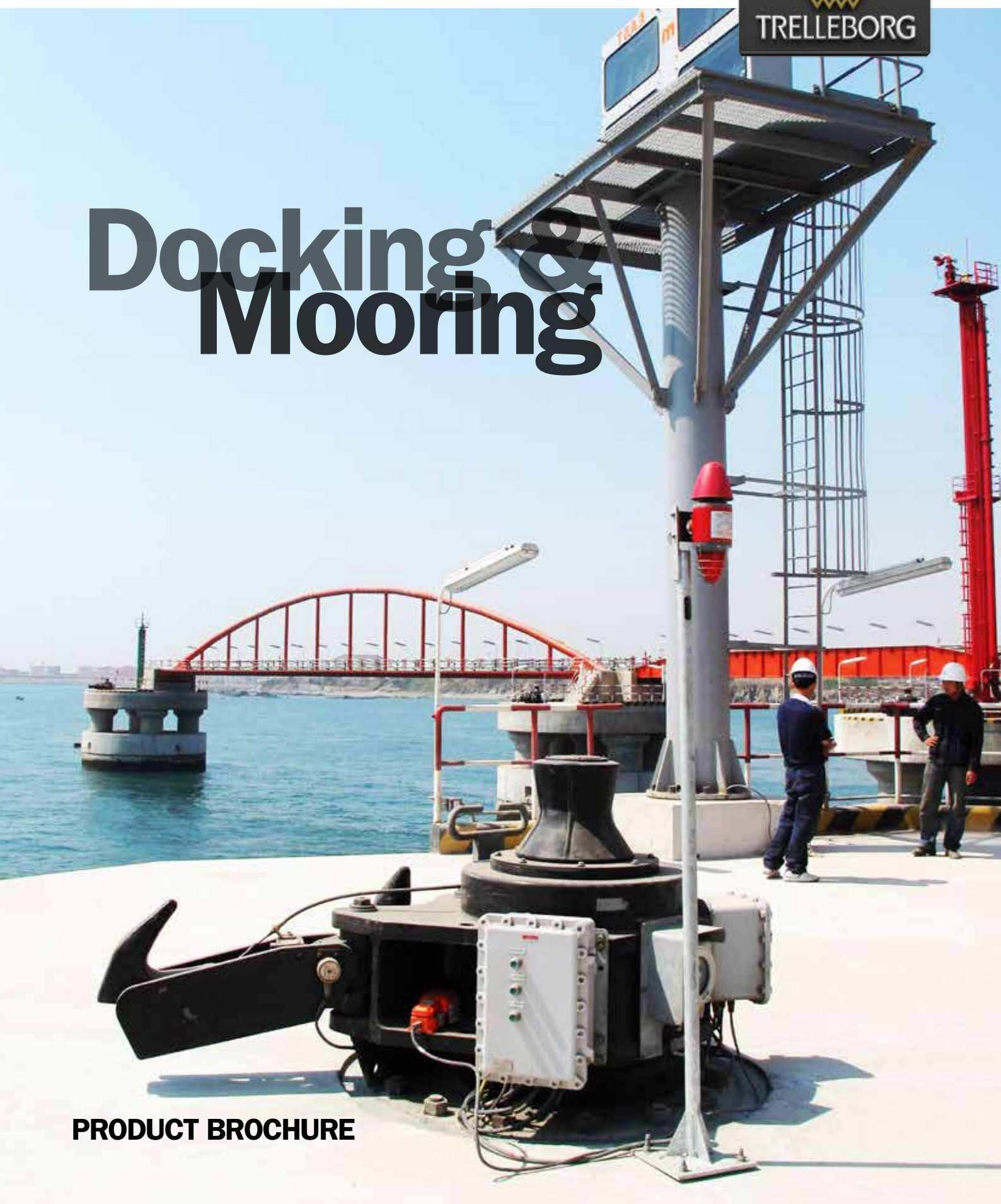


Docking & Mooring

PRODUCT BROCHURE



The Smarter Approach



Connect with The Smarter Approach

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Better connected systems mean faster turnaround and increased throughput, improved safety and lower operating costs.

Connecting decades of experience with a new, smarter approach to port and terminal equipment optimization, Trelleborg's marine systems operation helps ports and terminals deploy smart, engineered solutions for port approach, berthing, docking and mooring. This enables better informed real-time and strategic decision making, both onshore and on board the vessel.

From port owners and operators to consulting engineers, Trelleborg works with customers to determine best fit solutions for specific applications, and supply a fully integrated solution. End-to-end service and a comprehensive product portfolio meet and exceed customer needs, enhancing safety and improving efficiency in all marine environments, from conception to completion and beyond.

Docking & Mooring

When installing or upgrading Docking & Mooring Systems, you need to ensure you choose the right partner. Ensure your provider can deliver the solution for you, on time and on budget, wherever you are in the world.

Ensure your solution is designed around the needs of you and your customers, with a dedicated team that has the experience to understand them.

Ensure your Docking & Mooring Systems feature technically superior products to maximize durability and reliability, whilst minimizing downtime and whole life costs.

Ensure your partner can offer you the maintenance and aftersales service you need.

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DOCKING & MOORING

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A Smarter Approach at every stage

A smarter approach to...

CONSULTATION

Consultation from the earliest project phase to ensure the optimum fender, mooring, navigation and transfer solutions are specified, with full technical support from our global offices.



CONCEPTS

Conceptual design in your local office – with full knowledge of local standards and regulations, delivered in your language – for optimized port and vessel solutions.



DESIGN

Concepts are taken to our Engineering Center of Excellence where our team generates 3D CAD designs, application-engineering drawings, a bill of materials, finite engineering analysis and calculations for both our fender systems and marine technology solutions.



MANUFACTURE

Our entire product range is manufactured in-house, meaning we have full control over the design and quality of everything we produce. Our strategically located, state-of-the-art facilities ensure our global, industry leading manufacturing capability.



TESTING

Across our entire product range, stringent testing comes as standard at every step in our in-house manufacturing process. We ensure that life-cycle and performance of our entire product range meet your specifications, and more.



INSTALLATION

Dedicated project management, from solution design right the way through to on site installation support. We design products and solutions that always consider ease of installation and future maintenance requirements.



SUPPORT

Local support on a truly global scale, with customer support teams all over the world. And this service doesn't stop after a product is installed. You have our full support throughout the entire lifetime of your project, including customized training programs, maintenance and onsite service and support.



THE FUTURE

Deploying the latest in smart technologies to enable fully-automated, data-driven decision making that optimizes port and terminal efficiency. At Trelleborg, we're constantly evolving to provide the digital infrastructure our industry increasingly needs.



When you choose Trelleborg you ensure your expectations will be met, because we deliver a truly end-to-end service – retaining vigilance and full control at every stage.

Total Cost Of Ownership

When considering the selection of docking and mooring equipment, a holistic review of port and terminal operations should be undertaken. This should focus on how docking and mooring solutions can impact or improve facilities ability to transfer product or personnel. A docking and mooring system is far more than just a means to berth and moor a vessel. Like with any business case for investment, when reviewing Total Cost Of Ownership (TCO) of a docking and mooring system, return on investment should be first and foremost in the decision making process.

Proper selection of docking and mooring equipment can greatly reduce facility downtime and improve operational efficiency, safety and ultimately profitability.

Some of the key points that often get overlooked in this review are factors that can negatively impact operations and the solutions that are available. While the initial investment may be higher with a premium solution, the case for return on investment is overwhelming.

FACTORS THAT NEGATIVELY IMPACT THE COST OF OWNERSHIP

- Exposed berths having to slow or stop transfer operations when metocean conditions or passing ships result in vessel motions outside the guidelines for safe or efficient transfer.
- Inefficient mooring operations extending facility downtime and adding overheads for mooring crews, pilotage and tugs.
- Unbalanced mooring loads, parting lines and having to stop transfer to tend moorings.
- Using tugs to supplement mooring systems during extreme events – passing ship or environmental.

HOW TRELLEBORG SOLUTIONS CAN MINIMIZE TOTAL COST OF OWNERSHIP AND IMPROVE PROFITABILITY OF PORT AND TERMINAL OPERATIONS

- Automated mooring solutions that can dampen vessel motion and extend the range of metocean conditions in which efficient transfer can take place or combat effects from passing ships.
- SmartPort turnkey solutions integrating multiple port and terminal subsystems.
- Confidence that equipment complies with local regulatory requirements, design codes and standards.
- Class leading structural design to accommodate worst case loading conditions and provide superior integrity for dynamic loading.
- Global aftersales support network offering total lifecycle management packages, extending asset life and minimizing downtime.
- Accredited and best practice quality systems that ensure mooring solutions reliability.

Docking and Mooring

With just under 100 dedicated docking and mooring employees worldwide, Trelleborg has the largest and most experienced docking and mooring team to provide an unparalleled level of support and expertise throughout your docking and mooring journey.

Some of the key resources that form part of the docking and mooring lifecycle are:

FUNCTIONAL AREA	PURPOSE	CORE COMPETENCY
Technical Sales Managers	The first point of contact in the Trelleborg experience, to understand your needs and establish an aligned technical and commercial solution.	<ul style="list-style-type: none"> • Application Engineering • Customer Management
Project Management	An experienced project manager will oversee the design, manufacture and delivery of your docking and mooring solution; providing regular communication and ensuring project execution on time, to budget and in accordance with the project specifications and Trelleborg ISO9001 management system.	<ul style="list-style-type: none"> • Docking & Mooring Application Expertise • Contract and Risk Management • Customer Management
Project Design Engineers	Bespoke design solutions to meet the project requirements from concept to inspection and testing.	<ul style="list-style-type: none"> • Structural & Mechanical Engineering • Electrical & Instrumentation Engineering • Software Development • Mooring Analysis • Hazardous Area Product Development and Regional Statutory Compliance • International Design Codes Compliance • Offshore Design Code Compliance (Class DNV, ABS)
Research & Development	Developing the next generation of docking and mooring solutions to improve safety, efficiency and throughput and in doing so reducing facilities' overall total operating cost and improving profitability.	<ul style="list-style-type: none"> • Calibration Services • Routine Maintenance • Training
Site Service Engineers	Support for sites from commissioning, training and whole life product support.	<ul style="list-style-type: none"> • Calibration Services • Routine Maintenance • Training
Quality Assurance	Establish and ensure internal business processes and manufacturing activities are upheld to the highest achievable standards and in compliance with Trelleborg ISO9001 accredited Integrated Management System.	<ul style="list-style-type: none"> • Application Engineering • Customer Management

Applications Summary

APPLICATION	PRODUCT														
	Quick Release Hook Onshore	Quick Release Hook Offshore	Quick Release Hook Load monitoring	Quick Release Hook remote release	Free Standing Capstans	Tugger Winches	AutoMoor	Pelican (Buoy) Hooks	Hawser Hooks	Hawser Load Monitoring Bit	Chain Stoppers	Tandem Mooring Winch	Docking Systems	Enviro Monitoring	Integrated Systems
LNG carrier berths	✓		✓	✓	✓	✓	✓						✓	✓	✓
Oil berths	✓		✓	✓	✓	✓	✓						✓	✓	✓
LPG berths	✓		✓	✓	✓	✓	✓						✓	✓	✓
Bulk liquids berths	✓		✓	✓	✓	✓	✓						✓	✓	✓
Bulk materials berths	✓		✓	✓	✓	✓	✓						✓	✓	✓
Small scale mooring	✓		✓	✓											✓
Commercial (RoRo, ferry, container)					✓	✓	✓							✓	
Cruise terminals							✓								
Buoy moorings								✓						✓	
Tandem Mooring									✓	✓		✓	✓	✓	✓
Bow to a Single Point Mooring (SPM)											✓	✓			
Spread mooring											✓	✓		✓	✓
(F)LNG and FSRU vessels		✓	✓	✓										✓	✓
Offshore berths													✓	✓	
Ship-to-ship		✓	✓	✓									✓		✓
Bunkering		✓	✓	✓											✓

Application Summary

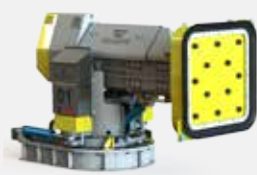
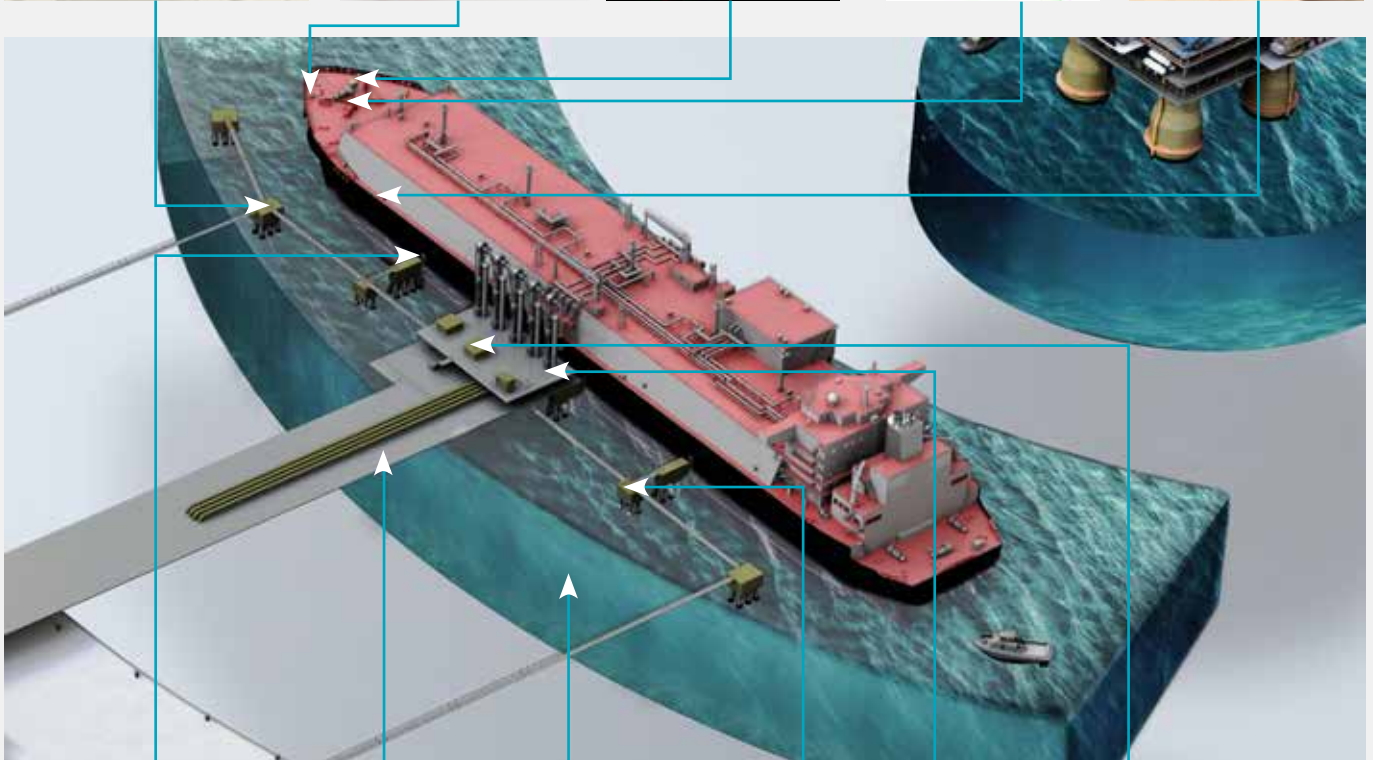
Quick Release Hook
Onshore
+ LMS/ERR/Capstan

Hawser Hook

Chain Stopper

Winches &
Hawser Reels

Quick Release Hook
Offshore
+ LMS/ERR/Capstan



AutoMoor

Environmental Monitoring

Docking
+ Display Board
+ Lasers

Integrated System

Quick Release Hook



Since 1972, Quick Release Hooks (QRH) have enabled mooring lines to be safely secured, and quickly and easily released, even when loaded to their safe working load limit.

A range of hook sizes and capacities are available, as well as various mounting options. Typically, a cast QRH base is used for new installations. To upgrade older facilities, fabricated hook bases can be designed to suit existing hold-down bolt patterns.

For offshore applications, the QRH is class certified and designed for a new generation of ship-to-ship FLNG and bunkering applications.

Powered By
SmartPort



QRH Onshore

FEATURES

Safe, efficient and reliable mooring operations

Options to suit all types of mooring ropes, loading conditions and foundations

Low maintenance option available

Integrated capstan available with speed and power options

Low profile and compact footprint

All hooks individually tested

All hooks can be safely released, even at the hook safe working load (SWL)

Compliant with international standards

APPLICATIONS

LNG carrier berths

Oil berths

LPG berths

Bulk liquids berths

Bulk materials berths

Small scale mooring

ADD-ONS

■ Low maintenance, dual lock, safety keeper bars and grit guards (refer to page 17)

■ Capstan (refer to page 20)

■ Load monitoring (refer to page 21)

■ Hook release (refer to page 23)

■ Tugger winch (refer to page 27)

■ Integration with the central monitoring system (refer to page 55)

QRH Offshore

FEATURES

Safe, efficient and reliable mooring operations

Low maintenance option available

Integrated capstan available with speed and power options

Low profile, compact footprint and efficient integration with ship deck super structure

All hooks individually tested

All hooks can be safely released, even at the hook safe working load (SWL)

Class certificate including DNV, ABS, Lloyds or BV

Stowing place for capstan foot switch to avoid damage due to ship movement

APPLICATIONS

Ship-to-ship mooring

Import LNG terminals

Export LNG terminals

Offshore ship-to-ship mooring on FLNG bunkering

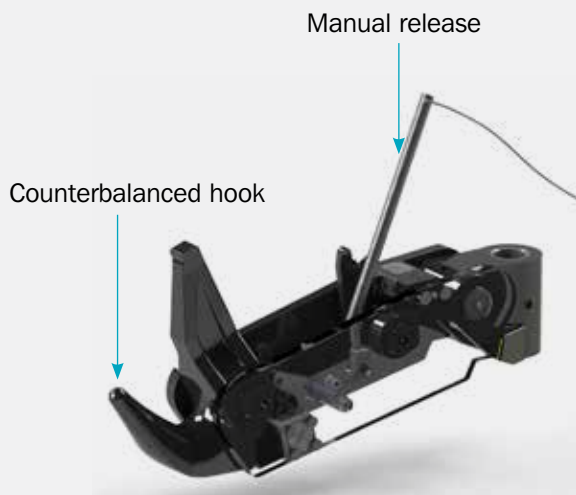
Quick Release Hooks

COUNTERBALANCED HOOKS

The cast mooring hook is counterbalanced for easy reset by operators. The smooth hook profile, rope throat area and steep rake angle ensure the rope sits correctly, providing greater load monitoring accuracy, reduced stress concentrations and chafing.

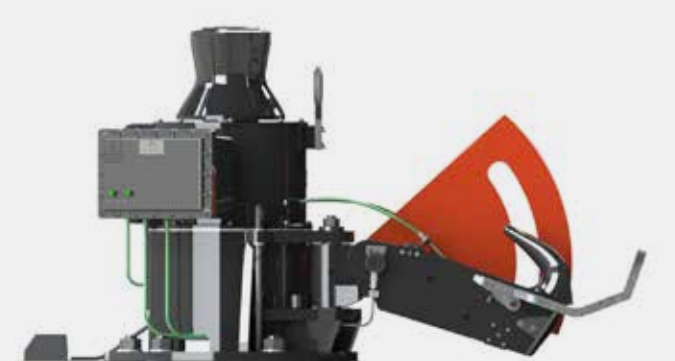
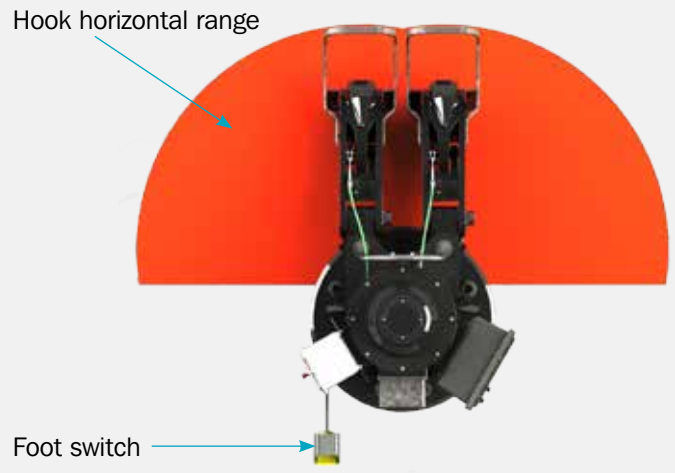
MANUAL RELEASE

All hook release components are enclosed within the hook side plates, protecting the mechanism from debris and damage. A 20kg force is required to release the hook at full load while a single operator stands safely behind the hook.



