VESSEL MOORING SYSTEM









MOORING SYSTEM SELECTION

Not an off-the-shelf decision

For owner/operators in today's shipping industry, safe working conditions, maximizing service life, and mitigating unnecessary failure of mooring lines are top priorities. Through proper vessel evaluation and selection of high-modulus polyethylene (HMPE) ropes, Samson will show you how to achieve all three.

We used to talk about mooring lines. However, with the advances in fiber and coating technology, and the innovations in chafe protection, we now talk about mooring systems. Selecting the right mooring system is **not a "one-size-fits-all"** proposition. Each component of the system should be considered independently; primary or

or the system should be considered independently; primary or secondary line, pendant, chafe protection, hardware, etc. Based on your specific needs, each component is selected to give you the best overall system and performance.

We understand the factors that weigh into these decisions and will help you select the system to get the job done correctly and safely, providing the best value for your investment. We want your system to be as safe as possible for as long as possible. It may seem counter-intuitive for a supplier to help you get more life out of their products; but at Samson, that is exactly what we do. We understand that adding real value to your business is how we become a valuable partner.

Knowing the intended use or application of the rope is not enough. There are a number of other factors that should be considered when selecting a mooring line:

- > Rope construction: jacketed vs. non-jacketed
- > Understanding abrasion
- > Maximize service life: mitigate abrasion
- > Proper installation procedures
- > End-for-ending
- > Line rotation
- > Inspection guidelines
- > Residual test program

This technical guide will aid you in selecting the mooring system that is right for your operation.

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WHY SAMSON?

You won't get this anywhere else

Beyond selecting the right line for each component of your mooring system, Samson also provides customers with unparalleled service. Samson's service packages can be designed for new builds and/or retrofits, and adds value with critical pre- and post-sale services and an ongoing partnership program. Our approach is driven by safety and is a proven model that cannot duplicated by any other rope manufacturer.

Whether it is vessel inspections prior to the sale, crew training for proper rope handling and splicing, establishing inspection and retirement schedules, or residual testing and/or laboratory analysis, the Samson team is available to you across the globe. Samson service programs can be customized, and range from straightforward install and use training through much more significant service and tracking programs like lcaria[™] for Mooring.

ADVANTAGES OF HMPE OVER WIRE

- > Size-for-size stronger than wire
- > Weighs 85% less than the wire it replaces
- > Typically outlasts wire 3-to-1
- OCIMF recognizes HMPE as an acceptable alternative to wire

COST EFFECTIVE

- > More efficient mooring times
- > No re-lubing or environmental issues
- > Less damage to ship equipment
- > Able to splice and repair on board

SAFETY

- > Fewer hand and back injuries
- > Lighter and easier to handle
- > Reduced recoil

PRE-SALE SERVICES

- Onboard mooring equipment surveys to understand and determine the most suitable products for your application
- > Thorough understanding of key mooring industry regulations and standards such as OCIMF
- > Library of mooring-related technical bulletins and case studies

S.it-gand

Samson's field technicians provide onboard inspections, repairs, and splicing assistance.

POST-SALE SERVICES

- > A customized mooring line manual
- On-site crew training, which includes: line handling, inspections, repair, splicing, use of chafe protection
- > Inspection programs

Samson is committed to ensuring safe and long-term operational benefits from our high-performance products, installation through retirement.



MOORING LINE SELECTION CRITERIA ROPE DESIGN: JACKETED VS. NON-JACKETED

One of the best ways to combat unforeseen situations and prevent failure is to select the mooring line and tail, or pendant, appropriate for your vessel. Many ship owners, managers, and terminal operators are aware of the advantages of ropes made with HMPE fiber and have commonly looked to jacketed mooring lines, as they have proven to be trustworthy and faithful over the years. Though proven serviceable and long-lasting, their newer counterpart, non-jacketed 12-strand mooring lines, are demonstrating the same advantages, if not more. Yes, jacketed construction does allow for full protection of the load-bearing core over the length of the line, but in heavy use scenarios, they can rupture, exposing a core that is then susceptible to abrasion. This is why some in the industry are starting a shift.

One of the best ways to combat unforeseen situations and prevent failure is to select the mooring line and tail, or pendant, appropriate for your vessel.

