

Synthetic Sling Solutions



Samson takes the HEAVY out

Samson slings made with Dyneema® high-performance synthetic ropes outperform wire and other synthetic alternatives

Save time and increase work-site safety with slings fabricated from easy handling, ultra-strong Samson high-performance ropes.

Ultra-strong high-performance synthetic ropes are as strong as wire rope, size-for-size, yet weigh only one-seventh as much. That means rigging is easier, requiring no additional equipment to move and handle the slings, and workplaces are safer and more efficient. There's minimal chance of damage to critical payloads or other installation equipment.

Neutrally buoyant in seawater, Samson slings make critical subsurface load transfers (the "wet handshake" procedure) much simpler, requiring less time and horsepower from the ROVs that handle them.

In an industry where experience counts, we've accumulated more than any other manufacturer.

We've got more experience designing and manufacturing high-performance, high modulus polyethylene (HMPE) ropes for critical marine applications than anyone else in the business. Since the early 1980s when Samson pioneered manufacturing ropes using HMPE fiber, we've amassed more information, done more testing in our labs, and conducted more field trials in partnerships with fleet owners and users than anyone else in the industry. From testing promising new fiber combinations and constructions to residual strength testing of ropes used in critical applications, we've developed a knowledge base on synthetic rope performance and design that is second to none. All that experience is built into each set of slings we deliver.

HMPE ropes are at least as strong as the wire they replace, 1/7th the weight, and last at least 3 times longer.



CASCADE & CHINOOK CASE STUDY

A CASE IN POINT: The Cascade and Chinook Projects



Technip personnel "pre-rig" the hardware packages with the 88-mm AmSteel®Blue grommets.

Samson high-performance synthetic slings help Technip and Petrobras install subsea hardware at the Cascade and Chinook projects.

Installing two pumping stations and two manifolds at the Cascade and Chinook fields in the Gulf of Mexico at depths in excess of 2,500 meters was accomplished with a "wet handshake" and the assistance of Samson's AmSteel®Blue fabricated into lifting slings for the operation. Technip was the contractor, and *Deep Blue* was the installation vessel used during the deepwater installation, completed in August of 2009. The project is among the deepest subsea installations in the Gulf of Mexico, and marks the first use of an FPSO in U.S. waters.

While formulating installation procedures, Southwest Ocean Services (SWOS) and Samson's offshore technical sales team were in contact with the operations and installation team at Technip, who intended to use the wet-handshake technique to transfer loads from *Deep Blue's* overboard crane to the A&R winch in the moonpool for delivery to the seafloor. Since the handshake was to be accomplished with remote operated vehicles (ROVs), the use of wire rope slings would have presented many rigging and handling issues due to the weight and stiffness of the wire. SWOS worked

of heavylift slings

The most advanced R&D organization in the cordage industry.

With expertise in chemical and mechanical engineering, materials science, nanoengineering, and polymer science, Samson's R&D department is among the most advanced in the industry. Our labs include a million pound plus tensile tester dedicated to synthetic ropes, and the team is backed by testing, quality control, and splicing specialists. While rope technology is their passion, they are fully grounded by the concept of application engineering: developing real solutions to critical challenges faced in the daily operations of some of the world's most demanding industries.

With all these resources, choosing the right sling configuration just got as easy as contacting your Samson distributor.

A global network of master distributors that stock and custom fabricate slings to order is available with a phone call. They've got the experience to help you engineer the most efficient lift possible, with support from Samson's technical sales and engineering team. We can configure the slings, proof load, and assist with third-party certifications.

The Samson Advantage: it's more than a catch phrase, it's our commitment to the customers we serve and the products they depend on

Samson ensures that all products are fabricated with approved, fully tested procedures. We have qualified personnel available during installations and to train crews in proper handling, splicing, and inspection.

It's all part of our continued commitment to providing the highest quality products supported by the best service in the industry. We call it The Samson Advantage, our customers call it peace of mind.

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with Technip's design team to develop a synthetic solution, not only for the sling, but also for the custom chafing gear and the project specific ROV handling slings. Close contact with the design team early in the planning phase of the project was paramount to ensuring sling compatibility with the existing hardware on *Deep Blue*.

