

Parallel Motion Fenders

**HANDLING, STORAGE, INSTALLATION
AND MAINTENANCE MANUAL**



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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.

Parallel Motion Fenders Handling, Storage, Installation and Maintenance Manual

Trelleborg Marine Systems is a world leader in the design and manufacture of advanced marine fender systems.

We provide bespoke solutions for large and complex projects all over the world. Best practice design and quality materials ensure a long, low maintenance service life, no matter how demanding the working and environmental conditions.

All fenders are supplied fully tested and meet PIANC 2002 guidelines. Our pneumatic fenders are also completely ISO17357-1:2014 compliant. Our high-performance solutions combine low reaction force and hull pressure with good angular performance and rugged construction.

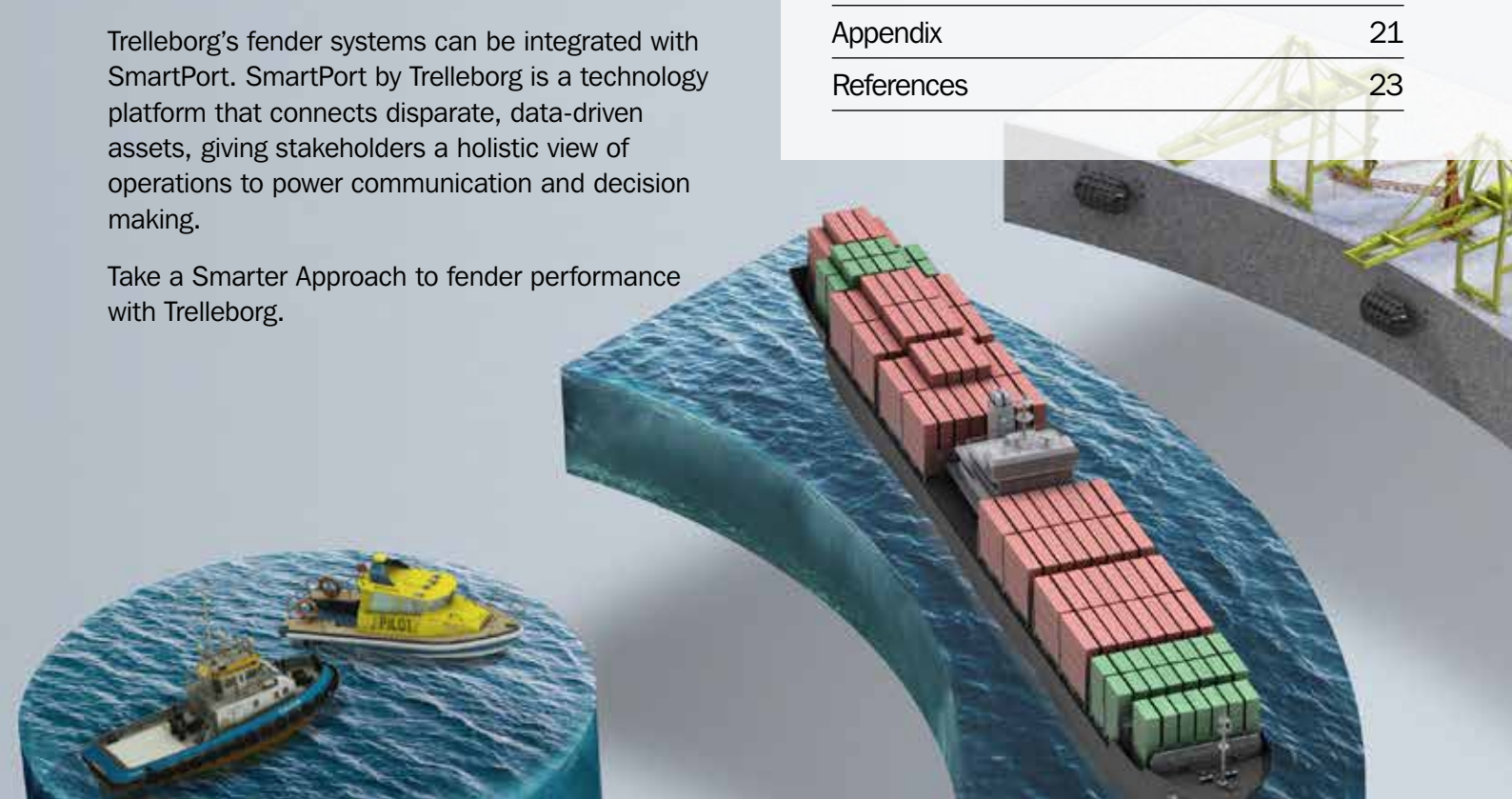
Trelleborg's fender systems can be integrated with SmartPort. SmartPort by Trelleborg is a technology platform that connects disparate, data-driven assets, giving stakeholders a holistic view of operations to power communication and decision making.

