Samson Professional Arborist Products

For well over 100 years, Samson has been the leader in developing and manufacturing braided ropes. During the 1800's, Samson perfected the unique concept of incorporating reinforcement cores within braids to significantly enhance product performance. In 1957, the engineers at Samson took this innovation another step forward and developed the modern synthetic double braid. By combining newly developed fibers in their patented construction, ropes could be engineered with those characteristics critical to the applications for which they were designed. Performance factors, such as strength, elongation, flexibility, and abrasion resistance, could now be engineered into the rope.

With this heritage, it's easy to see why Samson ropes excel in workplaces as tough as those encountered by the professional arborist. Samson's line of tree ropes are specifically engineered to maximize performance where ropes are expected to run against bark and through crotches, support and control descending loads while providing a reasonable working life and margin of security for climbers working in the tree.

The most complete line of products in the industry...Samson's line of Arborist ropes includes both climbing and rigging ropes, 12 and 16 strand braided constructions, double braided, and three strand twisted ropes. Each construction and combination of fibers offers its own mix of performance characteristics. Strength, elongation, abrasion resistance, and snag resistance are all factors to consider in choosing the appropriate line for a given task.

This catalog has been designed as a complete reference on Samson Arborist products. In it you will find specifications for each product, which allows comparison between products to ensure that the product chosen will function in its role in the workplace. In addition, we have included reference materials on usage and inspection techniques for ropes in general.

In order to promote safety on the job site, and ensure that our products are used most effectively, Samson has teamed up with the arborist community to promote and provide current information on effective and safe climbing techniques. Please refer to our special sections on Climbing Knots; Knots and Rigging; Slings; Standards for Strength and Usage and Rope Inspection and Retirement. While not intended to be a comprehensive guide to this demanding aspect of the arborist's profession, it will introduce a few basic concepts, and hopefully encourage the search for more information on this critical aspect of the arborist's occupation.

오 성 산 업

Products to meet the demanding requirements of the professional arborist

Our commitment to the arborist industry is evident on two levels. First, by supplying a wide variety of high quality products that can be trusted to provide consistent performance. Your performance, as well as your safety, depends on the choices you make in selecting the tools you work with. At Samson, our goal is to make our products your first choice for quality and economy. Along with our distributors and dealers, we are committed to providing information which helps you use our products in a safe and effective manner. This catalog contains critical safety and usage information.

Second, our commitment is directed toward the professional advancement of the industry.

Our support of effective training programs like those sponsored by the NAA and ISA, ArborMaster Training, Inc. and others is critical to informing and educating arborists everywhere. Our particpation at trade exhibitions as well as "hands on" seminars helps us better understand your needs and preferences. This process of feedback and involvement helps everyone and improves our value to the industry as well as yours.

TABLE OF CONTENTS 3

Table of Contents

☎02-896-5656 ☞www.OSC.CO.KR

Samson Climbing Lines

Samson has been in the cordage industry since 1884. During our many years of operation, we have responded to many requests for specialized products for new or unusual applications that require strength members built to specified characteristics such as strength, stretch, hand/knotting features or weight. Projects have ranged from developing a space capsule retrieval line, deep water lift lines to retrieve a Russian submarine, power company winch and pulling lines, and Arborist climbing lines.

In the early 1970's we were asked to develop a synthetic line to replace manila climbing lines. The project was accepted and we worked with universities, distributors and arborists. After fourteen months and seven design evaluations, Arbor-Plex was created and released as the first significant braided rope as a climbing line for the Arborist Industry.

ArborMaster®
premium 16-strand braided polyester construction. With a uniquely stabilized nylon core.

True-Blue™
12-strand braided 100% polyester construction. Each strand consists of blue fiber plied over white fiber to assist detection of cover wear.

Arbor-Plex™
12-strand braided construction of plied polyester and polyolefin fibers.

Tree-Master™
3-strand, 4-stage twisted construction of 100% polyester fiber.

As with all industrial applications, specialized needs and preferences are generated to meet these requirements, and a constant product development program is always underway at Samson. To meet the demand for a higher strength, lower stretch climbing line that would allow good visual recognition, True-Blue was developed. Traditional preferences continued for a 3-strand with low stretch, higher strength and better service life than manila. To service these requirements Tree-Master was created. Today, the continuing growth of the "Footlock" climbing technique has required the development of a braided rope construction that would have maximum flexibility while maintaining a firm round shape during operation; plus, be a high visibility rope and fully identifiable from all rigging lines.

Our latest innovation comes from working closely with ArborMaster® Training to create the ultimate climbing line: ArborMaster®. Several years of research and development went into creating this product to meet the demanding requirements of today's professional climbers.

Samson is committed to constantly meeting the challenges of the Arborist Industry and assuring the highest consistent quality climbing lines available. We are ISO 9001 certified and our climbing lines meet or exceed ANSI Standard Z133.11-2000.

It is our commitment to product development, compliance to industry standards and constant innovation that keeps us ahead of our competition.

Important Note About Climbing Lines for Lowering Operations:

Climbing lines should not be used as lowering lines, come-along ropes or bull ropes. These constructions are designed for maximum flexibility and excellent handling qualities when used in climbing applications. These design characteristics are not necessarily suitable with lowering operations. This is especially important if the rope has already been retired from climbing service. Other types of ropes specifically designed for lowering and come-along operations should be used for these types of applications.

AVERAGE STRENGTH & WORKING LOAD

PRODUCT	AVERAGE STRENGTH	WORKING LOAD	WEIGHT PER 100 FEET	ELASTIC ELONGATION* 200 LB. LOAD	400 LB. LOAD	800 LB. LOAD
ArborMaster	8,100 lbs.	810 lbs.	7.7 lbs	.60%	1.10%	2.20%
True-Blue	7,300 lbs.	730 lbs.	8.5 lbs	1.02%	1.65%	2.24%
Arbor-Plex	6,000 lbs.	600 lbs.	6.8 lbs	1.01%	1.75%	2.72%
Tree-Master	7,000 lbs.	700 lbs.	8.0 lbs	0.82%	1.89%	3.08%

Strengths and working loads are for new, unused 1/2-inch ropes with no splices or knots.
**Based on rope stablized from 200D²*

Samson Rigging Lines

Rigging is the use of ropes and other equipment to take down trees or remove limbs when free-falling is not advisable. Rigging is the most advanced aspect of tree work. Even for veteran arborists, it is best to practice new techniques in open areas where the risk of accidents can be controlled and personal safety can be ensured.

The techniques and tools will vary with each job site and an experienced worker will take advantage of the many new blocks and lowering devices to safely and efficiently lower tree sections. Advances in rope construction, as well as new and better synthetic fibers, are making the job of rigging easier and safer and the importance of using reliable rigging ropes cannot be overstated. Samson offers several types of rigging lines designed specifically for the Arborist industry. Samson's rigging ropes offer the best combination of strength, wear resistance and elongation while taking some of the mystery out of choosing the right rope.

Stable Braid™

Our strongest rigging rope, it is also the most widely used as a lifting line or winchline in many industries where higher strength and durability along with easy handling are needed in a relatively small diameter. It is available in sizes from 1/2'' to 7/8'', with other sizes available by special order. Introduced to the arborist industry in 1993 as a rigging line, this 100% polyester braided rope construction, offered with a urethane coating for maximum toughness, is spliceable using standard double braid procedures. It is designed to be used with false crotch blocks and other rigging hardware so you can take full advantage of its strength and durability.

Arbor-Plex™

A torque balanced rigging rope available in 5/8'' and 3/4''. It is a twelve-strand tightly braided construction with excellent wear resistance, high strength and light weight. Each strand has a core of polyolefin wrapped with polyester in a DuraTite construction process which makes it unspliceable. First offered to the industry in the mid 1970's as a rigging line, it is widely known and trusted as a "work horse" for virtually all rigging uses.

Tenex™

Tenex is a firm, round braided construction offering high strength, low stretch and outstanding abrasion resistance. The proprietary coating enhances the rope's firmness and resistance to abrasion and snagging. These characteristics make Tenex an excellent choice for rigging line and for slings.

Static Rope™

A kernmantle rope construction that can be used for specialty rigging requirements. Possesses excellent shock mitagation and firm round shape under load.

Pro-Master™

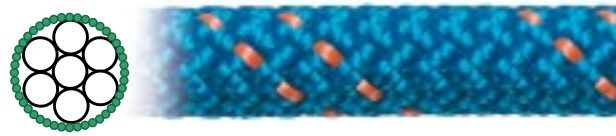
A firm three-strand rope construction offering reliability as well as economy. It holds its shape even under heavy use and the spun fiber on the surface offers excellent grip and knot holding. Identified by a green ID. For price and performance there isn't a better three-strand rigging rope in the marketplace.

STABLE BRAID™
2-in-1® double braid construction consisting of a braided polyester cover over a braided polyester core.

TENEX™
Twelve-Strand construction of high tenacity polyester with Samthane coating.

ARBOR-PLEX™
12-strand braided construction of plied polyester and polyolefin fibers.

PRO-MASTER™
3-strand, twisted construction of spun and filament polyester jacket fibers covering polyolefin core fibers.



STATIC™
Kernmantle construction with Polyester cover and heat stabilized nylon core bundles.

