



ROPE USER'S MANUAL

Guide to Rope Selection, Handling,
Inspection and Retirement

SamsonRope.com



WARNING STATEMENT



THE IMPROPER USE OF ROPE MAY BE DANGEROUS.

Rope WILL FAIL if worn-out, overloaded, misused, damaged or improperly maintained or abused.
Rope failure may cause death, serious injury, or property damage.

PROTECT YOURSELF AND OTHERS:

- > ALWAYS INSPECT rope for WEAR, DAMAGE, or ABUSE.
- > NEVER USE rope that is WORN-OUT, DAMAGED, or ABUSED.
- > Ropes are used for a variety of personal and commercial applications. To minimize the risks associated with product misuse, obtain the appropriate training for the specific application before using the rope.
- > Use the right size and rope construction for the intended application.
- > Never stand in line with or in the general path of rope under tension to avoid the risk of injury caused by recoil.
- > Avoid rope contact with abrasive surfaces.
- > Do not overload rope, shock load rope, or bend rope over sharp corners.
- > Check temperature rating of rope product before using rope in hot environments.
- > If in doubt about the condition of the rope, retire it.

BE ADVISED:

Samson provides the information and instructions set forth herein regarding rope use, inspection and retirement as general guidance. User is responsible to comply with industry/application safety standards, best practices, and/or employer policies regarding the use of rope. Further, a wide range of factors potentially affect product performance. Accordingly, user must obtain the appropriate training for the specific application before using the rope.

SAMSON'S MOST CURRENT CONTENT REGARDING ROPE USE, INSPECTION, AND RETIREMENT CAN BE FOUND AT **SamsonRope.com**. THE INFORMATION FOUND AT **SamsonRope.com** MAY SUPERSEDE THE INFORMATION IN THIS AND PREVIOUS PRINTED MATERIALS.

ABOUT SAMSON

For over 140 years, Samson has been recognized as a worldwide leader in the development and manufacture of high-performance ropes. Among its many innovations, Samson invented the double braid and pioneered the first high modulus polyethylene fiber ropes. Today, Samson engineers continue to pioneer the use of new fiber technology and the development of innovative coatings and constructions to produce ropes with unprecedented performance characteristics. Samson's research and development team is meeting an ever-expanding market need for products with exceptional performance in critical applications.

SamsonRope.com

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Importance of Proper Rope Selection, Handling, Inspection, and Retirement

Maximizing safety and service life begins with selecting the right rope, managing its proper functionality through optimal handling practices, and retiring it from service at the appropriate time — dictated by the characteristics of its application. Ropes are serious working tools, and when used properly they will give consistent and reliable service.

Maximizing safety and service life begins with selecting the right rope, managing its proper functionality through optimal handling practices, and retiring it from service at the appropriate time.

ROPE SELECTION **Select the right rope for the job**

Selecting a rope involves evaluating a combination of factors. Some of these factors are straightforward, like comparing rope specifications; others are not easily quantified, such as a preference for a specific color or how a rope feels in your hand. Due to this complexity, it is important for users to consider which variables are critical for their application in order to select rope products that are truly fit-for-purpose. The most common considerations are outlined in detail below:

STRENGTH

Rope tensile strength is one of the characteristics most commonly utilized for selecting rope products. In general, it is important to match a rope's strength to the requirements of the application. Oftentimes such requirements are clearly stipulated by regulatory and certification bodies or other safety requirements. The strength should always be some factor greater than the intended working load for a given application. While there is a tendency to select products with the highest tensile strength possible, care should be taken to assure other performance properties are not sacrificed.

Our published strengths and test results reflect, as accurately as possible, the conditions under which the ropes are to be used. Because the vast majority of ropes are terminated with a splice, most published strengths herein are spliced strengths, unless otherwise noted. This assists the customer in selecting the appropriate size and strength of rope for the application, and to ensure the utmost in safety and length of service life. When comparing our data to that of other rope manufacturers, please be sure that comparable strengths (spliced or unspliced) are used. *See Published Strengths and Testing section for additional information on page 17.*

It is important for users to consider which variables are critical for their application in order to select rope products that are truly fit-for-purpose.

When comparing our data to that of other rope manufacturers, please be sure that comparable strengths (spliced or unspliced) are used.

WORKING LOADS & SAFETY FACTOR

Working loads are the loads that a rope is subjected to under expected or typical working conditions. For rope in good condition, with appropriate splices, and under normal service conditions, working loads are based on a percentage of the breaking strength of new and unused rope.

Working loads, often called working load limits (WLL), are calculated by dividing the rope minimum breaking strength (MBS) by the required safety factor (sf).

$WLL = MBS \div sf$

Safety factor recommendations vary in accordance with the different safety practices and policies—typically determined through local regulatory standards, industry best practices, or internal safety, design, and retirement criteria. However, for rope used under normal conditions, where the circumstances described below do not apply, our general recommendation (which is commonly accepted for most industries) is a minimum 5:1 safety factor, or a 10:1 safety factor for climbing lines. Thus, your maximum working load should be approximately 1/5th (20%) or 1/10th (10%), depending on the required safety factor, of the quoted spliced rope breaking strength. This factor helps to provide greater safety and extends the service life.

Normal working loads do not account for dynamic conditions such as shock loads or long-term sustained loads; nor for the extra caution required where life, limb, or valuable property are involved. In these cases, a higher safety factor should be used. A lower safety factor (or 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 pickups), excessive use, elevated temperatures, or extended periods under load. If these details are insufficient to make an informed design or product decision for the application, contact Samson.

Working loads, often called “working load limits” (WLL), are calculated by dividing the rope minimum breaking strength by the required safety factor.

IMPORTANT: It is important to note that many industries are subject to state and federal regulations on working load limits that supersede the manufacturer’s recommendation. It is the responsibility of the rope user to be aware of and adhere to those laws and regulations.

Normal working loads do not account for dynamic conditions such as shock loads or long-term sustained loads.

ELONGATION

Elongation properties of synthetic ropes are primarily driven by the elastic properties of the fiber type acting as the primary strength member. Modern synthetic fibers have significantly lower elastic elongation (higher modulus) when compared to traditional synthetic fibers. *See fiber characteristics information on page 16.*

When considering rope elongation properties, care should be taken to ensure the selected product is fit-for-purpose. Ropes with higher elastic elongation are typically used to provide a form of energy absorption in a system, while ropes with relatively low elongation (i.e., ropes made from high modulus polyethylene [e.g., HMPE] fiber, such as AmSteel®Blue) provide increased position control and less stored energy at a given load.

ELASTIC STIFFNESS

Samson now publishes a new data point—elastic stiffness (EA)—in its specification charts when describing ropes developed for sailing applications. Elastic stiffness is defined as the resistance of a line to stretch under load and is referred to as EA, based on $E \times A$, where E is the material's elastic modulus or Young's modulus (the intrinsic stiffness of the material), and A is the cross-sectional area of the material. It incorporates strength, diameter, material, and construction of the line—the characteristics of most concern to the user. *See Sample EA Use Calculations formula to the right.* These stiffness values are available for each diameter of recreational marine running rigging products, along with break strength and weight.

As a rule of thumb, the higher the elastic stiffness (EA), the stiffer the rope. This allows the user to compare the elastic stiffness of two different diameters of the same line or two different lines directly and, using a simple calculation, determine the change in length that the rope will exhibit under a given load. *For additional information see Samson Technical Bulletin, "Elastic Stiffness: A Better Measure for Selecting Ropes."*

Sample Elastic Stiffness (EA)
Use Calculations
EXAMPLE: How much change in length can be expect in a halyard when the load on it varies due to fluctuating wind speed?

BREAK STRENGTH (BS) = 7,700 lb.
ELASTIC STIFFNESS (EA) = 305,000 lb.

The halyard has a length under load of 57' and the initial line tension is 900 lb, increasing to 1,400 lb in gusts.

EA METHOD	
EA = $\frac{\Delta \text{Load}}{\Delta \text{Strain}}$	
$\Delta \text{Strain} = \frac{\Delta \text{Load}}{\text{EA}} = \frac{(\text{Load 2} - \text{Load 1})}{\text{EA}} = \frac{(1,400 - 900)}{305,000}$	
$\Delta \text{Strain} = .0016 = 0.16\%$	
Change in Length = $\Delta \text{Strain} \times \text{Length} = .0016 \times 57'$	
Change in Length = 0.09' or 1.1 inch	

DIAMETER AND LINEAR DENSITY (WEIGHT)

While rope strength is often the critical performance characteristic, special attention should be paid to rope diameter and linear density to ensure proper fit for an application and an expectation for suitable service life. Rope diameter specifications are nominal values and, during the initial phases of use, the actual diameter will decrease slightly — a process called bedding in. Due to this, if a specific application requires an accurate fit within equipment (i.e. operating on sheaves or passing through parts), close attention should be paid to the load-dependent sizing impacts involved as the affects of bedding in vary across rope products.