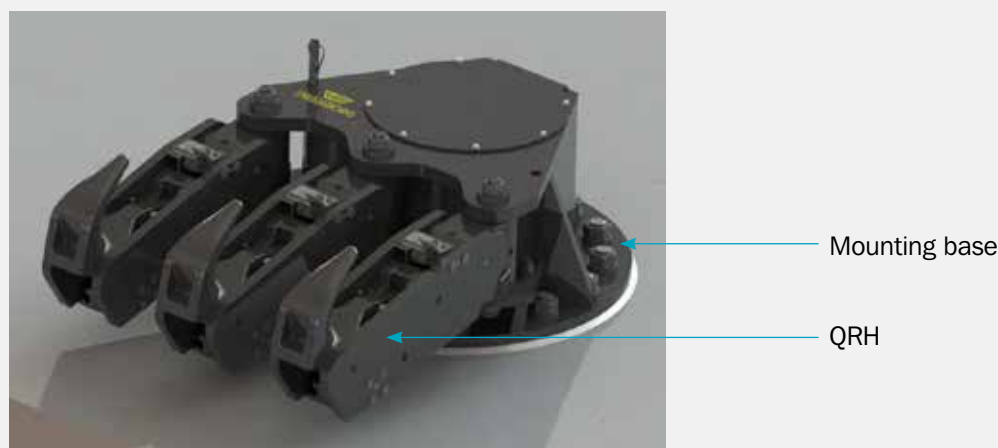
LARGE MOORING ANGLES

Hooks can rotate under full load through horizontal angles up to +/-90 degrees and vertical angles 0 to +45 degrees or more.



BASES

Single or multiple hooks configurations are available. Bases can be cast or fabricated to suit new or retrofit installations.



Add Ons

INTEGRATED CAPSTANS

Capstans are fully enclosed within the base for ultra low maintenance, corrosion protection and reliability. Various load ratings and running speeds are available to suit all ship sizes and mooring line materials (refer to page 20).

ROPE GUIDE

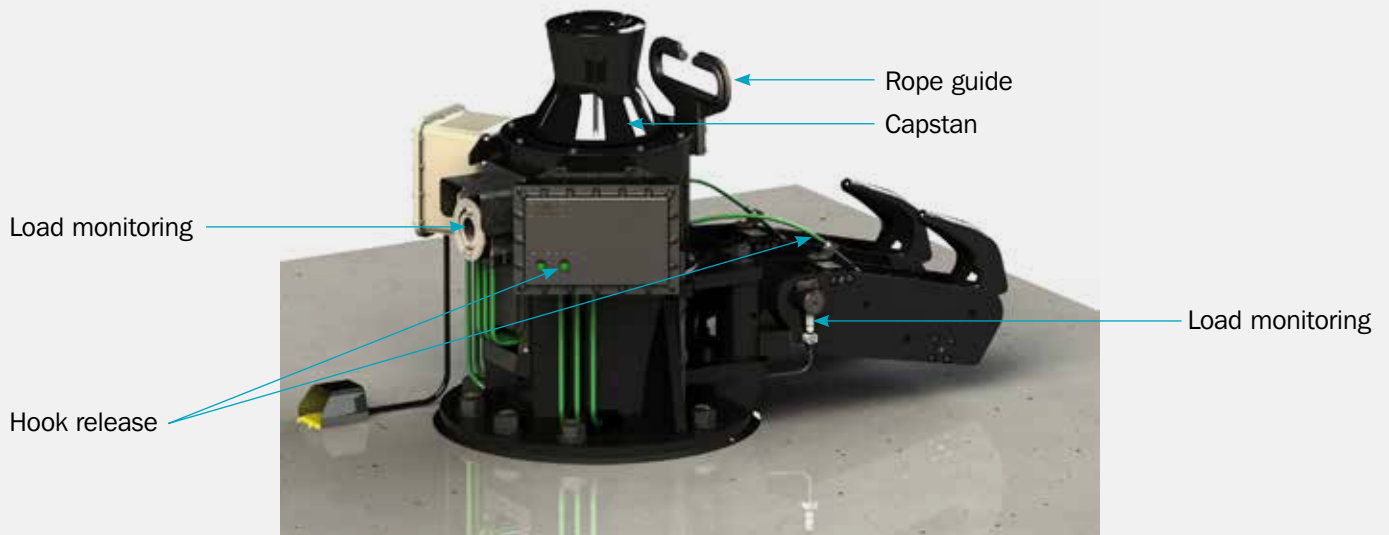
Rope guide for efficient and safe line handling during capstan operation.

LOAD MONITORING

Load cells can be incorporated into each hook to provide monitoring and warning of mooring line tension for each QRH installed on the jetty efficiently and with increased safety (refer to page 21).

HOOK RELEASE

The hook release system allows for simple and safe release of mooring lines from each hook using local or remote pushbutton controls (refer to page 23).



SAFETY KEEPERS

Safety Keepers prevent slack mooring lines from accidentally detaching at high vertical angles (refer to page 18).

HAZARDOUS AREA OPERATIONS

All electrical components are certified for hazardous area operations (where required). The hook design prevents contact with the structure during mooring and on release, eliminating spark risk.

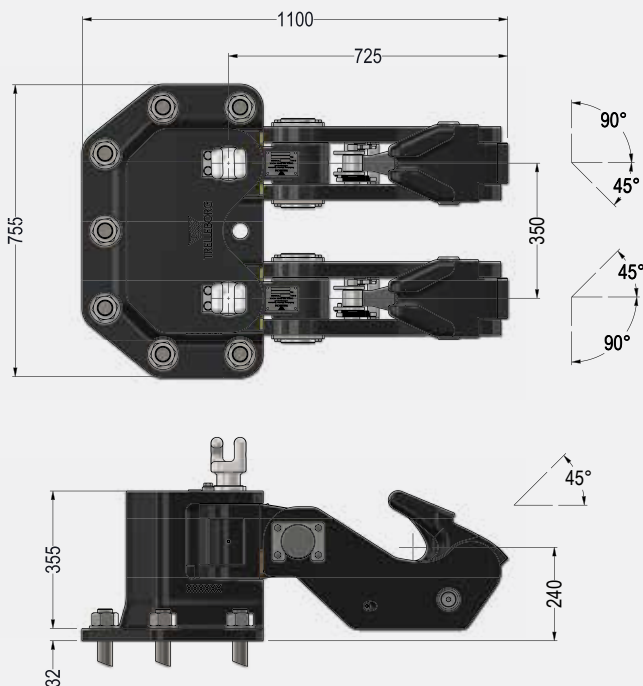
Quick Release Hook - Onshore Options

QUICK RELEASE HOOK & BASE OPTIONS	SWL (T)	INTEGRAL CAPSTAN
50 Series	50	N/A
60 Series	60	Available
75 Series	75	Available
100 Series	100	Available
125 Series	125	Available
150 Series	150	Available

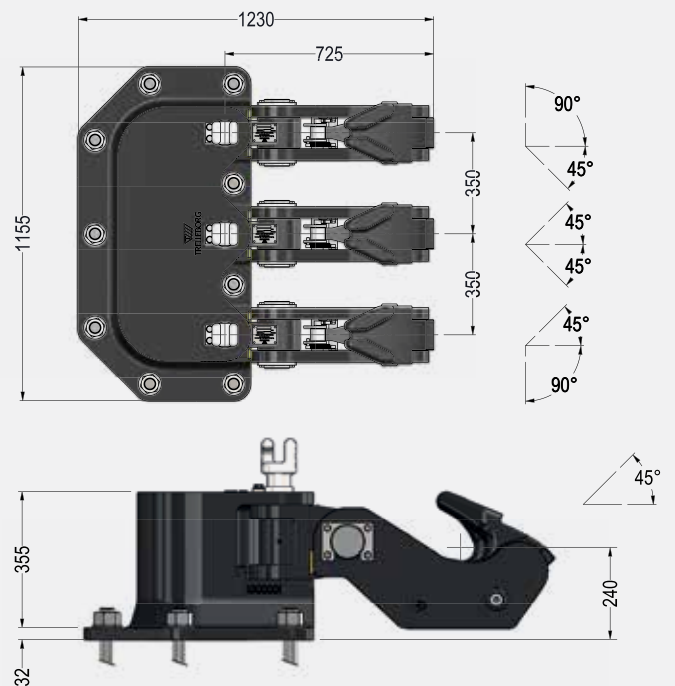


QRH 50 Series

DOUBLE HOOK

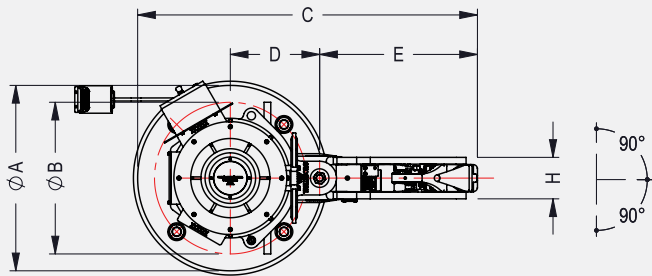


TRIPLE HOOK

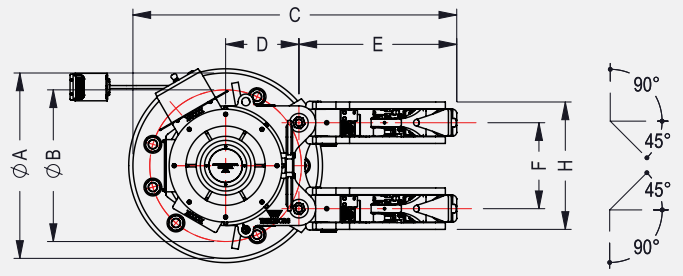


QRH 60-150 Series

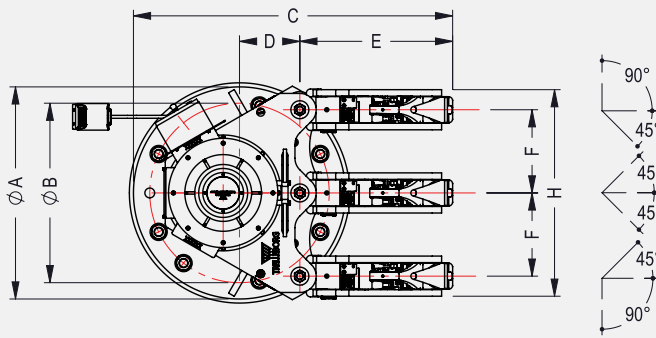
SINGLE HOOK



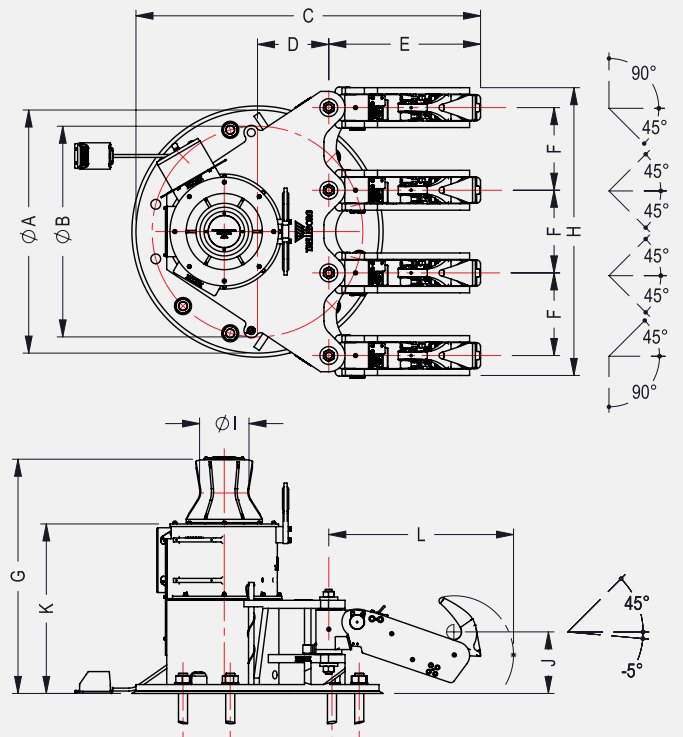
DOUBLE HOOK



TRIPLE HOOK



QUADRUPLE HOOK



Model numbers & Dimensions

MODEL NUMBER	QTY QRH	A	B	C	D	E	F	G	H	I	J	K	L	HD BOLT QTY	SHIPPING MASS kg
CB45 (SAFE WORKING LOAD = 45 T)															
CP45-01	Single	1100	900	2016	530	936	–	1445	246	305	380	1045	1140	4	1450
CP45-02	Double	1100	900	1921	435	936	510	1445	756	305	380	1045	1140	5	1500
CP45-03	Triple	1300	1100	1956	370	936	510	1445	1266	305	380	1045	1140	6	2130
CP45-04	Quad.	1500	1300	2126	430	936	510	1445	1776	305	380	1045	1140	10	2870
CB60 (SAFE WORKING LOAD = 60 T)															
CP60-01	Single	1100	900	2016	530	936	–	1445	246	305	380	1045	1140	4	1450
CP60-02	Double	1100	900	1921	435	936	510	1445	756	305	380	1045	1140	5	1500
CP60-03	Triple	1300	1100	1956	370	936	510	1445	1266	305	380	1045	1140	8	2130
CP60-04	Quad.	1500	1300	2126	430	936	510	1445	1776	305	380	1045	1140	10	2870
CB75 (SAFE WORKING LOAD = 75 T)															
CP75-01	Single	1100	900	2016	530	936	–	1445	246	305	380	1045	1140	4	1450
CP75-02	Double	1100	900	1921	435	936	510	1445	756	305	380	1045	1140	5	1500
CP75-03	Triple	1300	1100	1956	370	936	510	1445	1266	305	380	1045	1140	8	2130
CP75-04	Quad.	1500	1300	2126	430	936	510	1445	1776	305	380	1045	1140	10	2870
CB100 (SAFE WORKING LOAD = 100 T)															
CP100-01	Single	1100	900	2127	530	1047	–	1445	262	305	385	1045	1260	4	1530
CP100-02	Double	1100	900	2032	435	1047	510	1445	772	305	385	1045	1260	7	1600
CP100-03	Triple	1300	1100	2067	370	1047	510	1445	1282	305	385	1045	1260	10	2280
CP100-04	Quad.	1500	1300	2237	430	1047	510	1445	1792	305	385	1045	1260	14	3070
CB125 (SAFE WORKING LOAD = 125 T)															
CP125-01	Single	1100	900	2126	530	1046	–	1445	262	305	385	1045	1260	7	1700
CP125-02	Double	1200	1000	2081	435	1046	510	1445	772	305	385	1045	1260	11	1840
CP125-03	Triple	1300	1100	2066	370	1046	510	1445	1282	305	385	1045	1260	14	2460
CP125-04	Quad.	1650	1450	2324	440	1046	510	1445	1792	305	385	1045	1260	14	3370
CB150R (SAFE WORKING LOAD = 150 T)															
CP150R-01	Single	1100	900	2126	530	1046	–	1445	262	305	385	1045	1260	7	1700
CP150R-02	Double	1200	1000	2081	435	1046	510	1445	772	305	385	1045	1260	11	1840
CP150R-03	Triple	1300	1100	2066	370	1046	510	1445	1282	305	385	1045	1260	14	2460
CP150R-04	Quad.	1650	1450	2324	440	1046	510	1445	1792	305	385	1045	1260	14	3370
CP200 (SAFE WORKING LOAD = 200 T)															
Dimensions available upon request															

Note 1 : Dimensions are in mm.

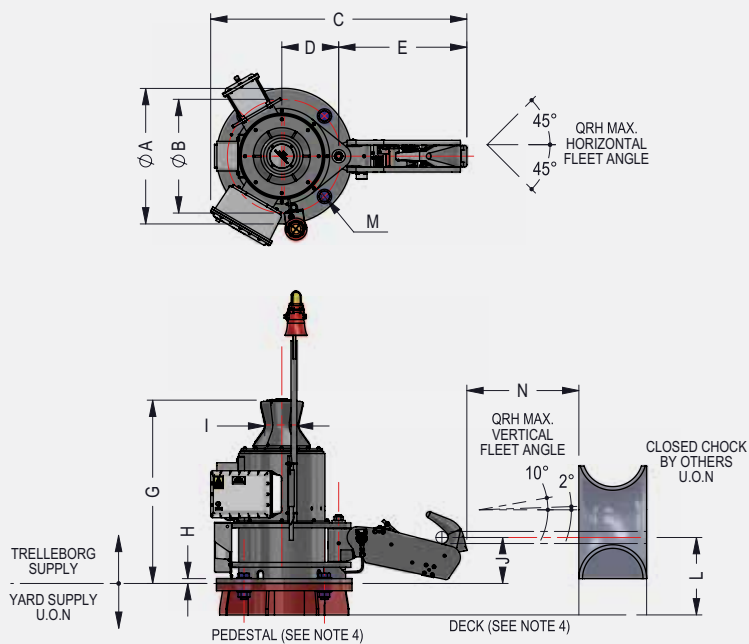
Note 2 : Dimensions are typical. Always request a certified hook/base drawing before starting construction.

Note 3 : Customized bases to suit bolt patterns are available upon request.

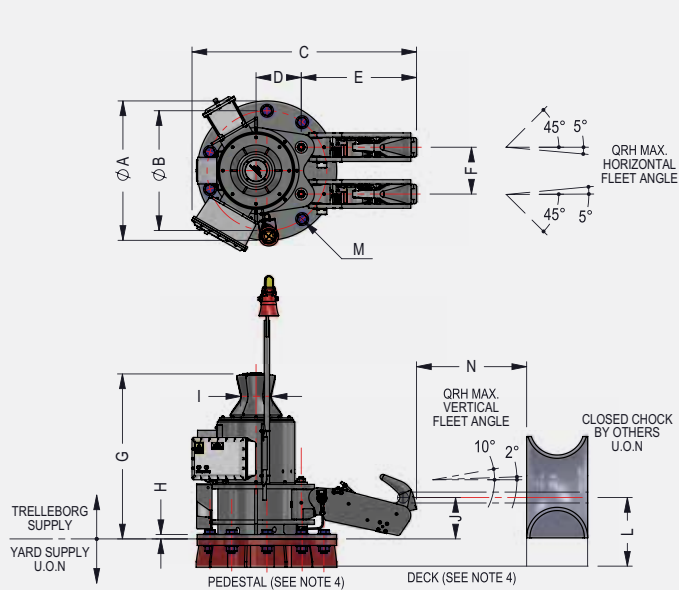
Note 4 : Shipping mass includes base, capstan, hold down bolts and packing. Mass is for indication only.

Quick Release Hook - Offshore Options

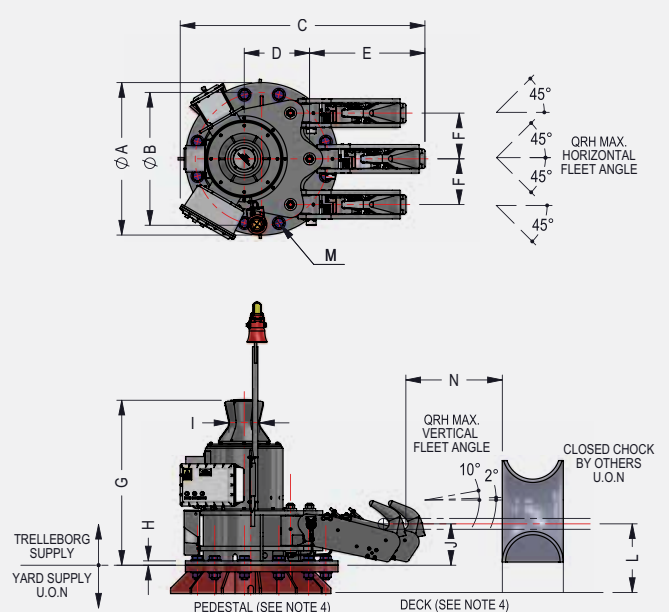
SINGLE HOOK



DOUBLE HOOK



TRIPLE HOOK



BASE	ØA	ØB PCD	C	D	E	F	G	H	ØI	J	L	M	N	HD BOLT (QTY)	APPROX MASS
STS137F-01	1120	940	2080	470	1060	NA	1515	40	305	380				4	1385
STS137F-02	1100	920	2025	415	1060	430	1515	40	305	380				6	1860
STS137F-03	1250	1080	2190	540	1060	420	1515	40	305	380	See Note 1	See Note 2	See Note 3	10	2535
STS150F-01	1120	940	2116	470	1060	NA	1515	40	305	380				4	1440
STS150F-02	1280	1100	2062	415	1060	430	1515	40	305	380				10	2135
STS150F-03	1400	1220	2247	600	1060	420	1515	40	305	380				12	3020

Note 1 : Closed chock height set to ensure mooring rope eye passes through at 0°.

Note 2 : M56 Studs grade 8.8 full screw thread into foundation plate and seal welded. Foundation plate flatness to be 1 to 500 ratio.

Note 3 : Set back of QRH to ensure mooring rope eye is fully clear & inboard of closed chock.

Note 4 : Consider deck camber & ensure foundation plate is installed level.