ELASTIC ELONGATION AT A % OF AVERAGE STRENGTH

PRODUCT	10%	20%	30%
Stable Braid	1.1%	1.7%	2.7%
Tenex	1.4%	2.3%	3.0%
Arbor-Plex	1.7%	2.9%	3.6%
Pro-Master	2.0%	3.2%	3.9%
Static	3.2%	4.5%	6.0%

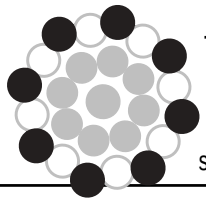
Based on rope stablized from 200D²

AVERAGE STRENGTH & WORKING LOAD

	STABLE BRAID			TENEX - 1 END			TENEX - 2 END			ARBOR-PLEX			PRO-MASTER			STATIC		
SIZE	STRENGTH BREAK	WORK LOAD	WEIGHT Lbs per	STRENGTH BREAK	WORK LOAD	WEIGHT Lbs per	STRENGTH BREAK	WORK LOAD	WEIGHT Lbs per	STRENGTH BREAK	WORK LOAD	WEIGHT Lbs per	STRENGTH BREAK	WORK LOAD	WEIGHT Lbs per	STRENGTH BREAK	WORK LOAD	WEIGHT Lbs per
Dia.	Lbs	Lbs	100-Ft	Lbs	Lbs	100-Ft	Lbs	Lbs	100-Ft	Lbs	Lbs	100-Ft	Lbs	Lbs	100-Ft	Lbs	Lbs	100-Ft
3/8"	N/A	N/A	N/A	5,800	580	4.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,700	570	4.2
7/16"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8,200	820	6.0
1/2"	10,400	1,040	8.2	11,800	1,180	8.5	13,100	1,310	9.4	N/A	N/A	N/A	6,300	630	6.5	11,000	1,100	8.0
9/16"	13,300	1,330	11.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5/8"	16,300	1,630	14.0	17,100	1,710	13.1	18,800	1,880	13.8	9,000	900	12.0	8,500	850	9.6	13,500	1,350	11.2
3/4"	20,400	2,040	18.0	22,400	2,240	17.2	24,800	2,480	18.5	12,000	1,200	16.2	10,900	1,090	13.9	N/A	N/A	N/A
7/8"	29,900	2,990	27.1	32,600	3,260	25.8	N/A	N/A	N/A	N/A	N/A	N/A	15,500	1,550	18.0	N/A	N/A	N/A

Arbor-Plex and Static strengths and working loads are for new, unused ropes with no splices or knots.
Stable Braid, Pro-Master and Tenex strengths and working loads are for new, unused ropes with splices and no knots.

ArborMaster®



16-strand braided polyester construction with stabilized nylon core.

The world-class champion climbers and arbor professionals at ArborMaster® Training worked closely with Samson engineers to develop the ultimate climbing line: ArborMaster®. With your life and livelihood on the line, you can rely on ArborMaster to perform smoothly. You have the assurance that some of the best arborists in the business have designed this product with you and your needs in mind and they rely on it themselves.

Your equipment and tools should minimize climber fatigue not contribute to it. This is why ArborMaster is built to a full 1/2" diameter. Not all 16-strand climbing lines are built this way. ArborMaster is a premium quality 16-stand line offering a smooth, durable surface to optimize footlock climbing. ArborMaster can be spliced both ends, right out of the bag (no milking or break-in required). This allows you to alternate the working end of the rope right from the start, which maximizes the service life of the rope.

Made from specially treated polyester with a stabilized nylon core. ArborMaster is available in three, high-contrast color combinations: blue/white, gold/white and red/black/white.

FEATURES

- Maximum firmness for the "Footlock" climbing technique
- High visibilty in trees
- Low stretch
- Full size 1/2" diameter makes for an easier grip and minimizes climber fatigue
- Non-rotational
- Excellent knot-heat reistance
- Available in spliced units
- Maintains excellent service flexibility

ArborMaster's various color combinations work well together when used in the split-tail climbing system.

SPECIFICATIONS

SIZE / DIAMETER:
1/2-inch

WEIGHT PER 100 FEET:
7.7 lbs.

AVERAGE STRENGTH:

UNSPLICED	SPLICED
8,100 lbs.	6,480 lbs.

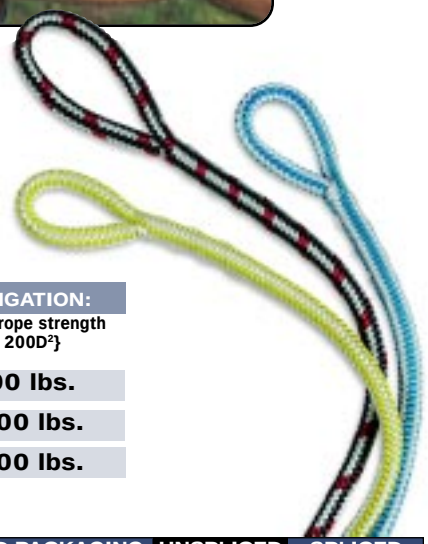
WORKING LOAD:

UNSPLICED	SPLICED
810 lbs.	648 lbs.

Rope strengths are for new, unused ropes.

ELASTIC ELONGATION:
{Percentage of new rope strength stabilized from 200D²}

.60% @ 200 lbs.
1.10% @ 400 lbs.
2.20% @ 800 lbs.



ARBORMASTER™

DIAMETER	PUT-UP	STANDARD PACKAGING	UNSPLICED	SPLICED
1/2"	4 foot polybag	4 polybags per carton	N/A	✔
1/2"	120 foot polybag	4 polybags per carton	✔	✔
1/2"	150 foot polybag	4 polybags per carton	✔	✔
1/2"	600 foot reel	1 reel per carton	✔	N/A

**Spliced units have 5-inch soft eye one end.*

☎02-896-5656 ☞www.OSC.CO.KR

12-strand braided 100% polyester construction. Each strand consists of blue fiber plied over white fiber to assist detection of cover wear.

True-Blue™

True-Blue offers the highest level of performance in a high strength, low stretch climbing line with maximum wear resistance and a highly visible blue color.

True-Blue braided climbing line is a unique combination of extrusion set blue polyester fiber wrapped over a white polyester core in a Samson twelve-strand DuraTite™ braid.

This 100% polyester braid also has each of the twelve strands coated with Samthane™ finish to add maximum wear life and consistent knot control. The outer blue polyester fibers also have Samson's Parallay™ parallel fiber orientation to minimize fiber wear on rough surfaces and prolong rope working life.

FEATURES

- Maximum wear life
- 100% polyester
- Low stretch, high strength
- Non-rotational
- Maintains excellent flexibility
- Stays firm and round in use
- Highly visible in trees

SPECIFICATIONS

SIZE / DIAMETER:
1/2-inch

WEIGHT PER 100 FEET:
8.8 lbs.

AVERAGE STRENGTH:
7,300 lbs.

WORKING LOAD:
730 lbs.

Strengths and working loads are for new and unused ropes with no splices or knots.

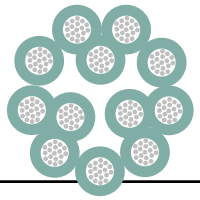
ELASTIC ELONGATION:
{Percentage of new rope strength stabilized from 200D²}

1.02% @ 200 lbs.
1.65% @ 400 lbs.
2.24% @ 800 lbs.

TRUE–BLUE

DIAMETER	PUT-UP	UNITS PER PACK
1/2"	120 foot polybag	4 polybags per carton
1/2"	150 foot polybag	4 polybags per carton
1/2"	600 foot reel	1 reel per carton
1/2"	2,400 foot drum	Drum self-packed

Arbor-Plex™



Twelve-strand braided construction of plied polyester and polyolefin fibers.

Arbor-Plex combines polyester and polyolefin fibers in a DuraTite™ construction. This process tightens the braid to keep the rope round and firm for knot control and to allow the strands to be snag resistant. The tough polyester jacket fibers surround the polyolefin center fibers to maximize resistance to wear and fiber fusing while creating a lightweight high-strength rope. The outer polyester fibers utilize Samson's Parallay™ fiber orientation to prolong rope life by minimizing the sawing action of fibers over rough surface.

FEATURES

- Excellent wear and snag resistance
- Excellent knot holding ability, non-rotational — hangs straight
- Works well when wet
- Rot and mildew resistant

SPECIFICATIONS

SIZE / DIAMETER:
1 / 2-inch

WEIGHT PER 100 FEET:
6.8 lbs.

AVERAGE STRENGTH:
6,000 lbs.

WORKING LOAD:
600 lbs.

Strengths and working loads are for new, unused ropes with no splices or knots.

ELASTIC ELONGATION:
{Percentage of new rope strength stabilized from 200D²}

1.01% @ 200 lbs.
1.75% @ 400 lbs.
2.72% @ 800 lbs.

ARBOR-PLEX CLIMBING

DIAMETER	PUT-UP	UNITS PER PACK
1 / 2"	120 foot polybag	4 polybags per carton
1 / 2"	150 foot polybag	4 polybags per carton
1 / 2"	600 foot reel	1 reel per carton
1 / 2"	2,400 foot drum	Drum self-packed

3-strand, 4-stage twisted construction of 100% polyester fiber.

Tree-Master™

The finest three-strand climbing rope available. Tree-Master is a premium 4-stage climbing rope made of premium polyester. Identified by an external green strand. It remains firm under load and has excellent knot holding characteristics when used with the Tautline Hitch and Blake Hitch.

FEATURES

- ✶ Maximum wear life
- ✶ Stays firm under load
- ✶ Mildew resistant

SPECIFICATIONS

SIZE / DIAMETER:
1 / 2-inch

WEIGHT PER 100 FEET:
8.0 lbs.

AVERAGE STRENGTH:
7,000 lbs.

WORKING LOAD:
700 lbs.

Strengths and working loads are for new and unused ropes with no splices or knots.

ELASTIC ELONGATION:
{Percentage of new rope strength stabilized from 200D²}

.82% @ 200 lbs.
1.89% @ 400 lbs.
3.08% @ 800 lbs.

TREE-MASTER CLIMBING

DIAMETER	PUT-UP	UNITS PER PACK
1/2"	120 foot polybag	4 polybags per carton
1/2"	150 foot polybag	4 polybags per carton
1/2"	600 foot reel	1 reel per carton
1/2"	1,200 foot reel	1 reel per carton

Zing–It™

The first throwing line designed specifically for the professional arborist. Samson Zing-It offers extremely high strength, exceptionally low stretch, and excellent abrasion resistance to enhance durability – all in a small diameter, lightweight throwing line.