Take a Smarter Approach to fender performance with Trelleborg.

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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 Centers of Excellence where our team generates 3D CAD designs, application-engineering drawings, a bill of materials, finite engineering analyses 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 meets 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 on-site 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.

Parallel Motion Fender System

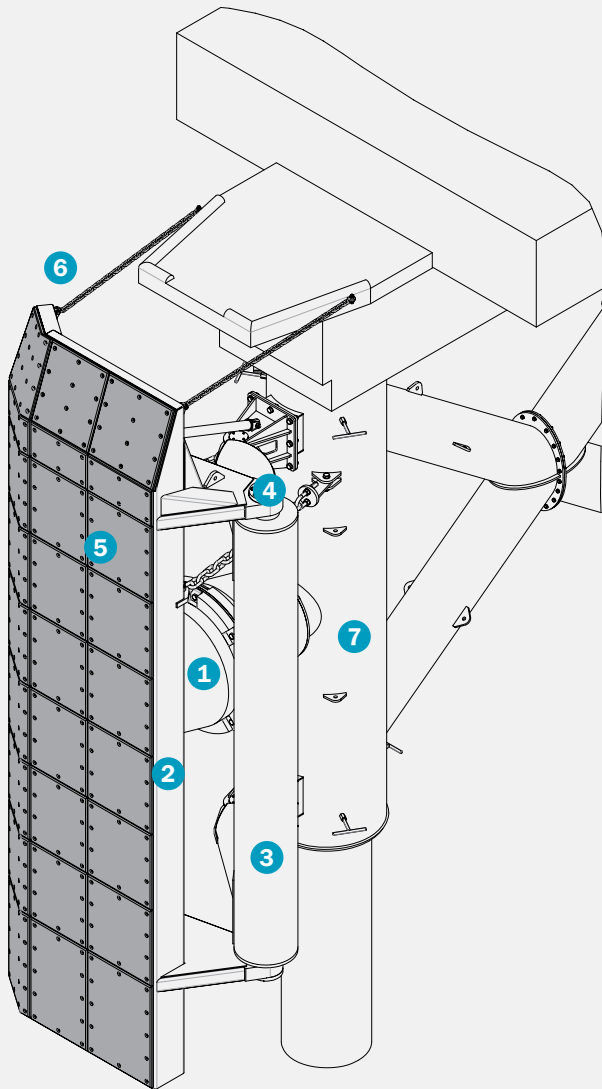


Parallel Motion Fender System keeps the panel vertical at all times – irrespective of where the impact loads are applied – but simultaneously allows the panel to rotate on plan to accommodate large berthing angles.

Parallel Motion Fenders can absorb the full design energy irrespective of impact level.

As Parallel Motion Fenders are mostly pre-assembled in the factory, installation is simple and fast. Maintenance is minimal too – contributing to the low service life cost of Parallel Motion technology.

Parallel Motion Fender System



1 Rubber fender units

Shown here are two Super Cones mounted in a back-to-back 'Twin-Series' configuration.

2 Closed box panel (frame)

Fully sealed, pressure tested design. Shown with optional lead-in bevels which are designed to suit each case.

3 Torsion tube and arm assembly

Also closed-box construction, the tube and arms keep the panel vertical whatever level impact loads are applied.

4 Hinge units

The maintenance-free stainless steel pins and bearings allow free rotation to accommodate berthing angles, also eliminating moments in the hinge pin.

5 UHMW-PE face pads

Trelleborg 'Double Sintered' UHMW-PE face pads are standard to minimize friction and maximize service intervals.

6 Check chains (optional)

Check chains act as rope deflectors to stop ropes from snagging, and to help with some large angle berthings.

7 Pile jackets (optional)

Purpose designed for every project, pile jackets are factory built for a perfect fit to the fender onsite. They can strengthen the structure and double as a corrosion barrier in the vulnerable splash zone. Jackets are also available for monopile systems.