DYNAMIC LOADING

Working loads, as described herein, are not applicable when rope has been subjected to shock loading. Whenever a load is rapidly picked up, stopped, moved, or swung, there is an increased force caused by the dynamic nature of the movement. The force increases as these actions occur more rapidly or suddenly. These rapidly applied forces (shock loading) result in peak loads that may be higher than the minimum break strength (MBS) of the rope, resulting in immediate line failure. Depending on the product, shock loading may also weaken the rope, so that it fails at a later time, even though it is then loaded within the working load range.

For applications requiring accurate fit within equipment (i.e. operating on sheaves or passing through parts), close attention should be paid to the load-dependent sizing impacts involved.

Shock loading results in peak loads that may be higher than the MBS of the rope, resulting in immediate line failure.

Examples of applications where shock loading occurs include ropes used as a tow line, picking up a load on a slack line, or using rope to stop a falling object. In extreme cases, the force put on the rope may be significantly higher than the weight of the object involved — by a factor of three or more times. Shock loading effects are greater on a low elongation rope, such as ropes made from HMPE or aramid, than on a high elongation rope, such as nylon. Also, the load/force amplification will be greater on a shorter rope than on a longer one.

Where shock loads, sustained loads, or where life, limb, or valuable property is involved, it is recommended that an increased working load factor be used. These vary by industry, region, and application, so proper consideration should be given to ensure the rope selected is fit-for-purpose.

For dynamic loading applications that involve severe exposure conditions, or for recommendations on special applications, consult the manufacturer.

Where shock loads, sustained loads, or where life, limb, or valuable property is involved, it is recommended that an increased working load factor be used.

FIRMNESS, CONSTRUCTION, AND ABRASION

Rope firmness is a characteristic that is usually dictated by the type of construction. This property is not always critical, but for applications that require durability when exposed to mechanical abrasion and regular wear and tear, a firmer rope usually provides longer service life. Soft or loosely constructed ropes will snag easily and abrade quickly causing accelerated strength loss. A loosely constructed rope will typically have a higher break strength than a similar rope that is firm and holds its shape because the fibers are more effectively aligned along the axis of the rope, which improves strength but compromises durability. These properties should be well understood before selecting a rope construction.

It is important to choose the right rope construction for your application because it affects resistance to normal wear and abrasion. 12-Strand braided ropes have a round, smooth construction that tends to flatten out somewhat on a bearing surface. This distributes the wear over a much greater area, as opposed to the crowns of a 3-strand or an 8-strand rope.

ROPE CLASS

Samson categorizes its ropes as a Class I or Class II construction for splicing and testing purposes.

Class I ropes are produced with traditional fibers such as olefins (polypropylene or polyethylene), nylon, or polyester. These fibers impart the strength and stretch characteristics to the rope, which have tenacities of 15 grams per denier (gpd) or less and a total stretch at break of 6% or greater.

Class II ropes are produced with high-modulus fibers that impact the strength and stretch characteristics of the rope design which have tenacities greater than 15 gpd and a total stretch at break of less than 6%. Typical Class II ropes are produced with HMPE (high-modulus polyethylene), aramid, or LCP (liquid crystal polymer).

Both Class I and Class II ropes can be produced in various rope constructions such as 3-strand, 8-strand, 8x3-strand, 12-strand, 12x3-strand, 16-strand, double braids, or core-dependent braids.

For applications that require durability when exposed to mechanical abrasion and regular wear and tear, a firmer rope usually provides longer service life.

Refer to detailed construction information and visuals on page 11.

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

COMPONENTS OF STRETCH ON A LOADED ROPE:

PERMANENT ELONGATION (PE) WHILE WORKING: The amount of extension that exists when stress is removed but no time is given for hysteresis recovery. It includes the non-recoverable and hysteretic extension as one value and represents any increase in the length of a rope in a continual working situation, such as during repeated surges in towing or other similar cyclical operations.

The percentage of PE over the working load range will vary slightly with different fibers and rope constructions. For applications with critical length requirements, please consult Samson.

Allowances must be made for this factor in applications such as subsurface mooring or when using devices that demand precise depth location and measurement.

ELASTIC ELONGATION (EE): 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 primarily the result of the fiber(s) used as opposed to the rope construction. Each type of synthetic fiber inherently displays a unique degree of elasticity. Relatively speaking, Class II high-performance fiber ropes have extremely low elasticity compared to Class I nylon fiber ropes.

HYSTERESIS: Refers to a recoverable portion of stretch or extension over a period of time after a load is released. Most recovery occurs immediately when a load is removed. Thereafter, a remaining small percentage of 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.

Each type of synthetic fiber inherently displays a unique degree of elasticity.

PERMANENT ELONGATION (PE) RELAXED: That portion of extension which, due to construction deformation (compacting of braid and helical changes) and some plastic deformation of the yarn fibers, prevents the rope from returning to its original length.

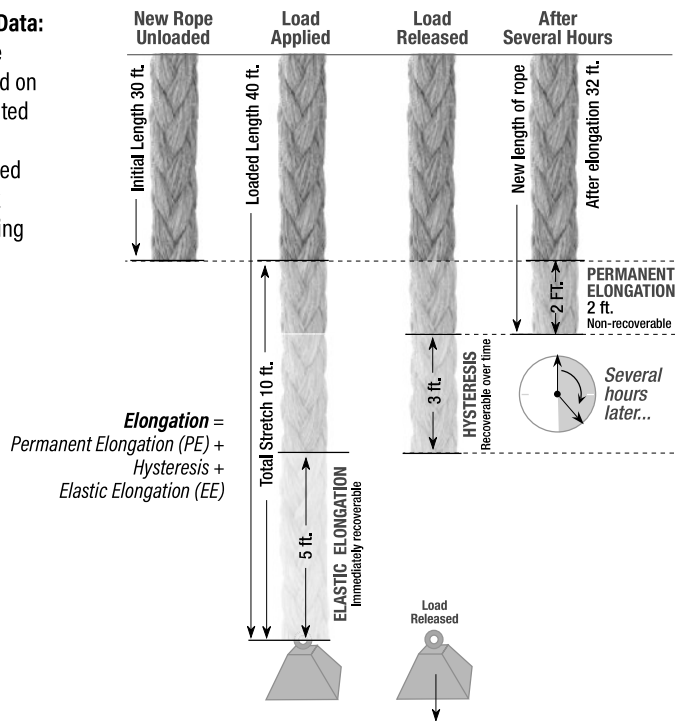
- **CREEP:** A material's slow deformation that occurs while under a constant static load over a long period of time. For example, creep would be a factor in permanent applications such as multi-year constant mooring or guy-wire installation for an antenna tower. Creep is mostly non-reversible. For some synthetic ropes, permanent elongation and creep are mistaken for the same property and the terms are used interchangeably when, in fact, creep is only one of the mechanisms that can cause permanent elongation. Some fibers, such as polypropylene and HMPE, exhibit characteristics of creep, but if minor fluctuations occur in the rate and frequency of load levels, these characteristics are negligible.
- **CONSTRUCTIONAL ELONGATION:** The elongation of a loaded rope that results from compaction as the fibers and strands align and adjust. This is the primary contributor to a rope's permanent elongation.
- **SPLICE SETTING:** The elongation of a spliced rope caused by the adjustment and settling of the strands in the splice. Splice setting also contributes to permanent elongation.

For some synthetic ropes, permanent elongation and creep are mistaken for the same property and the terms are used interchangeably when, in fact, creep is only one of the mechanisms that can cause permanent elongation.

COMPONENTS OF STRETCH ON A LOADED ROPE

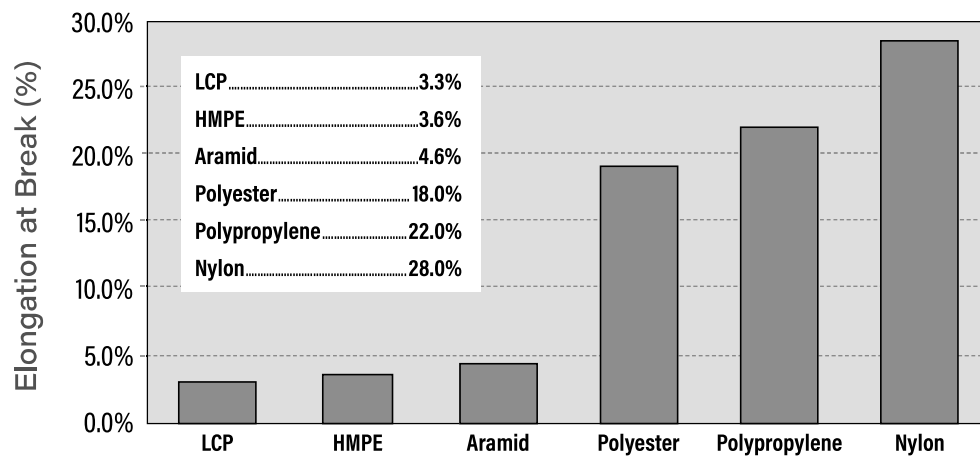
Published Elastic Elongation Data:

All reported values of clear rope elongation are an average based on tests of new rope, where evaluated samples have been stabilized with 50 load cycles to each stated percentage of its average break strength before the corresponding measurement is collected.