Zing-It helps you achieve higher throws with lighter weights, greater control due to its low stretch, and the ability to pull down "hangers" due to its high strength. The special coating reduces abrasion and allows Zing-It to glide easily over the roughest bark. Use for either hand or mechanical throwing with an 8 or 10 oz. throwing weight.

USAGE TIPS FROM THE PRO'S

After the first use of Zing-It, the throw line should be hand tended or faked into a small plastic pail, canvas bag, or plastic bag for storage. Zing-It should not be coiled since that will impart twist and could cause knotting during future use. If hand tended for storage, Zing-It will be free flowing for the next use.

FEATURES

- Low stretch for excellent control
- High strength for pulling down hangers
- Slippery, glides easily over rough bark
- Excellent abrasion resistance

SPECIFICATIONS

SIZE / DIAMETER:	
1.75mm	2.2mm
WEIGHT PER 100 FEET:	
.12 lbs.	.16 lbs.
AVERAGE STRENGTH:	
400 lbs.	580 lbs.

ZING-IT™

DIAMETER	PUT-UP	UNITS PER PACK
1.75mm	180 foot tube	12 hang tubes per carton
1.75mm	1,000 foot tube	1 each
2.2mm	180 foot tube	12 hang tubes per carton
2.2mm	1,000 foot tube	1 each

Bulk lengths available on request.

All sizes and put-ups packaged on cardboard tube. 180' put-ups are placed in hang tubes. Other put-ups are individually shrink-wrapped.

AmSteel®, Ultra-Tech™ and Accessory Cord

AmSteel®

A twelve-strand rope made from Dyneema® fiber that is Samthane™ Type S coated orange. AmSteel® is very light weight, strong for its size and may be used as a rigging control or positioning line. Easy to work with and highly visible in trees. More info on Samthane coatings see pg. 27.

AMSTEEL - WEIGHT & STRENGTH

DIAMETER	WEIGHT PER 600'	AVERAGE STRENGTH
1/8"	3.0 lbs.	**1,800 lbs.**

Average strength for new, unused rope with splices and no knots.

Ultra-Tech™

A unique, high strength double braid with an outer cover of polyester fiber and an inner core of Technora® fiber. Well suited for numerous climbing and rigging applications due to its excellent heat resistance. Available in four tracer colors: black, red, blue or green.

ULTRA-TECH- WEIGHT & STRENGTH

DIAMETER	WEIGHT PER 600'	AVERAGE STRENGTH
5/16"	20.5 lbs.	**7,800 lbs.**

Average strength for new, unused rope with splices and no knots.

Accessory Cords

Samson stregth and quality in multi-purpose accessory cords. Samson Accessory Cords are the "utility player" in the Samson arborist line up. From throwing lines to tie-downs and pruning pole cords, Accessory Cords have hundreds of uses on any job site.

Please note: This product is not intended or designed to be used for climbing, rappeling or rescue rope.

Put-ups: 300 foot spools (all diameters)

ACCESSORY CORD WEIGHT PER 300 FT

DIAMETER	2mm	3mm	4mm	5mm	6mm	7mm	8mm	9mm
WEIGHT / 300'	0.7 lbs.	1.7 lbs.	2.3 lbs.	3.7 lbs.	6.1 lbs	7.9 lbs.	10.3 lbs	13.2 lbs.

MINIMUM STRENGTH (LBS.)

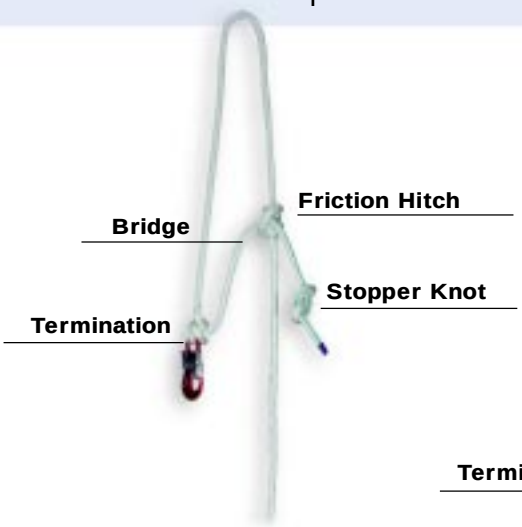
BLACK	230	460	760	1,175	1,700	2,350	3,025	3,700

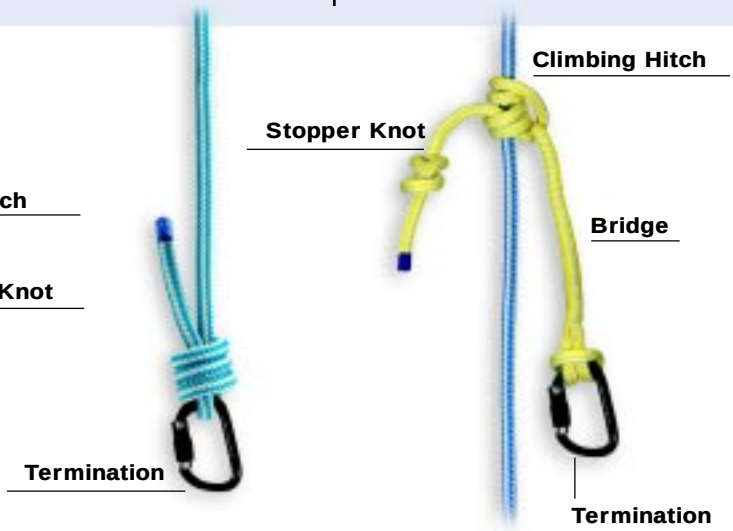
Minimum strength for new, unused rope with no splices or knots.

Climbing Knots

Synthetic lines are tied to hardware or fittings with a hitch and to other lines with a bend. While a knot, technically speaking, is an alteration in one line not affecting other objects, the word “Knot” has come to include the definitions of “hitch” and “bend” as well. No matter what you call it, a knot, bend or hitch works because of the friction created by the turns in the line. This friction also weakens the line, and sometimes is so great that the knot cannot be untied. There are several hitches and bends commonly used by arborists that are specific to climbing and others used for rigging at the job site. In climbing the Tautline Hitch and Blake’s Hitch are the most popular for moving around in the tree. Since the expected loads on climbing lines are normally less than 500 pounds, these hitches cause little strength loss because of bending. Even though the loads are small, a “bail out” descent can melt through a climbing line very quickly, usually before you reach the ground.

Choosing the appropriate knot or hitch is important from not only a safety perspective but also from a functionality point of view. The climbing system that an arborist chooses to work with will have much to do with the knots that will work best for the system selected. The two basic climbing systems most commonly used today are the traditional fixed tail system and the split tail system.





Traditional (Fixed Tail) System

This system has been the most widely used climbing system in North America for over 100 years. Traditionally it is tied using a bowline as a termination with the bridge and friction hitch being tied with the tail exiting the bowline. This system, while very simple, and requiring less hardware can make climbing more strenuous and does not allow for efficient re-crotching. The tail also wears inevitably over time and requires regular cutting of the end portion of climbing line reducing overall rope length and serviceable lifespan.

Split-Tail System

This system has grown in popularity due to its many advantages and versatility. This system, depending on how fully you wish to utilize its benefits, may require additional hardware. Basically the Split-Tail system “splits off” the bridge section or the “tail” from the traditional system. This system can reduce body pain and fatigue especially in the lower back, hips and knees. This system also allows you to maximize features offered in modern ergonomic saddle design. The split tail system also extends your climbing lines serviceable work life and allows for safe, easy and efficient re-crotching.

Terminations

Spliced Eye with Girth Hitch

The spliced eye is the strongest and most convenient termination that can be used. It is recommended that the eye be long enough to ensure that the splice can be girth hitched on the connecting link for a compliant interface and to reduce possible side loading if a carabiner is used. This termination will not work in the ”traditional system.”

Anchor Bend

This easily tied termination will cinch down on hardware, which also prevents side loading on carabiners. The anchor bend is easily untied from connecting links after use.

Buntline Hitch

Due to its cinching action this hitch will hold fast to hardware and minimize side loading potential on carabiners. This cinching action can also make it difficult to untie from connecting links when the connecting link cannot be removed from the hitch.

Climbing Knots

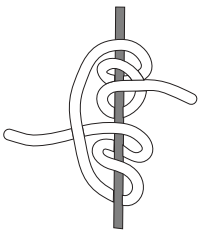
Triple Fisherman's Loop

This cinching type of termination finishes cleanly and minimizes potential side loading of carabiners. This hitch can be difficult to untie from connecting links with fixed or captive eyes such as locking rope snaps.

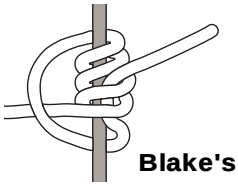
Bowline

This termination is easy to untie. However because it is not a cinching type of termination the potential for side loading of carabiners is greatly increased. This termination is commonly used in the conventional fixed tail climbing system where the tail exiting the bowline is secured by forming the bridge and the climbing hitch.

Climbing Hitches



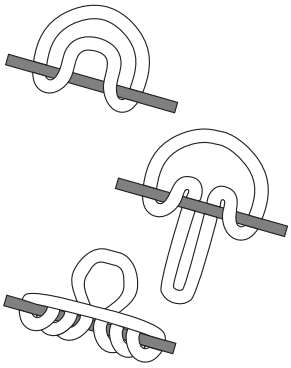
Tautline Hitch



Blake's Hitch

Tautline Hitch & Blake's Hitch

These are used as the "climbers knot" to tie in. They must be kept tight to be effective. Extreme care must be taken to minimize heat build up in these hitches caused by fast descents. It is likely that a "bail out" descent will create sufficient heat to melt completely through the climbing line.