Today's Optimal Mooring Rope

For use on split-drum winches, Samson now promotes its non-jacketed mooring lines in conjunction with specialized chafe protection. The combination of the non-jacketed line and chafe protection in high-contact areas is proving to be a superior option to a completely jacketed mooring line for several reasons: They are stronger than jacketed lines size-for-size, and they are easy to inspect and repair. Unlike jacketed lines, which rupture in the areas that suffer the greatest abrasion and have to be replaced, only the chafe protection on a non-jacketed rope has to be replaced, saving time and money.

A viable combination is a 12-strand mooring line system such as AmSteel®Blue, with Dynalene™ chafe protection. Dynalene provides a thick protective barrier that aids in cut and abrasion resistance, decreasing the chance of harmful wear, and promoting the longevity of the lines. The loose yet protective construction of Dynalene also allows the ship owner to easily inspect the lines, and, if necessary, repair and re-splice them in only the affected areas of the line. See more about *Dynalene* on page 18.

For use on single drum winches, Samson recommends jacketed mooring lines like Turbo-RC™.

	ADVANTAGES	DISADVANTAGES
Jacketed	High strength, low weight Core is completely protected by outer jacket Firm, round profile Potential for higher heat resistance on the cover Typically less expensive	Impossible to inspect the core (strength member) The cover will wear faster than the core Doesn't float Jacket can rupture Difficult to repair or splice
Non-Jacketed	Higher long-term residual strength because of 100% HMPE fiber Easy to inspect, repair, and splice Cut and abrasion resistant Floats No jacket ruptures Chafe protection can be easily replaced	Higher content of HMPE fiber increases cost

PENDANTS OR TAILS: AN INTEGRAL PART OF THE ULTIMATE MOORING SYSTEM

Proper selection of the mooring pendant also affects the performance of the mooring line. Recent studies have included the effects of tail length with varying materials. Depending on their application, there has been some success with increased tail lengths of 72 feet (22 meters) and nylon pendants have been found to be beneficial due to their increased elastic elongation.





Samson offers both jacketed and non-jacketed HMPE fiber-based lines. Our jacketed constructions include Turbo-EPX™ that utilizes a polyester jacket over a HMPE fiber core, while our non-jacketed lines include AmSteel®Blue, which is a 12-strand single braid made with 100% HMPE fiber.



UNDERSTANDING ABRASION

Abrasion is one of the biggest culprits of line damage. There are two types of abrasion: internal abrasion caused by the relative movement of internal and external yarns; and external abrasion caused by contact with external surfaces, such as roller and panama chocks.

An unprotected rope moving over a rough surface, such as a poorly maintained chock, can be subjected to both. Upon inspection, it's easy to see when the external strands are abraded by a rough surface. Often, fibers can be left behind on the surface that caused the abrasion and the surface of the rope readily shows abraded yarns.



WITHOUT CHAFE **GEAR (HMPE ON** METAL)

Friction caused by poorly surfaced deck hardware causes both external abrasion to surface strands and abrasion to internal strands by creating relative movement between the fibers in the rope.



WITH CHAFE **GEAR (HMPE** ON HMPE)

External abrasion is primarily limited to the chafe gear itself, and the relative movement of internal and external fibers is greatly reduced or eliminated completely.

MAXIMIZE SERVICE LIFE: MITIGATE ABRASION

DECK EQUIPMENT Vessels that have used wire rope often have significant damage and scoring to the deck equipment caused by the repeated wear and abrasion of wire rope mooring lines. These abrasive surfaces can damage or significantly reduce the life expectancy of HMPE ropes. Ignoring deck conditions can be a costly mistake. There are no synthetic lines that will perform to their maximum capability with poorly maintained deck equipment. Take preventative measures to mitigate these issues by repairing all rope contact points to a smooth and consistent surface before installation of the new mooring lines.

CHAFE PROTECTION The addition of chafe protection in the areas of the line most likely to suffer from abrasion is critical for the rope's longevity. Samson highperformance synthetic ropes have been engineered to provide ease of handling and inspection, extreme strength, and long service life. HMPE fiber, a major component in many of Samson's high-performance ropes, is extremely cut and abrasion resistant. While properly designed and engineered ropes take maximum advantage of this resistance, in the real world environment of the commercial marine industry, protecting ropes from abrasion and cutting significantly increases service life. Chafe protection can either be sleeves that slide on the rope or that are spliced into a line, depending on the type of chafe gear and the construction of the rope.

