CALM BUOY AND FPSO/FSO OFFTAKE HAWSER ASSEMBLIES
A BESPOKE PACKAGE

Survitec Group can provide a comprehensive range of equipment for Offshore Mooring Systems designed to suit the specific requirements of different locations and water temperatures. The focus is always on operational performance, reliability, safety and on time delivery.

Our bespoke packages cover everything from:
- Mooring hawsers
- High quality Pick-up and Messenger ropes
- Chafe chains
- Support buoys
- Shackles
- Associated fittings
- Load monitoring equipment
- Marine hose ancillary equipment to OCIMF standard.

HIGH QUALITY MATERIALS (OCIMF 2000)

We only use the best quality yarns of multifilament nylon, HT polyester and blended fibres to manufacture our mooring hawsers. These hawsers can be supplied with an inherent buoyancy flotation system and/or total PU encapsulation for increased durability and operational cost savings.

Our Circular Braid and Double Braid mooring hawsers are manufactured and supplied in strict accordance with the OCIMF 2000 ‘Guidelines for the Purchasing & Testing of SPM Hawsers’, following an exhaustive documented prototype testing fully witnessed and certified by Class.

WORK IN PARTNERSHIP

In addition to working very closely with customers, Survitec Group has established exclusive partnerships with major manufacturers. Survitec Group is responsible for marketing and supplying these high quality products to the offshore market. Together, we provide unparalleled product development, technical support and distribution for offshore mooring systems worldwide.

RESEARCH AND DEVELOPMENT

As a leading supplier to the offshore industry, the Survitec Group team work at the cutting edge of mooring technology. We use the latest computer-aided design software (AutoCad) to design and manufacture systems that are safe yet highly cost effective.

Our approach is always underpinned by practical experience in the field. We custom design Single Point and Tandem mooring systems to suit the individual project requirement. Work is carried out under stringent quality assurance conditions which conform to appropriate classification requirements and/or the latest OCIMF Guidelines.

The Survitec Group rope sales and engineering team has many years’ experience in the industry with particular expertise in design, development and product engineering. We have the resources to carry out a full range of forensic analysis tests as well as the in-house capability to evaluate reverse bend, elongation, abrasion and tensile loading of yarn and fibre rope.

WORLDWIDE SUPPORT

Survitec Group continues to develop a global site/office network worldwide in addition to a dedicated global network of agents/representatives.

Customer care and technical support

Our rope sales and engineering team is always on hand to provide a comprehensive customer care and technical support service. This may involve offering advice over the telephone, by fax or email. Alternatively we may visit a customer’s operation and discuss their individual needs on site. Whatever the application requirement, we are committed to providing a fast and efficient solution. All our systems can be supplied with high quality drawings and fully documented manuals to accompany the QA and/or independent inspection authority certification.

• ONLY THE HIGHEST QUALITY MATERIALS ARE USED TO OCIMF STANDARDS
• UNPARALLELED PRODUCT DEVELOPMENT, TECHNICAL SUPPORT AND DISTRIBUTION
• FULL RANGE OF MARINE HOSE ANCALLARY EQUIPMENT AVAILABLE TO OCIMF STANDARDS
• GLOBAL DISTRIBUTION NETWORK
Calm Buoy and FPSO/FSO Offtake Hawsers Assemblies

Superline Circular Braid Nylon SPM
- Made from polyamide (nylon)
- Construction of load-bearing cores with a protective polyamide cover
- Good abrasion resistance
- White in colour with a green marker
- Excellent UV resistance
- Specific Gravity 1.14
- Workable in sub-zero temperature
- Melting point of 215°C
- Can be stowed wet

Viking Double Braid Nylon SPM
- Made from polyamide (nylon)
- Double braided construction
- Treated with marine finish
- White in colour with a green marker
- Specific Gravity 1.14
- Melting point 215°C
- Excellent abrasion resistance
- Excellent UV resistance
- Wet strength equals dry strength

Nuflex Offshore 8 Strand SPM
- Made from composite fibre
- Construction 8-strand plaited
- White in colour with tri-colour marker
- Specific Gravity 1.14
- Melting point of 165°C/260°C
- Excellent abrasion resistance
- Excellent UV resistance
- Wet strength equals dry strength

For Single Point Mooring systems nylon is a well established material because of its excellent stretch characteristics. The behaviour of nylon is influenced by water, which can be seen when dry and wet breaking strengths are compared. Typically for nylon ropes this reduction in strength can be as much as 10%, but in the Superline Circular Braid Nylon SPM utilising a special marine finish on the yarns, the wet strength is only 5% lower than the dry strength. The rope is a circular braid design developed to give a rope extra protection against wear and tear without significantly changing the primary characteristics. It is a logical development from the double-braid, where the outer braid protects the inner braid and contributes to the strength. In the circular braided design this duality has been abandoned.