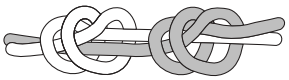


Prusik Loop

Used to "self-belay" when using the "foot-lock", it allows the climber to rest during the ascent. It must be tight to be effective and must never be used to descend a tree because it has little holding power in the direction it is pushed.

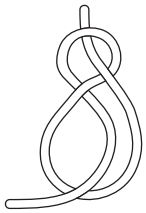
Double Fisherman's Knot

Normally used to tie two ropes of equal size together. Most commonly used by arborists to create a Prusik Loop.



The Figure "8"

The Figure "8" is tied into the ends of lines to stop them from running out through blocks or other knots. It is easily untied even when cinched down tight and should be tied at least four inches from the bitter end so it has room to slip.



Secured Static Footlock

There are many ways to ascend into a tree. Many arborists use a friction hitch system with the "body thrust" technique to access the canopy. Another method that is used, only for asending, due to its safety, ease and efficiency is secured footlocking. While the climber is secured to the climbing line with a friction hitch tied with a endless loop, usually a prusik or kreutzklem, it is not acceptable due to the static nature of the system to descend on this friction hitch. Whenever footlocking, a figure 8 descender should be carried. The only safe method of descending out of a secured static footlock is to utilize a figure 8 attached below the friction hitch.

A "kreutzklem" is a popular substitute for the Prusik hitch in the secured static footlock system.

Knots and Rigging

Rigging for tree removal is more complicated than climbing and demands more experience as well as an understanding of the effects on the rope of the various knots and hitches used. It is widely known that knots can significantly reduce rope strength with a corresponding reduction in the work load limit recommended by a manufacturer. The rigging techniques and knots presented here are meant to give a general overview of the basic principles of rigging.

Prior to beginning any tree work, it is important to thoroughly examine the tree for structural imperfections, faults or weaknesses that could compromise safety. This text is not a substitute for proper training.

The most difficult and dangerous aspect of rigging is “chunking out” trunk sections that are rigged vertically upon themselves. Safety, as always, is the primary concern. It is important when rigging to reduce shock-loads and manage friction efficiently. This is easiest to achieve when using arborist grade rigging blocks in conjunction with appropriate lowering devices both of which have been tested and rated.

Excessive shock loading must always be considered when rigging. The rigging system should be constructed to withstand the maximum shock-load potential. Generally, maximum shock loads are experienced in a rigging system when the rigged piece is not gradually decelerated or ”snubbed off”.

Testing and research has shown that the block and sling experience more than double the shock load force than any other part of the rigging system if the piece is “snubbed off,” a situation to be avoided whenever possible.

Cow Hitch with a Better Half

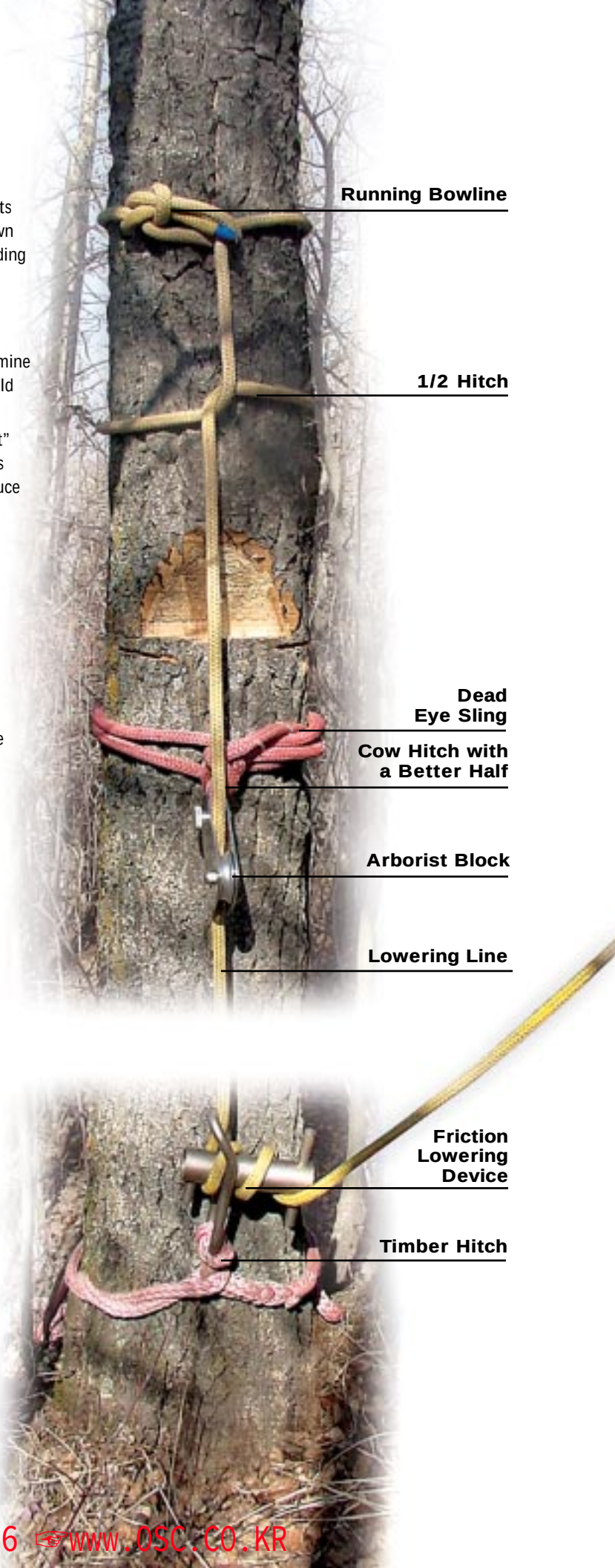
The cow hitch is essentially a girth hitch that is used to attach hardware to the tree. The hitch is easily tied and untied even after heavy loading. It is secure and reliable as it does not slip or come undone when finished with a better half. The better half is a half hitch in which the tail finishes over the bight of the girth hitch, any excess tail should be tucked out of the way of the attached hardware.

Running Bowline with Half Hitch

These knots are used in conjunction with one another to attach rigging lines to tree sections that are being rigged for removal. The running bowline is easily untied. It securely chokes the piece when steady pressure is applied, similar to a lasso. The half hitch reduces loading on the running bowline and provides stability and holding power.

Timber Hitch

The Timber Hitch is sometimes used to attach a false crotch to a tree as a lowering devise to lower or hoist limbs. It should be considered somewhat unreliable because it has a tendency to slip or come undone. This can be minimized by tucking for a minimum of 5 wraps, spreading out the tucks over as much of the circumference of the trunk as possible, and ensuring that the hitch is loaded “against the bight” whenever possible.



This is a simplified & compressed view of one type of rigging system.

Slings: Whoopie and TreeRig

Whoopie Sling

Adjustable load rated lifting slings. The sling has a permanent eye splice at one end, and an adjustable eye at the other end that allows it to adapt to loads of various sizes. The adjustment allows snug lifting control and minimizes the number of fixed length slings required. With three sizes to choose from, there is a Samson Whoopie Sling for any lifting job. Each is permanently tagged with its capacity, polybagged and shipped in a carton.

WHOOPIE SLING PRODUCT SPECIFICATIONS

SIZE	COLOR	UNIT WEIGHT	ADJUSTMENT LENGTH	PERM. EYE SIZE
1/2"	blue	1.2 lbs	2.5 ft. to 4 ft.	5-inches
5/8"	red	1.7 lbs	3 ft. to 5 ft.	6-inches
3/4"	orange	2.8 lbs	3.5 ft. to 6 ft.	7-inches

RATED CAPACITIES*

SINGLE LEG	CHOKER	BASKET
2,200 lbs	1,760 lbs.	4,400 lbs.
3,200 lbs	2,560 lbs.	6,400 lbs.
4,200 lbs	3,380 lbs.	8,400 lbs.

**Rated capacities are for slings in vertical lift use and spliced in accordance with Samson factory procedure. For angles other than vertical, multiply by the "Load Angle Factor" in the table shown to obtain the reduced rating based on the calculated sling lift angle.*

SLING ANGLE (FROM VERTICAL)	0°	15°	30°	45°	60°	75°
Load Angle Factor	1.000	.966	.866	.707	.500	.259

Strengths and working loads are for new, unused ropes with splices and no knots.

TreeRig™ Sling

Also know as a "Dead Eye" Samson TreeRig™ Slings are fabricated from Samthane™ coated Stable Braid™ spliced with a 6" eye splice on one end. These slings are commonly used to lash a block in place to establish a false crotch. Tie block with a cow hitch for best results.

TREERIG™ SLING

SIZE DIA.	COLOR	WGT. LBS.	LENGTH	PUT-UP
9/16"	Yellow	0.7	6'	Polybag (4)
9/16"	Yellow	0.9	8'	Polybag (4)
9/16"	Yellow	1.2	10'	Polybag (4)
9/16"	Yellow	1.6	14'	Polybag (4)
9/16"	Yellow	2.4	20'	Polybag (4)
5/8"	Red	0.9	6'	Polybag (4)
5/8"	Red	1.1	8'	Polybag (4)
5/8"	Red	1.4	10'	Polybag (4)
5/8"	Red	2.0	14'	Polybag (4)
5/8"	Red	2.8	20'	Polybag (4)
3/4"	Orange	1.1	6'	Polybag (4)
3/4"	Orange	1.5	8'	Polybag (4)
3/4"	Orange	1.8	10'	Polybag (4)
3/4"	Orange	2.5	14'	Polybag (4)
3/4"	Orange	3.6	20'	Polybag (4)
7/8"	Green	1.6	6'	Polybag (4)
7/8"	Green	2.2	8'	Polybag (4)
7/8"	Green	2.7	10'	Polybag (4)
7/8"	Green	3.8	14'	Polybag (4)
7/8"	Green	5.4	20'	Polybag (4)

PLEASE NOTE: Stable Braid strengths and working loads (on page 16) are for spliced rope. When used as a TreeRig Sling, additional bending and knot usage may further reduce rope strength with a corresponding reduction in work load limit. For safety considerations, the work load limit should not exceed 10% of the rope strength.