Hook Options

LOW MAINTENANCE

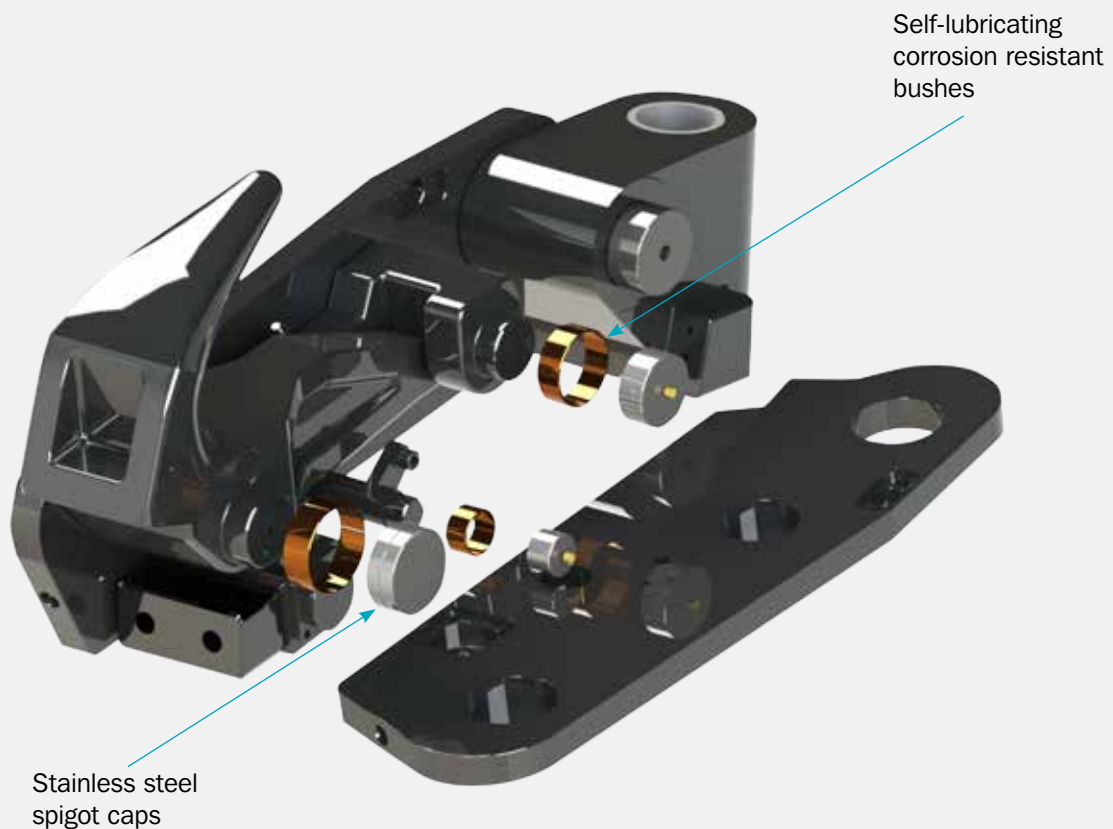
The low maintenance range of QRH builds on Trelleborg Marine Systems' renowned design to engineer a QRH that is virtually maintenance free, which is critical for operations where maintenance access is restricted or where there are extreme operating conditions.

Features

The upgrade uses a combination of custom self-lubricating bushes and stainless steel sleeves to provide a low friction bearing surface for all moving parts, offering excellent corrosion resistance and years of greatly reduced or maintenance free operation. This is available either as part of a new hook unit or as a kit for retrofit (requires rebuild).

Benefits

- Reduced maintenance costs and increased operational time.
- Increased protection against hook seizures caused by long periods of no maintenance.
- Increased lifespan in comparison to a standard hook.



Hook Options

SAFETY KEEPER BARS

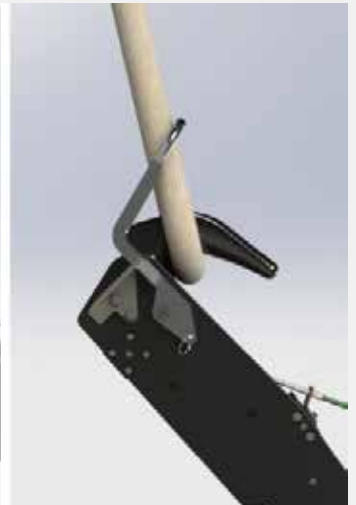
The Keeper Bar improves safety and efficiency of mooring operations by eliminating inadvertent releases of mooring lines caused by positive line angles. This is done by increasing the safe vertical operating range of a QRH and ensuring correct positioning of the mooring line at the throat of the mooring hook.

How It Works

The Keeper Bar holds the mooring line in the throat of the QRH. As tension is applied to the mooring line the Keeper Bar lifts the QRH to ensure it is correctly aligned with the applied load / mooring line.

Benefits

- Improved safety and efficiency by eliminating inadvertent line release.
- Acts as a rope guide during mooring.
- Protects against paint damage when adjacent hooks clash together as mooring lines are tensioned.



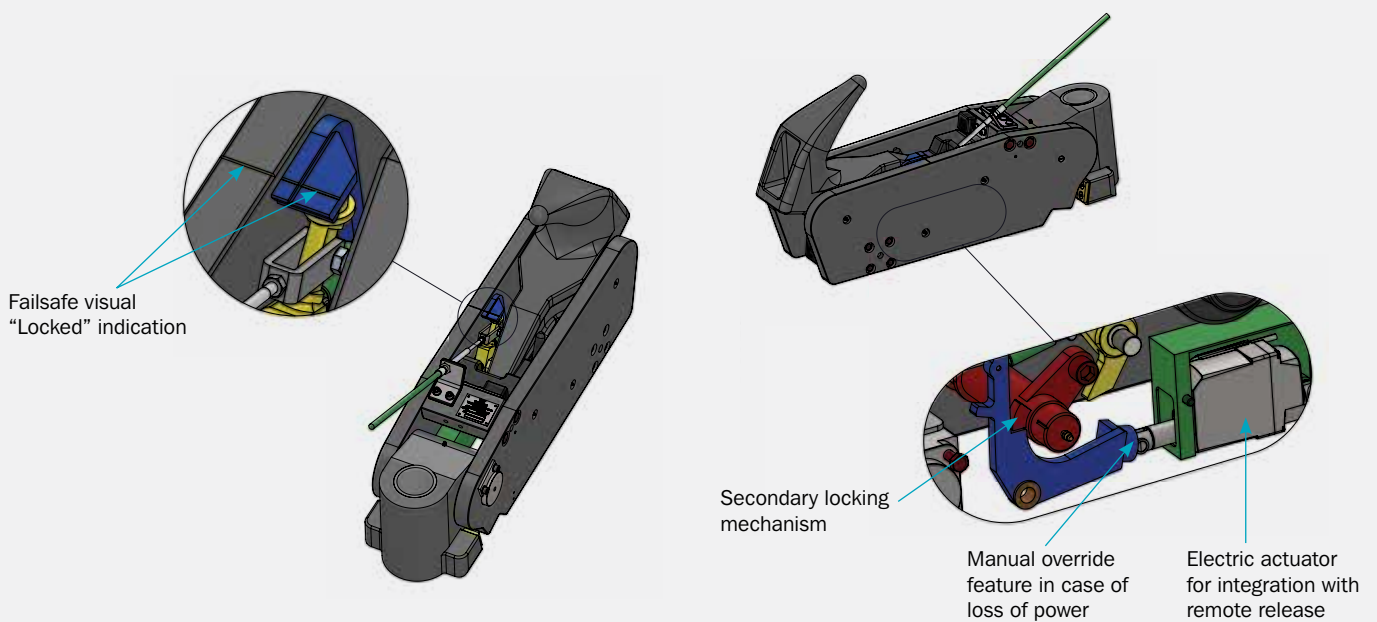
Hook Options

DUAL LOCK

The dual lock QRH provides a robust solution to increase plant safety for bulk material terminals. These terminals are subject to an environment with airborne particulate matter which can deposit on the locking mechanism of a conventional QRH, jeopardizing safety.

Without regular maintenance and careful operational checks, such deposits can result in a QRH being set in a “hair trigger” position. Often, busy shipping schedules leave little time for maintenance and correct operation of the hook is reliant on the training and diligence of the operator.

The dual lock QRH utilizes a secondary locking latch that engages with the primary locking mechanism of the QRH. The system can be provided as a manual only option or fully integrated into Trelleborg Electric Remote Release System. An upgrade kit can also be provided for retrofit to existing hooks.



GRIT GUARD

In bulk material terminals, especially iron ore, dirt may accumulate over the QRH mechanism which requires more frequent maintenance.

The grit guard is fitted on the hook to prevent dirt build up and reduce the maintenance frequency without obstruction to normal operation.



Hook Options

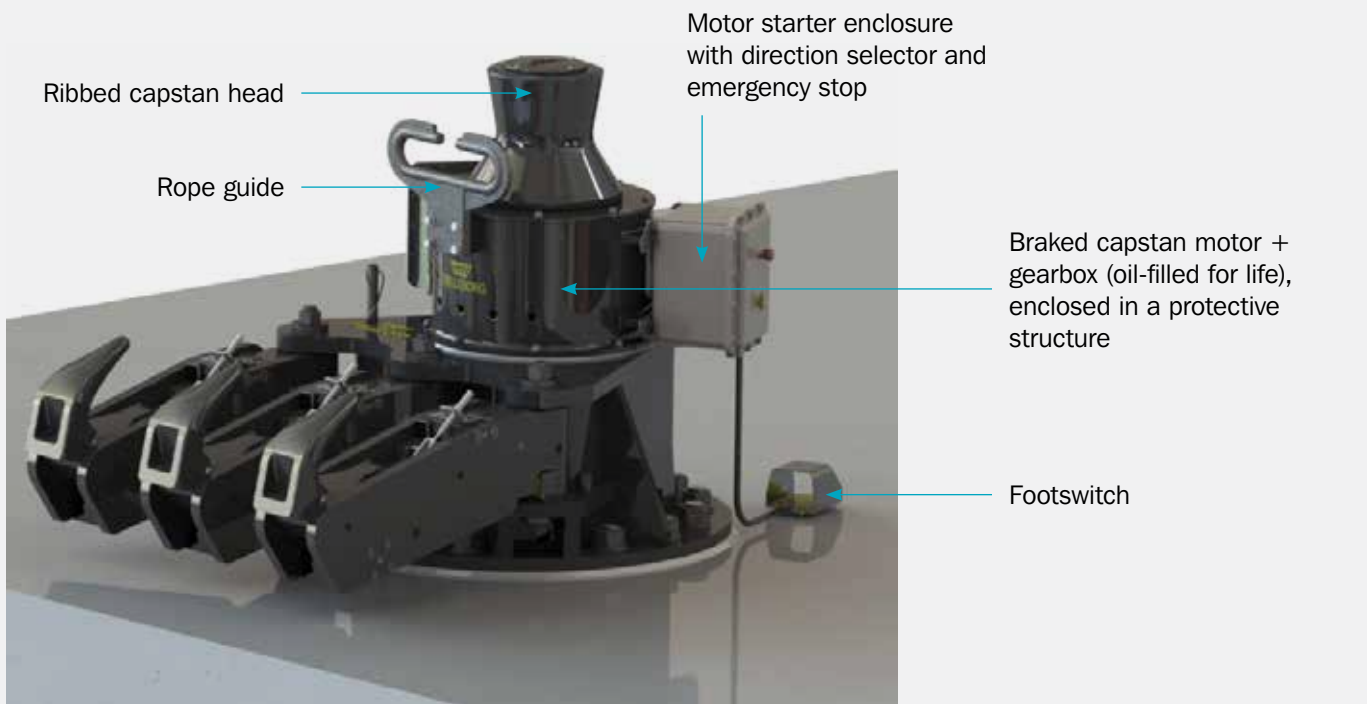
INTEGRATED CAPSTAN

Capstans are fully enclosed within the base for ultra low maintenance, corrosion protection and reliability. Various load ratings and running speeds are available to suit all ship sizes and mooring line materials.

Refer to Free Standing Capstans on page 25 for additional information.

Features

- Ribbed capstan head and integral rope guide for improved line handling.
- Enclosed design for protection from harsh marine environment and mechanical damage.
- Reversible direction, emergency stop and automatic brake for improved operator safety.
- Rugged low profile footswitch for safer operations.
- Nominal line speed of 30 meters / minute (other speeds and line pull sizes available upon request).



AREA CLASSIFICATION	LINE PULL (T)	STARTING PULL (T)	MOTOR SIZE (kW)
Hazardous Safe	1	2	5.5
Hazardous Safe	1.5	3	7.5
Hazardous Safe	2	4	11
Hazardous Safe	3	6	15

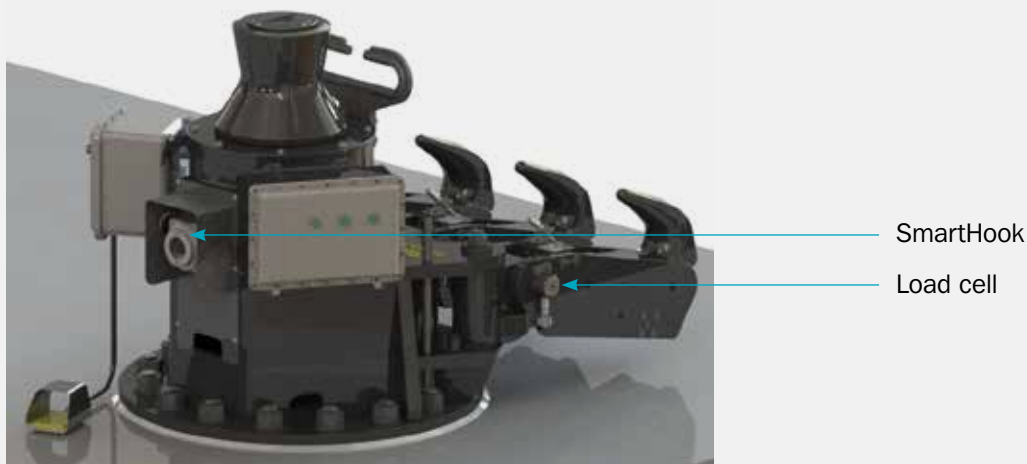
Load Monitoring Systems

Operating autonomously, or integrated with a central monitoring system, the Trelleborg SmartHook load monitoring system enables safe mooring and efficient line handling by providing real-time mooring line tension and alarm warning.

The Trelleborg load cell located in the QRH integrates seamlessly with the SmartHook on the QRH base. Local processing is then done before this data is sent to the central monitoring system; this also enables control of warning lights and sirens on the dolphin without a connection to a central monitoring system.

FEATURES

- Real-time monitoring of mooring tension
- Local processing and calculation of loads
- Autonomous operation
- Calibration data stored in load cell
- Logging of mooring tension (if connected to a central monitoring system)



SMARTHOOK

The SmartHook reads the calibration data stored in the load cell and uses this to calculate the mooring tension. A local display allows the mooring crew to quickly and easily see the current tension on the mooring rope. Alarms are also generated from the SmartHook and this can be connected to a warning light and siren to alert the ship's crew.

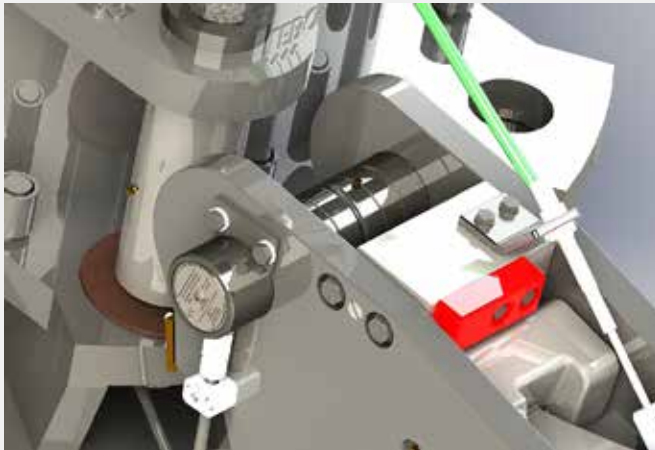


Load cells	Max of 4 load cells connected per SmartHook
Communications output	RS 485 Modbus RTU
LCD Display Information	Hook load, error information and alarm status
Area classification	Hazardous or non-hazardous
IP Rating	IP66

Load Monitoring Systems

LOAD CELL

Each load cell is manufactured from high quality stainless steel and load tested up to 150% of the safe working load (SWL). Calibration data is stored inside the load cell enabling load cells to be placed in any hook anywhere on the jetty.



Calibrated range	0 to SWL (T)
Accuracy	±2%
Material	Grade 431 or 630 stainless steel
Area classification	Hazardous or non-hazardous
IP Rating	IP66

WARNING LIGHT AND SIREN

The warning light and siren can be connected to the SmartHook to allow audible and visual indication of an alarm condition.



Hook Release System

The hook release system allows quick release hooks to be released from no load up to the SWL using either a manual release lever or an electric remote release system.

The electric remote release system has the added benefit of allowing the operator the option to release mooring lines safely from a distance.

FEATURES

- Release from no load to SWL
- Remote release keeps operators out of danger zone
- Manual release system as standard on all hooks

ADD-ONS

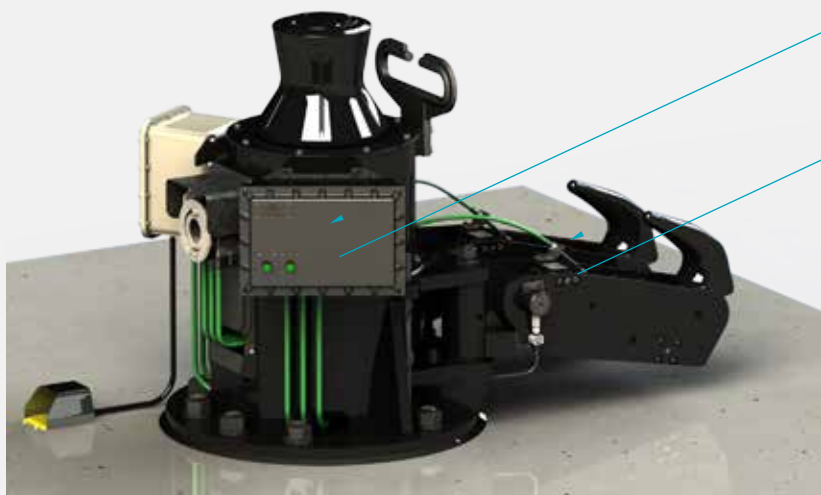
- Pushbutton remote release console
- PC based remote release console



Local release controller

Manual release

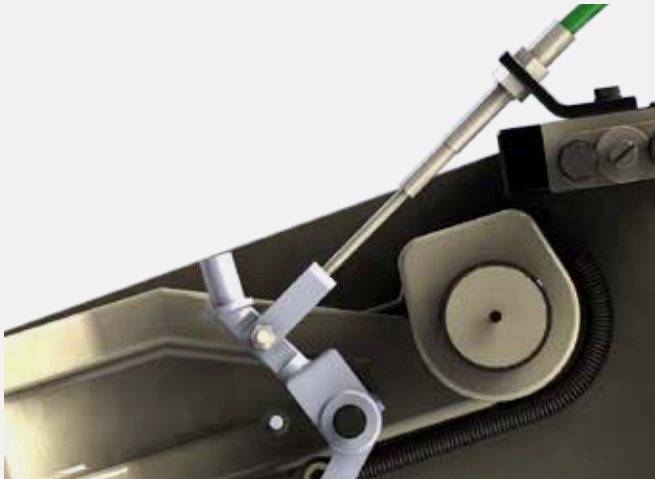
The manual release of the hook is possible up to the SWL. The release mechanism is designed so that only ~ 20kg of force is required to release the hook at the SWL.



Hook Release System

LOCAL RELEASE CONTROLLER

The local release controller enables the hook to be released by pushbuttons (on the front of the controller), or remotely from a release console. The hook release is achieved by an electric actuator connected to the hook via a stainless steel push-pull cable.



Release cable connection



Local release controller

ENCLOSURE DETAILS

Hooks	Max of 4 hooks connected per local release controller
Communications output	RS 485 Modbus RTU
Area classification	Hazardous or non-hazardous
IP Rating	IP66

REMOTE RELEASE CONSOLE

The remote release console enables releasing of the hook from a remote location, such as the jetty control room or the upper deck of the jetty. Consoles can be either pushbutton or PC based.

PC based consoles can also include an optional hook release control station for arming the hook release system.



Hook release control station



PC based console



Typical outdoor console

Free Standing Capstans



Trelleborg's free standing capstans provide a field proven, safe and reliable method of hauling in the mooring line alleviating the need for mooring crews to haul in the lines manually.

FEATURES

Ribbed capstan head and integral rope guide for improved line handling

Enclosed design for protection from harsh marine environment and mechanical damage

Reversible direction, Emergency Stop and automatic brake for improved operator safety

Rugged low profile footswitch for safer operations

APPLICATIONS

LNG carrier berths

Oil berths

LPG berths

Bulk liquids berths

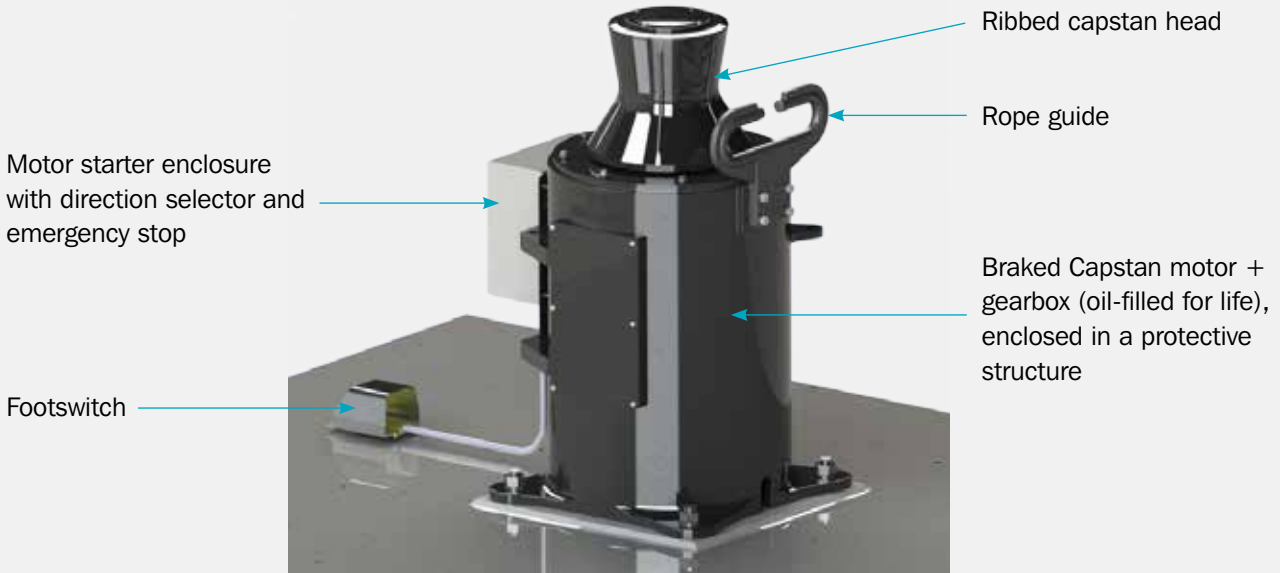
Bulk materials berths

Commercial (RoRo, ferry, container)

Free Standing Capstan

A critical part of the mooring operation, capstans need to be robust and reliable to ensure the line handling process is trouble-free and efficient.