Parallel Motion Fender System PROVEN IN PRACTICE



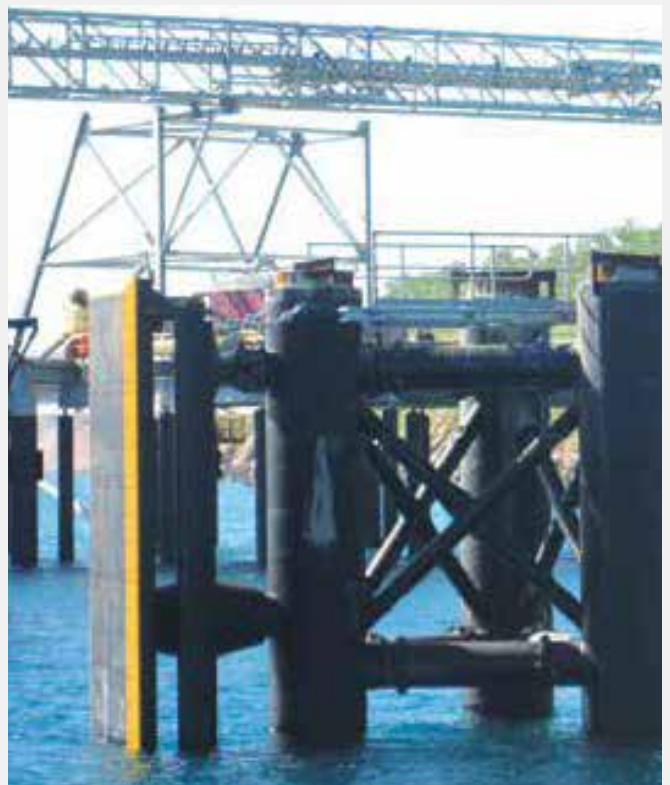
Reverse mounted twin cone fender PMF system installed on concrete structure



MV fender PMF system



Standard mounted twin cone fender PMF system installed on concrete structure



Reverse mounted twin cone fender PMF system installed on steel pile

Parallel Motion Fender System PROVEN IN PRACTICE



Reverse mounted single cone fender PMF system
installed on concrete structure



MV fender PMF system

Handling



The Parallel Motion Fenders (PMF) unit will be delivered completely plastic wrapped and protected with suitable paddings at the base and corners.

Handling

MATERIALS / CONSUMABLES REQUIRED	INFORMATION
Timber / rubber blocks	After unloading, all the equipment must be placed on timber / rubber blocks to avoid damage to the plastic or painted surfaces.
EQUIPMENT REQUIRED	INFORMATION
Crane	Refer to the General Arrangement drawing for the total weight of the equipment.
Rigging equipment with spreader beam	Refer to the General Arrangement drawing for the total weight of the equipment.

Unwrap the plastic packaging of the PMF unit with necessary tools

Caution

The unwrapping operation must be performed on the truck trailer so that the lifting points are exposed. Lifting point locations and sizes are subject to change based on the project requirement. Refer to the General Arrangement drawing for details.

A Spreader beam of suitable length & load rating must be used to lift the PMF unit from the truck trailer.

Recommendation

In the event of non-availability of a spreader beam, two separate lifting hooks can be used.

Caution

Lifting rope angles must be set in a way that they do not scrape off any painted surfaces. Paint damage while lifting is not covered under warranty & the damages must be repaired.

Do not walk under suspended loads. Refer to the General Arrangement drawing for details.



Figure 2: Unwrapped PMF unit on truck trailer

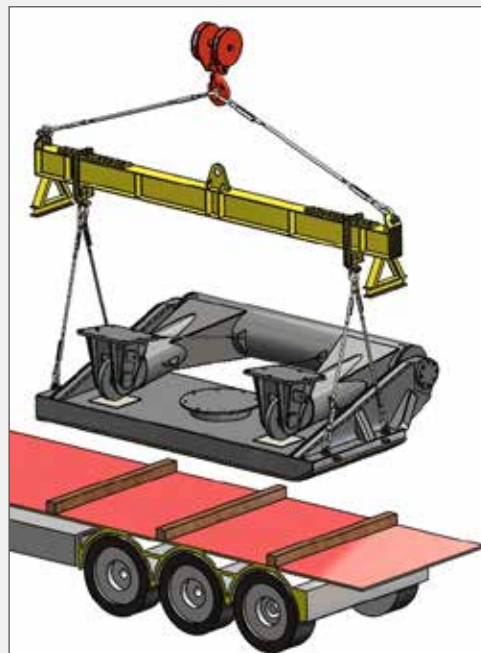


Figure 3: Lifting the PMF unit with a Spreader beam

Storage



At all times, all equipment must be stored properly to avoid any damage, environmental damage or damage occurring from nearby moving equipment.