A loaded rope will primarily exhibit three components of stretch—elastic elongation, hysteresis, and permanent elongation. See page 13 for information on creep.

FIBER ELONGATION AT BREAK



Samson's computer-controlled rope test bed records precise elongation measurements.

SECTION B: TECHNICAL INFORMATION

A B C D

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COMPARISON OF FIBER CHARACTERISTICS

GENERIC FIBER TYPE	NYLON	POLYESTER	POLYPROPYLENE	HMPE	LCP	ARAMID
Tenacity (gpd) ¹	7.5 – 10.5	7 – 10	6.5	40	23 – 26	28
Elongation ²	15 – 28%	12 – 18%	18 – 22%	3.6%	3.3%	4.6%
Coefficient of Friction ³	0.12 – 0.15	0.12 – 0.15	0.15 – 0.22	0.05 – 0.07	0.12 – 0.15	0.12 – 0.15
Melting Point	425°– 490° F (218°–254° C)	480°– 500° F (249°–260° C)	330° F (166° C)	300° F (149° C)	625° F (329° C)	930° F* (499° C*)
Critical Temperature ⁴	325° F (163° C)	350° F (177° C)	250° F (121° C)	150° F (65.5° C)	300° F (148° C)	520° F (271° C)
Specific Gravity ⁵	1.14	1.38	0.91	0.98	1.40	1.39
Creep ⁶	Negligible	Negligible	Application Dependent	Application Dependent	Negligible	Negligible

* Char temperature — does not melt

¹ **TENACITY** is the measurement of the ultimate tensile stress of the fiber. gpd = grams per denier.

² **ELONGATION** refers to percent of fiber elongation at break.

³ **COEFFICIENT OF FRICTION** describes the fiber's resistance to slipping.

⁴ **CRITICAL TEMPERATURE** is defined as the point at which degradation is caused by temperature alone.

⁵ **SPECIFIC GRAVITY** is the mass density (g/cm³). Water has a specific gravity of 1, rope with specific gravity less than 1 floats.

⁶ **CREEP** is defined as a material's slow deformation that occurs while under load over a long period of time. Creep is mostly non-reversible. For some synthetic ropes, permanent elongation and creep are mistaken for the same property and used interchangeably when in fact creep is only one of the mechanisms that can cause permanent elongation.

PUBLISHED STRENGTHS AND TESTING

Because ropes are asked to perform in the real world, Samson published strengths and test methods reflect, as accurately as possible, the conditions under which the ropes are intended to be used. Since a majority of ropes in use are terminated with a splice, throughout this document, and wherever strengths are noted, all published data are for spliced ropes unless otherwise indicated. This ensures that rope size and strength selections are based on real-world conditions. If a product is listed as being non-spliceable, then break strengths are determined by wrapping the rope around the test pins to secure it, rather than attaching with spliced eyes. When comparing Samson data to strengths of other manufacturer's products, please ensure that comparable strengths are used (spliced or unspliced).

TESTING METHODS AT SAMSON Testing is a critical stage in the design and manufacture of new ropes, and in determining retirement criteria for used ropes. Samson has established test methods that comply with industry standard methods including CI-1500 and ISO2307. The result is more consistent, reliable data for our customers.

Samson R&D maintains capacity for testing synthetic rope to failure up to 1.1 million pounds. Tensile test machines utilized by Samson are fully computer controlled, provide automated cycle loading, and capture precise elongation measurements. All data is acquired, stored, calculated, and reported automatically.

All ropes are tested spliced, unless otherwise noted.



1.1 million pound tensile test machine

SAMSON'S TESTING METHODOLOGY COVERS:

- > Sampling of test specimens
- > Diameter
- > Determination of lay/pitch, picks per inch
- > Linear density
- > Breaking force
- > Initial elongation (uncycled elongation)
- > Cycled elongation
- > Tension fatigue
- > Wet testing
- > Stiffness
- > Abrasion resistance
- > Reporting procedures
- > Cyclic bend over sheave (CBOS)
- > Coefficient of friction (COF)
- > Spooling
- > Yarn on yarn (YOY)
- > Shock loading
- > Snagging

Samson was one of the first U.S. rope manufacturers to receive ISO 9001 certification, a natural progression of our existing quality assurance program that incorporates:

- > Integrated product development and production software that translates engineering specifications into production orders for manufacturing
- > Specialized production documents for processing high modulus fibers
- > Standardized procedures for inspection, analysis, and testing of in-process product as well as finished goods
- > Individual specifications for all products

Samson test methodology covers a wide range of rope characteristics.

Samson has maintained ISO 9001 certification since 1997, and is currently certified in accordance with ISO 9001-2015.

TYPE APPROVAL CERTIFICATIONS:

Based on our Quality Assurance Program, Samson has received product type approval certifications from:

ABS – American Bureau of Shipping

CE – Conformance Européenne

DNV – Det Norske Veritas

LR – Lloyds Register

UL – Underwriter's Laboratory

MEG4 Certification*

And others



Product certifications are available upon request with order placement. As a long standing, active member of the Cordage Institute and Eurocord, Samson has been a major contributor in developing standards and specifications on behalf of these organizations.

*To qualify for MEG4 certification, the manufacturing, testing, and documentation steps are carried out as instructed in MEG4 Appendix B, with the results captured on a uniquely formatted Base Design Certificate. A certifying class society (for example, ABS) reviews the product's documentation and alignment to the MEG4 requirements and, upon approval, provides their endorsement on the product's certificate. Having this certification enables the user to be in compliance with the latest industry guidance, adhere to terminal requirements, and easily compare the performance indicators of multiple products while ensuring they meet a performance baseline. For each product, the regime of tests and endorsement must be renewed every 5 years.

For a full list of Samson's technical references, visit www.SamsonRope.com.

ROPE HANDLING/USAGE Use rope properly

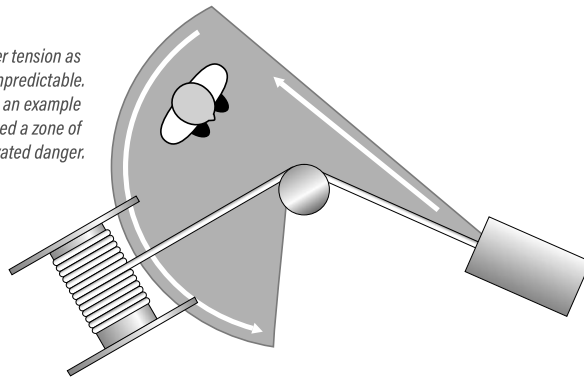
The use of rope for any purpose subjects it to varying levels and modes of tension, bending, friction, and mechanical damage; as well as a wide range of environmental variables such as temperature, chemical exposure, etc. Regardless of application, as fiber rope is exposed to particular service conditions it will begin to suffer some level of degradation. Maximizing rope performance and safety involves selecting the correct rope, using optimal handling during its use, and retiring it from service before it creates a dangerous situation. Ropes are serious working tools, and when used properly, they will give consistent and reliable service. The cost of replacing a rope is extremely small when compared to the physical damage or injury to personnel a worn out rope can cause.

Proper use and handling of the rope will extend service life and maximize safety.

DANGER TO PERSONNEL

In any application, 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 and speed. In all cases where such risks are present, or where there is any question about the load involved or the condition of use, the design safety factor should be substantially increased and the rope should be properly inspected before every use.

Do not stand near a rope under tension as recoil trajectory can be unpredictable. The areas marked in orange are an example recoil path, which is considered a zone of elevated danger.



Never stand near a rope under tension to avoid the risk of injury caused by recoil.

ROPE INSTALLATION CONSIDERATIONS

Prior to use, application specifics should be reviewed to understand the method of installation needed to ensure proper rope performance. Depending on the intended use, installation considerations may include, but are not limited to:

- > **Establishing proper tension and length (i.e. static applications)**
- > **Connection mechanism (winch drum, spliced thimble)**
- > **Back tension required to ensure effective spooling**

Rope performance will be influenced by the level of attention given to these factors during the installation process. It is highly recommended that the rope manufacturer be consulted if the user lacks experience handling and installing high-performance synthetic ropes. Examples of installation considerations are provided in the following sections.

RECEIVING ROPE ON REELS OR COILS

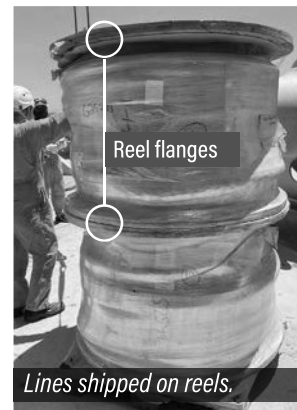
Rope on a reel refers to rope that has been spooled onto a reel, consisting of a cylindrical core drum and two flanges, one on either side, that help the spooled rope structure maintain its shape.

A coil is a rope structure that has been spooled, and then shipped without any additional hardware, and may be delivered with one or two coils on a pallet.

It is highly recommended that the rope manufacturer be consulted if the user lacks experience handling and installing high-performance synthetic ropes.