External abrasion without protection







Samson chafe protection products are perfectly suited to combat the causes of cutting and abrasion encountered in mooring operations







Samson field support technicians frequently assist with wire rope mooring line replacements while vessels are underway, complete with crew training in splicing, inspection, maintenance and proper rope-handling techniques.

INSTALLATION

After surfaces have been prepped, the working line should be installed on the winch with significant back tension. The device used to create the tension should have a smooth and consistent surface, and the installation speed or tension applied should not generate excessive heat build-up in the rope.

As the line is wound onto the winch, it should be closely packed to minimize areas where the rope may "dive" or bury into the layers of the winch. Install each layer in the valleys of the previous layers or crossed over each other to support each subsequent layer. Never stack the layers on top of each other.

When the line is used, eight to ten wraps must always remain on the tension side of the split-drum winch at the line's full extension. Furthermore, every precaution needs to be taken to prevent twist from being introduced into the line as it is used. Twist is often overlooked as a contributing factor in the reduced life of rope made with HMPE fiber. (See Samson's technical bulletin: Effect of Twist on Braided Rope at SamsonRope.com)



A minimum of 8–10 wraps, while never exceeding one full layer on the tension side of the split-drum, should be maintained at all times while lines are under tension.

EXTENDING MOORING LINE SERVICE LIFE

Along with the maintenance services provided by Samson, there are two important ways to extend the service life of your mooring lines by mitigating localized damage associated with deck equipment contact: end-for ending the lines and rotating lines around the vessel. Since Samson's high-performance mooring lines are 85% lighter than the equivalent wire ropes, and significantly lighter than other synthetics like polyester, both techniques are easily handled by typical crews without the need for additional equipment (like spooling trucks). Samson works with customers to set appropriate policies for these maintenance activities based on a variety of factors—e.g., life expectations, berthing frequency, deck equipment design specifics, etc.

END-FOR-ENDING MOORING LINES The outboard, or working, end of the line is subjected to repeated loading and abrasion from deck equipment. By reversing the line, putting the unused, storage end into service, the total service life of the mooring line can be extended. This is also a consideration when lines experience damage. In these cases lines should be carefully inspected using Samson's inspection guidelines to determine if the mooring line is worn or damaged beyond repair for a length extending too far down the line. Careful consideration should be taken regarding the benefits of reversing the line versus replacing it with a new mooring line.

ROTATING MOORING LINES On a given vessel, mooring lines will often experience different levels of cyclic and peak dynamic loading, depending on the layout of deck equipment, the crew's ability to deploy lines evenly and the direction of environmental forces. A procedure that can be easily conducted on board without additional equipment is line rotation from one winch to another. Using the Samson recommended winch installation guidelines, crews can rotate the lines to prevent excessive localized damage and thereby improve strength retention.

Note: While rotating and end-for-ending lines is a valuable tool in line maintenance, it is important that detailed records be maintained of all such movements to assure vessel crew understand the condition and usage history of all lines on board.

Both end-for-ending and rotating Samson's lightweight, high-performance mooring lines are handled easily by crews, without additional equipment.

EXTENDING MOORING LINE SERVICE LIFE (Continued)

Samson's testing capabilities include certified elongation and breaking testing up to 1.1 million pounds.

RESIDUAL TEST PROGRAM Samson offers residual strength testing to aid operators/owners in establishing line retirement criteria to improve safety and reduce operational risk. Samson's test lab conducts testing and analysis on thousands of ropes each year. Through proper testing and analysis, your line replacement schedule will be predictable and manageable.



INSPECTION TOOLS AND REFERENCE MATERIALS In addition to performing on-site inspections, Samson offers several tools to assist crews in inspecting and

repairing mooring lines. From posters for display on the vessel, to pocket reference



Samson offers a range of tools to assist in inspecting high-performance synthetic lines.







INSPECTION PROCEDURES

Any rope that has been in use for a period of time will show normal wear and tear. Some visual characteristics of a used rope will not reduce strength while others will. Below we have defined normal conditions that should be identified in the inspection process on a regular basis, along with recommended corrective actions.

The following criteria should be considered when inspecting 12-strand ropes made with HMPE fiber:

Regular inspections and repair as needed will extend the working life of highperformance mooring lines.

If upon inspection you find any of these conditions, you must consider the following before deciding to repair or retire it:

- > 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 to:

- > Repair the rope if the observed damage is in localized areas.
- > Retire the rope if the damage is over extended areas.

