NW LINE JAJ BENNES

ELEMENTS OF ROPE LINE - VOLTA - TREE Knots & Hitches

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Manual 1 of 8

Knots for arborists and climbers who use rope in man-carrying applications.

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DISCLAIMER

This manual, nor any other manual in this eight-part series, shall be considered an all-inclusive or stand-alone training aid. The goal of the manuals is to help guide you through the evolution of common topics and practices found throughout the United States. Tree work is inherently dangerous, and one must train under the supervision and instruction of skilled workers before attempting to replicate any of the following situations alone. **This manual is no substitute for thorough professional instruction and expert supervision**.

PREFACE

In this first manual of the series, you will be reading about the evolution of rope and rope construction from simple natural manila fiber to today's synthetic multi-braid ropes.

The tree care industry relies heavily upon ropes. Ropes support your life and the lives of your crew. There are many obstacles and challenges Line Clearance Tree Trimmers face: mistakes can cause the loss of your career or even a fatality. Ropes and proper rope handling can prevent accidents and help maintain control over all facets of the job, reducing 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 for life support. Be sure to read the description of each knot thoroughly; then tie, dress, and set each knot and hitch; and, finally, test each of your knots and hitches before use.

Throughout your career, you will use ropes and proper rope handling to save your life or rescue a coworker, complete a job with damaging property, and, generally, increase job site safety.

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



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-Charles M. Hayes



A BRIEF HISTORY OF ROPE

Material and Construction

According to a paleoanthropologist from Stony Brook University in New York, primitive rope- also known as "cordage"- dates back as far as half-a-million years ago. A fragment of material was discovered in April 2020 and believed by archaeologists to be Neanderthal cordage dating back between 41,000 and 52,000 years ago. The refinement of rope manufacturing and its' materials has had thousands of years to develop. We will cover some of its' more modern-day incarnations.



Manila hemp is not technically hemp, but simply categorized this way along with other various plant fibers, as true hemp was a major source of natural fibers for a long time.



Vintage photo of early tree climbing pioneer using Manila flip lines and a Cat's Paw knot to adjust their rope.

Let us begin with **manila rope-** also known as "hemp rope"has been used around the globe for thousands of years. However, it was not until the late 1700s that British Naval Captain James Cook named the rope after the Philippines' capital city of Manila. This rope has been the go-to choice for climbers for centuries. It is known for its flexible, nonstretching properties and durability; it is easy to see why it earned its popularity. The rope had the unique ability to absorb moisture- allowing the user to retain a solid grip – ideal for climbing situations.

Manila rope consists of natural fibers tightly twisted together and then braided into a single line. The natural fibers come from the leaves of the abacá plant, known as manila hemp. This plant is a species of banana plant native to the Philippines.

Ropemaking begins by turning tiny plant fibers into larger fibers until they are large enough to be one strand of a rope. Then that strand is added to another and another until they can all be braided together to create a rope.

In the past, ropes were made by hand from natural fibers. With the advent of synthetic fibers such as polypropylene, nylon, and polyester – a much safer, user-friendly, and longer-lasting rope material became available.

Using today's state-of-the-art machinery and software, rope manufacturers like Samson and Teufelberger can create a rope for literally every possible use found in the current arboriculture industry. Machines can create thousands of uniform feet with various colors, braiding patterns, and application properties. Drums of synthetic material



A rope braiding machine at the Arbetet's Museum (Museum of Work in Sweden.

are loaded onto a platform of spinning rods that rotate around one another in a specific configuration, the rotation is what makes the braid in the rope.

Rope material and construction have also improved tremendously thanks to new safety guidelines and standards created by the American National Standards Institute (ANSI) and the Occupational Safety and Health Administration (OSHA). ANSI states that no rope used as a climb line can be made of natural material. The rope must be constructed from a combination of synthetic and manmade fibers to specific requirements. ANSI and OSHA have outlined specific standards directly related to the arboricultural industry and the tools used.



Detailed image of a modern rope braiding machine creating a rope of specific color, pattern, and diameter.

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."



COMPARISON: High-Performance Synthetics vs. Wire Rope



In some cases, a synthetic rope can be stronger than braided steel, even lighter. A wonderful example of this is Samson Rope's "Amsteel" which is size-for-size equal to or stronger than steel cable but light enough to float on water.