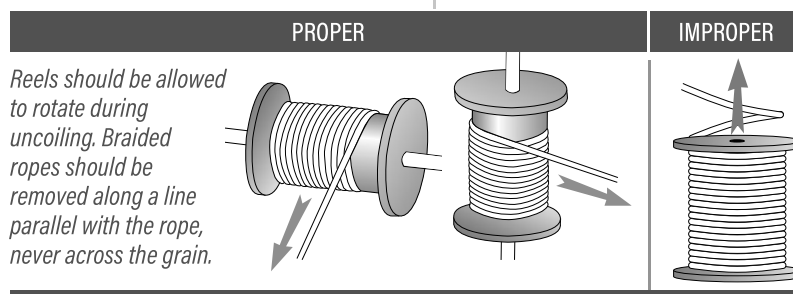
Lines shipped as coils.



Lines shipped on reels.

REMOVING ROPE FROM REEL

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.



REMOVING ROPE FROM A COIL

Coils should remain in packaging until you are ready to put the line into service or install it onto hardware such as a winch drum. Prematurely unpacking a coil will allow it to collapse, making deployment significantly more difficult.

Samson recommends dispensing from coils that are sitting on end, allowing the coil structure to be supported on the bottom by the surface on which it sits and gravity to assist in keeping the coil wraps compacted.

Attempting to unload a coil by passing a pipe horizontally through the bore is NOT recommended, as this will likely lead to the coil collapsing and the rope diving instead of dispensing. Once the packaging and binding that was applied during manufacture is removed, the coil can easily collapse, making deployment from this configuration difficult.



Do NOT unload a coil by placing a pipe through the bore, this will cause the coil to collapse.

REMOVING ROPE FROM A COIL (CONTINUED)

Coils can be deployed directly from the pallet using an aerial hoist and a swivel mechanism. Samson recommends this option for large, heavy coils. Run a 6–12 foot sling, strap, or grommet down through the bore, around the bottom of the pallet's edgewise mid-line 2x4, and back up through the bore. Connect the sling, strap, or grommet to the swivel. Connect the swivel to the hoist. If the pallet wood is in poor condition (rotten, broken, etc.), a bar or pipe may be passed through the pallet and under the coil to attach the sling. Lift the pallet so all four corners are slightly off the deck surface. Attach a tag line to the top of the swivel to limit sway and the twist imparted to the hoist line above. The pallet will equilibrate in a non-level configuration, supported by the bore resting against the center hoist line. This is normal and will not negatively affect installation, but care must be taken to ensure crew member safety and that the rope does not snag on the high corner of the pallet. Installation speeds should be slow and controlled.



Sling passed through the center bore of the coil. Top view.



Connection to pallet, from below.

Coils may be heavy. It is important to use well supported structural elements, such as the pallet's edgewise central 2x4 shown here with the overhead hoist method, to connect straps and slings.



Rotating turn-tables or lazy susans are also a good way to uncoil rope.



Coil and pallet (A) lifted slightly off the deck, allowing for free rotation during uncoiling. (B) Rope routing through pallet around structural elements.

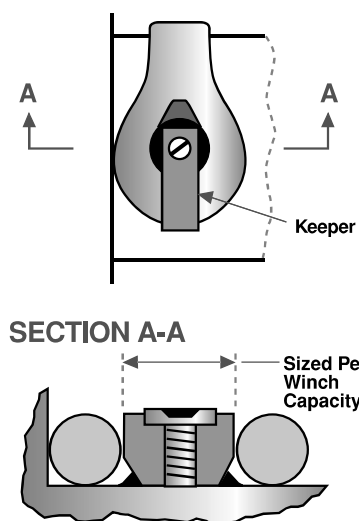
For additional information on removing rope from coils see, "Removing Rope From Coil Best Practices," available at SamsonRope.com/resources/technical-documents

ATTACHING LINE TO A WINCH DRUM

There are various methods of attaching a line to a winch drum including using a wedge or plug and set-screw in the main body of the drum, or using a "U" bolt through the side of the flange. Another method involves welding a round plug to the winch drum with the soft eye at the end of the line placed over the plug and held in place with a flat keeper. The preferred method will depend on the equipment and installer's ability to install a pre-spliced eye. If the rope connection is outside the drum flange, oftentimes an unterminated end is needed to ensure fit. In these cases, the rope manufacturer should be consulted to identify the proper splice or termination methods that complement the drum termination.

In all cases, the attachment method should not have a sharp edge that will cut the line under load. If possible, it is advisable to have an eye splice in both ends of the line so that it can be reversed in the event of damage to one end. However, this is not always possible depending upon the method of attachment to the winch drum and whether or not a closed thimble is spliced into the eye.

NOTE: Common winch terminations will not provide a full strength connection and rely on friction wraps to reduce tension observed at the attachment point.



Attach the end of the rope to the winch drum using the fittings and instructions supplied by the winch manufacturer.

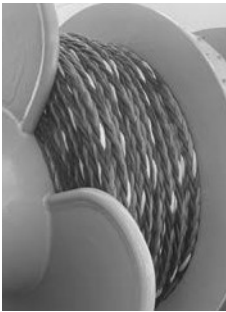
INSTALLING/TENSIONING WINCH LINES

Installing synthetic rope onto winches requires several specific considerations. Improper installation may prevent the rope from spooling effectively during use, causing a wide range of potential operational problems.

Install lines under adequate back tension to ensure proper packing and spooling performance. The exact tension required will vary depending on the size and strength of the rope, but indicators of proper tension include achieving a round compacted rope profile, firm wrap packing on the drum that cannot be shifted by hand, and a solid wall across flange openings in the case of split drum winches. If a controlled method for applying back tension is available at the time of installation, it is beneficial to install lines at higher tensions—approaching the intended working load of the system. However, specific care should be given to ensure lines are not running over rough surfaces or slipping around contact surfaces that can cause unnecessary damage in

the form of melting or fiber degradation. Depending on the number of layers of rope on the drum, installation of the bottom layers under maximum tension will help remove as much constructional elongation as possible from the rope and help avoid gaps from forming during service, which can increase the likelihood of rope diving. For new rope installations, a greater number of wraps/layers installed under the suggested tension will minimize or prevent subsequent wraps from diving or burying down into lower wraps. In certain instances, cross winding subsequent layers will help minimize line diving. (See page 29 for information on cross winding.)

Applying tension during installation creates a firm rope wall on the storage drum, minimizing diving.



Example of applying tension during installation.

For new rope installations, a greater number of wraps/layers installed using the suggested tension will minimize or prevent subsequent wraps from diving or burying down into lower wraps.

SPLIT-DRUM MOORING WINCHES: When determining the length of rope to be installed, allow enough rope that, when working, there is always a minimum of eight wraps on the working side of the winch drum. This ensures that the crossover point of the rope to the storage drum does not undergo significant tension.

SINGLE-DRUM WINCHES: In order to avoid a full working load from being applied to the winch connection, attention should be paid to define an appropriate minimum rope wrap and/or minimum layer count on the drum. The suggested minimums will depend on the width of the winch drum and the effective coefficient of friction, but proper consideration will ensure that the connection point of the rope to the drum does not undergo significant tension.

As the rope is used, the wrap tensions may loosen. If this is experienced, it is suggested that the rope be re-tensioned at original installation loads to prevent potential diving.



Maintain a minimum of eight wraps on the working side of the winch drum to prevent significant tension on the crossover point.

As the rope is used, the wrap tensions may loosen. If this is experienced, it is suggested that the rope be re-tensioned at original installation loads to prevent potential diving.

WINDING ONTO A WINCH

LEVEL WINDING: Using the appropriate amount of tension, wind the rope evenly, without spaces across the drum of the winch. The next level should wind over the previous layer of rope and follow the valley between turns on the previous level. This pattern is followed for all layers of rope, with each layer of turns slightly offset from the layer below.



DIVING: When the rope is placed under load it can dive, or push, into the previously wrapped level below it. To avoid diving, installation under increased tension or cross winding may be recommended.



LEVEL WINDING Guide the rope on to the winch drum during installation to prevent gaps between the wraps.

CROSS WINDING: When the rope is placed under load it can dive, or push into, the previously wrapped level below it. To avoid diving on a mooring winch storage drum, cross winding is recommended.

When cross winding, start with two layers of level wound rope using the appropriate back tension. At the end of the second layer, pull the rope quickly across the drum, allow it to wind one full turn at the side of the drum, then quickly pull it back to the opposite side of the drum. This will force the rope to cross in the middle and form a barrier that will prevent the rope from diving into the lower layers of the drum when placed under load. Follow the cross-wound layer with two layers of level wound turns, then form another cross. Repeat this pattern until the length of rope is fully spooled onto the winch.