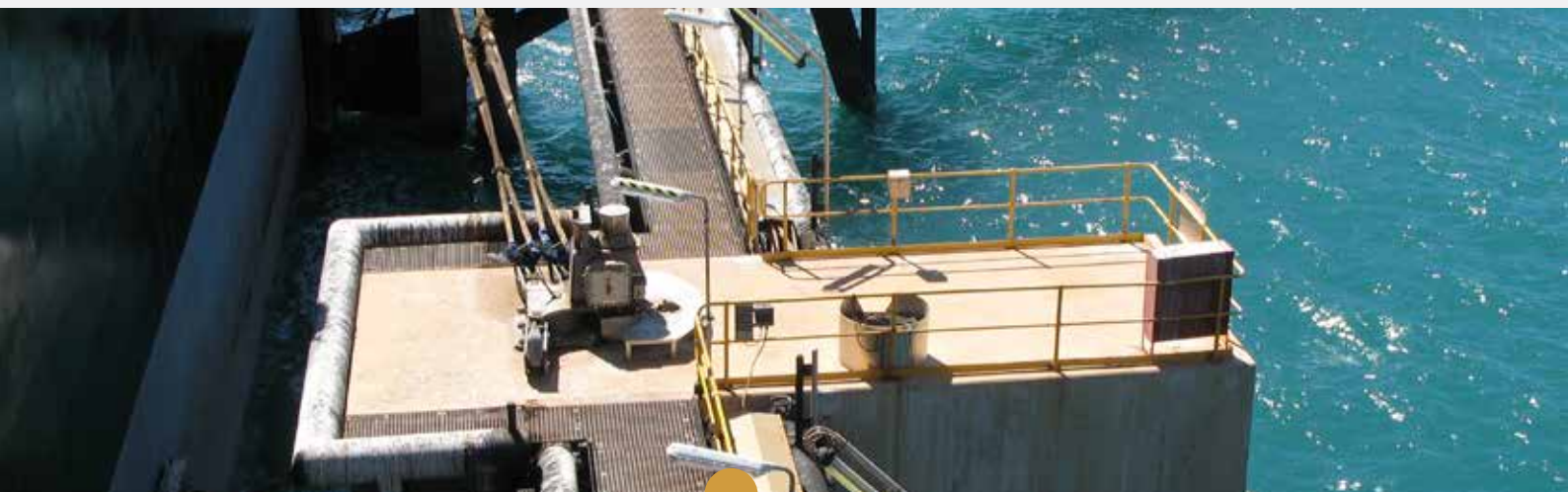
Capstans can be supplied for non-hazardous areas or as an explosion-proof certified unit for installation in hazardous areas. A range of capacities are available to suit many line handling applications.



LINE PULL (T)	STARTING PULL (T)	MOTOR SIZE (kW)
1	2	5.5
1.5	3	7.5
2	4	11
3	6	15

Line Speed	Nominal 30 meters / minute Note: other speeds and line pull sizes available upon request
Area Classification	Hazardous or non-hazardous
IP Rating	Capstan motor and motor starter: IP55 minimum Footswitch: IP68
Holding Capacity	Automatic, spring applied brake when de-energized holding torque > 150% of motor torque
Capstan Controls	Selector Switch: Counter clockwise / OFF / clockwise Emergency Stop Footswitch: Depress to operate
Electrical Supply	3Ø + Earth: 380 to 480 VAC(+/- 5%) @ 50 Hz or 60 Hz (+/- 5%) Note: voltages outside these ranges available upon request

Tugger Winch



The integral tugger winch improves safety and efficiency of mooring line retrieval for onshore and offshore applications through hands free control and industry leading safety features.

FEATURES

More efficient and safer line handling using remote control “hands free” line retrieval and variable speed control

Free spooling payout

Built in torque limiting clutch

Spooling device for retrieval

Rotational swivel and rope guide allows retrieval from any direction

Can be fitted to the Trelleborg Quick Release Hook (QRH) base structure or as a free standing unit

APPLICATIONS

LNG carrier berths

Oil berths

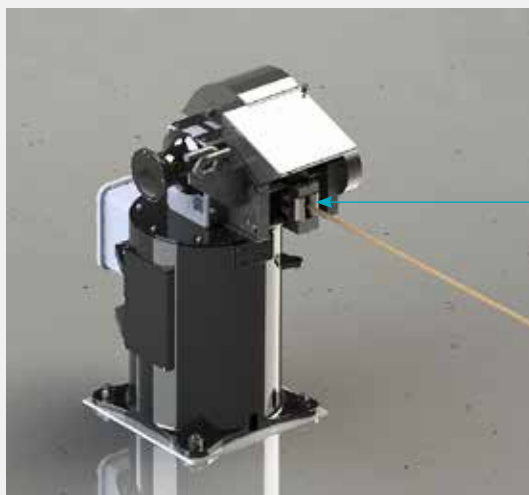
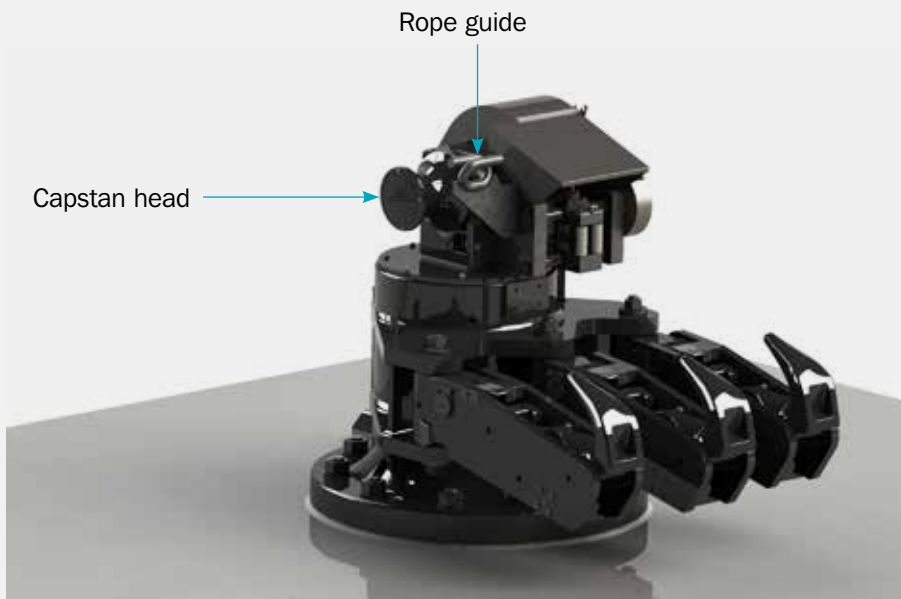
LPG berths

Bulk liquids berths

Bulk materials berths

Commercial (RoRo, ferry, container)

Tugger Winch



Spooling device



Local control stand

Line Pull	Typically 1000kg (Torque limited)
Line Speed	Pay Out : Free spooling to match ship's winch or line boat Pay In : Variable speed from 10 - 45m/min
Area Classification	Hazardous or non-hazardous
IP Rating	IP 66
Holding Capacity	Automatic, spring applied brake when de-energized holding torque > 150% of motor torque
Drum Capacity	120m of 14mm Dyneema (HMPE) rope
Tugger Winch Controls	Joystick Direction and Speed – payout / off / retrieve, Emergency Stop
Electrical Supply	3Ø + Earth: 380 to 480 VAC(+/- 5%) @ 50 Hz or 60 Hz (+/- 5%) Note: voltages outside these ranges available upon request

AutoMoor

Powered By
SmartPort



Make your berthing operations smarter, safer and more efficient with AutoMoor from Trelleborg.

Many ports and terminals are looking towards automated technologies to cope with increased demand and to compete safely and effectively.

AutoMoor is a rope-free, automated mooring system designed to improve operational efficiency and safety using the latest vacuum and passive damping technologies to rapidly attach to and secure a vessel at berth, optimizing the window for product transfer in a broader range of environmental conditions.

FEATURES

Rope-free vacuum mooring

Faster berthing operations

Patent-pending, passive damping system to reduce vessel motions

Patent-pending electro-mechanical drive system for pad extension and retraction

Operates with low power consumption and duty cycle

Delivers greater control by displaying mooring loads and unit operating conditions continuously

SmartPort enabled to allow integration with other port control systems

Three control interfaces provided:

- Wireless Handheld
- Port Control PC
- Mooring Machine PC

Suitable for hazardous area operations

Rotating base allows all maintenance to be undertaken onshore

Self-contained units, with all motors, mechanisms and control systems located within – no external auxiliary items

APPLICATIONS

Container Terminals

Bulk Liquids Berths

Bulk Materials Berths

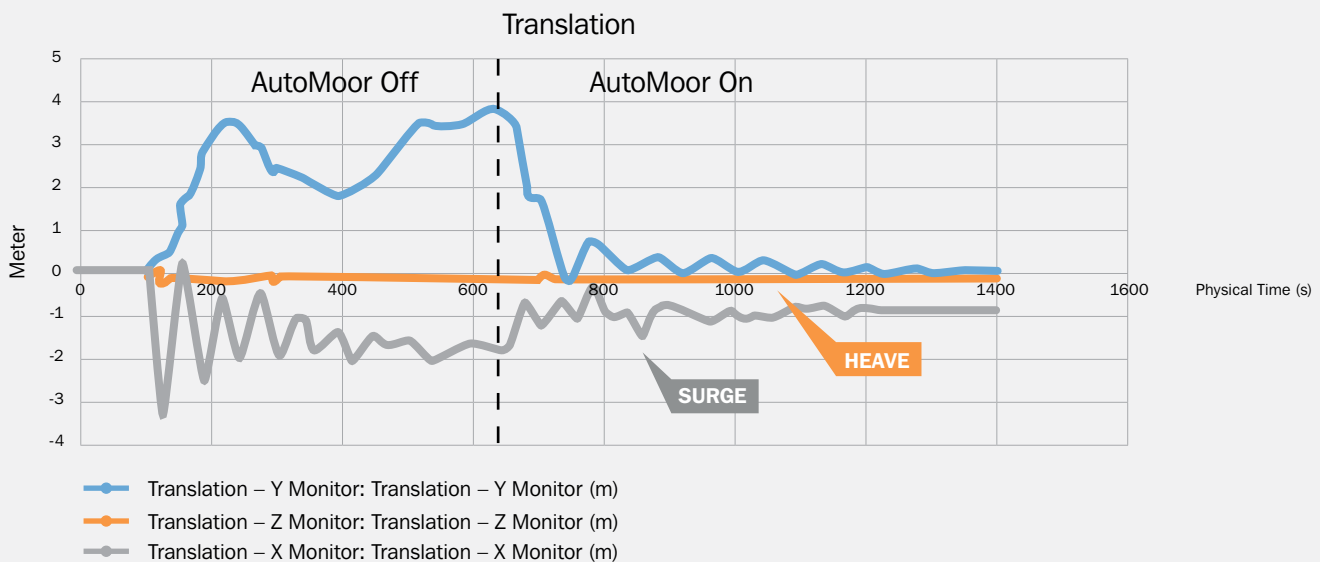
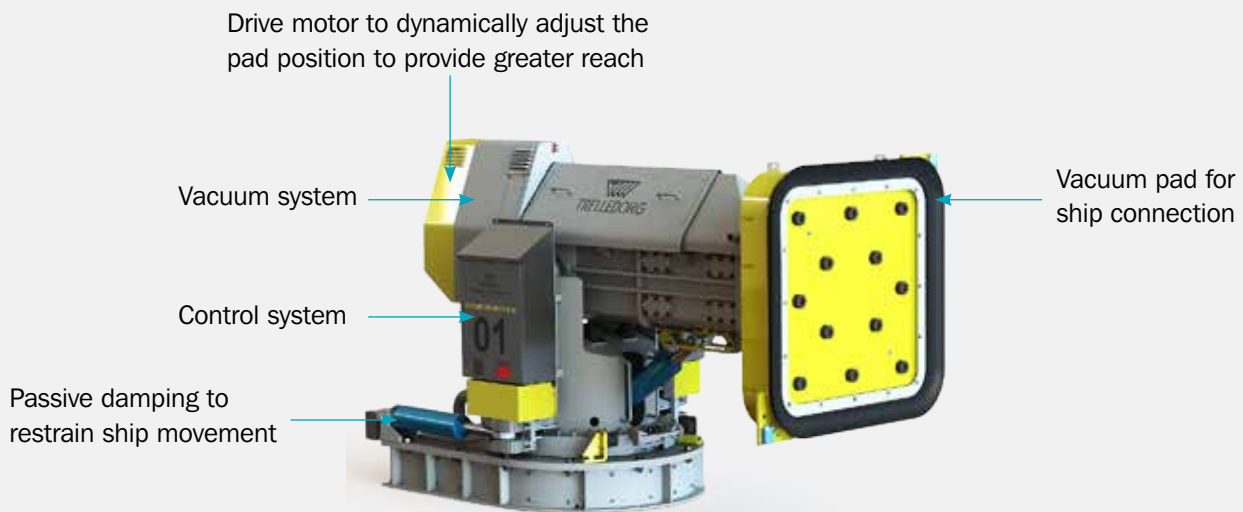
Ferry / RoRo Terminals

Cruise Terminals

AutoMoor

ADD-ONS

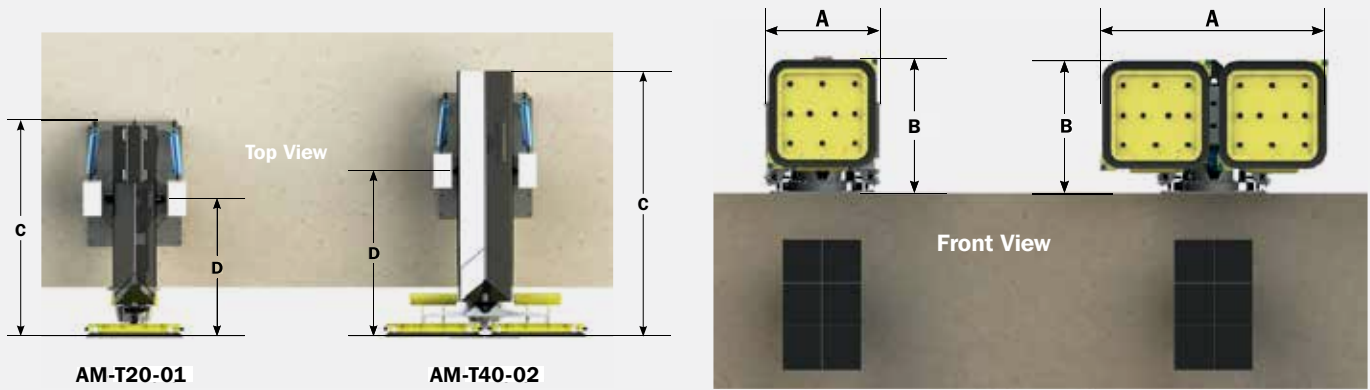
- Hybrid Mooring - combinations of AutoMoor with conventional mooring equipment
- Adaptive Mooring - Using SmartPort to connect assets such as environmental monitoring or vessel traffic systems to AutoMoor to enable adaptive mooring decisions to be made
- Cold climate version available
- SafePilot piloting systems, for navigation of the ship into the berth and information from the AutoMoor units



Comparison of vessel movement moored with conventional equipment versus AutoMoor using CFD mooring analysis software

AutoMoor

MODEL	QTY. PADS	A	B	C	D	ANCHOR BOLT SIZE (mm)	ANCHOR BOLT (QTY)	SHIPPING MASS (kg)
AM-T20-01	1	1780	2400	3845	2450	M30 x 500	14	7800
AM-T40-02	2	3430	2470	4065	2465	M30 x 500	18	11000



DESCRIPTION	T20	T40
1 GENERAL SPECIFICATIONS		
Max Outreach (from wharf edge)	Approx. 2100mm (to suit typical SCN700 fender system outstand and smaller)	Approx. 2600mm (to suit typical SCN800 fender system outstand and larger)
1.1 Horizontal Range of Movement (Surge)	+/-15° or +/-500mm	
Vertical Range of Movement (Heave)	+/-22° or +/-1000mm	
1.2 Vacuum Holding Capacity	1 Vacuum Pad = 20T	2 Vacuum Pads = 40T
1.3 Primary Fabrication Material	Low Alloy Steel Grade Q345B to GB/T1591-2008 equivalent to ASTM A572 Grade 50.	
1.4 Temperature Range	Operating: -15°C to +50°C Storage: -40°C to +70°C	
1.5 Foundation Design Requirements	Designed in accordance with AS4100. Suitable for surface mount concrete or steel foundations.	
1.6 Hold Down Bolts (Anchors)	Supplied with unit as standard. Hold down bolts: M30 x 500mmL, ISO898-1:1999 (E) Property Class 8.8 Finish: Hot-dip galvanizing to ISO10684: 2004 (E)	
1.7 Anchor Template	One mild steel template supplied per AutoMoor unit.	
1.8 Fasteners	Where possible all fasteners used in the assembly of AutoMoor units are 316 stainless steel. Non-stainless steel fasteners are high strength Property Class 8.8 alloy steel, treated with a solid-film coating of Molybdenum Disulphide for long-term corrosion protection and to provide anti-seizing properties.	

AutoMoor

DESCRIPTION	T20	T40
1 GENERAL SPECIFICATIONS		
1.9 Remote Release	Remote release from port control room, handheld wireless control device and control pedestal adjacent to mooring unit.	
1.10 Area Footprint	5.4m ² deck footprint	7.5m ² deck footprint
1.11 Peak Power Consumption		
Driveline Motor	5.5kW	7.5kW
Vacuum Motor	1.5kW	2.7kW
1.12 Power Supply Type	3-Phase, 440-480VAC 60Hz recommended	
1.13 Control System & Reporting	Operating System: PLC based. User Interface: Remote operator workstation. Remote Control: Included. Alarms: Audible & Visual.	
1.14 SmartPort Enabled	Data Logging & Reporting: Multiple reporting levels available.	
2 QUALITY AND TESTING		
2.1 NDT	ASTM E1444-05	
2.2 Welding	AWS D1.1 or AS1554	
2.3 Testing	Each unit is individually proof load tested using a specially designed test rig. Proof load testing equipment is calibrated by a certified body such as Lloyds Register. Each unit is functional control system tested in factory and series tested for multiple unit orders. AutoMoor units are commissioned once installed onsite to verify factory testing and system performance requirements.	
3 PROTECTIVE COATING		
3.1 Surface Treatment	Surface Preparation – Class 2.5 Blast (1). 1st Coat: Nominal 75μm DFT epoxy zinc-rich primer. 2nd Coat: Nominal 125μm DFT two-part epoxy, containing MIO. 3rd Coat: Nominal 75μm re-coatable two-part polyurethane. Color: As required to suit customer protective coating specifications. AS1627.4, USA, National Association Corrosion Engineers, NACE or Society for Protective Coatings, SSPC-SP10 Sweden, Sa 2.5).	
4 OPTIONAL SYSTEM UPGRADES (AVAILABLE AT ADDITIONAL COST)		
4.1 Vessel Warping System	Motor and system programming upgrade to allow AutoMoor units to warp a vessel along a berth.	
4.2 Extended Temperature Range	-40°C to +70°C.	
4.3 Hazardous Version	Electrical control system and motor upgrades to suit hazardous area operation.	
4.4 Class Design Approval	Independent 3rd Party inspection & certification.	

Pelican Hook



Trelleborg's Pelican Hook is a universal buoy hook used to moor vessels to single point mooring buoys.