ROPE TERMINOLOGY

Glossary of Common Rope Terms

- **BEND**: a type of knot that joins two ropes together
- BEND RATIO: the size or diameter of the device or limb a rope is placed over/through creating a bend ratio
- BIGHT: a loop of rope that does not cross over itself; it can also refer to where a knot cinches down onto itself when loaded
- BUGLE: a section of rope where internal fibers are bent and/or twisted inside the core creating a bump
- **CLIMBING LINE:** a rope that is used only for life support
- COIL: a method of rope storing where a person starts at one end of the rope and makes continuous overhand turns, stacking the rope back on itself
- **DIAMETER**: refers to a rope's cross-sectional width
- **DOUBLE BRAID**: rope with braided outer sleeve and braided inner core
- DYNAMIC: opposite of static, is a load or weight load (under tension) then unloaded (not under tension)
- FLAT SPOT: area of the rope where the internal fibers have broken or separated leaving a flattened area
- FRICTION: heat caused by rubbing, can cause damage, and rope glazing
- GLAZING: sections of a rope where it was exposed to excessive amounts of friction that melted the fibers
- HITCH: knot consisting of wraps and 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
- HOCKEL: small twist within the rope
- ► HOLLOW BRAID: rope with one or two carrier strands but has no core
- KERNMANTLE: type of rope with low elasticity and high abrasion resistance
- NON-WORKING END: the end of the rope is not active during the application
- OVERHAND TURN: a loop made in the rope by placing the working end over the non-working end
- RIGGING LINE: ropes reserved for lifting and lowering of wood and limbs
- **STATIC:** a load or applied weight that is constant and non-changing
- STOPPER KNOT: inline know tied near the tail to prevent another knot or hitch from moving or rolling off the tail
- THREE STRAND: three separate ropes braided together to form a larger diameter rope
- TIE, DRESS, & SET (TSD): after you tie a knot, perform this method to get the knot ready for use
- WORKING END: the end of the rope you are currently working with



TYPES OF ROPE

Used in Tree Removal, Tree Trimming, Powerline Clearance, and Arboriculture

We will go over the basics of these types of ropes – Static/Kernmantle, Dynamic, Double Braid, Hollow Braid, and Three Strand – and their individual properties in the diagram below:

STATIC/KERNMANTLE

These rope have little to no elongation and a high abrasion resitance. They are typically used for Single Rope Technique (SRT) climbing due to the beenfits of not having a rope that bounces while climbing. Additionally, the extra firmness and tough outer core can resist damage or "picking" from toothed ascender devices

DYNAMIC

This type of rope is used in Dynamic Double Rope Technique (DdRT) and is most commonly 16- or 24-strand rope. This rope has some elongation/stretch properties and works well with most hardward. The example, on right, is a version of Samson "Arbormaster" rope, a 16-strand climbing line that is very common within the industry.



DOUBLE BRAID

Double braid rope used in the arborist industry egenerally has an outter sheath with two carriers braided into 24 strands that house an internal core. These ropes share the load between the core and 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 securely encases the inner core. A common double braid rope is the Samson "Stable Braid" ropes which range in size from 1/2" to 1" and have considerable breaking strength while maintaining low stretch. This family of ropes is the most desireable for rigging applications.

HOLLOW BRAID

Hollow braid ropescan be made of either one or two carrier strands. This particular rope have no core, making it completely hollow – hence the name. This construction makes it inherently eacy to splice. The Samson Tenex-tec and Tenex are very widely used in sling systems for installing rigging blocks and Port-A-Wraps as well as slings used to wrap logs for lifting and lowering. This rope is exteremly strong and an advantageous choice for rigging applications.

THREE STRAND

While current three strand ropes are made from synthetic fiber, they still follow the same construction principle as the original Manila rope. They are geenrally used for hand or pull lines. Some devices such as the Masdam Rope Come-Along only work with three strand ropes. Tope advances have placed three strand construction types at the most basic level due to their low strength and heavy weight.



There are two categories of ropes used in the Arboriculture industry – Climbing and Rigging. Within those main categories, you will find subsequent rope types that we will outline shortly.

Traditionally, climbing lines must be at least ½" in diameter with an average breaking strength of 5,400 lbs. They must have less than 7% stretch. Therefore, their constructions lend toward the climbing style being used, level of use, and how pliable the user prefers their rope. On the other hand, rigging lines can range from ¼" in diameter, used as a pilot line, all the way up to 2", used for catching and lowering the largest of wood sections. These lines exhibit excellent wear resistance and work well in blocks and other rigging hardware. They can vary in the stretch from low to extreme. We will cover both.