Samson's AmSteel®Blue, a high-strength, lightweight Dyneema® fiber rope was used to fabricate the slings. AmSteel®Blue is as strong as wire ropes the same size, yet is neutrally buoyant or slightly positive in seawater, making handling by ROV a simple matter requiring a minimum of power. Southwest Ocean Services, a Samson master distributor located in Houston, Texas, fabricated the slings to Technip's specifications from existing stock, and were able to maintain Technip's tight delivery schedule. The 3-5/8" (88-mm) diameter AmSteel®Blue was spliced into grommets 50 meters in length. Both eyes of each sling were fitted with Samson's DC Gard high-performance chafe gear, equipped with two small-diameter ROV handling grommets made from 1/2" Samson Quik-Splice, and a polypropylene rod inserted into the eye section of each small grommet. This resulted in a rigid eye section with positive buoyancy perfect for capture by the manipulation arms of an ROV. A total of 16 slings rated at 190-metric-ton working loads were fabricated and tested for the installation of four hardware packages and four suction piles.

At the time of the installation, the subsea hardware arrived via barge, with each of the hardware packages and suction piles prefitted with two high-performance synthetic slings. *Deep Blue's* 400-metric-ton outboard crane was used to lift the

hardware packages using one of the two attached slings. The hardware was lowered to 100 meters, where an ROV captured a special grommet attached to the second lifting sling and ferried the eye of the sling to the hook of *Deep Blue's* moonpool A&R winch. With the load transferred to the A&R winch, the sling was freed from the hook of the outboard crane and the hardware lowered to the seafloor for installation. The wet handshake was complete.

Technip has specified Samson ropes for many other installation projects, and has used AmSteel®Blue on prior occasions. The high strength, reliability, and easy handling of Samson synthetic ropes are appreciated in the kind of complex installations Technip encounters.

After this installation was completed, these slings were inspected, proof loaded, and recertified at Southwest Ocean Services' Houston facility, then returned to Technip for use in future critical installations.



The use of a high-strength, buoyant sling was a must for this stage in the process. The hand-off from the 400-metric-ton overboard crane to the A&R winch was simplified with the help of the AmSteel®Blue grommets. The foundation piles, pump stations, and manifolds were all pre-rigged before the over boarding process.



BELOW: ROV handling grommets are used by the ROV to maneuver and position the AmSteel®Blue slings.



samson
THE STRONGEST NAME IN ROPE

Rely on Samson's experience and expertise

We test our ropes the same way you use them—in real-world conditions

Samson's R&D department has performed extensive testing of sling samples in different configurations. Our test methods comply with industry standards like CI-1500, but with more stringent specifications and testing instructions to eliminate wide tolerances or generalized procedures. The SRT testing methodology, based on spliced samples tested to destruction, mimics real-world conditions better than most testing protocols. Our strength information does not have to be adjusted or interpreted to compensate for the effect of splices. ISO strengths are also listed for comparison. This investment in testing results in a knowledge base that allows us to successfully design, fabricate, and proof load slings to match the requirements of critical high load lifts.

Help when and where you need it

We bring this extensive knowledge base to bear when assisting with third-party certifications. Samson or one of our master fabricating distributors serving the Americas, Europe, and Asia can also assist with proof loading and third-party certifications. Slings can be inspected and recertified after the project is complete, and inventoried for future projects. This knowledge base is incorporated into the Sling Configurator (see below)—a custom-designed software tool that takes into consideration the critical requirements of your project and determines the optimum sling design to meet the objectives.

Extensive testing and real-world experience you can rely on for successful sling designs and certifications.



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

ABS American Bureau of Shipping
NK Nippon Kaiji Kyokai
DNV Det Norske Veritas

THE CONFIGURATOR



The Configurator, a Samson exclusive.

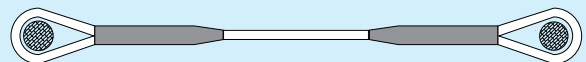
The Configurator is a proprietary software tool developed by Samson's engineers to quickly analyze the sling requirements, including pin sizes, working load limit (WLL), safety factor, and lengths, to produce options on rope sizes and configurations that will meet the requirements of the project. It allows us to quickly assess the design options available. This unique software tool is available to our master fabricating distributors worldwide, which means faster, more efficient design, fabrication, certification, and delivery of the required slings to your site.