The cover is optimised for wear and abrasion resistance and the core optimised for strength. This results in both a higher strength and a better life for this rope design. The core is manufactured from a number of sub-ropes laid parallel to each other. Produced in both right-hand and left-hand lay ensures that the finished rope has a torque balanced construction. The circular braided cover protects the cores against wear. Only after the cover has been worn through and the cores damaged will strength be affected.

Ropes with a double-braid design were traditionally the preferred construction for Single Point Mooring hawsers. Polyamide (nylon) was the first suitable synthetic fibre discovered with the best elongation properties so is now better established than polyester alternatives. The double braiding provides an outer jacket which helps prevent UV degradation as with circular braid construction and improves life expectancy of the rope.

Nuflex Offshore 8 Strand SPM is a composite fibre with polyester as the strength member, with excellent fatigue characteristics and abrasion resistance. The fatigue life is comparable to pure polyester, but the weight for a given strength is comparable to that of nylon. The behaviour of the rope is not influenced by water, thus wet and dry strength are identical. Because of material and its life cycle under use, 8 Strand is a cost-effective solution for SPM hawsers.

The initial elongation is lower than that of nylon alternatives, however it does not change significantly in use, while nylon rapidly stiffens. As a result average mooring forces will be comparable. The fatigue life of the hawser is influenced by both the fibre and the rope design. Nuflex Offshore 8 Strand SPM ropes have a plaited construction. This design is well established because of its ease of handling and non-rotating behaviour.

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MOORING FLotation

Survitec Group supply a number of hawser flotation methods:

Lace-on Float
Survitec Group lace-on floats are manufactured from a heavy duty polyamide fabric with expanded polyethylene closed cell foam strips. Floats are workable between temperatures -30°C and +65°C and offer good resistance against oil and chemicals. Each float has brass eyelets and available in either 1.06mtrs or 2.06mtrs lengths. The width will depend upon the rope size. The float is orange colour on the outside, and white colour on the inside.

Floating Pick-up/Messenger Rope
• Made from high tenacity co-polymer yarns and available in 3, 4 or 8 strand
• Flexible & easy to handle
• Specific gravity 0.91
• Fully UV stabilised
• Hi-vis yellow colour
• Excellent abrasion resistance and strength
• Wet strength equal to dry strength
• Permanent floatation in water
• Also available in SPunStaPle Polypropylene.

Chafe Chains
(please note: Chafe chains can be supplied configured to a customer’s own specification)
• Chafe Chain A OCMF 1993 - for use with full range of ship sizes
• Chafe Chain B OCMF 1993 - for use with ships of 350,000 tonnes or less deadweight
• Chafe Chain C OCMF 1993 - for use only in combination with chafe chain A or B at terminals accepting ships fitted with 54mm chain stoppers

Inherent Buoyancy Flotation System
A common issue in offshore mooring applications utilising hawsers with conventional lace-on floats, is that during the lifetime of the hawser the floats tend to suffer damage and can be ripped away from the rope. This means operators having to secure replacement floats and organise a maintenance crew to replace damaged or missing floats. Our Inherent Buoyancy Flotation System overcomes these issues, and in addition offers many other operational benefits.

Hawsers that incorporate our integral Floatation Systems are supplied with an additional layer of closed cell buoyancy foam ensuring that sufficient buoyancy is calculated to support the hawser in seawater. This is secured using an additional outer protective layer which can also be covered in a tough resilient polyurethane elastomer coating.

• The Inherent Buoyancy Flotation System DOES NOT need to be replaced during the hawser lifetime, cutting down the need for spare floats and expensive maintenance crews
• The make up of the Inherent Buoyancy Flotation System enhances the mooring hawser’s abrasion resistance to external items in the field, ie. Floating hose flanges. The polyurethane elastomer outer skin is tough and very hardwearing
• Especially in CALM buoyy systems where hawsers may be left floating in the water between offtakes, the Inherent Buoyancy Flotation System has the added benefit of reducing the amount the rope will flex with the wave action. This in turn reduces internal yarn-on-yarn abrasion damage, and helps to extend retirement times
• Where ropes are left floating in the water between offtake, the Inherent Buoyancy Flotation System prevents ‘water wash’ through the rope which on conventional ropes can over time remove the unique marine finishes applied to reduce internal abrasion/fatigue damage.