Climbing Ropes

As stated before, the ropes you will be using for life support must be a minimum of ½" diameter with a minimum breaking strength of 5,400 lbs and no more than 7% elongation with 540 lbs applied. ½" ropes are extremely common in most Dynamic Doubled Rope Technique (DdRT) systems because of their overall knot ability, breaking strength, ease of use, and cost. It is to be used by the 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. Single Rope Technique (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 a static rope. On the following page are examples of these two rope types, their sizes, and their differences.

Dynamic Doubled Rope Technique (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 knot ability 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 knot ability, and good overall value. It is a 16-strand DdRT climbing line offering a breaking strength of 6,500 pounds. It is braided inner core helps keep it firm and gives it great knot holding capability.





Yale XTC "Fire" 13 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 knot ability rating is high as well as its breaking strength (6,000 pounds). Its features make it last long and even work well when wet.



Single Rope Technique (SRT) Ropes

Sterling HTP "Snake Bite" 11 mm

Snakebite 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 color scheme on left is extremely bright while still offering excellent knot ability 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 does not stop this rope from producing 7,560 pounds of 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.

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.

Rigging Ropes

Rigging ropes can range from ¼", used as pilot lines, upwards of 2", used for catching and lowering the largest wood sections. Ropes manufactured for arborist tree rigging are made from an industry-specific blend of synthetic materials.

Three 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 paired with a mechanical advantage system. Its breaking strength ranges from 3,200 pounds up to 17,500 pounds. This 3-strand rope is the number one choice by local contractors and arborists.

CHAIP PARTS

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 as 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 rope's length at 30% load.

Yale "Dynasorb" / "Polydyne" 1/4 – 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 than 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 $\frac{1}{2}$ " diameter at 2,500 pounds up to 1-1/2" at 90,000 pounds average breaking strength.

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

Tenex-Tec & Tenex developed by Samson offers a low stretch and 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 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.

Below is a chart provided by Samson Rope. It breaks down a lot of the common rope types found in our industry. Each rope construction (strand/braid) has its' own unique uses and characteristics you should become familiar with. Some ropes are more suitable for climbing and others should be used for rigging.

ROPE CON	ISTRUCTIONS		
3-STRAND		\bigcirc	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	5555555		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	an a	-	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 KNOT Glossary of Common Knot Terms

- 1. WORKING END: This is the end of the rope actively being used to tie and form the know
- 2. BIGHT: a u-shaped section of rope usually used to tie knots onto, typically it will cinch down on itself when loaded
- 3. CROSSING POINT: any point where the rope crosses back over itself
- 4. OVERHAND LOOP: created when the working end is placed over the standing end
- 5. INTERLOCKING ELBOWS: occurs when the bight is twisted twice resulting in two crossing points
- 6. UNDERHAND LOOP: created when the working end is placed under the standing end, opposite of the overhand loop
- 7. STANDING END: the portion of rope not actively in use
- 8. STOPPER KNOT: the knot placed on the tail of the standing end to prevent it from pulling through a device or hitch

The first step in tying knots/hitches is to learn what the rope terminology is and where to apply it. Be sure to familiarize yourself with the terminology on this page. You may find yourself 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.

Now that you have been introduced to basic 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 placed 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

The rope has been tied to the section of dead wood to be lowered. It is the end of the rope doing the work.

STANDING END

The rope is placed through the rigging point in the tree and comes back down into the friction device. The standing end is controlled by hand.

TYPES OF ARBORICULTURE KNOTS

Glossary of Knot Names and How-To Guide

The following list covers most of the knots and hitches used in arboriculture today. Some require a lot of rope while others require very little. Some require two ropes instead of just one. Be sure to read each description to understand the elements of each knot/hitch and the included example of its respective application.

- **BOWLINE**
- **BOWLINE**, on the bight
- ► YOSEMITE BOWLINE
- RUNNING BOWLINE
- LARGE EYE BOWLINE
- **CLOVE HITCH, end of line**
- ► CLOVE HITCH, mid-line
- ► GIRTH HITCH
- **BUNTLINE HITCH**
- DOUBLE FISHERMAN'S BEND
- ► FIGURE EIGHT
- ► TIMBER HITCH
- **COW HITCH**
- SHEET BAND

- DOUBLE SHEET BEND
- BLAKE'S HITCH
- ► TAUNT LINE HITCH
- VALDOTAIN TRESSE
- DISTEL
- ZEPPELIN BEND
- MUNTNER
- SCHWABISCH
- ► KLEMHEIST
- PRUSIK
- ALPINE BUTTERFLY
- ANCHOR HITCH
- SLIPPERY SHEET BEND
- DOUBLE FISHERMAN'S KNOT

Bowline

The bowline 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 a considerable load has been applied.