*CROSS
WINDING
First Cross*



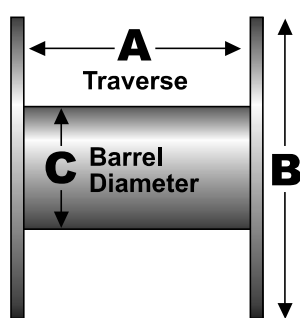
*CROSS
WINDING
Second Cross*



*CROSS
WINDING
Level Layer*

ROPE CAPACITY OF A WINCH DRUM
EFFECT OF ROPE DIAMETER ON DRUM CAPACITY

The formula for determining the length of rope that will fit on a winch drum is:



Length to be stored (feet) = $\frac{A(B^2 - C^2)}{15.3 (\text{rope dia.})^2}$

(Where A, B, C, and rope diameter are expressed in inches and length [L] is expressed in feet.)

Formula to calculate the storage capacity of a winch drum.

USE OF SLINGS WITH WINCH LINES

The winch line itself should not be used as a choker to pick up or pull objects (i.e., poles, vehicles). The hook attached on the end of the winch line can cut deeply into the rope itself. We recommend a separate line, sling, or strap be used as the choker and not the winch line itself.

END-FOR-ENDING

Samson recommends that winch line working ends be swapped (also called end-for-ending) on a periodic basis. This will vary high stress and wear points and can extend useful life. The recommended end-for-ending period will be highly dependent upon the nature of service, frequency of use, ability to perform the end-for-end process, and other factors. Regardless of end-for-end timing, a visual inspection should also be performed during the rope reinstallation.

SHARP CUTTING EDGES AND ABRASIVE SURFACES

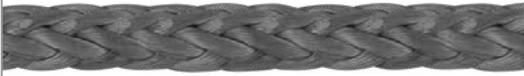
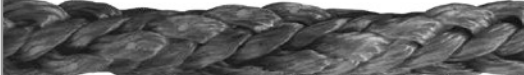
Samson lines should not be exposed to sharp edges and surfaces such as steel-wire gouge marks or metal burrs (on equipment such as winch drums, sheaves, shackles, thimbles, wire slings, etc.). This is especially important for lines under tension since our ropes are made from synthetic fibers and, as such, can be cut or damaged by sharp edges. When replacing winch lines, care must be exercised to ensure that the rope is not coming in contact with hardware that has been scored and chewed by previously used wire lines. When replacing steel-wire rope, in most cases it will be necessary to repair surface conditions of sheaves, shackles, thimbles, and other equipment that may contact the rope. Other surfaces should be carefully examined and dressed if necessary.

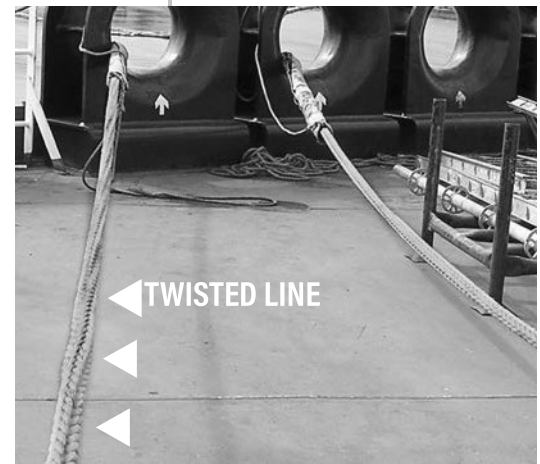
Winch line working ends should be swapped (also called end-for-ending) on a periodic basis.

Check all winch drum, sheaves, thimbles, and wire sling surfaces for sharp edges before use with a Samson winch line.

MINIMIZE TWIST IN THE LINE

Braided ropes are inherently torque neutral and, therefore, will not induce torque when tension is applied. However, it is important to prevent significant twist from being induced into the rope by outside factors such as handling, installation, or use in conjunction with a wire rope. Braided ropes that have been twisted can suffer from strength loss and accelerated degradation and therefore twist should be monitored and removed when identified. The impact of twisting braided lines is highly dependent on amount of twist and the size of the rope. When in doubt, Samson has helpful references at SamsonRope.com or contact Samson directly.

NO TWIST <i>Picks in a straight line</i>	
MODERATE TWIST <i>Picks not in a straight line</i>	
HEAVY TWIST <i>Picks spiral around the rope tightly</i>	



Example of twist in a line. As few as 3-4 turns per meter can have significant impact on the strength of a braided rope. Also, the effective strength loss due to twisting a braided rope is dependent on the size of the rope. While larger braided ropes are more resistant to being twisted due to their larger mass, they can suffer greater strength reduction if equal amounts of twist are, in fact, induced.

TEMPERATURE

High and low temperatures can influence rope performance in a variety of ways. Operating temperature conditions should be well understood and within the limits outlined in the table to the right. Generally speaking, extremely cold temperatures commonly will not have a negative impact on rope performance. However, moisture and subsequent freezing will impact a rope's handling and flexibility, but with no known negative long-term impact on rope life. High temperatures can reduce a rope's strength and fatigue resistance. If temperatures exceed the limits shown in Table 2, special care should be taken to ensure the product is fit-for-purpose.

High temperatures can also be a more localized phenomenon as a result of the rope moving through equipment in the system, where heat is generated by friction. In order to minimize this heat generation, ropes with appropriate coefficient of friction (i.e. grip) should be chosen based on the needs of the system and/or application.

High temperatures can be generated when checking rope on hardware or running them over stuck or non-rolling sheaves or rollers. Each rope's construction and fiber type will yield a different coefficient of friction (resistance to slipping) in a new or used state. It is important to understand the operational demands and take into account the size of the rope, construction, and fiber type to minimize localized heat buildup due to rope/hardware friction. Be aware of areas of heat buildup and take steps to minimize them.



Melting damage on AmSteel®Blue

CRITICAL* AND MELTING TEMPERATURES FOR SYNTHETIC FIBERS.

FIBER TYPE	CRITICAL TEMP.	MELTING TEMP.
HMPE	150° F (65° C)	300° F (150° C)
Polypropylene	250° F (120° C)	330° F (165° C)
Nylon	325° F (162° C)	425° F (218° C)
Polyester	350° F (176° C)	480° F (250° C)
Aramid	520° F (272° C)	930° F** (500° C**)

**Critical Temperature is defined as the point at which degradation is caused by temperature alone.*

***While the term "melting" does not apply to this fiber, it does undergo extreme degradation in these temperatures, and they char.*

TERMINATIONS

Samson recommends splicing as the preferred rope termination method. Knots can significantly decrease a rope's strength while, in most cases, splicing maintains 100% of the specified rope strength. Splice terminations are used in a vast majority of Samson rope testing to determine new and unused tensile strengths. *(If a product is listed as being non-spliceable, then break strengths are determined by wrapping the rope around the test pins to secure it, rather than attaching with spliced eyes.)*

EYE SPLICES: The standard eye splice cannot be pulled out under tension. However, some splice methods can be pulled out by hand when the line is in a relaxed state. To prevent such tampering, it is recommended that lock stitching be applied to the throat of the splice.

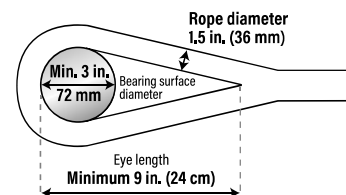
Eyes should be secured to a connection point with a bearing surface that is at least two times the diameter of the rope. For example, 1.5" (36 mm) diameter rope needs a 3" (72 mm) diameter minimum bearing surface. Thimbles may be needed to achieve this if the connection point would otherwise be too small.

The ratio of the length of an eye to the diameter of the object over which the eye is to be placed (for example, pin, shackle, bitt, cleat, etc.) should be a minimum 3:1 relationship. By using this ratio the angle of the two legs of the eye at its throat will not be so severe as to cause a parting or tearing action at this point (thimbles are normally designed with a 3:1 ratio).

Lock stitching may also prove advantageous on some splices to prevent no-load opening due to mishandling. The material required is one fid length of nylon whipping twine approximately the same size diameter as the strands in the rope you are lock stitching. You may download lock stitch instructions from our website SamsonRope.com, find them on our mobile app, or call customer service to receive them by mail.



The Samson Splice Training Kit comes complete with a fid, pusher, instructions for a double braid eye splice, and two lengths of double braided ropes.



Diameter of the bearing surface should be 2 times the rope diameter (2:1) and the eye length should be at least 3 times (3:1) the diameter of the object it will be placed over.

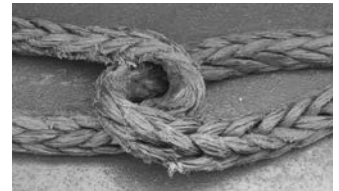
KNOTS: While a knot reduces rope strength, a knot can be a convenient way to terminate a rope for attachment to other hardware/equipment. The tight bends that occur in the knot result in strength loss. With some knots, ropes can lose up to 50% of their strength. However, this number can vary based on rope construction and fibers used. It is vital to take into account the reduction in strength by the use of knots when determining the size and strength of a rope to be used in an application. Whenever possible, spliced terminations should be used to maximize the rope strength for new and used ropes.

JOINING TWO ROPES

EYE-TO-EYE SPLICE CONNECTION: An eye-to-eye connection retains the highest percentage (up to 100% for similarly sized rope) of new rope breaking strength. This connection cannot be removed without re-splicing the ropes; however, splicing single braids is simple and easily performed in the field. If the ropes being joined are dramatically different sizes, consult with Samson to confirm suitability of such a connection without excessive strength loss.