FEATURES

Safe Working Load (SWL) up to 120 T

Accommodates a wide range of mooring rope sizes and types (nylon and steel rope)

Simple single pin connection to buoy

Able to release hawser, under no load, alongside the buoy

APPLICATIONS

Buoy Moorings

Pelican Hook

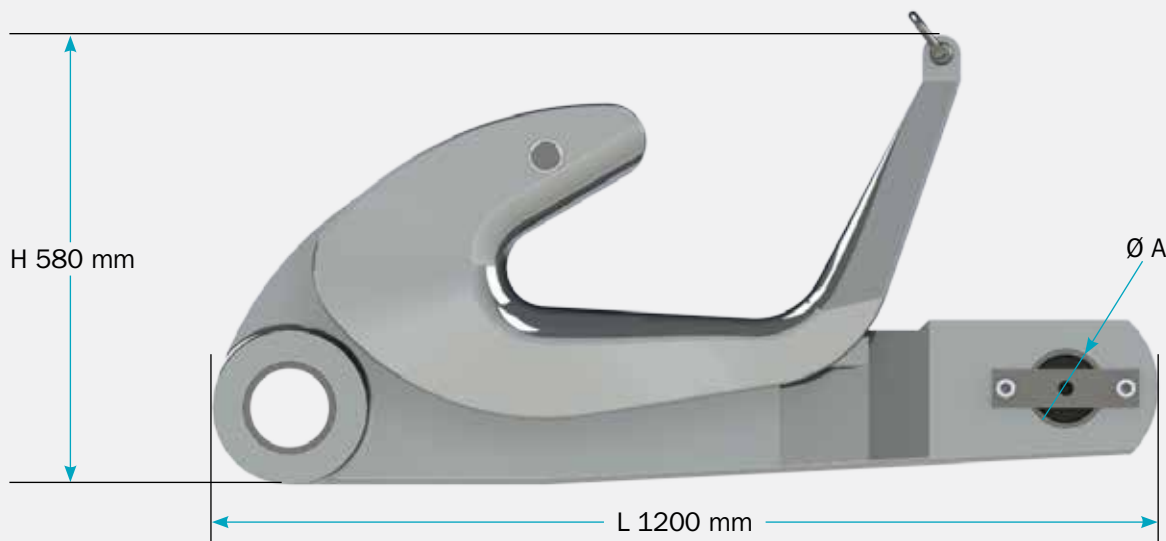
Mooring rope - suitable for sizes upto Ø100mm



Manual release – use a lanyard when the hook is under no load

Mounting - connected to buoy with single pin (Ø89 or Ø115).

MODEL NUMBER	LENGTH (L) mm	WIDTH (W) mm	HEIGHT (H) mm	MOUNTING PIN DIA (A) mm	MAX. SWL (T)	MAX. PL (T)	SHIPPING MASS (kg)
BH120-89	1200	210	580	89	120	120	215
BH120-115	1200	210	580	115	120	120	215



Hawser Hooks



Trelleborg's Hawser Hooks have been installed in over 100 FPSO facilities for tandem mooring or bow mooring during offloading.

FEATURES

Safe, efficient and reliable mooring operations

Low profile and compact footprint

Load monitoring & high load warning system designed for ship board operation

Emergency release, local or remote release from the cargo control room (CCR) panel

Designed in accordance with OCIMF Recommendations for Equipment Employed in the Bow Mooring of Conventional Tankers at Single Point Moorings 4th Edition and OCIMF Tandem Mooring and Offloading Guidelines for Conventional Tankers at F(P)SO Facilities 1st Edition

Class Approval to DNV, ABS, BV, Lloyds or RINA as applicable

APPLICATIONS

Tandem mooring

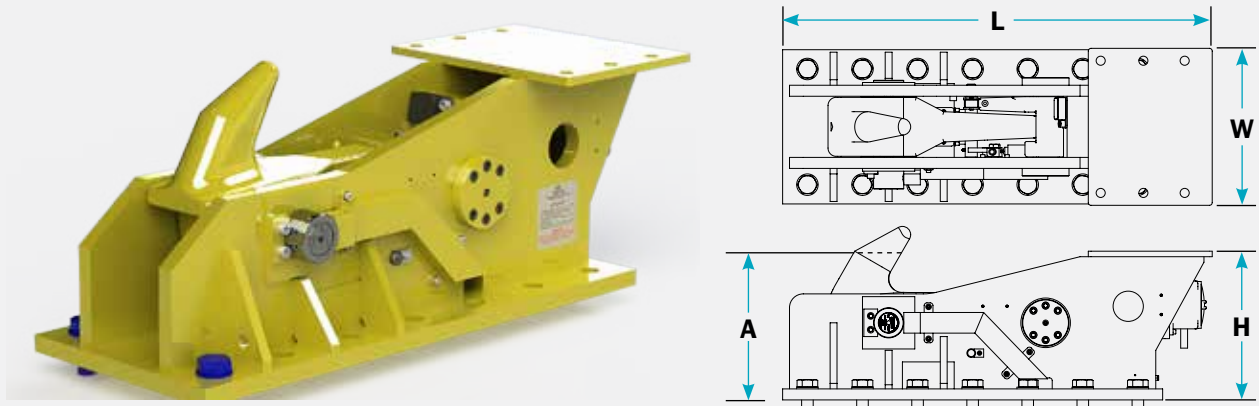
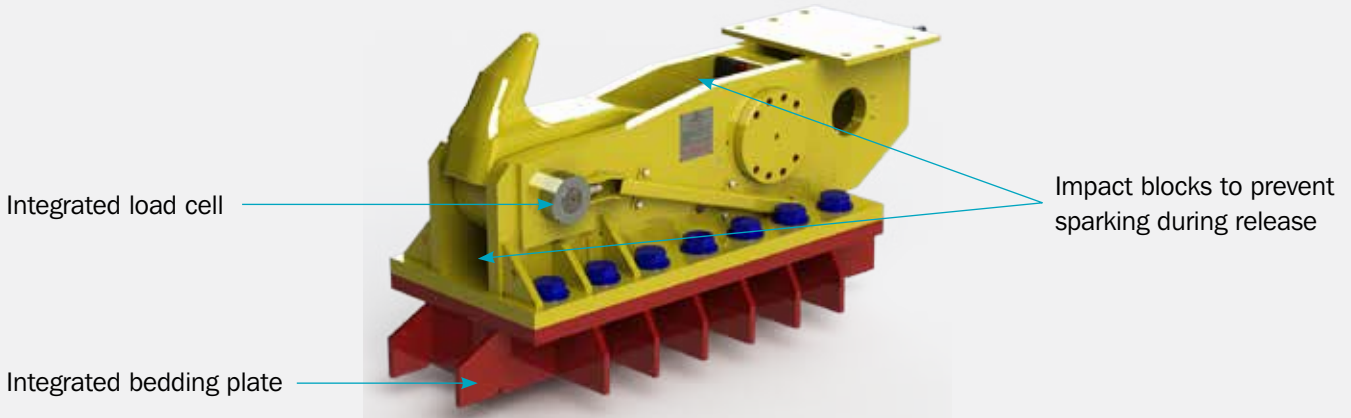
Bow mooring to a Single Point Mooring (SPM)

Hawser Hooks

ADD-ONS

- Hawser roller fairlead
- Bedding plate

- Load monitoring and remote release system located in the CCR (Refer to page 21)
- Trelleborg’s horizontal or vertical drum hawser winches (Refer to page 41)



MODEL NUMBER	LENGTH (L) mm	WIDTH (W) mm	HEIGHT (H) mm	HEIGHT TO CHAIN CENTRELINE (A) mm	MAX. SAFE WORKING LOAD (T)	MAX. PROOF LOAD (T)	HD BOLT QTY	SHIPPING MASS (kg)
H580	1560	560	540	440	250	313	14 x M42	950
H850	1790	680	540	580	350	550	14 x M56	1650

Chain Angles between Chock and Hook	Horizontal Plane: +/- 5° of centreline Vertical Plane: 0 to + 5° above centreline.
Mooring Connection	The Hawser Hooks will accept an OCIMF standard (open) end link of 76mm chafe chain. Type A or B as per OCIMF MEG3.
Area Classification	Hazardous
IP Rating	IP66
Local Control Unit	Display of hook load, error information & alarm status. Pushbutton control to release the hawser unit.
Hydraulic Power Pack	For release system, located below deck in safe area.

Hawser Load Monitoring Bitt



The load monitoring bitt is typically installed on the bow of a vessel and replaces the traditional mooring bitt or Samson post.

FEATURES

Safe, efficient and reliable mooring operations

Replaces the traditional mooring bitt or Samson post, which do not provide mooring line load monitoring

Reduces the risk of hawser damage by providing real-time monitoring and alarming of high mooring hawser tension

Real-time monitoring means the ships mooring crew can better ensure a safe mooring pattern, improving the vessels' stability

Suitable for hazardous area operations

Class compliance (OCIMF Mooring Equipment Guidelines (MEG 3) 2000, DNV, ABS, BV, Lloyds or RINA as applicable)

APPLICATIONS

Tandem mooring

Bow mooring to a Single Point Mooring (SPM)

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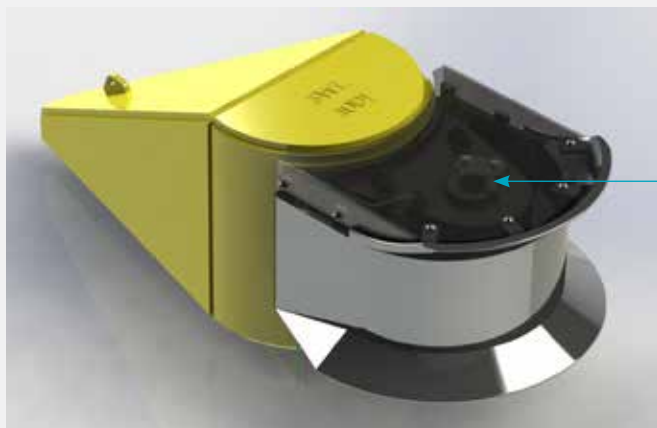


Hawser Load Monitoring Bitt

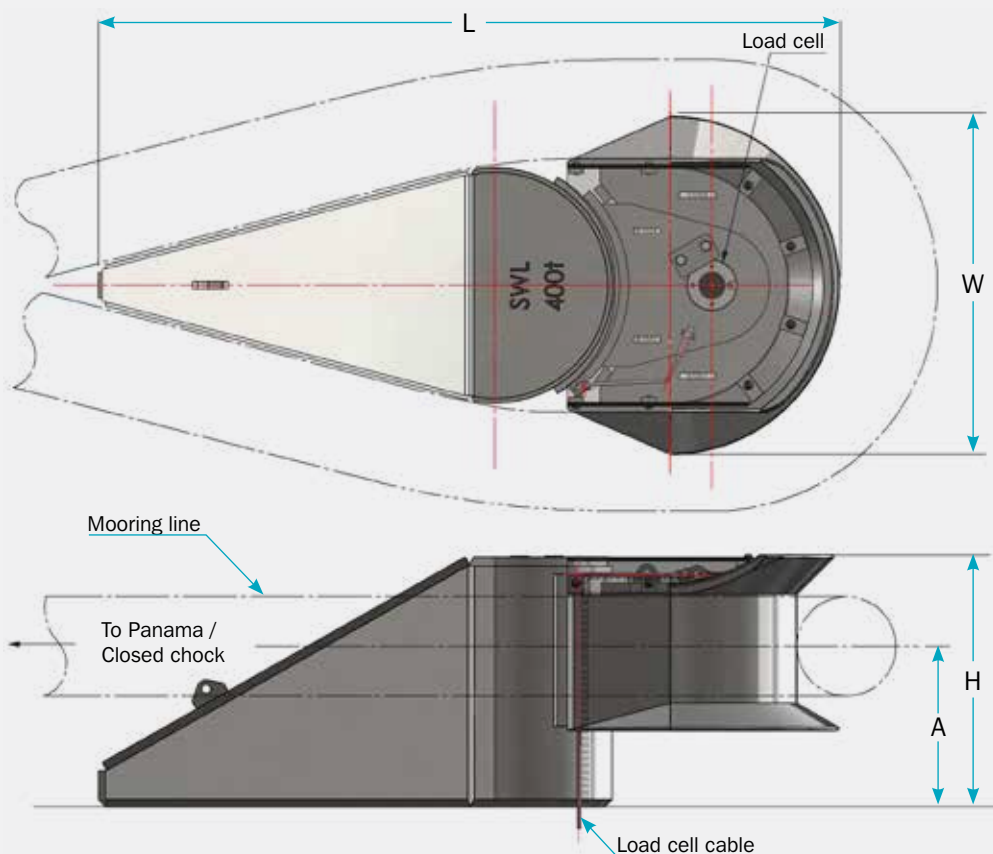
ADD-ONS

- Load monitoring system located in the CCR
- Deck mounted visible and audible alarm station for high loads

Max Hawser Size:	Ø 275mm
Area Classification	Hazardous
IP Rating	IP66
Local Control Unit	Display of hook load, error information & alarm status



Integrated load cell



MODEL NUMBER	LENGTH (L) mm	WIDTH (W) mm	HEIGHT (H) mm	HEIGHT TO C/L OF HAWSER	MAX. SWL (T)
LMB430	2050	950	700	435	430

Chain Stoppers



Deck mounted chain stoppers to 1,210 T for bow or spread mooring applications where emergency release under load and load monitoring functionality is required.

FEATURES

Safe, efficient and reliable mooring operations

Low profile and compact footprint

Releaseable from zero and up to the Safe Working Load (SWL)

Load monitoring & high load warning system designed for ship board operation

Emergency release, local or remote release from the cargo control room (CCR) panel

Designed in accordance with OCIMF Recommendations for Equipment Employed in the Bow Mooring of Conventional Tankers at Single Point Moorings 4th Edition and OCIMF Tandem Mooring and Offloading Guidelines for Conventional Tankers at F(P)SO Facilities 1st Edition

Class Approval to DNV, ABS, BV, Lloyds or RINA as applicable

APPLICATIONS

Bow mooring

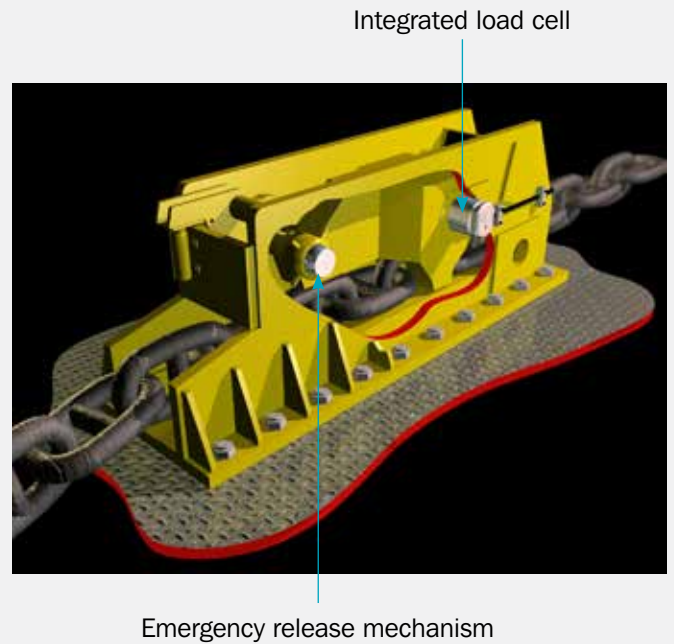
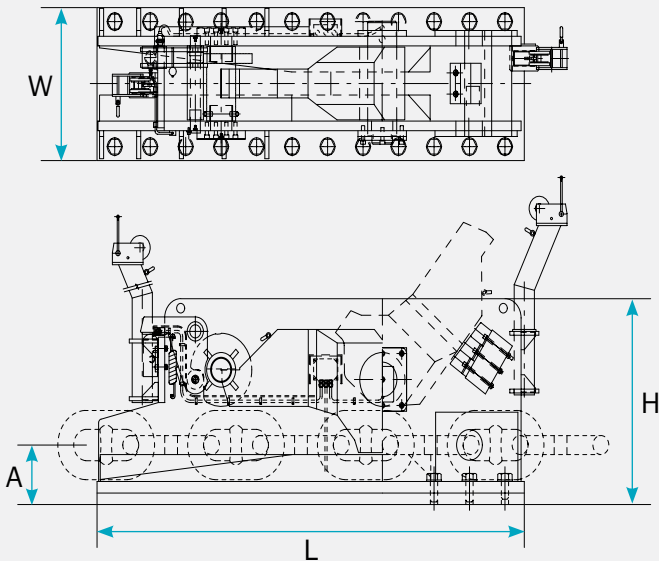
Single point mooring

Spread mooring

Chain Stoppers

ADD-ONS

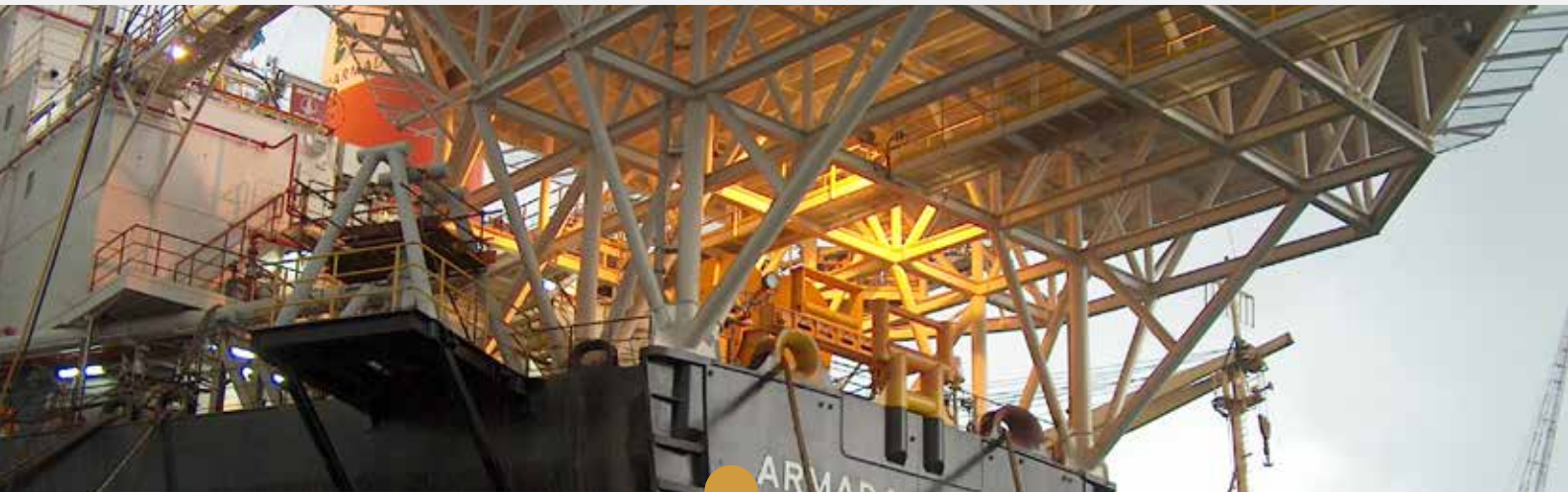
- Chain Tensioning Jack
- Chain Tensioning Winch / Pulley System
- Bedding Plate
- Load monitoring and remote release system located in the CCR (Refer to Page 21 and 23)



MODEL NUMBER	CHAIN SIZE/ GRADE	LENGTH (L) mm	WIDTH (W) mm	HEIGHT (H) mm	CHAIN CENTRELINE HEIGHT (A) mm	MAX. SAFE WORKING LOAD (T)	HD BOLT QTY	SHIPPING MASS kg
CS700	76mm R4	2650	850	1010	250	Up to 700	20 x M56	4800
CS1210	111mm R4	2650	850	1050	255.5	Up to 1210	24 x M56	5160

Chain Size	Up to 111 mm diameter stud or studless offshore chain.
Mooring Chain Fleet Angle	Horizontal plane: Max +/- 5 degrees each side of centerline of the unit.
Mounting Options	Bolt down or weld down to a levelled flat or elevated foundation plate.
Local Control Unit	LCD readout of load magnitude and load warnings. Pushbutton control to release the hawser unit.
Hydraulic Power Pack	For release system, located below deck in safe area.

Winches & Reels



Trelleborg's modular solution for Tandem Mooring conversions (FPSO's), using a hawser winch with a quick release hawser hook and spooling system.