*REFERENCES Cordage Institute International, International Guideline Cl2001-04, Fiber-Rope Inspection and Retirement Criteria: Guidelines to Enhance Durability and the Safer Use of Rope, 2004.

Compression



NOT PERMANENT—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



NOT PERMANENT—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 Fiber



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.

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.

Discoloration/Degradation



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.



REPAIR OR RETIRE

- WHAT
- > Two or more cut strands in proximity
- CAUSE > Abrasion
 - > Sharp edges and surfaces
 - > Cyclic tension wear

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
 - > Cyclic tension wear

CORRECTIVE ACTION

Consult abrasion images and color coding* 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



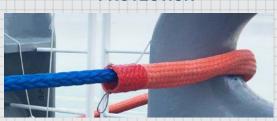
Request a copy of this handy reference tool from your Samson representative, or download the Samson app.

ULTIMATE MOORING SYSTEM COMPONENTS

PRIMARY MOORING LINE

SLIDING CHAFE PROTECTION

SECONDARY MOORING LINESee page 16 for product recommendations



PRIMARY MOORING LINES

WINCH/DRUM Single drum or split drum

AMSTEEL®-BLUE

{872} CLASS II 12-STRAND

FEATURES AND BENEFITS:

- > Made with Dyneema® fiber
- > Wire rope replacement
- > Size-for-size as strong as wire
- > 1/7th the weight of wire
- > Similar elastic elongation to wire rope
- > Torque-free construction
- > Flexible
- > Easy to inspect and splice in the field
- > Floats
- > Excellent abrasion resistance

TURBO-RC™

(861) CLASS II CORE-DEPENDENT DOUBLE BRAID

FEATURES AND BENEFITS:

- > Made with Dyneema® SK78 core
- > Enhanced creep properties when under static load and at elevated temperatures
- > 1/7th the weight of wire
- > Abrasion resistant
- $\,>\,$ Firm construction retains shape with use
- > Excellent drum spooling capabilities
- > Easy to handle
- > Excellent cut resistance
- > Durable

SIZE	/ WEIGHT	/ ISO S	STREN	GTH
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Diameter (INCHES)	1"	1-5/16"	1-1/2"	1-5/8"	1-3/4"	2"
Diameter (MM)	24 mm	32 mm	36 mm	40 mm	44 mm	48 mm
Weight per 100 ft	21.8 lb	41.8 lb	51.7 lb	65.2 lb	78.4 lb	87.0 lb
Weight per 100 m	32.4 kg	62.2 kg	76.9 kg	97.0 kg	117 kg	129 kg
ISO 2307 Strength*	49.4 mt	84.0 mt	103 mt	128 mt	152 mt	173 mt

Additional sizes available. Please contact customer service or see SamsonRope.com for specifications.

AT PERCENT OF BREAK STRENGTH	10%	20%	30%
Elastic Elongation Percentage	0.46%	0.70%	0.96%

*ISO strength specifications are for unspliced rope.



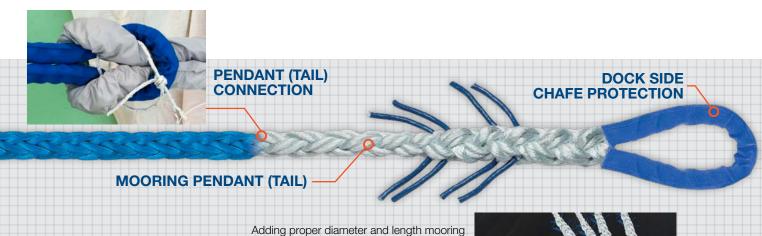
Diameter (INCHES)	1"	1-5/16"	1-1/2"	1-5/8"	1-3/4"	2"
Diameter (MM)	24 mm	32 mm	36 mm	40 mm	44 mm	48 mm
Weight per 100 ft	25.5 lb	43.3 lb	59.5 lb	67.0 lb	85.5 lb	99.0 lb
Weight per 100 m	37.9 kg	64.4 kg	88.5 kg	99.7 kg	127 kg	147 kg
ISO 2307 Strength*	44.0 mt	74.8 mt	95.3 mt	113 mt	138 mt	166 mt

Additional sizes available. Please contact customer service or see SamsonRope.com for specifications.

AT PERCENT OF BREAK STRENGTH	10%	20%	30%
Elastic Elongation Percentage	0.30%	0.50%	0.80%

*ISO strength specifications are for unspliced rope.