Samson's proprietary software tool quickly analyzes lift requirements and offers multiple configuration options.

GROMMET CONFIGURATION / PIN SPLICE POSITION



SINGLE-LEG CONFIGURATION



Extensive testing for successful heavylift projects

TECHNICAL CONSIDERATIONS

Know your options: critical points when designing slings

High-performance synthetic rope slings offer the greatest range of options for working loads, lengths, sling types, and rigging options of any of the available materials. Lightweight, easy handling slings made with Dyneema® outperform wire rope, chain, or other forms of synthetic slings (web slings or round slings).

When designing slings for an engineered lift, several factors are accounted for to provide the perfect blend of safety, efficiency, and performance:

- > **Required lifting capacity: the combination of the WLL and the safety factor**
- > **D/d ratio: the relationship between the pin diameter and the diameter of the rope**
- > **Overall sling-length tolerance**

SLING TYPES: SINGLE-LEG OR GROMMET

Single-leg slings or grommets are the two configurations typically fabricated with high-performance synthetics. Single-leg slings are more efficient at smaller D/d ratios, and grommets perform at higher working loads.

Single-leg slings

Whenever possible, single-leg slings should be considered when specifying slings. They are more efficient at smaller D/d ratios. The eye splice at each end results in a limit to the shortest length possible due to the length of each splice and the required spacing between splices. SRT strengths for Samson ropes are always based on testing spliced ropes; the strengths listed can be expected in fabricated single-leg slings.

Grommet slings

Grommets perform at higher working loads than the nominal minimum break strength of the rope itself, due to load sharing between the two legs of the sling. This increase in strength is expressed as a multiplier—the grommet efficiency factor. Testing has shown that the efficiency factor is dependant on the static bend or D/d ratio. Positioning of the splice also effects the grommet's efficiency factor. Both splice positioning and various D/d ratios have been extensively tested by Samson's R&D department.

Chafe protection

While synthetic ropes made with Dyneema® fiber are inherently resistant to cutting, abrasion, and chemical attack, either single-leg or grommet slings are available with chafe material for added protection at weight bearing points and high-contact areas. Chafe material can be added during fabrication and allows for removal/replacement to facilitate on-site inspection. Samson has developed Dynalene and DC Gard chafe materials for this purpose, and has extensive experience with woven fabric options as well.

OTHER CONSIDERATIONS

SPECIFIC GRAVITY AND FLEXIBILITY

For subsea installations where subsurface load transfers from the initial handling crane to the lowering winch are required (also known as the 'wet handshake'), specific gravity and flexibility become issues. Samson's high-performance slings made with Dyneema® fiber are extremely flexible and neutrally buoyant in seawater making handling by ROVs for the load transfer much faster and easier than extremely heavy and stiff wire rope. With synthetic lines, there is no need for the ROV to overcome the extreme weight or account for the leverage of stiff, inflexible wire slings.

ROPE CONSTRUCTIONS

Although Samson manufactures a full spectrum of constructions from 6-, 8-, and 12-strand single braids to double braids, jacketed ropes and twisted ropes, the two best suited to fabricating slings are 12-strand and 8-strand constructions. For heavy lift situations, 12-strand constructions provide the optimum level of strength to weight with straightforward fabrication and resistance to abrasion.

STATIC BEND OR D/d RATIO

The size of the pins, trunnions, and rigging hooks are important in designing the slings. Samson's R&D department has done extensive testing of single-leg slings and grommets at various D/d ratios and splice placements to determine the optimum design and the effective grommet efficiency factor to predict working loads for grommets.

EYE SIZE/LENGTH

The length of the eye and the diameter of the pin or weight-bearing surface affects the angle of the leg in relationship to the body of the rope, and thus can have an affect on the strength of the sling itself.

COEFFICIENT OF FRICTION (COF)

Synthetic ropes made with Dyneema® have an inherently low coefficient of friction. Where a higher COF is required or desirable, Samson offers Quantum-12 and Quantum-8 ropes incorporating DPX™ technology, which increases the COF by adding spun polyester fiber to the surface yarns of the rope. These patented constructions show significantly increased COF for more efficient splices or handling by traction winches or capstans.