FEATURES

Safe, efficient and reliable mooring operations

Minimizes deck space requirements

Emergency quick release, providing safe release upto the SWL

Load monitoring, enabling an early warning of increasing mooring tensions or surging mooring loads

An independent winch, meaning it needs minimal under-deck stiffening

Suitable for hazardous area operations

Class Approval to DNV, ABS, BV, Lloyds or RINA as applicable

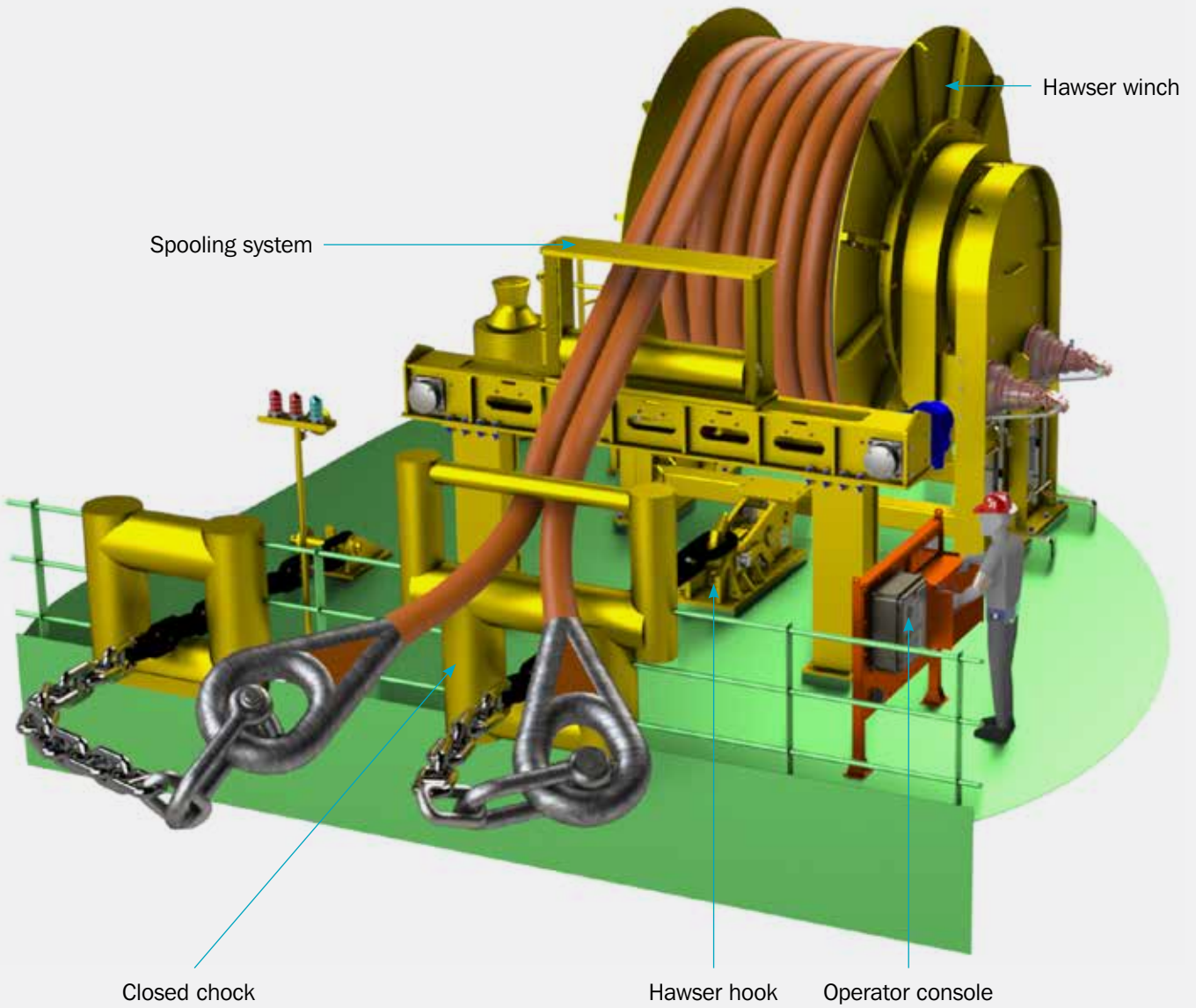
APPLICATIONS

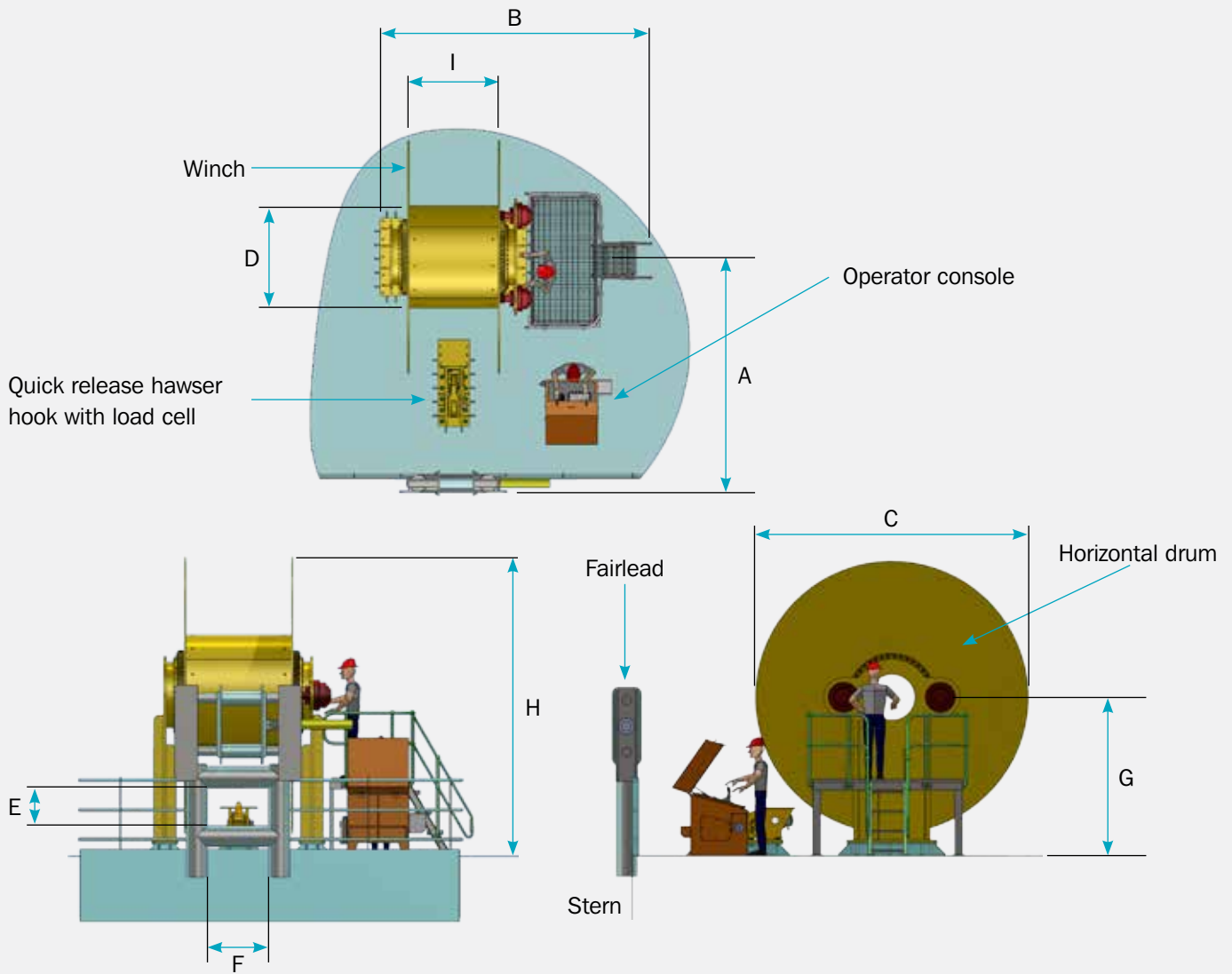
F(P)SO tandem mooring

Tandem Mooring Winch



Tandem Mooring Winch





A	B	C	D	E	F	G	H	I	SHIPPING MASS (kg)
4300	5200	4000	2000	450	600	3000	4800	2070	20000

Note: Dimensions (mm) may change subject to equipment layout and spooling system provisions.

Drum Storage Capacity	One 150 m, up to 21 inch circumference hawser
Winch Speed	Reel-in/out : 0 to 7.5 m/min Note: Free wheeling enabled for emergency only
Winch Pull Capacity	Running pull 15 T and 3rd layer
Winch Static Load Capacity	25 T
Drum Dimensions	Diameter : 2.0 m Length : 1.8 m
Winch Drive and Brake	Dual slow drive with integral brake. 50% hot redundancy.
Hydraulic Power Unit	Self-contained, skid mounted unit with tank, motor and controls and closed loop system, located below deck in safe area
Hawser Hook	Option to use either a model H580 or H850 hawser hook

Docking Aid Systems (DAS)



Docking Aid Systems provide feedback essential to the safe docking of vessels and to reduce berthing velocities to prolong fender and jetty life.

FEATURES

Safe, efficient and reliable docking operations

Day and night visibility

Long range

Vessel database and data logging, including ship details and pilot name

3 modes of operation – Approach, Drift and Depart

APPLICATIONS

LNG carrier berths

Oil berths

LPG berths

Bulk liquids berths

Bulk materials berths

Offshore berths and ship-to-ship docking

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SmartPort



Docking Aid Systems (DAS)

Speed and distance information can be viewed on the display board from the ships' bridge using lasers located on the jetty. Logging of data can also be used to diagnose any damage caused by abnormal events and help prolong the life of the fenders and jetty structure.

DAS Lasers

Highly accurate laser sensors are used to measure the distance of the ship to the fender line. The Central Monitoring System processes this into speed, distance and longitudinal angle for use by the pilot and operations personnel.

Laser sensors are eye safe and can be used in all weather conditions.

Range	0 to 300m ¹
Area classification	Hazardous or non-hazardous

¹ The maximum range of the laser is dependent on the angle, reflective quality and color of the ship's hull



DAS Display Board

The display board provides speed and distance information for the vessel, as produced from the DAS lasers. Vessel angle relative to the fender line can also be shown as an option.

A traffic light system (red, amber, green) gives visual indication of whether the vessel is moving too fast toward the fender line.

Mounting options for the display board include both fixed and rotating pedestals.

Distance Display	0 to 199m
Speed Display	0 to 99cm/s
Speed Warning Lamps	Red/Amber/Green
Viewing Angle	Horizontal $\pm 60^\circ$ Vertical $\pm 50^\circ$
Rotating Pedestal Range	$\pm 150^\circ$
Area Classification	Hazardous or non-hazardous



SafePilot

SafePilot provides high accuracy piloting and navigation solutions for offshore and pilotage operation to the highest reliability and safety levels.

PRODUCT	OVERVIEW
SafePilot CAT ROT	The CAT ROT is a small and compact pilot unit primarily designed to connect to a ship's AIS pilot plug and transmit data via Wi-Fi to the Pilot's tablet/notebook.
SafePilot CAT I	The CAT I is a standalone high accuracy GPS receiver with the capability of GPS/GLONASS and available SBAS systems such as EGNOS, WAAS, MSAS and GAGAN.
SafePilot CAT II	The SafePilot CAT II offers a precise, reliable tool for navigation and berthing, providing all required navigational data.
SafePilot CAT III	For more demanding piloting applications requiring accuracy to the centimeter as well as heave, pitch and roll monitoring.
SafePilot Piloting Software	The SafePilot Piloting Software is a professional piloting/navigation iOS based software that is developed in collaboration with marine pilots worldwide.

	CAT ROT	CAT I	CAT II	CAT III
Speed Accuracy	From ships instruments	1 cm/sec	1 cm/sec	1 cm/sec
Position Accuracy	3.0m	0.6m	DGPS – 0.4m SBAS - 0.6m Stand-alone - 1.5m	DGPS – 0.4m SBAS – 0.6m Stand-alone – 1.2m RTK – 1 cm + 1ppm
Rate of Turn	0.5 deg/min	–	0.5 deg/min	0.3 deg/min
Heading Accuracy	0.1 deg	–	0.05 deg	0.05 deg
Roll & Pitch	NA	NA	NA	Optional
Battery Life	22 hrs	17 hrs	9 hrs	7 hrs





Environmental Monitoring

Powered By
SmartPort



Accurate real-time environmental and MetOcean monitoring is vital to the safe docking and mooring of vessels, as well as prolonging the life of the fender and jetty assets.

FEATURES

Meteorological monitoring options

Oceanographic monitoring options (MetOcean)

Deployment and retrieval systems

Safe and efficient docking and mooring operations

Accurate, real-time data

Integrated with mooring and docking systems or as a standalone system

Can be installed remotely with solar power and telemetry options available

APPLICATIONS

LNG carrier berths

Oil berths

LPG berths

Bulk liquids berths

Bulk materials berths

Buoys

Commercial (RoRo, ferry, container)

Meteorological Monitoring

WEATHER STATION

Monitoring capabilities:

- Wind Speed
- Wind Direction
- Temperature
- Air Pressure
- Humidity
- Rainfall
- Lightning detection (optional)
- Solar radiation (optional)



Temperature	-50 to 60°C
Relative Humidity	0 to 100%
Solar Radiation Spectral Range	300 to 1100 nm
Solar Radiation Measuring Range	1400 W/m ²
Lightning Detection	Number of lightning events
Pressure	300 to 1200 hPa
Wind Direction	0 to 360°
Wind Speed	0 to 30 m/s 0 to 75 m/s (optional)
Area Classification	Non-hazardous

WIND

Wind Speed	0.6 to 100 m/s
Wind Direction	0 to 360°
Area Classification	Hazardous or non-hazardous



Meteorological Monitoring

VISIBILITY

Measuring Range	10 to 20,000 m
Area Classification	Non-hazardous



LIGHTNING DETECTION

Detection Range	30 nautical miles
Detection Bearing	0 to 360°
Area Classification	Non-hazardous

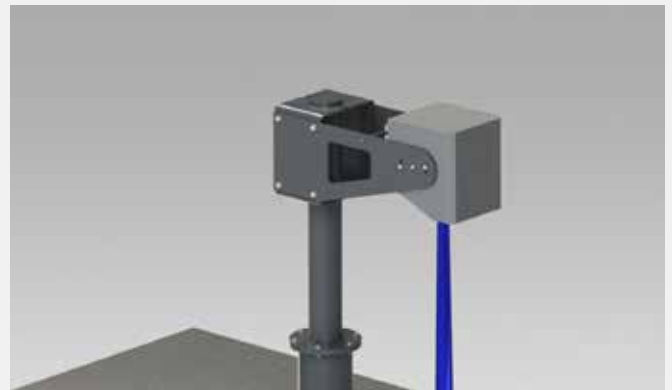


Oceanographic monitoring

WAVE TIDE LASER

- Significant wave height
- Long wave height
- Short wave height
- Period of significant waves
- Water level

Measuring Range	2.5 to 30 m
Area Classification	Hazardous or non-hazardous



SINGLE POINT CURRENT METER

- Current speed
- Current direction
- Water temperature (optional)
- Salinity (optional)

Current Speed	0 to 300 cm/s
Current Direction	0 to 360°
Water Temperature	-4 to +36°C
Conductivity Range	0 to 7.5 S/m
Depth Rating	2000 m



SALINITY

- Conductivity
- Water temperature

Conductivity	0 to 70 mS/cm
Water Temperature	-5 to +35°C
Depth Rating	250 m

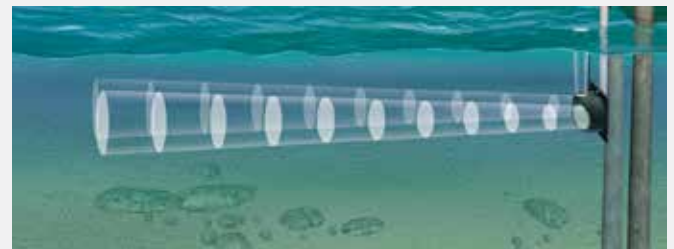


Oceangraphic Monitoring

SIDE LOOKING CURRENT PROFILER

- Multiple cells for readings at different distances
- Current speed
- Current direction
- Water temperature
- Tide level

Current Speed	0 to 6 m/s
Current Direction	0 to 360°
Tide Level	0.2 to 18 m
Water Temperature	-5 to +40°C
Depth Rating	30 m



BOTTOM MOUNT CURRENT PROFILER

- Multiple cells for current readings at different depths
- Current speed
- Current direction
- Water temperature
- Max wave height
- Mean wave period
- Significant wave frequency (long and short)
- Significant wave height (long and short)
- Peak wave period (long and short)
- Wave direction (optional)
- Tide level

Current Speed	0 to 5 m/s
Current Direction	0 to 360°
Water Temperature	-5 to +45°C
Conductivity Range	1 s
Depth Rating	200 m





Integrated Monitoring System



Integration is the key to maximum safety and optimum productivity.

Trelleborg Marine Systems operation can combine the Docking, Mooring and Environmental systems into a logical and easy to operate IMS (Integrated Monitoring System). Key information and statuses are then distributed to the right people at the right time whether they are on board the vessel, at the control room or on the jetty.

The IMS is built into either a small or large 19" equipment rack or a compact wall mount enclosure.

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Integrated Monitoring System

FEATURES

Presents an overall view of docking, mooring and metocean

Improves safety and operations

Provides information to the right people at the right time

Flexible architecture between the IMS and field equipment (Multidrop, Star, Ring options)

Various communications methods available (Serial, Ethernet and Fibreoptic options)

Redundant server and/or communications facilities

Dedicated server system to connect field equipment and provide information to operations staff, with logging of all docking, mooring and environmental data

Fully integrated with other Trelleborg Marine Systems products

APPLICATIONS

LNG carrier berths

Oil berths

LPG berths

Bulk liquids berths

Bulk materials berths

Small scale mooring

ADD-ONS

■ Additional workstations, mobile tablets/laptops and handheld devices

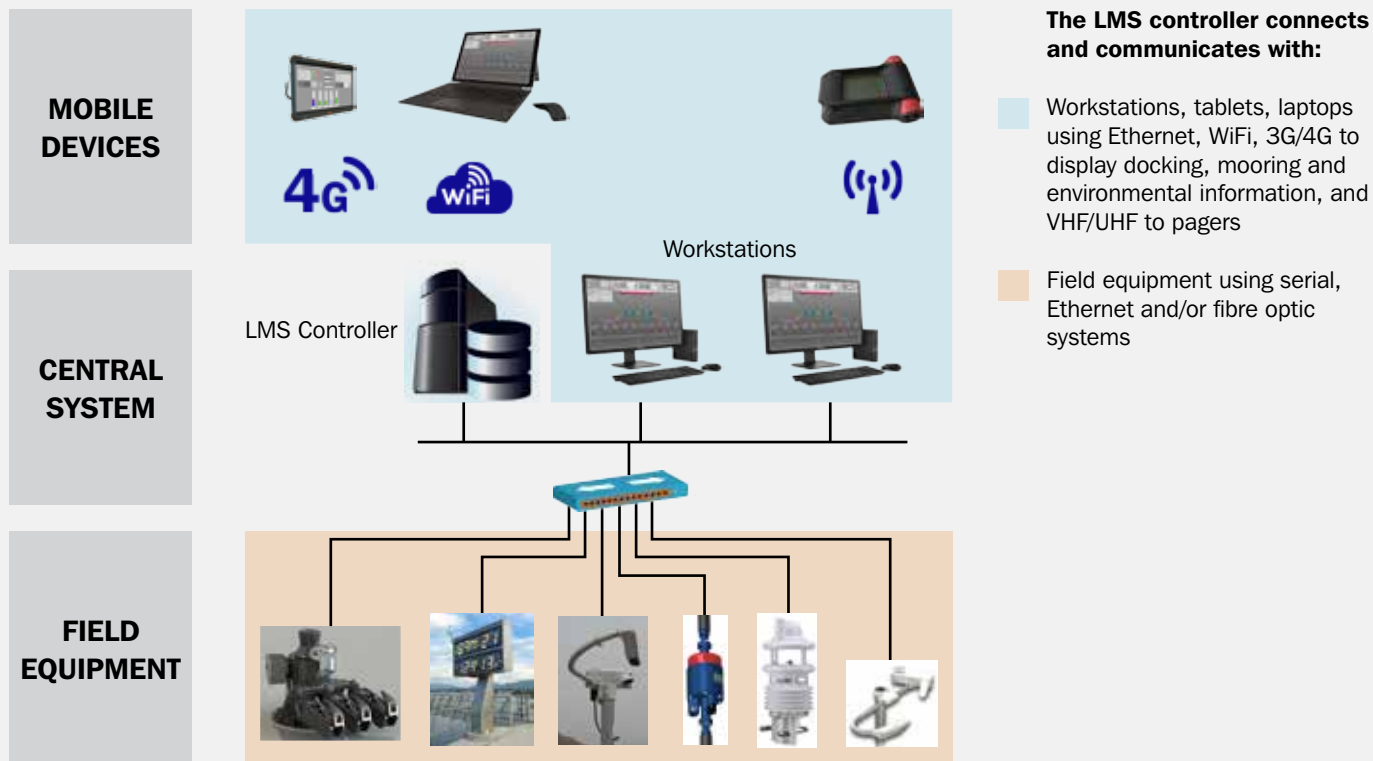
■ Radio systems for Carry-On-Board (COB) tablets/laptops and the Portable Marine Monitor

■ Interface module to Ship to Shore Link System

■ SafePilot Navigation System

Integrated Monitoring System (IMS)

SYSTEM ARCHITECTURE KEY COMPONENTS



IMS EQUIPMENT RACK OPTIONS

- Small or large 19" racks
- Wall mount enclosures



LMS controller communicates with equipment and logs all docking, mooring and environmental data, and provides alarms and generates reports.