Other possible Sling Configurations Made with Tenex

Eye to Eye

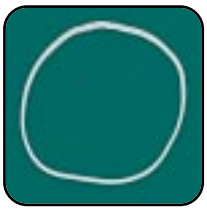
The Eye and Eye Split Tail is a fairly new innovation utilizing Tenex. This Split Tail is being used to tie a variety of highly effective friction hitches such as the Schwaebisch Prusik and the Distel Hitch.

Loopie

Single end Tenex loopie – An adjustable endless loop sling. This could be used, among other things, to attach an arborist block while in the tree. It is important to note that when used it is critical that when the sling is "choked" the attachment point for the sling is through the center of the buried part.

Endless Loop Sling

7/16" single end Tenex endless loop sling.



Spider Leg Balancer

Two end per carrier construction Tenex Spider Leg Balancer. This would be used either singly or with multiple "spider leg balancers" in conjunction with a lowering line to balance pieces being lowered to the ground. The lowering line would be affixed to the piece to be lowered. The "spider leg balancer" would be affixed to the lowering line using a friction hitch and then the free end of the spider leg balancer would be attached to the end of the piece opposite where the lowering line is affixed.

Stable Braid™

2-in-1® double braid construction consisting of a braided polyester cover over a braided polyester core.

Stable Braid is a 100% polyester double braid construction that is high strength, low stretch, low snag and durable. Bright Samthane™ Type A coating improves visibility and enhances resistance to abrasion and snagging. All sizes are color-coded for easy identification: 1/2-inch blue, 9/16-inch yellow, 5/8-inch red, 3/4-inch orange and 7/8-inch green.

FEATURES

- Low stretch
- Excellent abrasion resistance
- High strength-to-weight ratio
- Flexible and easy to handle
- Minimal UV degradation
- Torque-free

More about Samthane coatings on page 21.

STABLE BRAID

DIAM.	COLOR	AVERAGE STRENGTH	WORK LOAD	WT.PER 100'
1/2"	Blue	10,400 lbs.	1,040 lbs.	8.2 lbs.
9/16"	Yellow	13,300 lbs.	1,330 lbs.	11.0 lbs.
5/8"	Red	16,300 lbs.	1,630 lbs.	14.0 lbs.
3/4"	Orange	20,400 lbs.	2,040 lbs.	18.0 lbs.
7/8"	Green	29,900 lbs.	2,990 lbs.	27.1 lbs.

Strengths and working loads are for new, unused ropes with splices and no knots.

ELASTIC ELONGATION

(at percentage of average strength)

10%	1.1%
20%	1.7%
30%	2.7%

Elastic elongation based on rope stabilized from 200D²

STABLE BRAID	UNITS PER PACK				
PUT-UP	1/2"	9/16"	5/8"	3/4"	7/8"
150-foot Polybag	4	4	4	2	1
600-foot Reel	1	1	1	1	1

TreeRig™ Dead Eye Slings are made from Stable Braid and are available pre-fabricated. Please refer to page 15 for details.

12-Strand construction
of high tenacity polyester
with Samthane coating.

Tenex™

Tenex™ is a firm, round braided construction offering high strength, low stretch and outstanding abrasion resistance. The proprietary coating enhances the rope's firmness and resistance to abrasion and snagging. These characteristics make Tenex and excellent choice for rigging line and for slings.

Tenex is offered in a single end per carrier construction in sizes 3/8" diameter through 7/8" diameter. Tenex is also available in a double end per carrier, "sling construction". This version is more flexible and easier to splice than the single end version (due to the double ends per carrier) is also slightly heavier and stronger than the single end construction. The sling construction is available in 1/2", 5/8" and 3/4" diameter.

Both versions of Tenex are available with your choice of coating colors, clear, red, blue, green, orange, yellow or black.

More about Samthane coatings on page 21.

FEATURES

- Firm, round construction
- Excellent snag and abrasion resistance
- Easy to splice

TENEX – SINGLE END

DIAM.	AVERAGE STRENGTH	WORK LOAD	WT. PER 100'
3/8"	5,800 lbs.	580 lbs.	4.2 lbs.
1/2"	11,800 lbs.	1,180 lbs.	8.5 lbs.
5/8"	17,100 lbs.	1,710 lbs.	13.1 lbs.
3/4"	22,400 lbs.	2,240 lbs.	17.2 lbs.
7/8"	32,600 lbs.	3,260 lbs.	25.8 lbs.

ELASTIC ELONGATION

(at percentage of average strength)

10%	1.4%
20%	2.3%
30%	3.0%

Elastic elongation based on rope stabilized from 200D²

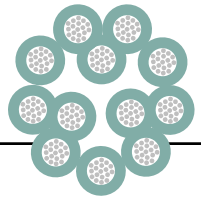
TENEX – DOUBLE END

DIAM.	AVERAGE STRENGTH	WORK LOAD	WT. PER 100'
1/2"	13,100 lbs.	1,310 lbs.	9.4 lbs.
5/8"	18,800 lbs.	1,880 lbs.	13.8 lbs.
3/4"	24,800 lbs.	2,480 lbs.	18.5 lbs.

Strengths and working loads are for new, unused ropes with splices and no knots.

TENEX	UNITS PER PACK				
PUT-UP	3/8"	1/2"	5/8"	3/4"	7/8"
150-foot Polybag	4	4	4	4	4
600-foot Reel	1	1	1	1	1

Arbor-Plex™



Twelve-strand braided construction of plied polyester and polyolefin fiber.

Arbor-Plex is an economical, torque-balanced twelve-strand rope. Its tightly braided construction holds its shape with use. Arbor-Plex has excellent wear resistance, it is light weight and has high strength. First offered in the 1970's as a rigging line, it is widely known and trusted as a "workhorse" for virtually all uses. Identified by a green ink stripe.

FEATURES

- Excellent wear and snag resistance
- Excellent knot holding ability
- Rot and mildew resistant
- Remains flexible throughout service life
- Non rotational
- Low stretch

A demonstration of advanced rigging techniques.

SPECIFICATIONS

SIZE / DIAMETER:	
5/8-inch	3/4-inch
WEIGHT PER 100 FEET:	
12.0 lbs.	16.2 lbs.
AVERAGE STRENGTH:	
9,000 lbs.	12,000 lbs.
WORKING LOAD:	
900 lbs.	1,200 lbs.

Average strength for new, unused rope with no splices and no knots.

ELASTIC ELONGATION (at percentage of average strength)	
10%	1.7%
20%	2.9%
30%	3.6%

Elastic elongation based on rope stabilized from 200D²

ARBOR-PLEX PUT-UP	UNITS PER PACK 5/8"	3/4"
150-foot Polybag	4	2
600-foot Reel	1	1

3-strand, twisted construction of spun and filament polyester jacket fibers covering polyolefin core fibers.

Pro-Master™

A firm and balanced three-strand rope offering reliability as well as economy. It holds its shape even under heavy use and the spun fiber on the surface offers excellent grip and knot holding. It is identified by a green surface tracer. For performance and price, there isn't a better three-strand rigging rope in the marketplace.

Measuring forces in rigging with a dynamometer.

FEATURES

- Lightweight, easy to handle
- High strength, low stretch
- Excellent knot holding
- Can be stored wet or dry
- Excellent chemical resistance

ELASTIC ELONGATION

(at percentage of average strength)

10%	2.0%
20%	3.2%
30%	3.9%

Elastic elongation based on rope stabilized from 200D²

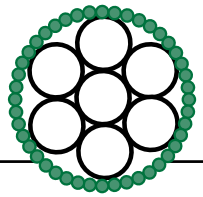
PRO-MASTER

DIAM.	AVERAGE STRENGTH	WORK LOAD	WT.PER 100'
1/2"	6,300 lbs.	630 lbs.	6.5 lbs.
5/8"	8,500 lbs.	850 lbs.	9.6 lbs.
3/4"	10,900 lbs.	1,090 lbs.	13.9 lbs.
7/8"	15,500 lbs.	1,550 lbs.	18.0 lbs.

Average strength for new, unused rope with splices and no knots.

PRO-MASTER	UNITS PER PACK			
PUT-UP	1/2"	5/8"	3/4"	7/8"
150-foot Polybag	4	4	2	1
600-foot Reel	1	1	1	1
1,200-foot Reel	1	1	1	1

Static Ropes



Kernmantle construction with polyester cover and heat – stabilized nylon core.

Static rope is designed to equal or exceed the 2001 NFPA standards. A firm body flexible Kernmantle construction designed to meet the demands of rescue, rappelling, and specialty rigging operations. It is a balanced non-rotational rope with a high tenacity solution dyed braided polyester cover over a heat stabilized nylon core.

FEATURES

- Excellent wear resistance
- Good shock mitigation
- Maintains firm round shape when working
- High strength to weight ratio

White

Yellow

Orange

Red

Black

ELASTIC ELONGATION

(at percentage of average strength)

10%	**3.2%**
20%	**4.5%**
30%	**6.0%**

Elastic elongation based on rope stabilized from 200D²

STATIC ROPES

DIAM.	MM	AVERAGE STRENGTH	WORK LOAD	WT.PER 100'
3/8"	9	5,700 lbs.	570 lbs.	4.2 lbs.
7/16"	11	8,200 lbs.	820 lbs.	6.0 lbs.
1/2"	12	11,000 lbs.	1,100 lbs.	8.0 lbs.
5/8"	16	13,500 lbs.	1,350 lbs.	11.2 lbs.

Average strength for new, unused rope with no splices and no knots.