Tubular Rope Float
Survitec Group tubular rope floats are manufactured from closed cell polyethylene foam, encapsulated within a tough polyurethane elastomer skin. This high performance outer skin is resistant to ultraviolet degradation and provides protection from abrasion. Tubular rope floats can be supplied factory fitted, or ‘split’ for retrofitting to existing hawser operations by banding or strapping.

SSD Nutech®
Made from high tenacity co-polymer yarns, available in 3, 4, 8, 12 and 24 strand. A competitive alternative to Nylon and Polypropylene.

SSD Nutech® Plus
Constructed principally from High tenacity Polypropylene & Polyester composite fibres, offering exceptional abrasion and frictional heat damage resistance with an enhanced fatigue life.

SSD Winchtech
A 100% high tenacity, low elongation Nylon (mono and multifilament) 6 strand cross laid rope. A competitive alternative to Atlas.

SSD Nutech® Plus
A floating winch line with a 12 strand core made from co-polymer fibre, overbraided with Survitec Nutech® Plus yarns lending itself to mooring line applications.

SSD High Performance Ropes
Constructed from Ultra High Modulus Polyethylene (UHMPE) fibre and available in 8/12 strand or overbraided constructions.
Survitec Group standard range of chain support buoys have a typical reserve buoyancy of 2000 lb up to 12000 lb - but our flexible production process allows us to manufacture products to suit our customers exact buoyancy requirements.

The buoys can also be supplied configured with swivel eyes top and bottom, or with a chain through/locking plate arrangement. We also supply pick-up buoys with a reserve buoyancy of up to 500kg.

**CAST SPM HAWSER THIMBLE**

- Material: cast steel/stainless steel
- Finish: galvanised or plastic coated on request

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**TUBULAR HAWSER THIMBLE**

- Material: mild steel
- Finish: galvanised or plastic coated on request

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**BELLMOUTH HAWSER THIMBLE**

- Material: carbon steel/stainless steel
- Finish: galvanised

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Survitec Group can offer load monitoring system packages for SPm and Tandem mooring operations. We have the flexibility to simply measure hawser loading, through to a fully integrated system offering load monitoring and recording with radio data transfer from the SPm to ship, shore or platform.

All equipment is designed for use in an offshore environment and to withstand the harshest conditions. Monitoring systems provide vital information on the safety of the mooring system. Monitoring enables loading to continue in marginal weather conditions in the knowledge that design limits are not being exceeded. This can permit more cost effective use of both SPm and tankers. Load monitoring reduces the risk of break-out with consequent savings in hawser and hose replacement costs.

Operating within known safety margins improves safety for operational personnel. It may be possible to develop operational practices at the terminals which reduce both peak and average loads. This will assist in extending hawser life and reducing wear on the buoy itself.

Monitoring can provide:

- Accurate indication of mooring loads
- Audible and visual alarms
- Historic information of the hawser loads for analysis
- Optional data on hawser service history for fatigue life assessment
- A safer mooring operation.

Features of our load monitoring solutions:

- Load monitoring on the buoy is suitable for hazardous locations
- Systems can include handheld monitors
- Optional estimation of hawser residual life based on the OCMF Guidelines
- Integrated GPS available to monitor buoy position and relative speed with shuttle tanker.

Survitec’s International Rope Sales team offer a diverse range of proven high performance synthetic fibre ropes for commercial shipping, harbour and escort towage, naval and the offshore exploration and production industries. Products are manufactured to ISO standards and conform to International Classification regulations.

Over the years we have built up a vast wealth of knowledge in manufacturing and supply, gaining us a wide-ranging customer base for our products. Our focus is always on the continued development and improvement of our products to service the changing requirements of our customers.

In the past few years we have developed a new generation of high performance synthetic fibre ropes that are superior to steel wire. The ropes are manufactured from Ultra High Modulus Polyethylene (UHMPE) material and used in applications such as:

- Deepwater installation and lifting lines
- Submerged turret buoy pull in lines
- Retrieval lines
- Heavy lift slings
- Towing lines
- Work wires.

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**CHAIN SUPPORT BUOY**

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Operating within known safety margins improves safety for operational personnel. It may be possible to develop operational practices at the terminals which reduce both peak and average loads. This will assist in extending hawser life and reducing wear on the buoy itself.

Monitoring can provide:

- Accurate indication of mooring loads
- Audible and visual alarms
- Historic information of the hawser loads for analysis
- Optional data on hawser service history for fatigue life assessment
- A safer mooring operation.