COW-HITCH CONNECTION: Ropes can be attached with a cow-hitch connection. This allows ropes to be disconnected without having to re-splice. However, this is a less efficient method and results in strength loss of approximately 15% system strength for ropes of similar size (system strength based on the weaker component).

SOFT SHACKLE CONNECTION: Samson's Link-It™, Link-It™ Plus, and Link-It™ Max family of button-knot soft shackles are made from AmSteel®Blue, providing an easy to use, lightweight connection method. Replacing steel shackles or other connection types, Link-It soft shackles will not corrode or rust, are very light weight and have short connection lengths. To achieve the strength specified on the tag, Link-It shackles should be used with bearing surface diameters (hardware or connecting rope) that are at least 1.5 times greater than the shackle's base rope diameter, which is listed on the attached tag. Using Link-It shackles with smaller bearing surfaces will decrease the effective working load limits listed on the product tags and cause increased abrasion to the product.



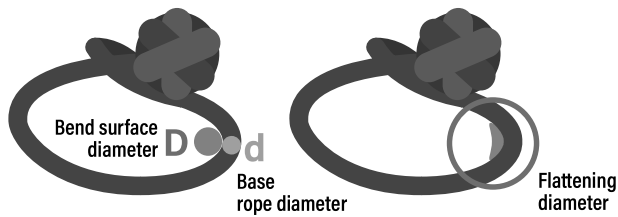
Eye-to-eye splice connection.



Cow-hitch connection.



Link-It soft shackle connection.



When a Link-It shackle connects to another rope, the round profile of the rope structure will flatten out under tension. This flattening effectively increases the bend diameter that both the Link-It and connected rope experience.

AVOID CHEMICAL EXPOSURE

STRENGTH RETENTION OF HMPE FIBER AFTER CHEMICAL IMMERSION
(HMPE strength retention after 6 months of immersion)

AGENT	HMPE	AGENT	HMPE
Sea Water	100%	5 M Sodium Hydroxide	100%
Hydraulic Fluid	100%	Ammonium Hydroxide (29%)	100%
Kerosene	100%	Hypophosphite Solution (5%)	100%
Gasoline	100%	Perchloroethylene	100%
Glacial Acetic Acid	100%	10% Detergent Solution	100%
1 M Hydrochloric Acid	100%	Bleach	91%

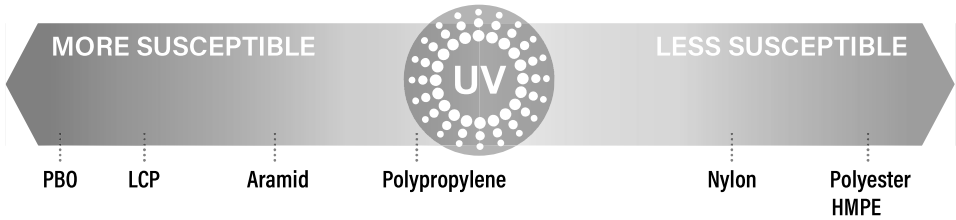
Consult Samson for recommendations when a rope will be used where chemical exposure (either fumes or actual contact) can occur.

STRENGTH DEGRADATION FROM ULTRAVIOLET LIGHT

Prolonged exposure of synthetic ropes to ultraviolet (UV) radiation from sunlight and other sources may cause varying degrees of strength degradation. Samson designs products with coatings, fibers, and other attributes to combat such effects. In coated ropes, darker pigments are able to absorb more UV radiation and prevent it from reaching the rope fibers. However, the best way to avoid UV degradation is to limit exposure. UV degradation may be seen as discolored fibers—rich or vibrant colors may appear faded, and whites may take on a yellowish hue. Note that discoloration does not necessarily indicate strength loss. Fibers may also become rough and splintered on the surface of the rope.

UV typically only penetrates the outer surface of a rope. A given depth of UV damage will cause less strength reduction to a larger rope than a smaller one. However, the twisted and braided construction of ropes means that many fibers will find their way to the surface at some point and will thus have areas of exposure. In double braided constructions, only the cover is likely to experience the effects of UV exposure. Non-load bearing covers, such as in core-dependent double braids or chafe protection, provide excellent UV protection.

Each fiber type responds differently to the effects of UV exposure. While users of all ropes should work to limit exposure to UV, extra consideration should be given to those fibers that are particularly susceptible, such as PBO, LCP, aramid, and polypropylene. The magnitude of UV damage is dependent on fiber type, construction, coating, and color.



Prolonged exposure of synthetic ropes to ultraviolet (UV) radiation from sunlight causes varying degrees of strength degradation.

ROPE CLEANING

It's important first to understand how different fibers react when exposed to various contaminants and cleaning agents. Traditional fibers such as nylon, polyester, and olefin are generally resistant to alcohol, greases, and oils but have poor resistance to acids. High-performance fibers such as HMPE, Aramid, LCP, and PBO can withstand some acid exposure, alcohol, and alkali contact. Generally, greases and oils do not impact high-performance fibers. However, extended exposure, high concentration, and temperature of chemical interaction may cause degradation resulting in rope failure. Therefore, it's crucial to consider which chemicals the rope encounters and what products the rope is cleaned with to ensure rope life isn't cut short from exposure to chemicals and substances.

When deciding to clean a rope, Samson recommends using mild soap or liquid detergent in room-temperature water. Gentle agitation may be used to massage the fiber/strands to ensure the soap or solution is thoroughly worked in the braid structure. Avoid using excessive force, as this will lead to abrasion of the fiber. Clean room temperature water should be used to wash the soap or solution out of the rope by submerging the rope or pouring the water throughout the braid structure. The rope should dry at ambient temperatures in a location that supplies good airflow. Avoid direct sunlight, as UV exposure is harmful to the fiber. Certain circumstances may require disinfecting the rope. In this case, submerge the rope in 70% Ethyl or Isopropyl alcohol solution for a short duration (2-3 minutes) at room temperature. Alcohol solutions can reduce the fiber tenacity for some ropes, so the number of times an alcohol solution is applied throughout the lifetime of a rope should be limited.

Following proper cleaning procedures, the rope's performance should not be impacted (elongation, strength, weight, or diameter). After cleaning, continue to use the rope following Samson's recommended use and inspection procedures.

Following proper cleaning procedures, the rope's performance should not be impacted (elongation, strength, weight, or diameter). After cleaning, continue to use the rope following Samson's recommended use and inspection procedures.

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

STORAGE

All rope should be stored in a clean, dry area, out of direct sunlight, and away from extreme heat. It should be kept off the floor and on racks to provide ventilation underneath. Never store rope on a concrete or dirt floor, and under no circumstances should cordage and acid or alkalis be kept in the same vicinity. No shelf life has been established for synthetic fiber ropes and shelf life will vary based on storage conditions.

ROPE STORAGE: COILING, FLAKING, AND BAGGING

Great care must be taken in the stowing and proper coiling of 3-strand ropes to prevent the natural built-in twist of the line from developing kinks and 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.

Three-strand and braided 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 method is to flake out the line in a figure-eight. This avoids putting twist in the line in either direction and lessens the risk of kinking.

Bagging is the most common method of storing shorter lengths of smaller diameter braided or twisted lines. The rope is allowed to fall into its natural position without deliberate direction.



*Figure-eight
flaking*

*Coiling —
twisted ropes*



Hockle in a twisted rope.

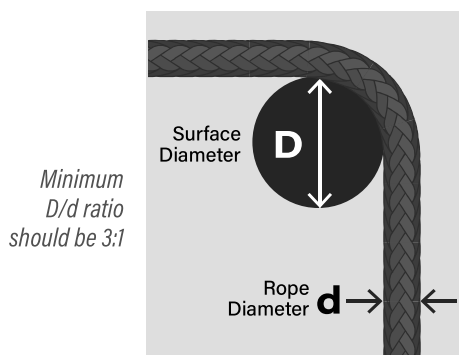
BENDING RADIUS

SIZING THE RADIUS OF BITTS, FAIRLEADS, AND CHOCKS

Any sharp bend in a rope under load decreases its strength and may cause premature damage or failure. In sizing the radius of bitts, fairleads, sheaves, and chocks for best performance, the following guidelines are offered: Where a rope is deflected more than 10 degrees around a surface (e.g., bitts or chocks), the effective diameter of that surface should be at least three times the rope diameter. Larger diameters may be required by specific industry guidelines and are better because the durability of the rope increases substantially as the diameter of the surface over which it is worked increases.

For mooring line applications MEG4 recommends a 15:1 D/d ratio. See *Samson's Mooring Manual* for additional information.