For assistance in selecting the best line for your vessel/ application, please contact your Samson technical sales representative or email CustServ@SamsonRope.com



pendants (tails) to the high-modulus mooring line provides elasticity to create the optimal mooring system. Chafe gear and a hardware-free connection method completes this package to promote the longest and safest service life.



Designed For FSRU

SRU MOORING LINES

NEW: EVERSTEEL"-X

{844} CLASS II 12-STRAND

Samson's EverSteel-X mooring lines are designed to replace steel wire, and are optimized for the semi-permanent operations inherent in FSRU applications.

EverSteel-X offers a size-for-size replacement of wire ropes that combines the lightweight, high-strength, abrasion resistance and superior fatigue performance of high-modulus polyethylene (HMPE) mooring lines with resistance to creep that allows for the long-term semi-static loading inherent in FSRU mooring operations. EverSteel-X uses Dyneema® DM20 fiber for proven dimensional stability and performance over long periods of continuous loading. All the traditional benefits of HMPE lines apply to EverSteel-X: It's safer, easier to handle, light weight and requires less maintenance than steel wire rope. Utilizing DM20 fiber allows EverSteel-X to endure such long-term loading conditions without experiencing creep failure. Combining this new technology with Samson's proven line maintenance services means the benefits of synthetic ropes can now be realized in FSRU moorings.



2" 2-1/2" 42 mm 44 mm 48 mm 60 mm Diameter (MM) 40 mm Weight per 100 ft 62.1 lb 65.5 lb 72.2 lb 81.5 lb 130 lb 92.4 kg 121 kg 193 kg Weight per 100 m 97.5 kg 107 kg ISO 2307 Strength* 128 mt 140 mt 157 mt 175 mt 277 mt

Additional sizes available. Please contact customer service or see SamsonRope.com for specifications

AT PERCENT OF BREAK STRENGTH	10%	20%	30%
Elastic Elongation Percentage	0.30%	0.55%	0.80%

*ISO strength specifications are for unspliced rope.



FEATURES AND BENEFITS:

- > Superior creep performance
- > Flex-fatigue resistant
- > Floats in water
- > Size-for-size as strong as wire
- > Durable and lightweight
- > Made with Dyneema® DM20 fiber
- > Easy to inspect

DM20: Dyneema® Max Technology

DSM Dyneema DM20 fiber enables ultra high strength at low weight and unrivalled rope strength, stiffness, durability and longevity. This fiber is designed, at the molecular level, to deliver high performance in continuous or permanently-loaded applications. DM20 has long-term dimensional stability and a long creep life unrivaled by other HMPE in the market today, fundamentally changing HMPE for the better.

SECONDARY MOORING LINES

PATENTED SIZE / WEIGHT / ISO STRENGTH Additional sizes 1" 1-5/16" 1-1/2" 1-5/8" 1-3/4" 2" Diameter (INCHES) available. Please 40 mm 44 mm Diameter (MM) 32 mm 36 mm 48 mm 24 mm contact customer service or see Weight per 100 ft 21.0 lb 33.0 lb 44.7 lb 50.0 lb 60.8 lb 79.4 lb

31.2 kg

37.4 mt

Weight per 100 m

ISO 2307 Strength*

49.1 kg

66.2 mt

74.4 kg

103 mt

66.5 kg

86.6 mt

90.5 kg

120 mt

118 kg

158 mt

120 mt

QUANTUM-12™

{873} CLASS II 12-STRAND

FEATURES AND BENEFITS:

- > Made with Dyneema® fiber
- > Wire rope replacement
- > Excellent abrasion resistance
- > High coefficient of friction provides excellent grip
- > Flexible and easy to handle
- > Lightweight
- > Floats

Dyneema*							2
			Talling.				The same
	SIZE / WEIGHT	/ ISO S	TRENG	ТН	. Agency		
Additional sizes available. Please	Diameter (INCHES)	1"	1-5/16"	1-1/2"	1-5/8"	1-3/4"	2"
contact customer	Diameter (MM)	24 mm	32 mm	36 mm	40 mm	44 mm	48 mm
service or see	Weight per 100 ft	25.0 lb	41.5 lb	55.4 lb	68.0 lb	74.8 lb	99.0 lb
SamsonRope.com for specifications.	Weight per 100 m	37.2 kg	61.8 kg	82.4 kg	101 kg	111 kg	147 kg

ISO 2307 Strength* | 27.7 mt | 52.4 mt | 63.0 mt | 70.6 mt | 95.7 mt |

PROTON-8[™]

{830} CLASS II 8-STRAND

FEATURES AND BENEFITS:

- > Made with Dyneema® fiber
- > High strength-to-weight ratio
- > Grips winches, bitts, and capstanshigh coefficient of friction
- > Heat resistant
- > Low water absorption
- > Firm, yet flexible torque-free construction



*ISO strength specifications are for unspliced rope.