Bowline, on the bight

This knot is a mid-line knot and offers multiple anchor points because the finished product ends with two fixed eyes. It can be untied after a 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 emergencies.

Yosemite Bowline

This is a version of the Bowline knot, the major difference is 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.

Running Bowline

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

Large Eye Bowline

This version of a bowline is tied the same as the original. The only difference is that the eye of the bowline is kept extremely large. One might use this knot to tie a rope over a limb that is high off the ground without applying too much pressure causing the rope to choke itself around the limb (running bowline). Also prevents one from being able to retrieve and untie the knot. Keeping the eye large allows you to untie it from the same location it was tied.

Clove-Hitch, end of line

A clove hitch is similar to a constrictor knot and is commonly used in rigging practices for installing blocks, equipment, or tying off a limb.

Clove-Hitch, mid-line

A mid-line clove hitch is the same knot, just tied using a different method. Instead of using one end of the 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. With the rope in hand, twist one loop to form an underhand loop and the other twist to form an overhand loop. The left (underhand) loop is then laid over the right (overhand) loop. This creates a hole while keeping the knot separated and in line place the knot over the object.

Girth Hitch

The girth hitch resembles the cow hitch which we will look over in the following pages. A girth hitch is for an endless loop (circle of rope) that is placed over an object and pulled back through itself. It is an easy way to connect a loop to a fixed point like a static rope, pictured in the walk-through below.

Buntline Hitch

The buntline hitch is considered an acceptable life support knot. It is an off the constrictor-knot family and if the knot is laid well (i.e. properly tied, dressed, and set) it is virtually impossible to untie without tools, making it an excellent knot for binding. A large benefit of this knot is the direction the tail is facing when the knot is tied properly. The tail can be oriented in a more favorable position when tying a friction hitch in a closed system.

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.

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.

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 tucking the 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, the wraps to secure the rope should always be at least one-third of the tree and include a minimum of five (5) tucks.

Cow Hitch

This knot can serve the same purpose as the Timber Hitch but takes more rope to complete. When the hitch is finished properly it will look like a Girth Hitch. It is excellent for securely installing a rigging block to a tree if enough rope is available.

** While not pictured above, this knot should always be finished with a half-hitch over the standing end of the rope to secure it.

Sheet Bend

This is a very effective bend to join two ropes of unequal, or similar size. The most common application is sending a rope up to the climber by using this bend between the climber's climb line and the new rope.

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 diameters.

Blake's Hitch

Blake's Hitch is a series of four (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. Remember to always tie, dress, and set (TDS) each knot before application and the tail end of the knot should always have a stopper knot tied before use.

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 too tight and will need re-worked for it to function properly. It is tied very similarly to the "Distel Hitch" you will tie later as a 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 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.

****** While not pictured above, once this knot is pulled taunt a tie stopper knot should be tied.

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.

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 differently depending upon the climb line diameter, the hitch cord diameter, and the condition of both. If one hitch does not bite as it should then you should tie the other.

Zeppelin Bend

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

Muntner

The Muntner is a knot that can be used to hold or control the 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 due to its inherent nature of being used as a belay knot.

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.

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 four wraps then the large loop is placed through the small one.

Prussik

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

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 "spike" the line in a floating crotch, or used to anchor something via mid-line. To set this knot, you must pull on each standing end of the rope opposite one another.

Anchor Hitch

This hitch is used to secure an end of the 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 a rope to a carabiner or rigging device during ziplining or lowering branches.

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 pulling a bite of rope through and then setting the knot. This leaves a tail sticking out that can be pulled to quickly untie the knot, much like a shoelace.

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 itself 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 Cords

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

Tying your friction hitch out of material that is designed for this purpose has 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 a smaller diameter than the host rope will help the hitch actually bight and hold onto the host rope much easier and quicker than using one of the same diameters.

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

Samson "Ice Tail"

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 paired with a mechanical advantage system. Its breaking strength ranges from 3,200 pounds up to 17,500 pounds. This 3-strand rope is the number one choice by local contractors and arborists.

Yale "Veritas"

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"

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

Yale "Beeline"

This is a staple and probably the most common of all hitch cords. 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 increases the wear life of this cord. This version below is 10mm with an ABS of 7,500 lbs.

Teufelberger "Ocean"

This 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 to many applications of tree care, however, its big brother Ocean 10 (right) is. Breaking strength of 7,410 lbs. and high melting point makes this cord another favorite.