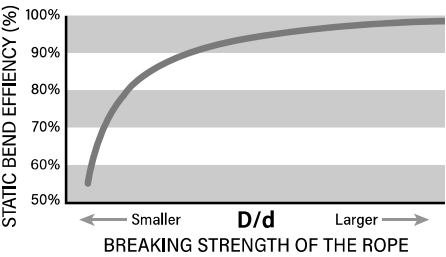
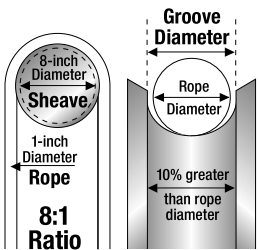
Where a rope bends more than 10 degrees around a surface (e.g., bitts or chocks), the effective diameter of that surface should be at least three times the diameter of the rope.



SHEAVE RECOMMENDATIONS

To ensure maximum efficiency and safety, sheaves utilized with ropes should be sized to align with existing industry standards for the specific application. In some cases, static or infrequent operation can allow for relatively low D/d ratios between the diameter of the sheave ("D") and diameter of the rope ("d"), however as the D/d ratio becomes smaller, the static strength and operational longevity will be reduced. 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.

Effect on rope strength when bent around sheaves or pins of various sizes



Twisted / Plaited:
10 times rope diameter
Braided: **8 times rope diameter**

TYPICAL BEND RATIOS BY USE CASE

APPLICATION*	MINIMUM D/d	WORKING LOADS	CONSIDERATIONS
Arborist Pulleys	3 to 4	Small	Minimize size & weight. Low cycle frequency.
Lifting Sheaves (<i>cranes, hoists, derricks, etc</i>)	15 to 18	Moderate	Maximize safety and rope lifespan. High cycle frequency.
Commercial Vessel Mooring Hardware	15	Significant	Maximize rope lifespan.
General Use, <i>short term</i>	8 to 10	Moderate	Size & cost. A limited rope lifespan and number of bend cycles is acceptable.

*Refer to industry standards for more specific guidelines for your region and application.

SPECIAL INSTRUCTIONS FOR DIELECTRIC ROPE

Rope that is specifically identified as dielectric, indicating it meets the electrical performance properties defined by IEC 62192 or ASTM F1701-12, as noted on the product tag, is a very poor conductor of electric current. Dielectric rope is designed to provide superior electrical insulation and is suitable for live working by skilled persons at the power frequency system voltages up to and including 800 kV r.m.s. This rope is not intended for live working procedures under rain or snow. The rope has not been qualified for Direct Current (DC) conditions. Do not use the rope for DC conditions without first contacting Samson at the address or numbers provided on the first page of this Guide and, letting them know of your intended use and discussing with the Samson representative the testing it has done on the rope in DC conditions. During the manufacturing process, different additives are applied to give this rope excellent dielectric performance, negligible water absorption, and improved UV resistance if handled properly. To ensure the highest dielectric performance, it is recommended to keep the rope free from debris, and in good working condition. The rope should be thoroughly inspected prior to use, following Samson's inspection guidelines. Although the rope is capable of use in high humidity conditions, it should not be used if it becomes wet or saturated with any liquid until it has been fully dried. Samson's dielectric ropes are compatible with most dielectric field-testers, which after the first use may be used to confirm the rope's dielectric performance prior to continued use. In addition to the standard selection, handling, and usage requirements for all synthetic ropes, store dielectric ropes away from UV and at temperatures below 85° Fahrenheit (30° Celsius). Contact with acids should be especially avoided. Inspect the rope regularly and



Samson's LightSpeed-3 is a dielectric 3-strand rope utilizing high-tenacity monofilament polypropylene fibers with an advanced coating solution.

discard if strands have any defects or signs of wear or breakage (even partial), and clean dielectric rope only with a dry cloth, never with solvents. Terminate and join dielectric rope according to Samson's standard splicing instructions for Class I ropes as set forth in Samson's splice manual found on Samson's website at SamsonRope.com.

The mechanical and physical properties of dielectric rope will remain in effect for at least five years from the date of manufacture when kept in its original packaging and stored according to manufacturer instructions.



The double triangle symbol means the rope meets or exceeds the electrical performance requirements of IEC 62192 as indicated on the product tag. Qualified Samson dielectric ropes also meet the electrical requirements of ASTM F1701-12.

ROPE INSPECTION & RETIREMENT

One frequently asked question 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 or industry guidelines to establish when a rope should be retired because there are so many variables that affect rope strength. Factors such as load history, bending radius, abrasion, chemical and environmental 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 cut strands, compression, pulled strands, melted or glazed fiber, discoloration, degradation, inconsistent diameter and abrasion. Glossy or glazed areas, inconsistencies in texture, and stiffness are indicators that the rope has been subjected to elevated temperatures, has embedded grit, or has been subjected to shock loading and possible loss of strength.

Factors such as load history, bending radius, abrasion, chemical and environmental 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.

VISUAL INSPECTION BY CONSTRUCTION

SINGLE BRAIDED ROPES In the case of 12-strand single braids such as AmSteel® and AmSteel®Blue, each of the 12-strands carries approximately 1/12th, or 8%, of the load. In 8-strand ropes, each strand carries 1/8th or 13% of the total load on the rope. If upon inspection, there are cut strands, significant abrasion, or other significant damage to the rope that result in a reduction of load bearing material, the rope must be retired or the areas of damage removed and the rope repaired with the appropriate splice.

DOUBLE BRAIDED ROPES The load-bearing capacity of double braid ropes, such as Stable Braid™, is divided equally between the inner core and the outer cover. If, upon inspection, there are cut strands, significant abrasion, or other significant damage the rope must be retired because the strength of the entire rope is decreased.

CORE-DEPENDENT DOUBLE BRAIDS Such as Turbo-RC™ and MLX3™ have 100% of their load-bearing capacity handled by the core alone. For these ropes, the jacket can sustain damage without compromising the strength of the load-bearing core. Inspection of core-dependent double braids can be less conclusive because it is difficult to see the load-bearing core.

For more information about Samson rope construction, refer to SamsonRope.com and browse products by construction.



Inspect for pulled strands



Inspect for internal abrasion



Compare surface yarns with internal yarns

CUT STRANDS

SINGLE BRAIDED ROPES Cut strands can significantly degrade the strength of a rope.

In 12-strand ropes, two cut strands in proximity necessitates that the rope be either repaired by cutting out the damaged section and re-splicing, or the rope must be retired. For 8-strand and 3-strand single braids, a single cut strand indicates that the rope must be repaired or retired.

DOUBLE BRAIDED ROPES In these ropes the cover is often composed of multiple yarns arranged in groups of two or three in the weave of the cover. Each group of yarns is considered a single strand of the cover braid. In standard double braids where the cover and core share the load, three or more cut strands in proximity indicate repair or retirement.

In core-dependent double braided ropes, 100% of the rope's strength is carried by the core. The cover functions as protection for the strength member. While cover damage does not affect the ropes' strength, a damaged cover can allow the strength-bearing core to be subjected to damage from abrasion or other mechanisms leading to reduction in strength. Covers should be repaired when damage is evident.

COMPRESSION

Often seen on winch drums, compression is caused by fiber molding itself to the contact surface while under a radial load. Compression can be identified by a visible sheen and stiffness that can be reduced by flexing the rope. Compression is not a permanent characteristic and does not have a significant impact on rope strength. Compression should not be confused with melted or glazed fibers. If fibers or strands remain fused together after flexing the rope, fiber may be melted or glazed (see below).



12-strand with cut strands



Double braid with cut strands



Example of 12-strand with compression

PULLED STRAND

Strands that are pulled away from the body of the rope, not cut or otherwise damaged, are usually caused by snagging on equipment or rough surfaces. This is not a permanent condition. Pulled strands can be carefully worked back into position in the braid by following the strand through the braid pattern and equalizing the tension to that of the surrounding strands.

MELTED FIBER / GLOSSY OR GLAZED AREAS

Glossy or glazed areas are signs of heat damage. The strength loss may be more than the amount of melted fiber indicates, as fibers adjacent to the melted areas are probably damaged from excessive heat even though they appear normal. The melted fiber will have likely damaged an equal amount of adjacent unmelted fiber and indicates a significant loss of strength.

DISCOLORATION

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

INCONSISTENT DIAMETER OR TEXTURE

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. Inconsistent texture or stiff areas can indicate excessive dirt or grit embedded in the rope or shock load damage and is usually reason to replace the rope.



12-strand with pulled strand



Double braid melted fiber



12-strand with discoloration



Double braid inconsistent diameter

ABRASION

When a 12-strand single braid rope, such as AmSteel®Blue, is first put into service, the outer filaments of the rope will tend to abrade and fuzz up. This is the result of these filaments breaking, which actually forms a protective cushion and shield for the fibers underneath. In most applications, this condition should stabilize, not progress. If the surface roughness increases, excessive abrasion takes place and strength is lost. When inspecting the rope, look closely at both the inner and outer fibers. When either is worn, the rope is degrading, and users should reference Samson's Inspection and Retirement tools for additional guidance (see page 49).

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.

To determine the extent of fiber damage from abrasion, a single yarn in all abraded areas should be examined. The diameter of the abraded yarn should then be compared to a portion of the same yarn or an adjacent yarn of the same type that has been protected by the strand crossover area and is free from abrasion damage.