STATIC ROPES	UNITS PER PACK			
PUT-UP	**3/8"**	**7/16"**	**1/2"**	**5/8"**
600-foot Reel	1	1	1	1

Samthane™ Coatings

Samson provides advanced technology in developing protective coatings and other chafe protection materials. If you have specialized requirements and need a wear problem solved, contact our Product Manager at the Ferndale facility.

Samthane™ coatings are a family of urethanes that are formulated for specific rope constructions and fiber types. These coatings are applied to match end-user requirements for improved wear-resistance, rope firmness, spliceability, and color identification.

SAMTHANE™ SELECTOR

Property	Samthane A	Samthane F	Samthane C	Samthane S
Spliceability	Yes	Yes	No	Yes
Shore Hardness	N.A.	N.A.	85 A	N.A.
Break Strength	2,500 psi	2,500 psi	5,400 psi	5,000 psi
Elongation at Break	610%	610%	450%	250%
Modulus at 300%	600 psi	600 psi	1,900 psi	N. A.
Type	Waterborne Polyurethane	Waterborne Polyurethane	2-part Polyurethane	Waterborne Polyurethane

SAMTHANE™ TYPES A, F AND S

All three coatings allow the rope construction to be hand spliced per appropriate splicing procedure for the product. Coatings are available in red, green, blue, black, orange, yellow and clear. All three coatings will increase rope weight by approximately 3% to 5%.

The Type S coating is the hardest of the three coatings and adds the most firmness and is generally used with single braid constructions.

Type A coating will create less product firmness than Type S and is generally used with double braid rope constructions.

Type F coating will generate the least firmness of the three coatings and is generally used on rope constructions that are firm by design.

All three coatings:

- **Enhance wear resistance**
- **Reduce snagging**
- **Reduce cutting**
- **Allow ease of splicing**
- **Offer color identification**

SAMTHANE™ TYPE C

A very durable urethane that is normally applied to a 1/8" thickness to protect ropes in extremely abrasive situations. Generally applied to specific sections of rope however it can be applied in up to 160-foot lengths. This is a non-spliceable coating and is applied to pre-fabricated ropes. The areas that are coated become stiffened and do not maintain the product's original flexibility. Type C can also be utilized for thimble encapsulation. Standard color is orange, other colors are available.

Fiber Characteristics

Using Nylon as a basis of 1.0

1. Bulk Strength is defined as strength per circumference squared.
2. Coefficient of Friction is based on reluctance to slip or slide.
3. Critical Temperature is defined as the point at which degradation is caused by temperature alone.
4. Cold Flow (Creep) is defined as fiber deformation (elongation) due to molecular slippage under a constant static loading situation. Fibers that have this inherent characteristic will display extremely low or negligible creep if minor fluctuations occur in the rate and/or frequency of load levels. In rope form, this would apply to polypropylene and Dyneema® (HMWPE) fibers.

FIBER CHARACTERISTICS

GENERIC FIBER TYPE	Nylon	Polyester	Polypropylene	Dyneema®	Technora®	Manila
Bulk Strength[1]	1.0	1.05	.6	3.1-3.5	2.6	.5
Weight	1.0	1.21	.80	.85	1.22	1.21
Elongation of fiber @ break	1.0	.60	.55	.24	.22	.5
Coefficient of Friction[2]	.10 – .12	.12 – .15	.15 – .22	.08	.12 – .15	.15
Melting / Decomposition Temp	460℉	480℉	330℉	297℉	900℉	Chars @ 350F
Critical [3] Temperature	350℉	350℉	250℉	150℉	450℉	180℉
Specific Gravity	1.14	1.38	.91	.97	1.39	1.38
Cold Flow (Creep)[4]	Negligible	Negligible	Negligible to High	Negligible to High	Negligible	Negligible

Technical Information

A continuing commitment to quality and innovation

Through the years, Samson has worked closely with the leading fiber manufacturers to develop new products utilizing the latest in fiber technology. Our experience has resulted in the establishment of Samson's development and testing facilities and the implementation of the Samson Quality Assurance Program.

Samson's complete arborist product line includes climbing lines, rigging lines, and rigging accessories – all designed specifically for the professional.

The development and testing facility maintains fully certified testing capabilities for tensile/break testing to 1,100,00 pounds, wet and dry abrasion testing, rope analysis for construction and fiber type, and termination expertise and development.

To ensure Samson products consistently meet the highest standards, we have developed a Quality Assurance Program that conforms to Military Standards. Routine inspections, analysis and testing of finished products assures highest quality. Computer generated production documents and individual specifications for all products mean Samson's products consistently meet the highest standards.

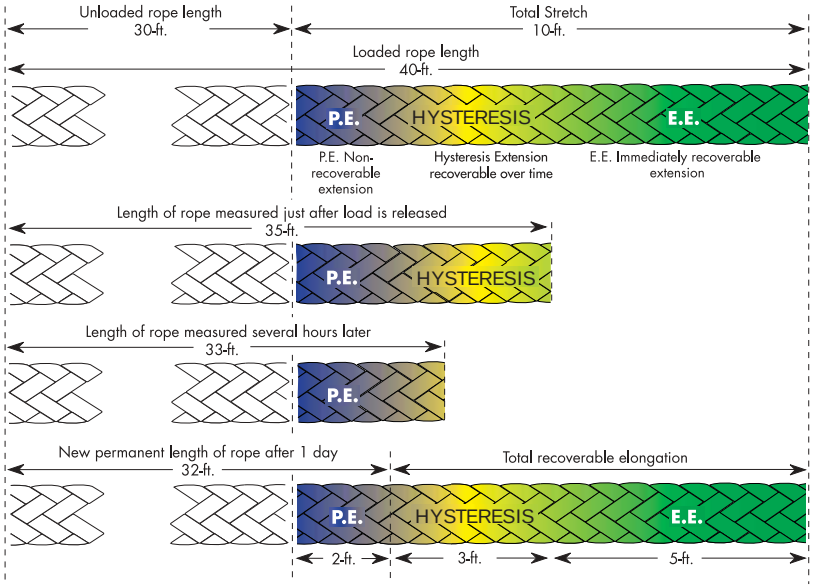
Elongation Data

To illustrate the three (3) basic states of extension, the following table lists Samson standard definitions used in reporting test information.

Elastic Elongation (E.E.): Refers to the portion of stretch or extension of a rope that is immediately recoverable after the load on the rope is released. This recoverable tendency is a primary result of the fiber (or fibers) used as opposed to the rope construction. Each type of synthetic fiber inherently displays a unique degree of elasticity. Relatively, HMWPE fiber has an extremely low elasticity compared to nylon fiber.

Hysteresis: Refers to a recoverable portion of stretch or extension over a period of time after a load is released. In measuring elastic recovery it is the recovery that occurs immediately when a load is removed. But thereafter, a remaining small percentage of elastic recovery will occur slowly and gradually over a period of hours or days. This retardation in recovery is measured on a length/time scale and is known as hysteresis or recovery over time.

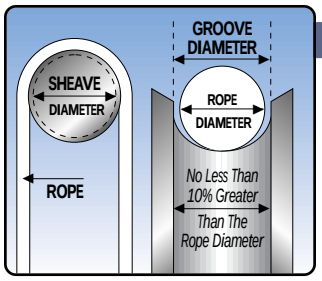
Permanent Extension (P.E.) After Relaxed = That portion of extension which, due to constructional deformation (compacting of braid and helical changes) and some plastic deformation of the yarn fibers prevent the rope returning the original length.



Permanent Extension (P.E.) While Working = The amount of extension which exists when stress is removed but no time is given for hysteresis recovery.
It includes the nonrecoverable and hysteresis extension as one value and represents any increase in length of a rope in a constant working situation such as during repeated surges in towing or other similar cyclical operations.

The percentage of Permanent Extension over the working load range is generally in order of 4 or 6% for braided ropes and two to three times as much for plaited – but will vary slightly with different fibers and rope constructions. In some applications – such as sub-surface mooring or devices that demand precise depth location and measurement, allowances must be made for this factor.

Creep Flow (Creep) = Fiber deformation (elongation) due to molecular slippage under a constant static loading situation. Fibers that have this inherent characteristic will display extremely lower or negligible creep if minor fluctuations occur in the rate and or frequency of load levels.



Sheave Diameter and Sizes

Sheave Diameters Should Be:

■ Twisted/Plaited = 10 times rope diameter ■ Braided = 8 times rope diameter

To assure maximum efficiency and safety, sheaves for braided ropes should be no less than eight (8) times rope diameter. The sheave groove diameter should be no less than 10% greater than the rope diameter. The sheave groove should be round in shape. Sheaves with "V" shaped grooves should be avoided, as they tend to pinch and damage the rope through excessive friction and crushing of the rope fibers. Sheave surfaces should be kept smooth and free of burrs and gouges. Bearings should be maintained to ensure smooth rotation of sheaves.

Bending Radius

Any sharp bend in a rope, under load, decreases its strength substantially – and may cause premature damage or failure. Many rope users are surprised to learn that a simple overhand knot (a series of sharp bends) reduces rope strength by almost 50%.

In sizing the radius of Bitts, Fairleads, and Chocks, for best performance – the following guidelines are offered:
Where a rope bends more than 10 degrees around its bitts or chocks, or, for that matter, is bending across any surface – the diameter of that surface should not be less than 3 times the diameter of the rope. Another way of saying it is that – the diameter of the surface should be at least 3 times the rope diameter. A 4/1 ratio (or larger) would be better yet – as durability of the rope increases substantially as the diameter of the surface over which it is worked increases.

Standards for Strength and Usage

New Rope Tensile Strengths

New rope tensile strengths are based on tests of new and unused rope of standard construction in accordance with manufacturer's Standard Test Methods. It can be expected that strengths will decrease as soon as a rope is put into use. Because of the wide range of rope use, changes in rope conditions, exposure to the many factors affecting rope behavior, and the possibility of risk to life and property, it is impossible to cover all aspects of rope applications or to make blanket recommendations as to working loads.