Storage

MATERIALS / CONSUMABLES REQUIRED	INFORMATION
Timber / rubber blocks	All equipment must be placed on timber / rubber blocks to avoid damage to plastic or painted surfaces.
Tarpaulin	Heavy-duty waterproof plastic.

PROCEDURES

- Timber / rubber blocks must be placed on a dry surface and the PMF unit should be carefully placed on the blocks.
- After successful placement of the PMF unit, cover it with a waterproof plastic tarpaulin to protect it from dust, direct sunlight and ambient moisture.

Recommendations

- Use medium-duty tarp with an approximate thickness of 0.007 - 0.008 in (0.18 - 0.20 mm).
- For long-term storage (>6 months), use heavy-duty tarp with an approximate thickness of 0.011 – 0.012 in (0.28–0.30 mm)
- The tarpaulin must be tightly bound using nylon straps, making sure that there are no exposed areas.

Caution

Do not place any equipment, tools or furniture over the covered PMF unit.



Figure 4: PMF unit placed on timber/ rubber blocks

Installation



Installation

2.1 FENDER TO STEEL PANEL

This section showcases the various steps involved for assembling the fender/fenders to the PMF unit.

MATERIALS / CONSUMABLES REQUIRED	INFORMATION
Timber / rubber blocks	The fender must be placed on timber / rubber blocks to avoid any damage to the rubber body.

EQUIPMENT REQUIRED	INFORMATION
Fasteners	Supplied by Trelleborg
Spanner	Suitable to the supplied bolt size

RECOMMENDED EQUIPMENT	INFORMATION
General PPE	As per site / plant requirements

2.1.1 SCN fenders to Steel Panel

Assembling SCN fenders

- Fix the "first" fender on the spool.
- Align the Sandwich plate as shown on the image.
- Lower the "second" fender on the Sandwich plate such that the bolt holes are aligned.
- Insert and torque the bolts.

Recommendations

- After inserting the bolts, only turn enough to ensure the threads are engaged and in line. Once all bolts are loosely inserted and the holes are aligned, tightening may be commenced. Firmly fasten all bolts and then torque down, ensuring that adjacent bolts are not tightened in sequence.
- For fastening to rubber, torque values from Appendix A should be used.
- Standard bolt torque values should be used when fastening to steel.
- Refer to MN-I&M-RUB-SCN&SCK-v1.0- EN, 2017 for fender lifting methods.

Caution

The "first" and "second" fenders must be identified based on their grades prior to the commencement of installation. Refer to the General Arrangement drawing.



Figure 6: Assembling "back-to-back" SCN fenders

Installation

2.1 FENDER TO STEEL PANEL

2.1.1 SCN fenders to Steel Panel

Installing "back-to-back" SCN fenders on Steel panel of the PMF unit

- The "back-to-back" SCN fenders are to be fixed with the fender spool as shown in the image.
- Insert and torque the bolts.

Recommendations

- After Inserting the bolts, only turn enough to ensure the threads are engaged and in line. Once all bolts are loosely inserted and the holes are aligned, tightening may be commenced. Firmly fasten all bolts and then torque down, ensuring that adjacent bolts are not tightened in sequence.
- For fastening to rubber, torque values from Appendix A should be used.
- Standard bolt torque values should be used when fastening to steel.
- Refer to MN-I&M-RUB-SCN&SCK-v1.0- EN, 2017 for fender lifting methods.

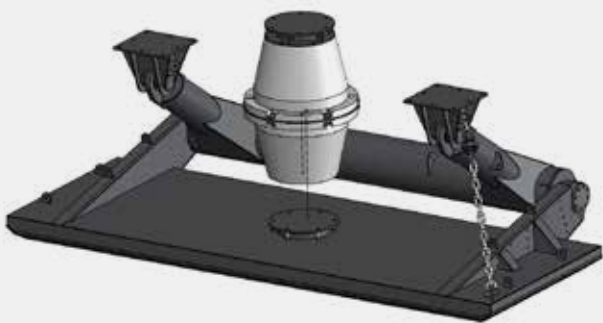


Figure 7: Installing "back-to-back" SCN fenders on steel panel of the PMF unit

Installing MV fenders

- Place the frontal frame face down to the ground, supported on timbers.
- Place and align the rubber fender holes with ferrules of the steel panel.
- Insert and torque the bolts.