Features of our load monitoring solutions:

- Load monitoring on the buoy is suitable for hazardous locations
- Systems can include handheld monitors
- Optional estimation of hawser residual life based on the OCMF Guidelines
- Integrated GPS available to monitor buoy position and relative speed with shuttle tanker.

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- Deepwater installation and lifting lines
- Submerged turret buoy pull in lines
- Retrieval lines
- Heavy lift slings
- Towing lines
- Work wires.

<p>| Material: forged high alloy steel  Finish: galvanised or painted  Minimum break load 5 x SWL |
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<td>333</td>
<td>720</td>
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</table>

**HAWSER SHACKLE**

- **Material:** forged high alloy steel
- **Finish:** galvanised or painted
- **Minimum break load 5 x SWL**

**RESIDUAL HAWSER STRENGTH TESTING**

Survitec Group can help operators to understand the hawser behaviour and performance in specific field operations by residual strength testing of used/retired mooring hawser.

Our high tech laboratory has the capability to analyse mooring hawser for condition, signs of internal abrasion damage or ingress of foreign particles, and perform a residual break test. All this information will help operators understand the hawser in use at their terminal better and make informed judgements on current and future retirement programmes. Survitec Group engineers are able to offer advice and guidance on this.

Making preparations for a residual break test in the Survitec Group, Lowestoft facilities.
**EQUIPMENT SELECTION**

**Calm Buoy/FPSO Side**

**Mooring Hawsers**

When selecting hawsers, terminal operators should take into account not only strength but also energy absorption and fatigue performance (OCMF Thousand Cycle Load Level). Detailed information can be found in the OCMF 2000 ‘Guidelines for the Purchasing and Testing of SPm-Hawsers’.

The NVWS (New Wet Break Strength), energy absorption and fatigue performance of hawsers will deteriorate during service under the influence of factors such as service life, cyclic load history, hawser type, construction, environmental conditions, damage and stowage arrangements between use. Terminal operators should take these factors into account when determining the appropriate hawser for the mooring system and hawser retirement criteria. Survitec Group can help operators with hawser retirement criteria. It is recommended that terminal operators develop hawser retirement procedures based on a combination of manufacturer’s recommendations, their own experience at the location and the results of hawser testing. Service data gained using hawser load monitoring equipment can be valuable in this respect.

**Chafe Chains**

Each mooring hawser should terminate at its shipboard end with a chafe chain. The standard recommended size of the chafe chain has been established at 76mm base on the diameter of the material forming the common stud links. Terminal operators should select the appropriate chain by taking into account the designed SPm mooring arrangement, SWL required and the properties of the chain grade selected. Typically chafe chains form a single chain of approximately 8 metres or more in length, composed of 76mm stud link chain. If through-type chain support buoys are utilized the length of the chain may have to be increased. Each chain should terminate at the shipboard end with an oblong plate for connecting the chain to the pick-up rope bow shackle.

**Weak Links**

Weak links, if fitted, should be selected such that the recommended bow chain stopper, chafe chain, hawser or connection to the SPm do not constitute the weakest yield strength of MBL component of the entire system. Weak links, if fitted, should be designed, manufactured and tested under a certification scheme. Survitec Group can provide guidance on inspection criteria.

**Support Buoys**

When the berth is unoccupied, each chafe chain may be supported by flotation devices. One method is to use a swivel-ended type support buoy that is connected by a short length of chain to the end link of the chafe chain, adjacent to the hawser. Another method is to use a through-type chain support buoy. Support buoys should have reserve buoyancy equivalent to at least 20% of the weight in air of the material to be supported.

**Pick-up/Messenger Rope**

The pick-up rope is connected to the ship end of the chafe chain and typically consists of 150 metres of floating rope (generally polypropylene based) complete with an eye at each end. The rope can vary in length from 120-180 metres, and in diameter from 64-80mm. At some terminals where the pick-up rope is not kept connected to the chafe chain when the berth is unoccupied, differing arrangements may be employed to facilitate connection/disconnection of the pick-up rope.
Survitec Group are able to source and supply marine hose ancillary equipment meeting OCIMF standards. Products include:

- Butterfly Valves, Camlock Couplings, Blind Flanges
- Pick-up & Snubbing Chains, Marker Buoys
- Studbolts, Nuts & Gaskets
- Hinged Hose Flaps for Submarine Hoseline Systems
- Spool Pieces, Reducers, Y-Pieces

**MARINE HOSE ANCILLARY EQUIPMENT TO OCIMF STANDARDS**

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