Working Loads

Working loads are for rope in good condition with appropriate splices, in noncritical applications and under normal service conditions. Working loads are based on a percentage of the approximate breaking strength of new and unused rope of current manufacture. For our arborist rope products, when used under normal conditions, the working load percentage is 10% of published strengths. Normal working loads do not cover dynamic conditions such as shock loads or sustained loads, nor do they cover where life, limb or valuable property are involved. In these cases a lower working load must be used.

A higher working load may be selected only with expert knowledge of conditions and professional estimates of risk, if the rope has been inspected and found to be in good condition, and if the rope has not been subject to dynamic loading (such as sudden drops, snubs or pick-ups), excessive use, elevated temperatures, or extended periods under load.

Normal Working Loads

Normal working loads are not applicable when rope has been subject to dynamic loading. Whenever a load is picked up, stopped, moved or swung there is an increased force due to dynamic loading. The more rapidly or suddenly such actions occur, the greater the increase will be. In extreme cases, the force put on the rope may be two, three, or even more times the normal load involved. Examples could be ropes used as a tow line, picking up a load on a slack line, or using rope to stop a falling object. Dynamic effects are greater on a low elongation rope such as polyester than on a high elongation rope such as nylon, and greater on a short rope than on a long one. Therefore, in all such applications normal working loads as given do not apply, for more information see pages 24 through 26.

Dynamic Loading

For dynamic loading applications involving severe exposure conditions, or for recommendations on special applications, consult the manufacturer, for more information see pages 24 and 25.

Danger to Personnel

Persons should be warned against the serious danger of standing in line with a rope under tension. Should the rope part, it may recoil with considerable force. In all cases where any such risks are present, or if there is any question about the loads involved or the condition of use, the working load should be substantially reduced and the rope properly inspected before every use.

Winching Lines

Braided rope can develop a twist when constantly used on a winch. This makes handling more difficult and the rope should be relaxed and rotated in the opposite direction to remove a twist. To avoid this condition the direction of turns over the winch should be alternated regularly.

Splicing and Knots

Splices should be used instead of knots whenever possible because knots can decrease rope strength up to 50%. When splices are used, always use the manufacturer's recommended splicing procedures. When knots are used, be sure to take into consideration the knot's corresponding reduction to the rope strength and adjust your working load accordingly. For more information please see the Knots and Rigging section, pages 14 and 15.

Rope Inspection

Avoid using rope that shows signs of aging and wear. If in doubt, destroy the used rope.

No type of visual inspection can be guaranteed to accurately and precisely determine the actual residual strength. When the fibers show wear in any given area, the rope should be re-spliced, downgraded, or replaced. Check the line regularly for frayed strands and broken yarns. Pulled strands should be re-threaded into the rope if possible. A pulled strand can snag on a foreign object during rope operation.

Both outer and inner rope fibers contribute to the strength of the rope. When either is worn, the rope is naturally weakened. Open the strands of the rope and look for powdered fiber, which is one sign of internal wear.

A heavily used rope will often become compacted or hard which indicates reduced strength. The rope should be discarded if this condition exists.

Avoid All Abrasive Conditions

All rope will be severely damaged if subjected to rough surfaces or sharp edges. Chocks, bitts, winches, drums and other surfaces must be kept in good condition and free of burrs and rust. Pulleys must be free to rotate and should be of proper size to avoid excessive wear.

Avoid Chemical Exposure

Rope is subject to damage by chemicals. Consult the manufacturer for specific chemical exposure, such as solvents, acids, and alkalies. Consult the manufacturer for recommendations when a rope will be used where chemical exposure (either fumes or actual contact) can occur.

Avoid Overheating

Heat can seriously affect the strength of synthetic ropes. The temperatures at which 50 percent strength loss can occur are: Polypropylene 250°F, Nylon 350°F, Polyester 350°F. When using rope where the temperature exceeds these levels (or if it is too hot to hold), consult the manufacturer for recommendations as to the size and type of rope for the proposed continuous heat exposure conditions. When using ropes on a capstan or winch, care should be exercised to avoid surging while the capstan or winch head is rotating. The friction from this slippage causes localized overheating which can melt or fuse synthetic fibers, resulting in severe loss of tensile strength.

Storage

All rope should be stored clean, dry, out of direct sunlight, and away from extreme heat. It should be kept off the floor on racks to provide ventilation underneath. Never store on a concrete or dirt floor, and under no circumstances should cordage and acid or alkalies be kept in the same vicinity. Some synthetic rope (in particular polypropylene or polyethylene) may be severely weakened by prolonged exposure to ultraviolet (UV) rays unless specifically stabilized and/or pigmented to increase UV resistance. UV degradation is indicated by discoloration and the presence of splinters and slivers on the surface of the rope.

Rope Inspection and Retirement

Since 1884 Samson has been producing premium quality ropes and cords. In the mid 1970's we began developing a climbing rope specifically for arborists, it was a braided 12 strand construction and was called Arbor-Plex. Today Samson offers a wide range of quality climbing and rigging ropes specifically for the arborist and we pride ourselves with the knowledge that we helped contribute to the growth and professionalism of the Arborist Industry.

In addition to the information on rope selection and usage shown here there are several other professional arborist associations and publications as well as performance specifications:

- **ANSI Z133.1 - 2000 and A300**
- **NAA (National Arborist Association)**
- **ISA (International Society of Arborculture)**
- **ASCA (American Society of Consulting Arborists)**
- **Tree Care Industry Magazine**
- **Arbor Age Magazine**
- **Arborist Equipment by Don Blair**
- **NFPA (National Fire Protection Association)**
- **Cordage Institute**

Using rope for any purpose subjects it to friction, bending and tension. All rope hardware, including pulleys and carabiners, as well as knots and hitches, are in varying degrees damaging to the rope and it is important to remember that rope will lose strength during use, even under ideal conditions. As an Arborist your safety depends upon how you manage this strength loss and making sure ropes are retired before they become dangerous. Your ropes are tools, the same as a chainsaw or a climbing saddle. Used properly they will give you consistent and reliable service. The cost of replacing a rope is very small compared to the damage or injury a worn out rope can cause.

Rope Life Factors

There are basically three steps to consider in providing the longest possible service life for ropes, the safest conditions and long range economy: Selection, Usage, and Retirement.

1. SELECTION: Select the right rope for the job in the first place:

Selecting a rope involves evaluating a combination of factors. Some of these factors are straight forward like comparing rope specifications. Others are less qualitative like a preference for a specific color or how a rope feels in your hand. Cutting corners, reducing application factors, sizes or strengths on an initial purchase creates unnecessary replacements, potentially dangerous conditions and increases long term costs. Fiber and construction being equal, a larger rope will outlast a smaller rope – because of the greater surface wear distribution. By the same token, a stronger rope will outlast a weaker one – because it will be used at a lower percentage of its break strength with less chance of over stressing.

Strength

When given a choice between ropes, select the strongest of any given size. A load of 200 pounds represents 2% of the strength of a rope with a breaking strength of 10,000 pounds. The same load represents 4% of the strength of a rope that has a breaking strength of 5,000 pounds. The weaker rope is having to work harder and as a result will have to be retired sooner. Braided ropes are stronger than twisted ropes that are the same size and fiber type and therefore are the most popular climbing lines.

Elongation

It is well accepted that ropes with lower elongation under load will give you better load control, a big help at complicated job sites. However, ropes with lower elongation that are shock loaded, like a lowering line, can fail without warning even though it appears to be in good shape. Low elongating ropes should be selected with the highest possible strength. Both twisted ropes and braided ropes are suitable for rigging. Twisted rope has lower strength and more stretch. Braided rope has higher strength and lower stretch.

Firmness

Select ropes that are firm and round and hold their shape during use. Soft or mushy ropes will snag easily and abrade quickly causing accelerated strength loss. Because the fibers are in a straighter line, which improves strength but compromises durability, loose or mushy rope will almost always have higher break strengths than a similar rope that is firm and holds its shape.

2. USAGE: Use rope properly: Observe recommended usage factors. Keep ropes clean and eliminate abrasion whenever possible.

Consider the opinion of professional climbers who may have more experience as to how well a rope performs. Consider also the reputation of the rope manufacturer. Are they involved with and supportive of the arborist industry? Do they stand behind their products with consistent quality and reliable service? Buying unproven ropes because they are a little less expensive is false economy and can lead to disaster.

Working Loads

Working loads are the loads that a rope is subjected to in everyday activity. They are normally expressed as a percentage of new rope strength and should not exceed 10%. A point to remember is that a rope may be severely overloaded or shock loaded in use without breaking. However, damage and strength loss may have occurred without any visible indication. The next time the rope is used under normal working loads the acquired weakness causes it to break. Do not blame the rope, it was simply overloaded and failed from what is known as fatigue.

Recommended Workload limit:

(expressed as a percent of new rope strength)

Rope Used	Braided	Twisted
Climbing Line	10%	10%
Rigging Rope	10%	10%

Shock Loads

Shock loads are simply a sudden change in tension – from a state of relaxation or low load to one of high load. Any sudden load that exceeds the work load by more than 10% is considered a shock load. The further an object falls, the greater the impact. Synthetic fibers have a memory and retain the effects of being overloaded or shock loaded and can fail at a later time even though loaded within the work load range.

Bending

Any sharp bend in a rope, under load, decreases its strength substantially and may cause premature damage and failure.

Sheave diameters on rotating sheave blocks

Twisted Rope = 10 times the rope diameter

Braided Rope = 8 times the rope diameter

Fixed PIN Termination Diameter:

The diameter on fixed pin termination should be at least 3 times the diameter –i.e., the bending radius for 1/2" rope should be 1-1/2"

Knots and Hitches

While it is true that a knot reduces rope strength, it is also true that a knot is a convenient way to attach a rope to tree limbs and other ropes. The strength loss is a result of the tight bends that occur in the knot. With some knots ropes can loose up to 50% of their strength which is part of the reason the work load limit should not exceed 10% of the rope strength.