Recommendations

- After Inserting the bolts, only turn enough to ensure the threads are engaged and in line. Once all bolts are loosely inserted and the holes are aligned, tightening may be commenced. Firmly fasten all bolts and then torque down as required.
- Standard bolt torque values should be used when fastening to steel.
- Refer to MN-I&M-RUB-MV&UE-v1.0-EN, 2017 for fender lifting methods.

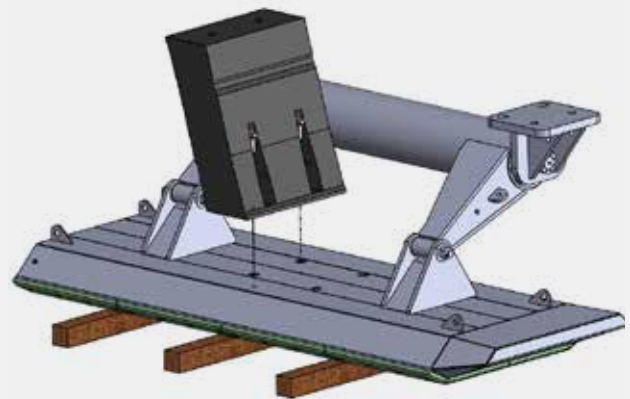


Figure 8: Installing MV/UE fenders on steel panel of the PMF unit

Installation

2.2 PMF UNIT TO STRUCTURE

This section showcases the various steps involved for installing the PMF unit to concrete.

MATERIALS / CONSUMABLES REQUIRED	INFORMATION
Timber / rubber blocks	The PMF must be placed on timber / rubber blocks to avoid any damage to the rubber body.

EQUIPMENT REQUIRED	INFORMATION
Fasteners	Supplied by Trelleborg
Spanner	Suitable to the supplied bolt size

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT	INFORMATION
General PPE	As per site / plant requirements

2.2.1 Installation on concrete structure

- Unfasten ropes which connect the mounting brackets to the torsion tube.
- Identify the top side and orientation of the steel panel from the General Arrangement drawing.
- Fasten the lifting brace with two lifting points on the top side of the steel panel as shown in the image. Rotate the torsion arms and fix the third lifting point with the lifting brace.

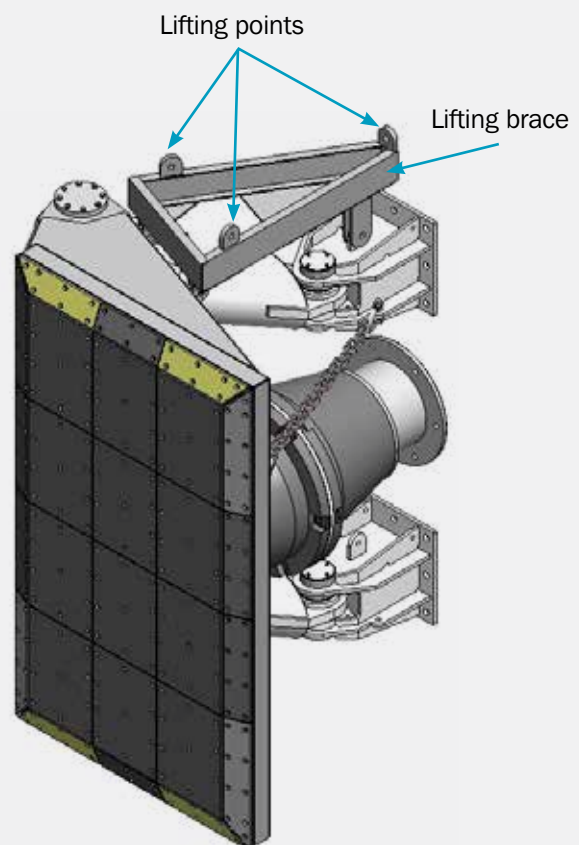


Figure 9: Lifting brace installation on PMF

Installation

2.2 PMF UNIT TO STRUCTURE

2.2.1 Installation on concrete structure

- ▮ Pivot the PMF unit and position it in vertical orientation.
- ▮ Move PMF unit to the structure where it is to be installed with the assistance of a crane.
- ▮ Align the fender / spool holes with the anchor location on concrete.
- ▮ Fasten the fender with the supplied hardware shown in the general arrangement and anchor layout drawings.