SamsonRope.com

for specifications.

QUANTUM-8[™]

{863} CLASS II 8-STRAND

FEATURES AND BENEFITS:

- > Made with Dyneema® fiber
- > Wire rope replacement
- > Abrasion resistant
- > Excellent grip
- > Excellent drum spooling capabilities retains shape with use
- > Compression resistant on winch
- > Lightweight
- > Flexible

SECONDARY MOORING LINE STOPPERS

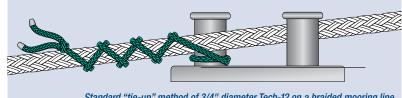
Mooring line stoppers are only for use on synthetic fiber secondary mooring lines, or mooring lines not deployed on winches. Stoppers are used to maintain the tension of the secondary mooring line while the crew removes the line from the capstan and puts the secondary line around bitts or cleats. Tenex-TEC™ should not be used on high performance secondary lines. It should only be used on Class I secondary lines made from fibers like polyester, nylon, or a polyester/ polypropylene blend like SSR-1200." AmSteel® Blue—like all 100% HMPE fiber lines—has a very slippery surface with a low coefficient of friction, and will not perform well as a secondary line; hence they are normally used on winches. Samson recommends using Proton-8, Quantum-8, or Quantum-12 for secondary lines. Due to the fact that secondary lines will be a similar diameter to primary lines, Samson recommends Tech-12™ as a stopper due to its high strength and good grip.

Samson recommends that mooring stoppers be regularly inspected and retired after five years of service regardless of their physical appearance.

Samson recommends that mooring stoppers be regularly inspected and retired after five years of service regardless

of their physical appearance. Mooring stoppers with cut strands or other physical deformations that may severely affect residual break strength should be retired immediately.

Even though Samson stoppers come with certificates of compliance, like all synthetic ropes, strength can deteriorate. To ensure safe use of stoppers for mooring or installation of mooring lines on winch drums, care and attention to all safe rope handling guidelines must be employed.



Standard "tie-up" method of 3/4" diameter Tech-12 on a braided mooring line.

Use 1-1/4" Tenex for Class I or larger diameter mooring lines.

MOORING PENDANTS (TAILS)

EFFICIENT MOORING PENDANTS DESIGNED TO REDUCE DYNAMIC LOADS ON PRIMARY MOORING LINES

Samson recommends the use of mooring pendants with our primary high-performance mooring lines to provide elasticity in the mooring system. This elasticity provides safer operations and protection from surging and shock loading, especially in exposed mooring berths. Pendants also provide long-term performance benefits and longer service life.

KEY ASPECTS OF MOORING PENDANTS (TAILS)

- > **CONNECTION** The tails are to be connected to the primary mooring line by cow hitch (see below, or by shackle or link—typically Mandel, Tonsburg, or Boss.)
- RETIREMENT/RESIDUAL STRENGTH Per OCIMF guidelines, it is recommended to retire mooring tails after 18 months of use, or prior to residual strength reduction to 60% of the original minimum break strength (MBS).
- > STANDARD LENGTH The standard recommended overall length for mooring tails is 11 meters (36.1 feet); however, for exposed moorings a 22 meter (72.2 foot) tail provides additional elongation in the mooring arrangement.
- > MINIMUM BREAK STRENGTH Per OCIMF guidelines, polyester and blended mooring tails have a 25% higher MBS, and nylon (or polyamide) mooring tails should have a 37% higher MBS than the primary mooring line.

PENDANT (TAIL) CONFIGURATIONS



SINGLE-LEG Standard single-leg pendants have a 2 meter (6.6 foot) soft eye on one end and a 1 meter (3.3 foot) soft eye on the other end. Hardware and chafe protection can be added upon request.