HEAVYLIFT SLINGS

Synthetic Rope Slings vs. Steel & Synthetic Round Slings

As strong as steel, lighter than round slings—synthetics are the perfect fit for heavylift applications

High-performance synthetic rope slings offer the best combination of benefits when planning heavylift operations. Light weight means more than easier handling. Safety of crews is increased, and additional equipment is not required for positioning during rigging. For subsea operations, neutral buoyancy facilitates handling by ROVs while not adding to the payload weight.

SYNTHETIC ROPE SLINGS VS. WIRE ROPE SLINGS

- > Safer operations
- > More efficient rigging—saves time
- > Neutral buoyancy—the best option for subsea operations
- > No contact damage to the payload

SYNTHETIC ROPE SLINGS VS. CABLE-LAID STEEL WIRE ROPE SLINGS:

- > Reduced fabrication costs
- > Dramatic weight savings without sacrificing strength
- > Easier handling without additional equipment

SYNTHETIC ROPE SLINGS VS. ROUND SLINGS

- > More robust construction withstands abuse and abrasion better
- > Long lengths easily fabricated

Lightweight slings made with Dyneema® increase crew safety, do not require additional equipment for rigging and are neutrally buoyant.

CNOOC CASE STUDY

A CASE IN POINT: CNOOC Lifting Project



High-performance synthetic slings lift 16,213 metric tons.

Weather windows are notoriously short in the South China Sea. They place a premium on efficiency and speed for complex offshore installations like the recent installation of a jacket in the Pan Yu natural gas field by COOEC (China Offshore Oil Engineering Corporation).

The installation engineers of COOEC turned to high-performance synthetic heavylift slings fabricated from Samson's Quantum-8 for this project. The jacket, installed in March of 2008, was 75-m square and 213-m high, weighing in at 16,213 metric tons. It was the heaviest lift to date using high-performance synthetic slings. COOEC reports that the slings outperformed either the cable-laid wire or the synthetic webbing slings they had been using. The lightweight, easy handling Quantum-8 slings were attached manually, without the assistance of heavy equipment required by cable-laid or synthetic webbing alternatives, resulting in a faster, more efficient installation.

Quantum-8 high-performance synthetic slings lift 16,213 metric tons on COOEC installation (March 2008).

A CASE IN POINT: Seaway Heavy Lifting Project



Samson high-performance synthetic slings used to install monopiles in rough seas, expected to perform 140 lifts total.

Seaway Heavy Lifting is currently using very large-diameter synthetic-rope slings fabricated from Samson's AmSteel®Blue in the installation of monopiles in the North Sea. The Greater Gabbard project involves installation of 140 turbine foundation monopiles in the typically demanding conditions of the British sector of the North Sea. Located in the sandbanks 23 km off the coast of England, the Greater Gabbard project is the world's largest wind farm currently under construction.

Seaway Heavy Lifting (SHL) anticipated rough seas during the installation of the monopiles. Because of their light weight and easy handling, SHL specified synthetic woven-round-sling systems for the job instead of the heavy, awkward wire or cable-laid version. Synthetic heavylift slings would also mitigate potential damage to the monopiles during their transfer from the supply barge to the deck of the installation vessel, the *Stanislav Yudin*. Each lift system called for two slings attached to the lifting pins at one end and a single grommet, making a basket configuration at the opposite end.

SHL has been a customer of Endenburg BV of Gouda, The Netherlands, for many years and has used Samson's synthetic ropes successfully in the past. Because of this relationship, SHL sought Endenburg's advice. Endenburg brought the Samson technical sales team into the discussion, and together with SHL,

they examined the possibility of using a synthetic rope solution in place of the proposed round slings.

While the advantages of using synthetic fiber over wire in heavylift slings, such as the differences in weight and ease of handling, are obvious, the advantages of using synthetic rope over synthetic round slings are not commonly known. Among the key advantages of using synthetic rope slings are:

- > Strengths are available to 4,457 metric tons in a grommet configuration;
- > Removable chafe gear can be placed on them for protection from abrasion, but are easily removed and replaced for inspection purposes;
- > They are simple to repair and splice in the field; and
- > Longer lengths are available.