Other modules that may be included in the rack for field equipment include:

- SmartDock controller (JCU replacement)
- SSL Interface module to goto the Ship to Shore System
- Telemetry Interface Module for mobile communications devices
- Hook Release Interface Module for QRH units

Integrated Monitoring System (IMS)

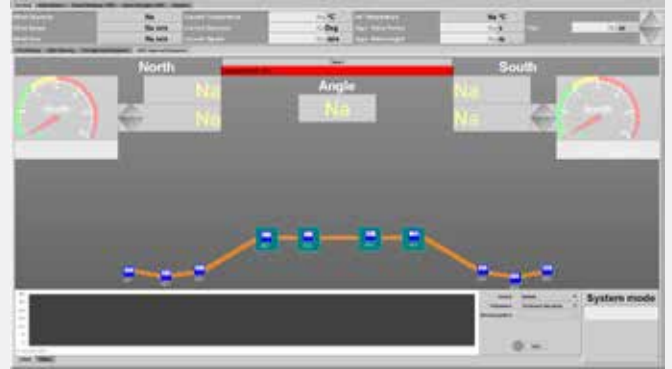
WORKSTATIONS



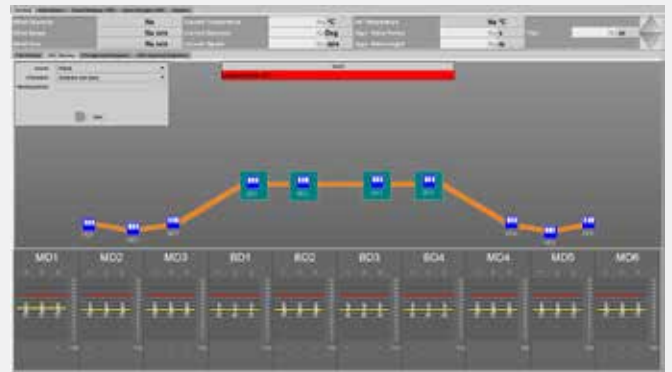
Desktop PC

Typical user interface displayed on the workstation:

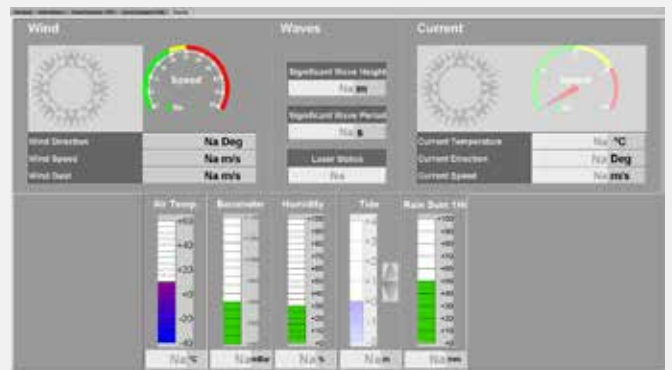
■ Docking



■ Mooring



■ Environmental



Integrated Monitoring System

MOBILE DEVICES

Mobile tablets and laptops (using one of WiFi, 3G/4G, VHF or UHF)

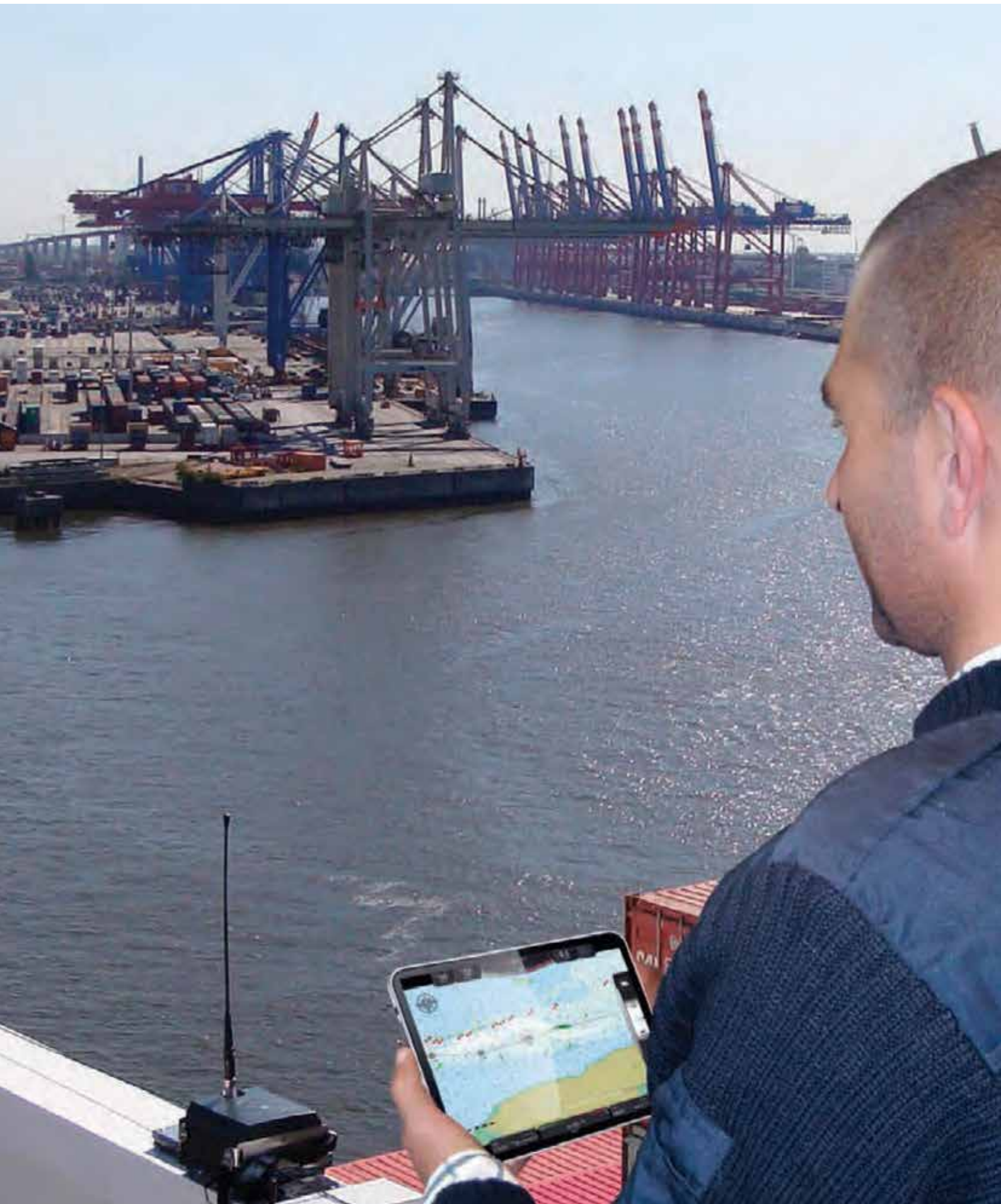


Handheld devices (using one of WiFi, 3G/4G)



Portable marine monitor – pagers (using one of VHF or UHF)





Aftersales Service & Support

By their very nature, marine terminals and installations are located in hostile environments. Industry bodies such as SIGTTO and OCIMF recognize how critical it is for mooring and monitoring equipment to function correctly to ensure safety.

To help meet the challenge in these demanding environments Trelleborg Marine Systems offers clients a full range of Aftersales Services across the Docking and Mooring range.

Trelleborg also recognizes that the maritime industry is inherently a global business and is uniquely positioned to provide rapid response through our Global Service Network.



Australia	China	Europe	Japan	Middle East	Singapore	South America	USA
<ul style="list-style-type: none"> ■ Sales ■ Service ■ Engineering ■ Production Facility ■ Project Management ■ Project Engineering ■ Research & Development 	<ul style="list-style-type: none"> ■ Production Facility ■ Sales ■ Service Engineering 	<ul style="list-style-type: none"> ■ Sales ■ Service Engineering 	<ul style="list-style-type: none"> ■ Sales 	<ul style="list-style-type: none"> ■ Sales ■ Service Engineering 	<ul style="list-style-type: none"> ■ Sales ■ Service Engineering 	<ul style="list-style-type: none"> ■ Sales 	<ul style="list-style-type: none"> ■ Sales ■ Service Engineering

Service Agreements

Leading companies recognize that it is the total cost of ownership which really matters in the purchase of capital equipment. Without doubt, regular preventative maintenance reduces downtime, improves productivity and manages risk.

A tailored service program gives you inside access to Trelleborg product experts and allows you to leverage our experience and product knowledge for your benefit.

A Trelleborg aftersales representative can work with you to tailor a service solution including some or all of the following:

- Programmed maintenance and inspection
- Call out service with defined response times
- Onsite calibration
- Refresher training
- Audit of spare parts holdings
- Remote technical support and diagnostics
- Comprehensive reporting and recommendations



Training Programs

Our experienced trainers can help you invest in your most important asset – your people. Training can be customized to your needs, whether at our factory or onsite.

Training is offered in three levels:

- Level 1 – System Overview
- Level 2 – Operator Training
- Level 3 – Maintenance Training



Calibration and Inspection Services

LOAD CELL CALIBRATION

Trelleborg offers a number of convenient options to keep your load cells calibrated to meet SIGTTO guidelines.

■ Factory Calibration

■ Onsite Calibration

- Trelleborg portable calibration equipment is shipped to site
- A Trelleborg engineer completes calibration checks together with your team

■ Load Cell Exchange Programs

- A full jetty set of calibrated load cells with cables are delivered ready for installation
- A Trelleborg engineer will be onsite (if needed) to work with your team to perform the exchange
- Removed load cells are returned to Trelleborg
- Exchange agreements typically run for 3 – 5 years



Warranty

All new Trelleborg docking and mooring projects are backed by an 18 month back to base warranty. For warranty extensions or details please talk to your Trelleborg sales representative and they'll be happy to discuss your needs.

Spare and service warranty is valid for 12 months and non-extendable.

ONSITE INSPECTION

Our experienced and knowledgeable Service Engineers are ready to assist in assessing your installed Trelleborg equipment for:

- General equipment condition
- Damage inspections
- Onsite technical advice
- Maintenance tips and recommendations
- Replacement and upgrade options for existing equipment – Trelleborg or others



Technical Support

If you have any queries on the operation of your Trelleborg docking and mooring products, please contact your local Trelleborg representative. We can provide both remote and onsite support options.

For mission critical technical support, Trelleborg offers Priority Support Packages with defined response times.



Spare Parts, Equipment Overhaul & Repair

Leveraging our extensive experience across our customer base, we are able to make recommendations for consumable, operation and capital spares holdings across multiyear time periods, e.g., 1, 2 or 3 years, to help ensure maximum equipment availability.

We also offer a number of options to support and extend the life of your existing equipment through factory repair and overhaul. Services include:

- QRH hook refurbishment and testing
- Capstan motor / gearbox refurbishment and testing
- Load cell repairs and overhaul
- General equipment repairs

Upgrades

Trelleborg recognizes the decision to upgrade equipment requires more than just a set of equipment specifications. What's needed is a deeper understanding of port operating parameters and the condition and functionality of existing equipment.

Whether you're upgrading equipment which is worn out, superseded or adding functionality, our broad industry knowledge and extensive experience means we can tailor a solution to meet your operational needs and budget.



From upgrading footswitches to entire jetty equipment replacements, some examples of upgrades we can provide include:

- Adding functionality to existing Quick Release Hooks (QRH) and bases
 - Load monitoring
 - Remote release
 - Capstans
 - Increased operating line angles
 - Fitting safety keeper bars
- Replacing obsolete or worn QRH utilizing existing bases or bolt patterns
- Replacing bollards with QRH
- Low maintenance QRH for jetties with limited maintenance windows
- Upgrading obsolete computer software / hardware
- Upgrading or replacing environmental monitoring systems
- Replacing capstans with tugger winches

Technical



Class leading solutions are based on understanding the industry, commitment to quality and using guidelines and codes.

Trelleborg Marine Systems is the world leader of onshore and offshore docking and mooring applications. We pride ourselves in maintaining and continuously developing the highest industry practices, exceeding applicable codes and standards in all aspects of design, manufacturing and testing of equipment.

Explore our pursuit of excellence!

- Total Cost of Ownership
- Our Commitment to Quality
- Materials
- Paint Systems
- Electrical Load List
- Instrumentation, Signal and Control Cables
- Industry Guidelines Codes and Standards
- Classification Societies
- Trelleborg Quality Management

Total Cost of Ownership

- What to look for to ensure class leading solutions
- Comparing bollards with QRH
- Supplier selection criteria for customers

WHAT TO LOOK FOR TO ENSURE CLASS LEADING SOLUTIONS

- Cast bases and hooks provide superior corrosion resistance and higher strength.
- Weld free hooks and bases offer extended design life and excellent fatigue resistance.
- Cast hooks with optimal throat size minimizes rope wear.
- Compact and strong cast hook design offers double the yield strength of forged mild steel hooks by others.
- Unobtrusive release mechanism (no protruding components outside the hook body which could act as rope catching points).
- Enclosed capstan design offers significantly increased protection from harsh marine environment and mechanical damage during operation, maximizing service life.
- Compact footprint with an all-in-one design minimizes deck space usage and installation costs.
- Standard capstan design has reversible control with automatic brake, enabling operator to take in or let out the line while tension and control is maintained.
- Superior insulation design insulates hooks and capstans from the base, as opposed to “under the base” insulation pads by others which are susceptible to cracking due to movement under load over a period of time.
- High quality three-coat paint specification offers industry best protective coating.

COMPARING BOLLARDS WITH QRH

- Mooring lines on a bollard cannot be released under tension whereas a QRH is designed to release the lines up to full SWL.
- Multiple lines on a bollard can cause departure delays if entangled. One line per QRH is the normal practice to assist with accurate line load monitoring.
- No facility to upgrade bollards with integral capstans, load monitoring and electric release.
- Bollards are normally installed closer to edge of the dock which increases the risk of mooring crew falling in to water while handling heavy mooring lines. QRH units require minimal line handling when compared to bollards.
- Mooring crews are at risk in close proximity of mooring lines that may be under high tension and/or are prone to failure due to their bad condition. The port often has little control over the condition of the mooring lines which are the property of the visiting vessel. The associated risks can be mitigated by using a QRH with remote release fitted.
- The number of personnel required to release a vessel can be minimized on facilities with QRH and remote release systems fitted. This also ensures that mooring personnel are not required to be in the “risk zone” in case of an emergency situation i.e., fire.

Total Cost of Ownership

SUPPLIER SELECTION CRITERIA FOR CUSTOMERS

- Does the supplier have in-house design engineering, manufacturing and testing capabilities?
- Is the supplier outsourcing an entire subsystem from a third party? If so then who controls the design, manufacturing, QA and aftersales?
- Is the supplier taking “single point responsibility” for complete system?
- Is the supplier capable of offering custom solutions to meet project requirements?
- Is the supplier providing 100% proof loading of the complete hooks’ assembly prior to dispatch? Be aware some suppliers only test components, not complete assemblies!
- Is the supplier offering a comprehensive system warranty (not just product warranties)?
- Does the supplier have a documented track record in similar product handling berths?
- Is the supplier confirming to project location specific hazardous area compliance?
- Does the supplier have current ISO9001 QA certification for the offered solution?
- Is the supplier offering aftersales service support capability?
- Is the supplier capable of offering annual service programs in accordance with SIGTTO/ OCIMF guidelines i.e. “JETTY MAINTENANCE AND INSPECTION GUIDE”?
- Does the supplier have ability to interface with third party systems i.e. PLC/DCS, SSL etc.?
- An “apple to apple” comparison of detailed technical specifications and product features to ensure compliance with project requirements and to evaluate the inherent commercial implications of overall solution (which may not be visible from a line by line price comparison).



Our Commitment to Quality

Trelleborg's commitment to quality drives the way we work and operate and includes:

- Global commitment to customers around the world with almost 100 dedicated docking and mooring employees worldwide, to provide an unparalleled level of support and expertise.
- Business processes developed and regularly audited and validated through the ISO9001 quality process.
- Key products and associated manufacturing processes audited through certification bodies such as Simtars/CSA for hazardous area products and DNV GL/ABS/BV/Lloyds for classified equipment for use on vessels including FPSOs/FSOs, FLNG and FSRUs/FSUs.
- A proven track record of hazardous area product design and manufacturing capabilities, with numerous products manufactured under the IECEx and ATEX hazardous schemes. Certificates are available upon request.
- Bringing manufacturing and certification of critical products into the Trelleborg business to ensure total control over the design, sourcing, manufacturing and testing of products such as QRH, load cells, hook release systems and docking displays.

1. SURFACE ROUGHNESS CHECK
2. CNC IN OPERATION
3. DMG HNC 6300 CNC
- 4 & 5. LOAD CELL GAUGING CLEAN ROOM.



Materials

Trelleborg mooring fittings are designed in compliance with international standards including:

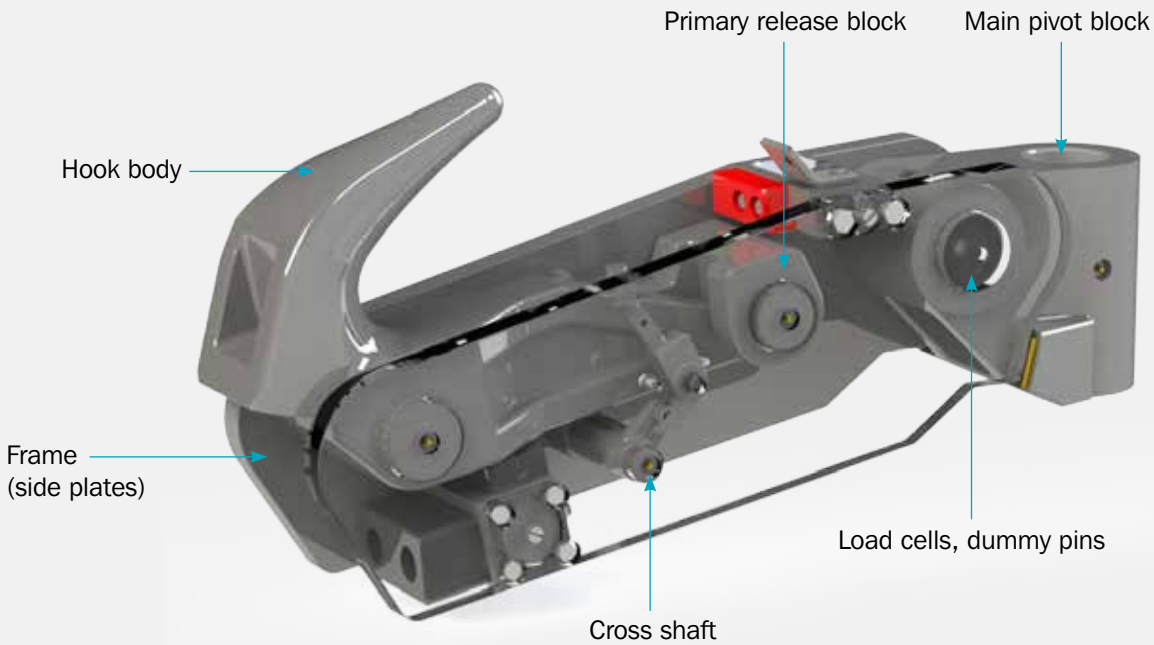
1. OCIMF: Mooring Equipment Guidelines
2. BS6349-4: Code of Practice for design of fendering and mooring systems
3. MOTEMS: Marine Oil Terminal Engineering and Maintenance standards
4. AS3990: Mechanical equipment steel work
5. AS4100: Steel Structures

The selection of the engineering material used for various components has been conducted in light of the following criteria:

- Performance (Mechanical properties)
- Resistance to wear
- Resistance to corrosion
- Practical and compact design
- Sustainability
- Reliability in extreme temperatures

QUICK RELEASE HOOK

Frame (side plates)	Carbon Steel ASTM A572 Grade 50 equivalent to AS 3678 Grade 350
Hook body, main pivot block, primary release block and cross shaft	High strength alloy steel to ASTM A148 Grade 115-95, equivalent to AS 2074
Vertical pin	High tensile alloy steel grade SAE4140
Load cells, dummy pins	ASTM A276 431 equivalent to AS 2837 431



Materials

ONSHORE BASE

Hook base	Spheroidal graphite cast iron, ASTM A536 65-45-12 equivalent to 400-12 to AS1831
Holding down bolts	BS4190 equivalent to ISO898. Property Class 8.8 Finish: Hot-dip galvanizing to ISO 10684:2004 (E) or Xylan coated



SHIP-TO-SHIP HOOK BASE (OFFSHORE)

Hook base	Fabricated steel plate AS 3678 / ASTM A572
Holding down bolts	BS4190 equivalent to ISO898. Property Class 8.8 Finish: Hot-dip galvanizing to ISO 10684:2004 (E) or Xylan coated



Materials

HAWSER HOOK

Structural carbon steel grade 350 to Australian standard AS / NZS 3678:1996 or equivalent ASTM A572

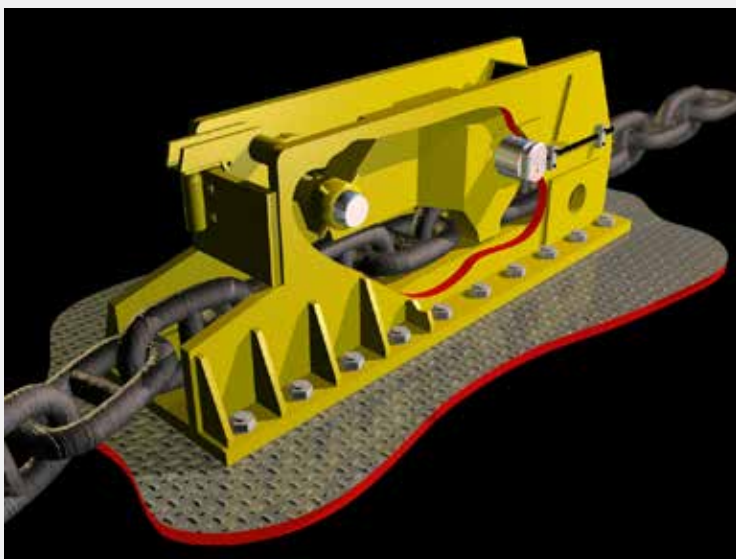
Casting	Alloy Steel AS2074:2003 or equivalent to ASTM A148
Welding	American Welding Society AWS D1.1
Load cell	Stainless steel Grade 630
Holding down bolts	BS4190 equivalent to ISO898. Property Class 8.8 Finish: Hot-dip galvanizing to ISO 10684:2004 (E) or Xylan coated



CHAIN STOPPER

Structural carbon steel grade 350 to Australian standard AS / NZS 3678:1996 or equivalent ASTM A572