As a general rule for braided ropes, when there is 25% or more wear from abrasion, or the fiber is broken or worn away, the rope should be retired from service. For double braid ropes, 50% wear on the cover is a common retirement point, and with 3-strand ropes, 10% or more wear is a common retirement point. Rope users operating in industries with specific retirement guidelines should follow those when establishing their discard thresholds

RESIDUAL STRENGTH TESTING

Samson offers customers residual strength testing of our ropes. Periodic testing of samples taken from ropes currently in service ensures that retirement criteria are updated to reflect the actual conditions of service.



*New
12-strand
rope*

*Used
12-strand
rope*

*Severely
abraded
12-strand
rope*

Inspection and Retirement Quick Reference Tool*

Any rope that has been in use for any period of time will show wear and tear. Some characteristics of a used rope will not reduce strength while others will. Below we have defined conditions that should be inspected for on a regular basis.

During your inspection you must consider the following before deciding to repair (when possible), downgrade, or retire your rope:

- > the length of the rope,
- > the time it has been in service,
- > the type of work it does,
- > where the damage is, and
- > the extent of the damage.

In general, it is recommended that you:

- > Repair the rope, when possible, if the damage is limited only to localized areas.
- > Retire the rope if the damage covers an extended area, or is localized damage that is significant and not repairable.

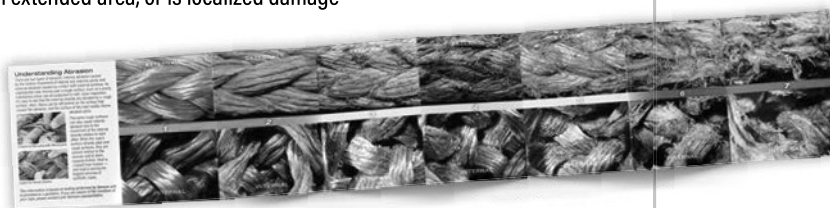
*Additional inspection and retirement information can be found in the Cordage Institute's publication *CI-2001 Fiber Rope Inspection and Retirement Criteria* and is available for purchase or download at www.RopeCord.com.

Samson offers additional product-specific inspection guides for Tenex™ Polyester Single Braids, Link-It™ Soft Shackles, and Taurus™ Lifting Slings — request a copy from customer service at CustServ@SamsonRope.com or find at SamsonRope.com



Samson App

This handy app features inspection and retirement criteria, internal and external abrasion inspection information, plus splice instructions. Download it from the app store.



12-Strand Inspection and Retirement Pocket Guide

Request a copy of this handy reference tool from your Samson representative.

SINGLE BRAIDS Examples included herein are the most common types of wear and damage to rope and are for illustration purposes only.**Cut Strands: REPAIR OR RETIRE**

WHAT > 12-STRANDS: Two or more cut strands in proximity
> 8-STRANDS / 3-STRANDS: One or more cut strands

CAUSE > Abrasion
> Sharp edges and surfaces

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*

**Compression: REPAIR**

WHAT > Visible sheen
> Stiffness reduced by flexing the rope
> Not to be confused with melting
> Often seen on winch drums

CAUSE > Fiber molding itself to the contact surface under a radial load

CORRECTIVE ACTION *Flex the rope to remove compression.*



Pulled Strand: REPAIR

- WHAT** > Strand pulled away from the rest of the rope
> Is not cut or otherwise damaged

CAUSE > Snagging on equipment or surfaces

CORRECTIVE ACTION *Work back into the rope.*



Melted or Glazed: REPAIR OR RETIRE

- WHAT** > Fused fibers
> Visibly charred and melted fibers, yarns, and/or strands
> Extreme stiffness
> Unchanged by flexing

CAUSE > Exposure to excessive heat, shock load, or a sustained high load

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*



SINGLE BRAIDS (CONTINUED)**Discoloration: REPAIR OR RETIRE**

- WHAT**
- > Fused fibers
 - > Brittle fibers
 - > Stiffness

- CAUSE**
- > Chemical contamination
 - > Common causes of discoloration (grease, paint, etc) are less serious than true chemical contamination

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*

**Inconsistent Diameter: REPAIR OR RETIRE**

- WHAT**
- > Flat areas
 - > Lumps and bumps

- CAUSE**
- > Broken internal strands
 - > Shock loading

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*



Abrasion: REPAIR OR RETIRE

WHAT > Broken filaments and yarns

CAUSE > Abrasion
> Sharp edges and surfaces
> Broken internal strands

CORRECTIVE ACTION Consult abrasion images* and rate internal/external abrasion level of rope. Evaluate rope based on its most damaged section.

- **Minimal strength loss (continue use)**
- **Significant strength loss (consult Samson)**
- **Severe strength loss (retire rope)**

*Refer to images on Inspection & Retirement Pocket Guide or Samson app

Request a copy of this handy reference tool from your Samson representative, or download the Samson app.



Open the rope and look for powdered fiber, which is one sign of internal abrasion.



To determine the extent of outer fiber damage from abrasion, a single yarn in all abraded areas should be examined. The diameter of the abraded yarn should then be compared to a portion of the same yarn or an adjacent yarn of the same type that has been protected by the strand crossover area and is free from abrasion damage.

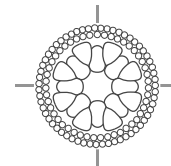
DOUBLE BRAIDS Examples included herein are the most common types of wear and damage to rope and are for illustration purposes only.**Double Braid vs. Core-Dependent**

Double braid ropes consist of a cover or jacket braided over a separately braided core. Samson produces two types of double braided ropes: standard double braids and core-dependent double braids.

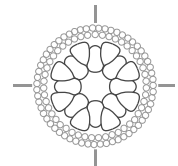
The strength of standard double braid ropes is shared between the cover and the core. Damage to the cover also usually affects the core and ultimately the strength of the rope.

In core-dependent double braids, the core is the strength member and carries the entire load. Damage to the cover of a core-dependent double braid may not compromise strength of the rope.

Inspection of both standard double braids and core-dependent double braids is essential to determining whether the rope can be repaired or if it needs to be retired.



**STANDARD
DOUBLE BRAID**
*Load shared between
cover and core.*



**CORE-DEPENDENT
DOUBLE BRAID**
*Load carried
by the core only.*

Cut Strands:

DOUBLE BRAID: *Repair or retire* **CORE-DEPENDENT:** *May not affect strength*

WHAT > Three or more cut strands in proximity

CAUSE > Abrasion
> Sharp edges and surfaces

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*



Compression: REPAIR

- WHAT** > Visible sheen
> Stiffness reduced by flexing the rope
> Not to be confused with melting
> Often seen on winch drums
- CAUSE** > Fiber molding itself to the contact surface under a radial load
- CORRECTIVE ACTION** *Flex the rope to remove compression.*



Pulled Strand: REPAIR

- WHAT** > Cover strand(s) pulled away from the rest of the rope
> Is not cut or otherwise damaged
- CAUSE** > Snagging on equipment or surfaces
- CORRECTIVE ACTION** *Work back into the rope.*

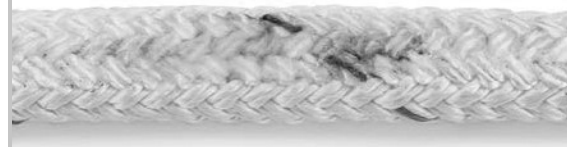


DOUBLE BRAIDS (CONTINUED)**Melted or Glazed:** REPAIR OR RETIRE

- WHAT**
- > Fused fibers
 - > Visibly charred and melted fibers, yarns, and/or strands
 - > Extreme stiffness
 - > Unchanged by flexing

CAUSE > Exposure to excessive heat, shock load, or a sustained high load

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*

**Discoloration:** REPAIR OR RETIRE

- WHAT**
- > Fused fibers
 - > Brittle fibers
 - > Stiffness

CAUSE > Chemical contamination

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*



Inconsistent Diameter: REPAIR OR RETIRE

WHAT > Flat areas
> Lumps and bumps

CAUSE > Shock loading
> Broken internal strands

CORRECTIVE ACTION *If possible, remove affected section and re-splice with a standard end-for-end splice. If re-splicing is not possible, retire the rope.*



Abrasion:

DOUBLE BRAID: *Repair or retire* **CORE-DEPENDENT:** *May not affect strength*

WHAT > Broken filaments and yarns

CAUSE > Abrasion
> Sharp edges and surfaces
> Broken internal strands

CORRECTIVE ACTION

DOUBLE BRAID: *If there is a 50% volume reduction of the cover yarns (or more), the rope should be retired.*

CORE-DEPENDENT: *If no damage to the core has occurred, the jacket can be repaired.*



NOTES:

[illegible]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Samson App

The Samson app brings you the latest in rope maintenance, innovation, and technology. Now it's easier than ever to track the condition of your rope while you are in the field.

The Samson App allows users to:

- > take the guesswork out of what to inspect.
- > pinpoint and document the exact positioning and severity of damaged ropes.
- > easily align rope condition to Samson retirement guidelines.
- > reduce time with automated reporting.
- > make informed decisions based on inspection results.

Find it at the app store!



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