For the Greater Gabbard project, each monopile weighs from 519 to 676 metric tons. Based on the required working load limit supplied by SHL, Endenburg determined that heavylift slings fabricated from Samson's 144-mm diameter AmSteel®Blue would meet specifications.

SHL agreed and ordered two lifting systems; each included two slings and a grommet. The very large diameter rope was manufactured at Samson's Lafayette, La., plant. Break tests were performed locally under Lloyd's third party supervision to certify the rope's minimum breaking strength met or exceeded the strengths required. Endenburg, Samson's Master

Distributor in Europe, then fabricated the slings and grommets, complete with all weight-bearing points protected with chafe gear. Upon delivery, these became the first very large-diameter synthetic heavylift slings certified by Lloyd's for multiple uses in offshore installations.

By the end of the third quarter of 2010, all 140 turbine foundation monopiles were installed using the first set of lifting slings.

Upon inspection, they showed no signs of wear according to Endenburg's master splicer who conducted several inspections throughout the project. These inspections included removing the chafe gear and closely examining the entire line for wear and damage. Lloyd's also proof loaded the slings and recertified them for continued use.

Through this process, it has been determined that the original set of slings and grommets can be used again. The second set is still in storage.



All 140 turbine foundation monopiles were installed using the first set of lifting slings. After completion Lloyd's proof loaded the slings and recertified them for continued use.

Gaylin International Pte Ltd. of Singapore fabricated and tested the slings. Gaylin, a Samson master distributor and partner serving the Asia/Pacific market, maintains a significant stock of Samson high-performance ropes enabling them to respond quickly with the fabrication and testing required by COOEC. Design specifications called for 120-mm Quantum-8 spliced grommets with protected eyes at both ends, and extra protection for the mid-body of the sling. The slings were ABS witness tested at Gaylin's facilities to 836 metric tons, with a proof load of 245 metric tons.

Samson Quantum-8 is uniquely suited for use in heavylift slings. This patented 8-strand construction uses Samson's proprietary DPX™ technology combining the extreme strength and light weight of Dyneema® with the high coefficient of friction of polyester. The result is an extremely strong rope that handles and splices easily with increased grip to help hold splices very securely.

Quantum-8 is one of a family of high-performance Samson products designed to replace wire rope size for size with the same or greater strength. Typically weighing in at one-seventh the weight of wire ropes, most of these high-performance lines float or are neutrally buoyant in seawater. The chief advantages are extreme strength, light weight, ease of handling, increased crew safety, and significantly longer service life in tough applications.



The lightweight, easy handling Quantum-8 slings were attached manually, without the assistance of heavy equipment required by cable-laid or synthetic webbing alternatives, resulting in a faster, more efficient installation.



Samson designs and manufactures a complete line of high-performance synthetic ropes for the offshore market. Samson's technical sales group works together with the most advanced research and development team in the industry to develop custom engineered solutions for critical offshore applications like deep and ultra-deepwater winch lines, riser pull-in lines, heavylift slings, working lines, and grommets for critical applications.

THE SAMSON ADVANTAGE

Offshore Projects List

Samson has extensive experience in supplying synthetic-rope solutions for critical offshore applications