Rope Storage

Keep your ropes as clean and dry as possible and store them in a coil away from heat sources. Many climbers keep their ropes in special rope bags which keeps them clean and makes them easy to identify at the job site.

3. RETIREMENT:

Retire rope from use when it has reached its discard point.

One of the most frequently asked questions is "When should I retire my rope?" The most obvious answer is before it breaks. But, without a thorough understanding of how to inspect it and knowing the load history, you are left making an educated guess. Unfortunately, there are no definitive rules nor industry guidelines to establish when a rope should be retired because there are so many variables that affect rope strength. Factors like load history, bending radius, abrasion, chemical exposure or some combination of those factors, make retirement decisions difficult. Inspecting your rope should be a continuous process of observation before, during and after each use. In synthetic fiber ropes the amount of strength loss due to abrasion and/or flexing is directly related to the amount of broken fiber in the rope's cross section. After each use, look and feel along every inch of the rope length inspecting for damage as listed below.

Abrasion

When the rope is first put into service the outer filaments of the rope will quickly fuzz up. This is the result of these filaments breaking and this roughened surface actually forms a protective cushion and shield for the fibers underneath. This condition should stabilize, not progress. If the surface roughness increases, excessive abrasion is taking place and strength is being lost. As a general rule for braided ropes, when there is 25% or more wear from abrasion the rope should be retired from service. In other words, if 25% or more of the fiber is broken or worn away the rope should be removed from service. With three-strand ropes, 10% or more wear is accepted as the retirement point.

Look closely at both the inner and outer fibers. When either is worn the rope is obviously weakened. Open the strands and look for powdered fiber which is one sign of internal wear. Estimate the internal wear to estimate total fiber abrasion. If total fiber loss is 20%, then it is safe to assume that the rope has lost 20% of its strength as a result of abrasion.

Glossy or Glazed Areas

Glossy or glazed areas are signs of heat damage with more strength loss than the amount of melted fiber indicates. Fibers adjacent to the melted areas are probably damaged from excessive heat even though they appear normal. It is reasonable to assume that the melted fiber has damaged an equal amount of adjacent unmelted fiber.

Inconsistent Diameter

Inspect for flat areas, bumps or lumps. This can indicate core or internal damage from overloading or shock loads and is usually sufficient reason to replace the rope.

Discoloration

With use, all ropes get dirty. Be on the lookout for areas of discoloration which could be caused by chemical contamination. Determine the cause of the discoloration and replace the rope if it is brittle or stiff.

Inconsistency in Texture and Stiffness

Can indicate excessive dirt or grit embedded in the rope or shock load damage and is usually reason to replace the rope.

Temperature

When using rope, friction can be your best friend or worst enemy if it is not managed properly. By definition, friction creates heat, the greater the friction, the greater the heat buildup. Heat is an enemy to synthetic fiber and elevated temperatures can drastically reduce the strength and or cause rope melt-through.

The critical and melting temperatures for synthetic fibers are listed below:

TEMPERATURES	Critical	Melting
Polypropylene	250°F	330°F
Dyneema®	150°F	297°F
Technora	450°F	900°F*
Nylon	350°F	460°F
Polyester	350°F	480°F
Manila	180°F	350°F*

*While the term "melting does not apply to these fibers, they do undergo extreme degradation at these temperatures: Technora and Manila char.

High temperatures can be achieved when surging rope on a capstan, checking ropes on a cable, running over stuck or non-rolling sheaves or rollers. Each rope's construction and fiber type will yield a different coefficient of friction (reluctance to slip) in a new and used state. It is important to understand the operational demands and insure the size, rope construction and fiber type be taken into account to minimize heat buildup.

Never let ropes under tension rub together or move relative to one another. Enough heat to melt the fibers can buildup and cause the rope to fail as quickly as if it had been cut with a knife.

Always be aware of areas of heat buildup and take steps to minimize it; under no circumstances let any rope come in contact with an exhaust muffler or any other hot object.

The strength of a used rope can be determined by testing but the rope is destroyed in the process so the ability to determine the retirement point before it fails in service is essential. That ability is based on a combination of education in rope use and construction along with good judgment and experience. Remember, you almost always get what you pay for in the form of performance and reliability.

Rope Inspection and Retirement

Volume Reduction

Below: Rope displaying original bulk.

Above: Rope displaying 25% strand volume reduction from abrasion – rope should be retired from service.

Note: *Amount of volume reduction that indicates retirement depends on rope construction. Refer to "check list" below.*

Below: Rope Strands showing full volume.

Above: Rope strands reduced by 25% abrasion.

Cut Strands

Rope displays two adjacent cut strands. This rope should either be retired or the cut section should be removed and the remaining rope re-spliced.

Note: *Number of cut strands that indicate retirement depends on rope construction. See "check list" below.*

Compression

Rope exhibits fiber-set from compression. A slight sheen is visible. This is not a permanent characteristic and can be eliminated by flexing the rope. This conditions should not be confused with glazed or melted fiber (see Melting below.)

Melting or Glazing

Damage depicted at below caused by excessive heat which melted and fused the fibers. This area will be extremely stiff. Unlike fiber compression, melting damage cannot be mitigated by flexing the rope. Melted areas must be cut out and rope respliced or the rope must be retired.

ROPE INSPECTION CHECK LIST

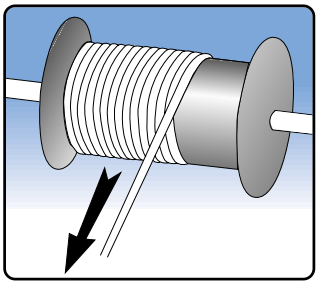
Condition	Discard Point
1. Original rope bulk reduced by abrasion:	
• Double braid* cover by 50%	✔
• Twelve-strand braid by 25%	✔
• Eight-strand plait by 25%	✔
• Three-strand by 10%	✔
2. Fiber strands cut:	
• Double braid* by three or more adjacent strands cut	✔
• Twelve-strand braid by two or more adjacent strands cut	✔
• Eight-strand plait by one or more adjacent strands cut	✔
• Three-strand by one or more adjacent strands cut	✔
**Refers to double braids that have both core and cover strength members.*	

Condition	Discard Point
3. Diameter inconsistency:	
• Localized diameter reduction	✔
• Flat areas	✔
• Lumps and bumps in rope	✔
4. Glossy or glazed fiber:	
• Localized or extended areas	✔
5. Inconsistency of texture:	
• Localized or extended areas of stiffness	✔
6. Discoloration:	
• Localized or extended areas	
• caused by chemical contamination	✔

Rope Handling

Removing Rope from Reel or Coil:

Synthetic fiber ropes are normally shipped on reels for maximum protection while in transit. The rope should be removed from the reel by pulling it off the top while the reel is free to rotate. This can be accomplished by passing a pipe through the center of the reel and jacking it up until the reel is free from the deck. Rope should never be taken from a reel lying on its side. If the rope is supplied on a coil, it should always be uncoiled from the inside so that the first turn comes off the bottom in a counter-clockwise direction.



Avoid Kinking and Hockling:

The continuous use of a line on one side of a winch or windlass is a common abuse which can render a line useless in a comparatively short time. Repeated hauling of a line over a winch in a counterclockwise direction will extend the lay of the rope and simultaneously shorten the twist of each strand. As this action continues, kinks (or hockles) will develop. Once these hockles appear, they cannot be removed and the rope is permanently damaged at the point of hockling.

If, on the other hand, the line is continuously hauled over a winch in a clockwise direction, the rope lay is shortened and the rope becomes stiff and will kink readily.

To avoid detrimental conditions, the direction of turns over the winch should be alternated regularly. Clockwise turns are recommended for the initial use of a new line. If this practice is observed, the original rope balance will be maintained and the lines will have a much longer useful life.

This condition also arises in the deep-sea mooring of free-rotating buoys where a three-strand rope will rotate until it spins and twists itself into hockles and eventually destroys itself. The use of swivels with three-strand ocean-towing hawsers, or transmission stringing lines, may also cause damaging hockles. The sudden release of a heavy strain may also cause hockles or hard kinks.

Excessive turns can cause kinking in any rope but hockles can occur only in the basic “twisted” ropes (three-strand, four-strand and cable-laid).

Braided and plaited ropes cannot be hockled; their inter-locking strand construction prevents the unlaying. Strands run in both directions creating a torque-free balance thus eliminating any inherent tendency toward twist or rotation. Swivels can be used safely but are seldom necessary. One word of caution here: when marrying a braided line to a twisted line (and also to wire rope) the twisted line can impart its twist to the braided line if the ropes are married without a swivel in between.

A braided or plaited rope, being torque-free, can have twist induced by constant working on winches and capstans. If a twist develops, it can easily be removed by “counter-rotating” when the rope is relaxed.

Coiling and Flaking:

Three-strand ropes should be coiled in a clockwise direction (or in the direction of the lay of the rope) and uncoiled in a counterclockwise direction to avoid kinks. An alternate and perhaps better method is to flake out the line figure-eight fashion. This avoids putting twist in the line in either direction and lessens the risk of kinking.

Figure “8”

Great care must be taken in the stowage and proper coiling of three-strand ropes to prevent the natural built-in twist of the line from developing kinks and damaging hockles.

Braided ropes on the other hand have no built-in twist and are far more resistant to kinking. Even if kinks do develop they cannot develop further into hockles.

The best method for making up braided rope for deck stowage is in figure-eight fashion either flaked flat on the deck or figure-eight vertically around bulkhead cleats. It should not be hand coiled in either direction as this merely puts turn into the line which may develop into kinks when paying-out. Remember that there is no turn or twist in the line to begin with so do not produce it by coiling.