of smaller diameter than the host rope will help the hitch actually bight and hold onto the host rope much easier and quickly then using one of the same diameter.

Below you will find several examples of hitch cord in multiple diameters and braid types.

Samson "Ice Tail" is a hollow braid 12 strand hitch cord. It has a soft and supple feel with and extremely high melting point of 900°F. It is offered in 5/16 with an ABS of 8,800 lbs.

Yale "Veritas" is an upcycled cordage that is made by using left over scraps of 5000 denier polyester. It is a firm cord with good knotability once set. It is offered in two sizes; 10mm (top) and 8mm (bottom) with a breaking strength of 5,220 lbs.

Sterling "RIT" is a supple kernmantle rope that is extremely abrasion resistant with and excellent melting point of 932°F and an ABS of 6,969 pounds in 9mm. This is favorite for climbers using it in conjunction with the hitch hiker climbing device.

Yale "Beeline" is a staple and probably the most common of all hitch cord. With a 900°F melting point and a very firm design this makes it a go-to hitch cord. The cover jacket is made of Technora & Polyester which increase the wear life of this cord. This version below is 10mm with an ABS of 7,500 lbs.

Teufelberger "Ocean" is offered in 8mm and 10mm. Originally this construction and material combo was used in the maritime industry but has been adapted to tree care. The 8mm (left) breaking strength of this rope is lower than most at 5,000 lbs. so generally this rope is not adapted into to many applications of tree care, however it's big brother Ocean 10 (right) is. A breaking strength of 7,410 lbs. and high melting point makes this cord another favorite.

END

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