- > Technip for Petrobras *Cascade Chinook* AmSteel®Blue 10-inch circ. lifting slings, 2010
- > MODEC *Jubilee* FPSO Turbo-EPX 5-5/8 inch diameter riser pull-in and mooring tensioning rope, 2010
- > Seaway Windmill Pedestal Lift AmSteel®Blue 144-mm diameter slings, 2009
- > Shell *Perdido Spar* Quantum-12 72-mm diameter x 2800-m spar-based deepwater lifting line and winch, 2009
- > Intermoor for ATP Oil & Gas *Mirage* AmSteel®Blue 72-mm diameter rig tow lines, 2009
- > Intermoor for ATP Oil & Gas *Mirage* Super Strong Nylon 10-inch circ. SVMS (Supply Vessel Mooring System), 2009
- > Noble Drilling Corporation *Rig Noble Jim Day* Super Strong Nylon 12-inch circ. SVMS, 2009
- > Noble Drilling Corporation *Rig Noble Danny Atkins* Super Strong Nylon 12-inch circ. SVMS, 2008
- > CNOOC *PanYu 30-1* jacket-lift, Quantum-8 120-mm diameter (836 metric ton MBL) sling/grommets, 2008
- > CNOOC *FPSO MV Nan Hi Sheng Li* AmSteel®Blue 88-mm diameter buoy pick-up line, 2008
- > CNOOC *JV (Agip, Chevron/Texaco) FPSO MV Nan Hi Fa Xian* AmSteel®Blue 72-mm diameter buoy pick-up line, 2008
- > Technip for Vincent Field *NW Australia* 44-mm diameter polyester/Vectran riser hold-back line, 2008
- > Technip for Stybarrow Venture *NW Australia* 80-mm diameter Neutron-8 riser pull-in grommets, 2008
- > SOFEC *Pyrenees FPSO* multiple components supplied, 2008:
 - Spider Buoy Retrieval Lines:
Tapered Quantum-8 16-inch circ. x 80-m
 - Float Line:
RP-12 Ultra Blue 3-inch circ. x 75-m
 - Riser Recovery Winch Ropes:
Quantum-8 6-inch circ. x 35-m
Quantum-8 7 1/2-inch circ. x 250-m
 - Float Assembly Pendant:
Force-8 3-inch circ. x 90-m
 - Spider Buoy Floating Leader Rope:
Force-8 3-inch circ. x 50-m
- > Delmar Systems *Anadarko M-8* OMNI-Max™ anchor line, 2008
- > Technip *Kikeh Spar* AmSteel®Blue rig tows, 2007
- > Enfield Project Jacketed and tapered Dyneema® riser winch lines, 2006
- > Frontier Drilling Neutron-8 10-inch tow bridle, 2006
- > SOFEC *Stybarrow FPSO* multiple components supplied, 2006:
 - Tie-Down Sling:
AmSteel®Blue 7/8-inch x 21-m
 - Riser Install Winch Ropes:
Neutron-8 12-inch circ. x 60-ft
Neutron-8 10-inch circ. x 65-m
 - Riser Recovery Winch Rope:
Neutron-8 7 1/2-inch x 35-m
 - Two Spider Buoy Winch Ropes:
Tapered Quantum-8 16-inch circ. x 70-m
 - Float Assembly Pendants:
Force-8 3-inch circ. x 50-m
Force-8 3-inch circ. x 90-m
Force-8 3-inch circ. x 90-m
 - Slings:
AmSteel®Blue 3/8-inch x 165-m
AmSteel®Blue grommet 1 1/8-inch x 8-ft
Force-8 1 1/4-inch x 15-ft
Tech-12 grommet 3/4-inch x 11-ft
 - Winch Lines:
Quantum-8 7 1/2-inch circ. x 250-m
Tapered Quantum-8 16-inch circ. x 70-m
Neutron-8 7 1/2-inch circ. x 115-ft
- > SOFEC *Terra Nova* 16-inch circ. Neutron-8 winch lines, and 7-inch circ. x 18-ft AmSteel®Blue grommets, 2006
- > BP *Atlantis* AmSteel®Blue rig tows, 2005
- > Saipem AmSteel®Blue and Neutron-8 heavy lift slings, 2005
- > BP *Thunderhorse* AmSteel®Blue rig tows, 2004
- > Marco Polo TLP AmSteel®Blue riser protection barrier net, 2002
- > Prince TLP AmSteel®Blue riser protection barrier net, 2001
- > JHN FPSO AmSteel®Blue 11-inch spider buoy retrieval line, 2000
- > Shell Auger TLP Super Strong SVMS, 1991
- > Conoco Joliet TLP Super Strong SVMS, 1989
- > Diamond Offshore Drilling *Ocean Confidence* Super Strong SVMS
- > Noble Drilling *Noble Homer Ferrington* Super Strong SVMS
- > Aker Marine Contractors/Chevron *Genesis* SPAR Platform Super Strong SVMS
- > Diana/Hoover – SVMS
- > Gunnison – SVMS
- > Magnolia – Tow out system
- > Red Hawk – SVMS
- > Front Runner – SVMS
- > Shell Mars – SVMS
- > URSA – SVMS
- > Petronius – SVMS
- > Neptune – SVMS
- > Ram Powell – SVMS
- > BoomVang – SVMS

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Omni-Max™ is a trademark of DelMar.



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