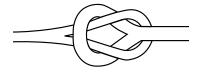
GROMMET (STROP) Standard grommet pendants have 2 meter (6.6 foot) and 1 meter (3.3 foot) soft eyes formed by lashings. The body of the grommet is lashed together 3 meters (9.8 feet) from each eye lashing. Grommet strength is 1.6x the single-leg rope strengths. Hardware, chafe protection, and additional whipping can be added upon request.

MP-1™ PENDANT {264} is a non-rotational 8-strand rope with excellent abrasion and wear resistance for use as a pendant in vessel mooring applications. It has been proven to provide superior abrasion resistance and strength retention with extensive use. MP-1 also utilizes a polyester/polyolefin blend that provides a 10% lower linear density (lbs./ft.) compared to traditional 100% polyester fiber pendant constructions. This decreased weight makes for easier handling by crew members in mooring situations. See product details in Samson's Commercial Marine Product Guide.

HTP-12™ PENDANT {703} is a round-plait 12-strand construction of high-tenacity polyester treated with our proprietary Pro-Gard Marine Finish. It has been tested and proven to meet the OCIMF guidelines of 85% strength efficiency for cow-hitch connections. HTP-12 is a safer, more efficient mooring pendant that provides higher residual strength when compared with parallel-core type constructions. See product details in *Samson's Commercial Marine Product Guide*.

RP-12™NYLON PENDANT {323} is a round-plaited 12-strand construction of nylon treated with our proprietary Pro-Gard Marine Finish. This combination provides reduced wet-strength loss, improved abrasion resistance, and high energy-absorbing properties in single-leg or grommet pendants. This line meets OCIMF guidelines and, in 22 meter (72.2 foot) lengths, provides additional elongation for exposed terminal moorings. See product details in *Samson's Commercial Marine Product Guide*.

COW HITCH CONNECTION



After properly installing the mooring lines on the winch drum, the pendants should be attached to the working end of the mooring line. This is done by a cow hitch connection per OCIMF guidelines.



It is important to choose a mooring pendant that provides adequate elongation to reduce dynamic loads induced on the primary mooring lines, especially in exposed mooring berths.

Hardware, chafe protection and extra whipping can be added to pendants upon request.



RP-12 Nylon



Cow hitch connection, shown with pigtails to assist in separating the connection.

HIGH-PERFORMANCE CHAFE PROTECTION



MAXIMIZING SERVICE LIFE

Samson's innovative chafe protection extends the service life of high-performance lines



An innovative construction that allows easy inspection without removal. Made with 100% HMPE fiber and coated for enhanced abrasion resistance.

DYNALENE[™] {975}

FEATURES AND BENEFITS:

- > Made with 100% HMPE fiber
- > Coated for enhanced abrasion resistance
- > Easy inspection without removal
- > Excellent durability
- > Lightweight
- > Flexible
- > Floats



Tightly-woven sliding chafe sleeve made with HMPE fiber provides maximum protection. Coated with Samson's proprietary Saturn coating for enhanced abrasion resistance.

DC MOOR-GARD[™] {705}

FEATURES AND BENEFITS:

- > Made with 100% HMPE fiber
- Coated with Samson's proprietary Saturn coating for enhanced abrasion resistance
- > Fixed or adjustable for easy positioning
- > Easily moved for rope inspection
- > Lightweight
- > Flexible
- > Floats

If operating in regions where extreme heat is an issue, contact Customer Service for information about Samson's TC Gard made with aramid fiber

Tightly-braided cover made with HMPE fiber provides maximum protection. Designed for use in applications where frequent handling and use put a premium on rope protection and resistance to snagging.

DC GARD[™] {706}

FEATURES AND BENEFITS:

- > Made with 100% HMPE fiber
- > Superior durability
- > Can be removed for rope inspection
- > Cut resistant
- > Lightweight
- > Flexible
- > Floats

SPECIALTY PRODUCTS

VULCAN A synthetic emergency tow-off pendant Product Code: 893

Emergency tow-off pendants (ETOPs), commonly referred to as "fire wires," provide a means of towing the ship away from the dock in the event of a fire. Wire rope is currently used in this application; however, the handling of these heavy wire ropes has resulted in many injuries to deckhands. Samson has developed a synthetic alternative called Vulcan, which is significantly lighter and eliminates "fish-hooks," broken wires that protrude from the wire rope that result in hand injuries. Maintenance costs are also reduced when using synthetic ropes in comparison with wire ropes. The patented synthetic ETOP Vulcan is made of aramid fiber in conjunction with a proprietary fire-resistant coating that meets the OCIMF required breaking strength after exposure to flames and a high-temperature environment. Contact customer service for order assistance and pricing.