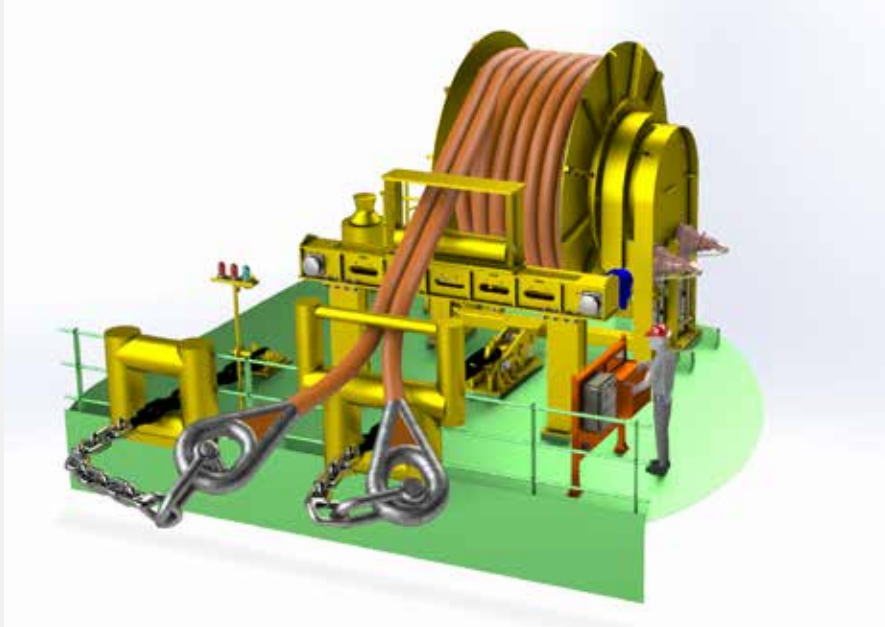
Casting	Alloy Steel AS2074:2003 or equivalent to ASTM A148
Welding	American Welding Society AWS D1.1
Holding down bolts	BS4190 equivalent to ISO898. Property Class 8.8 Finish: Hot-dip galvanizing to ISO 10684:2004 (E) or Xylan coated



Materials

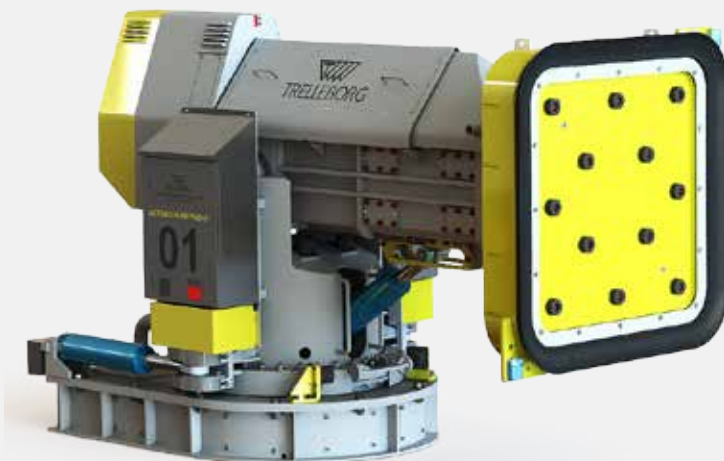
WINCHES AND REELS

Structure & drum	Fabricated structural carbon steel to ASTM A 572
Welding	American Welding Society AWS D1.1



AUTOMOOR

Low Alloy Steel Grade Q345B to GB/T1591-2008 equivalent to ASTM A572 Grade 50.



Paint System

HIGH CORROSIVITY RESISTANT PAINT SYSTEM

Trelleborg Marine Systems produces various mooring systems, which operate in harsh marine environments. These systems are expected to operate for many years and it is therefore crucial that a high standard corrosion protection system is applied.

Trelleborg designed a paint system in conformance with ISO 12944-5 category C5-M which is the highest atmospheric-corrosivity category according to ISO 12944. The system also conforms to ISO 12340 and NORSOK M-501.

Carbon steel surfaces are painted to the following system:

Each surface is sandblasted to class 2.5 to SSPC-SP10.

A three coat system is then applied:

- 60 - 80 μm DFT Zinc-rich epoxy primer
- 160 - 280 μm DFT two part epoxy, containing MIO
- 60 - 80 μm DFT re-coatable two-part polyurethane

Standard color is gloss black but other colors are also available as required.

TESTS CONDUCTED

TEST	APPLICABLE STANDARD
Pre-Cleaning of Surfaces	SSPC-SP1
Surface Preparation	ISO 8501-1
Surface Profile Determination	ISO 8503-5
Dry Film Thickness Measurement	ISO 19840
Adhesion	ISO 16276-1

TRELLEBORG QUALITY

- All equipment used for application of the painting system are maintained, calibrated and inspected in accordance with Trelleborg inspection and test plan
- All environmental conditions are recorded at various stages of the paint process.
- Dry film thickness is measured after each coat and verified statistically according to applicable standards.
- A paint report is generated that covers all the steps of surface preparation and paint application.
- Two test reference panels are prepared for each batch of painted items. One reference panel is used for testing during surface preparation and paint application and the second is retained for future reference. To ensure traceability, each panel is stamped with a unique identifier traced back to the relevant batch.
- Trelleborg engages only qualified and experienced paint applicators and third party paint inspectors qualified to NACE Level II or III as required.

Electrical Load List

The following tables provide guidelines for commonly used Trelleborg products. Refer to product datasheets for more specific information and for products not shown below.

CAPSTANS					
LINE PULL (Tonnes)	POWER SUPPLY ¹	POWER SUPPLY BY	LINE SPEED IN METERS / MINUTE		
			20	25	30
			POWER IN kW		
1	3 Ø	Others	5.5	5.5	5.5
1.5	3 Ø	Others	5.5	7.5	7.5
2	3 Ø	Others	7.5	11	11
2.5	3 Ø	Others	11	11	15
3	3 Ø	Others	11	15	15

Electrical Load List

DESCRIPTION	POWER SUPPLY ¹	POWER SUPPLY BY	POWER IN kW
REMOTE RELEASE			
Local Release Single to Quadruple Hook arrangement	1 Ø	TMS ²	0.2
Remote Release Push Button Console 16-32 Hooks	1 Ø	Others	0.3
33-48 Hooks	1 Ø	Others	0.3
Virtual Release Console (PC Workstation)	1 Ø	Others	0.3
LOAD MONITORING - SMARTHOOK®			
Controller Unit with Load Cells (Single to Quadruple Hook Arrangement)	24 VDC	TMS ²	0.1
Warning Light & Siren (Optional)	1 Ø	TMS ²	0.1
LOAD MONITORING & REMOTE RELEASE			
Load Monitoring & Remote Release Single to Quadruple Hook Arrangements	24 VAC	TMS ²	0.3
DOCKING AID SYSTEMS - SMARTDOCK®			
Lasers	24 VDC	TMS	0.02
Main Display Board	1 Ø	Others	0.2
Electric Rotator	3 Ø	Others	0.5
ENVIRONMENTAL SYSTEMS			
Standard Weather Station - Wind, Temperature, Pressure, Humidity	24 VDC	TMS	0.1
Current Meter (Doppler)	1 Ø	Others	0.1
Non-Contact Wave Tide Laser	1 Ø	Others	0.1
ENVIRONMENTAL SYSTEMS			
Integrated Docking, Load Monitoring, Remote Release, Environmental, complete with Portable Monitor transmitter, Server PC Monitor	1 Ø	Others	0.5
PC Workstation, Monitor, Printer	1 Ø	Others	0.3

Note¹: 1 Ø = Single Phase Power Supply, 3 Ø = Three Phase Power Supply.

Note²: In the standard arrangement, the power supply is taken from the capstan supply. If there is no capstan, or if client requires independent power, then 'Others' to provide a single-phase power supply into each Hook Release Controller.

Instrumentation Signal and Control Cables

The following table indicates the acronyms used in Trelleborg drawings as well as the cable types and maximum recommended distances.

NO.	TYPE	CABLE CONFIGURATION	MAXIMUM RECOMMENDED DISTANCE
CAB1	Communications	4 twisted pair, 1.5 mm ² shielded, 13.6 ohm / K	600 m with communications only. 500 m typical for QRH, Remote Release and Laser Sensor.
CAB2	Communications	2 twisted pair, 0.5 mm ² shielded, 13.6 ohm / K	600 m
CAB3M	Fibre Optic	Multimode 50/125 uM 4 Cores with SC Connectors Or Multimode 62.5/125 uM 4 Cores with SC Connectors	2 km
CAB3S	Fibre Optic	Single Mode 9/125 uM 4 Cores with SC Connectors	Upto 20 km
CAB4	Control	XC + E size, construction and armoring dependant on installation requirements.	Distance dependant on power demand and conductor cross sectional area.
CAB5	Network	CAT5	100 m
CAB6	Printer	USB	3 m
CAB7	Control	1.5 mm ² shielded, number of cores to suit.	20 m
CAB8	Antenna VHF, UHF or GPS	RG213 / CNT400	30 m
CAB9	Single Phase Power	2C + E	Distance dependant on power demand and conductor cross sectional area.
CAB10	Three Phase Power	3C + E	Distance dependant on power demand and conductor cross sectional area.

NOTES:

1. Please confirm distance limitations with Trelleborg engineers as actual configurations can affect maximum distances.
2. Construction and armoring of cable dependant on regional installation requirements.
3. Trelleborg to be notified where neutral can not be provided with three phase power.

Industry Guidelines Codes and Standards

The following tables provide a listing of industry guidelines, standards and codes applicable to Trelleborg Marine Systems.

Applicable Standards – Standard to which the Trelleborg business process or product has been developed in accordance with.

Trelleborg Specifications – Internal Trelleborg document detailing explicit set of requirements to be satisfied by a material, product, or service. Typically based on an internationally recognized standard.

QUALITY MANAGEMENT SYSTEM		
Trelleborg Specifications	QM001 - Integrated Management System Manual	
Applicable Standards	AS/NZS ISO 9001	Quality Management System - Requirements
	AS/NZS 14001	Environmental Management System
INDUSTRY GUIDELINES		
Trelleborg Specifications	N/A	
Applicable Standards	OCIMF	MEG3 - Mooring Equipment Guidelines
	SIGTTO	Jetty Maintenance and Inspection Guide LNG Operations In Port Areas Ship/Shore Interface – Safe Working Practice for LPG & Liquefied Chemical Gas Ca
CASTINGS – ALLOY CAST STEEL (QRH COMPONENTS)		
Trelleborg Specifications	D00112 – Hook Casting Process Map D00115 – Tensile Test Certificate D00116 – Chemical Analysis Test Certificate D00151 – Offshore Casting Specification D00153 – Hook Casting NDT	
Applicable Standards	ASTM A148-05	Standard Specification for Steel Castings, High Strength, for Structural Purposes. (Grade 115-95)
	AS2074-2003	Cast Steels. (Grade. LB6-2)
CASTINGS – SPHEROIDAL GRAPHITE IRON (HOOK BASES)		
Trelleborg Specifications	D00108 – Cast Base Process Map D00059 – Cast Base Heat Bars D00109 – Tensile Test Report D00095 – Cast Base NDT D00086 – Cast Base Dimension Checks	
Applicable Standards	ASTM A536-2004	Standard Specification for Ductile Iron Castings (Grade 65/45/12)
	AS1831	Ductile Cast Iron. (Grade 400/12)

Industry Guidelines Codes and Standards

MILD STEEL PLATE (HOOK FRAME)

Trelleborg Specifications D00113 – Hook Machining Process Map
D00118 – Hook Steel Traceability

Applicable Standards	ASTM A572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel. (Grade 50)
	AS3678-2011	Structural steel - Hot-rolled plates, floor plates and slabs. (Grade 350)

PINS AND SHAFTS

Trelleborg Specifications N/A

Applicable Standards	ASTM A56/A564M	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes. (Grade 630)
	AS2837-1986	Wrought alloy steels - Stainless steel bars and semi-finished products. (Grade 630)
	ASTM A29/29M	Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements. (Grade 4140)
	AS1444-1996 4140	Wrought alloy steels - Standard, hardenability (H) series and hardened and tempered to designated mechanical properties. (Grade 4140)

NON-DESTRUCTIVE TESTING OF CASTINGS

Trelleborg Specifications D00153 - Hook Casting Component Non-Destructive Testing
D00095 - Cast Base Non-Destructive Testing

Applicable Standards	ASTM A609M-91	Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof.
	ASTM E1444-05	Standard Practice for Magnetic Particle Testing
	ASTM A903M-99	Standard Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection.
	ASTM A370-07a	Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
	AS3998	Non-destructive testing - Qualification and certification of personnel.

Industry Guidelines Codes and Standards

FABRICATION CONSTRUCTION & TESTING OF STEEL STRUCTURES

Trelleborg Specifications D00128 - Fabrication Construction Testing

Applicable Standards	AS 1554.1	Structural steel welding – Part 1: Welding of steel structures.
	AWS D1.1/D1.1M	Structural Welding Code – Steel.
	AS 2207	Non-destructive testing - Ultrasonic testing of fusion welded joints in carbon and low alloy steel.
	AS 1171	Non-destructive testing - Magnetic particle testing of ferromagnetic products, components and structures.
	ASTM E 709	Standard Guide for Magnetic Particle Testing.

PROTECTIVE COATINGS - STEEL & IRON

Trelleborg Specifications D00135 - Standard Paint Specification for Steel & Iron

Applicable Standards	AS 1627.4	Preparation and pretreatment of surfaces - Abrasive blast cleaning of steel.
	ASTM D1005-95	Standard Test Method for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers.
	ASTM D7091-05	Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
	AS 3894.3	Site testing of protective coatings - Determination of dry film thickness.

STRUCTURAL DESIGN

Trelleborg Specifications N/A

Applicable Standards	AS4100	Steel Structures.
	AS3990	Mechanical Equipment Steelwork.
	DSC/04-1994	Australian Institute of Steel Constructions. Design of Structural Connections.

FASTENERS

Trelleborg Specifications D00094 – Anchor Bolt Manufacturing and Traceability

Applicable Standards	BS4190	ISO metric black hexagon bolts, screws and nuts. Specification. (Grade 8.8)
	ISO 3506	Mechanical properties of corrosion resistant stainless steel fasteners.

Industry Guidelines Codes and Standards

ELECTRICAL EQUIPMENT FOR EXPLOSIVE ATMOSPHERES

Applicable Standards	IEC60079/ EN60079	Parts 1 - 28 Explosive Atmospheres.
	AS/NZS 2381	Design, selection and installation of Electrical Equipment for Explosive Atmospheres.

PACKAGED ELECTRICAL EQUIPMENT

Applicable Standards	AS/NZS 3000	Electrical installations.
	AS/NZS 3008.1.1	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions.
	IEC60529	Degrees of Protection Provided by Enclosures.

ENVIRONMENTAL MONITORING SYSTEMS

Applicable Standards	WMO - No. 8	Guide to Meteorological Instruments & Methods of Observation.
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WIRELESS COMMUNICATION

Applicable Standards	IEC 60945	Maritime navigation and radio communication equipment and systems – General requirements – Methods of testing and required test results.
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SATELLITE NAVIGATION SYSTEMS

Applicable Standards	IEC 61108	Maritime navigation and radio communication equipment and systems – Global navigation satellite systems (GNSS).
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Classification Societies

QRH and other mooring fittings used on board of vessels for offshore applications in tandem, spread or ship-to-ship mooring are required to comply with stringent design and quality requirements to ensure the structural integrity of the ship is met. These are applicable for FPSOs/FSOs, FLNG and FSRUs/FSUs and any offshore facility.

Trelleborg mooring fittings for offshore applications are designed in compliance with:

1. OCIMF Mooring Equipment Guidelines MEG-3
2. IMO MSC / 1175 (Guidance on Ship Towing and Mooring)
3. Classification Societies Rules as applicable including:
 - a. DNV-GL
 - b. American Bureau of Shipping (ABS)
 - c. Bureau Veritas (BV)
 - d. Registro Italiano Navale (RINA)
 - e. Lloyds

The mooring system will be provided with a **“Product Certificate”** issued by the relevant classification society as assigned by the ship owner. The Product Certificate covers the following compliance requirements:

SURVEY	COMPLIANCE REQUIREMENTS
Design survey conducted	<p>The mooring fitting, its support structure holding down bolts and foundation plate must satisfy the design rules of the classification society. See picture on the right.</p> <p>The design is then assessed by the classification society. When approved, a “Design Verification” document is issued to demonstrate compliance.</p>
Manufacturing survey	<p>A surveyor deputed by the classification society inspects each manufacturing step to ensure compliance with class rules from a material testing and traceability points of view. These inspection activities are:</p> <ol style="list-style-type: none"> a. Witness plate cutting b. Sample stamping c. Witness sample testing d. Welding qualification e. Witness welding testing f. Casting or forgings process witness and sample cutting g. Witness sample testing for castings or forgings <p>Each inspection activity is documented by a “Statement of Fact” issued by the surveyor. At the conclusion of this step, a “Manufacturing Survey” document is issued detailing the inspection activities in accordance with class rules and as specified in the design verification document.</p>
Hook proof load and calibration witness	<p>A surveyor deputed by the classification society witnesses the proof load of each mooring fitting to the nominated proof load and the calibration process to the safe working load. A “Proof Load and Calibration Certificate” is then issued to document this step. The proof load and calibration certificate is also a statement of fact.</p>
Manufacturing Documentation Records (MDR) review	<p>In this step, all documents issued above are compiled and reviewed by the classification society to ensure full compliance. Any of the documents issued in the previous steps does not demonstrate compliance on its own. Only a “Product Certificate” does that once all records have been checked by the surveyor.</p>

- ① Foundation plate
- ② Support structure
- ③ Mooring fitting



Image courtesy of OLT Offshore LNG Toscana

Trelleborg Quality Management

Mooring fittings are critical for the operation of a terminal. Failure of any component can have a significant impact on the safety of the personnel, port infrastructure and vessels. The cost to human life and assets is catastrophic. Therefore, the selection of reliable mooring equipment is crucial

Trelleborg has a global supply chain to deliver to our customer the best quality product at a competitive price. Trelleborg's quality system exceeds the requirements of international standards and includes many tests and check points before the final product is delivered to site.

PRODUCT QUALITY

While ISO 9001 accreditation provides a certain level of confidence in accredited suppliers, practical experience shows that this alone does not guarantee purchasing a quality product.

Trelleborg has put in place a quality system that ensures the quality of its products, focusing on the following aspects:

1. Material specification: The material mechanical properties and chemical composition is in line with specifications.
2. Material integrity: Depending on the manufacturing method - whether the material is machined, formed, cast or fabricated, correct manufacturing procedures complying with international standards must be followed.

3. Size: The product dimensions and weight are an important factor of conformance. Checkpoints are put in place to ensure any non-conformance is picked up and rectified in a timely manner.
4. Functionality: The product must be fit for the purpose for which it's intended to be used.

Traceability of samples and product material is ensured throughout the manufacturing process.

To ensure the quality of supplied products, the following steps are taken:

SUPPLIER EVALUATION

Every supplier must be evaluated according to a set of corporate rules including a review of their quality accreditation, track record and ability to sustain and support their product and ethical responsibility.

These aspects are reviewed in rigorous processes following strict procedures by our purchasing and quality personnel.

ONGOING SUPPLIER EVALUATION

All suppliers are reviewed on periodic basis against a number of criteria including compliance with specifications, on time delivery, quality control procedures and quality documentation.

Trelleborg Quality Management

MATERIAL TRACEABILITY

To maintain traceability, Trelleborg goes above and beyond the requirements of international standards and codes and industry practices. To ensure full traceability, Trelleborg uses its own employee or an internationally recognized third party (e.g. Lloyds, SGS, BV ...) to witness the cutting of test samples. Major structural components such as hooks and bases include a built-in test sample that is extracted from the finished product and is available to our customer for testing purposes.



Built-in test sample



MATERIAL SPECIFICATION

To ensure compliance with material specifications, the following tests are conducted for structural components:

- Mechanical and chemical testing of samples by manufacturer
- Mechanical and chemical testing of samples by internationally recognized third party
- Random mechanical and chemical testing of samples by Trelleborg

SIZE

All products are dimension checked by Trelleborg to ensure compliance with the requirements.

FUNCTIONALITY

A range of tests and checks is conducted in accordance with our inspection and test plan specially designed for each project.

MATERIAL INTEGRITY

To ensure the integrity of the material produced, the following tests are put in place:

- Non-destructive testing of 100% of cast components (MPI and/or Ultrasonic)
- Random radiographic testing for a full scan on selected batches
- For all QRH:
 - Proof load testing of assembled hooks to 125% or 150% of its safe working load three times
 - Releasing the assembled hook at the nominated safe working load

DISCLAIMER

Trelleborg AB has made every effort to ensure that the technical specifications and product descriptions in this catalog are correct.

The responsibility or liability for errors and omissions cannot be accepted for any reason whatsoever. Customers are advised to request a detailed specification and certified drawing prior to construction and manufacture. In the interests of improving the quality and performance of our products and systems, we reserve the right to make specification changes without prior notice. All dimensions, material properties and performance values quoted are subject to normal production and testing tolerances. This catalog supersedes the information provided in all previous editions. If in doubt, please check with Trelleborg Marine Systems.

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Trelleborg is a world leader in engineered polymer solutions that seal, damp and protect critical applications in demanding environments. Its innovative solutions accelerate performance for customers in a sustainable way.

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