2011: SeaTrade Award Finalist for Innovation in Ship Operations, Vulcan Emergency Tow-Off Pendant, Seatrade Magazine



ETS: EMERGENCY TOW SYSTEM

An emergency kit for your vessel Product Code: 896

Samson's Emergency Towing System (ETS) offers a complete package in compliance with resolution MSC.35(63) of the 1994 Solas Convention. Proven AmSteel®-Blue towlines and high visibility messenger lines provide the strength and durability to do the job while remaining light and easy to handle. In one easy-to-store container, this ETS has all the necessary equipment for quick deployment. AmSteel®-Blue towlines are class certified to ABS and DNV Standards.



KIT	INCLUDES:	

- > AmSteel®Blue main towline
- > 5/8" diameter AmSteel®Blue messenger line
- > Durable, insulated polyurethane tote
- > Lighted retrievable buoy
- > MODEL A&B: Carabiner and swivel to prevent line twist
- > MODEL C: Two "D" shackles for easy interfacing of towline with deck hardware

This easy-to-store kit includes all the necessary equipment for quick deployment.

M	MODEL A 20,000 – 50,000 DWT									
	SSEMBLY NUMBER	MESSENGER LINE DIA. inches/mm	MESSENGER LINE MBS* pounds/metric tons	TOWLINE LENGTH feet/m	TOWLINE DIAMETER inches/mm	TOWLINE MBS* pounds/kg	ISO 2307** STRENGTH metric tons	ASSEMBLY WEIGHT pounds/kg		
E.	TS-484	5/8"	47,500 lb	250'	2-1/4"	484,000 lb	244 mt	492 lb		
E.	TS-484	16 mm	24.0 mt	76 m	56 mm	244,000 kg	244 mt	224 kg		
M	ODEL	B Over 5	50,000 DW1	-						
E	TS-906	5/8"	47,500 lb	300'	3-1/4"	906,000 lb	457 mt	1,060 lb		
ETS-906		16 mm	24.0 mt	92 m	80 mm	457,000 kg	457 mt	481 kg		
MODEL C Prince William Sound										
ΕΊ	rs-Pws	5/8"	47,500 lb	400'	2-1/4"	484,000 lb	244 mt	566 lb		
EI	S-PWS	16 mm	24.0 mt	122 m	56 mm	244.000 kg	244 mt	257 kg		

SAMSON & DSM DYNEEMA:

Strong relationship delivers customer benefits



Samson and DSM Dyneema—redefining the strongest and safest rope for maritime solutions.

Name in Rope"—and DSM Dyneema—Creator of Dyneema® "The World's Strongest Fiber"—is delivering innovative, high-quality solutions for customers around the world.

The strong and successful partnership between Samson—"The Strongest

As a leader in rope design and manufacturing, Samson has a long history of supplying synthetic lines made with Dyneema® to all markets, with a proven track record of high performance and long service life. In the LNG marketplace, the two companies have collaborated since 1996, when AmSteel®Blue was developed to take full advantage of the benefits of 100% Dyneema® and quickly became the most trusted steel wire rope replacement on the market.

Samson has been working with DSM Dyneema since converting their first tanker fleet to AmSteel®Blue in the 1990s. Samson and DSM Dyneema leverage each other's knowledge and technical capabilities through joint development and testing programs. Such collaboration delivers the best combinations of fibers, rope constructions, and coatings to customers. The result—improved performance, reliability, and service life.



FOR MORE INFORMATION



SamsonRope.com We've put all our information here for easy downloading for anvone with access to the web. We think it is the best resource for information on highperformance synthetic ropes available anywhere.

- > Rope specifications
- Product breakdowns by application and industry
- **Technical bulletins**
- Case studies
- Splicing instructions



Detailed product information and specifications are available in Samson's Commercial Marine Product Guide.



Samson App

For the iPhone and iPad this handy app features:

- > Inspection and retirement criteria
- Internal and external abrasion inspection information
- Splice instructions

Download it at SamsonRope.com









 ${\rm AmSteel}^{(0)}$ is a registered trademark of Samson Rope Technologies, Inc. All Samson named products herein are trademarks of Samson Rope Technologies, Inc.

Dyneema® is a registered trademark of Royal DSM N.V. Dyneema® is DSM's high performance polyethylene product.