Recommendations

- ▮ Use the standard bolt torque values when fastening to the steel.
- ▮ Use torque values from Appendix A when fastening to fender.

For anchor installations refer to MN-I&MANCHOR-v1.0-EN, 2017

- ▮ Locate the torsion arm brackets on the anchor locations.
- ▮ Fix the brackets with the supplied fasteners shown in the general arrangement and anchor layout drawings.



Figure 10: PMF unit assembly lifting

Installation

2.2 PMF UNIT TO STRUCTURE

2.2.2 Installation on steel pile

EQUIPMENT REQUIRED	INFORMATION
Fasteners	Supplied by Trelleborg

RECOMMENDED PERSONAL PROTECTIVE EQUIPMENT	INFORMATION
General PPE	As per site / plant requirements

While installing on steel pile:

Mounting of the hole locations and connecting plate sizes of the pile structure must be in accordance to the approved anchor layout drawing.

Recommendations

- Use the standard bolt torque values when fastening to the steel.
- Use torque values from Appendix A when fastening to fender.



Figure 11: Typical installation on steel pile

Maintenance and Inspection



For maintenance of steel panel and chains, refer to MN-I&M-FEN-SYS-v1.0-EN, 2017.

For inspection, repair and maintenance of rubber fenders, refer to MN-I&M-RUB-SCN&SCK-v1.0- EN, 2017 / MN-I&M-RUB-MV&UE-v1.0-EN, 2017.

PMF units are equipped with Orkot bearings which do not require any periodic maintenance other than regular checks that the bearings are still in place and are operating normally without excessive clearance.

External visual checks should be possible without stripping down the fender. If the bearings have excessive play or are damaged, then the fender will not operate.

It is not easy to measure the wear rates with Orkot bearings unless they are dismantled and measured with appropriate micrometers. Thrust bearings can more easily be checked for wear allowance between the bearing surface and its retaining screws. Measurements of 1-2mm will mean the bearing should be replaced.

Appendix

Torque table based on Anchor Loading

SCN FENDERS (F1.9 TO F3.1)

FENDER	AXIAL FORCE (kN) (F)	BOLT SIZE	CO-EFFICIENT (k)	TORQUE (T) N.m $T = KFD$
SCN 2250	401	M64	0.18	4614
SCN 2250	374	M56		3765
SCN 2000	317	M56		3190
SCN 1800	279	M56		2812
SCN 1600	264	M48		2281
SCN 1400	203	M42		1531
SCN 1300	177	M42		1338
SCN 1200	167	M42		1259
SCN 1100	128	M36		826
SCN 1050	143	M36		923
SCN 1000	131	M36		846
SCN 950	117	M30		632
SCN 900	107	M30		575
SCN 860	98	M30		527
SCN 800	84	M30		454
SCN 700	84	M30		454
SCN 600	63	M30		340
SCN 550	54	M24		233
SCN 500	41	M24		175
SCN 400	29	M20		103
SCN 350	21	M16		60
SCN 300	17	M16		48

Torque table based on Anchor Loading

SCN FENDERS (F0.7 TO F1.8)

FENDER	AXIAL FORCE (kN) (F)	BOLT SIZE	CO-EFFICIENT (k)	TORQUE (T) N.m T = KFD
SCN 2250	254	M48	0.18	2190
SCN 2250	236	M48		2035
SCN 2000	200	M42		1508
SCN 1800	177	M42		1338
SCN 1600	167	M42		1259
SCN 1400	128	M36		826
SCN 1300	111	M36		719
SCN 1200	96	M30		518
SCN 1100	81	M30		437
SCN 1050	90	M30		486
SCN 1000	83	M30		446
SCN 950	75	M30		405
SCN 900	68	M30		365
SCN 860	62	M24		266
SCN 800	54	M24		233
SCN 700	54	M24		233
SCN 600	38	M20		135
SCN 550	35	M20		124
SCN 500	26	M20		92
SCN 400	18	M16		52
SCN 350	14	M16	39	
SCN 300	11	M16	30	

k=0.18 for hot-dip galvanized screw threads with normal metric thread, clean and dry (ungreased).

k=0.15 for bolts with normal metric thread, clean and lightly oiled, in the manner the manufacturer usually delivers.

k=0.12 for bolts with normal metric thread of which the screw thread and the nut face are lightly greased with a Moly slip screw thread paste (or similar).

■ Torque value calculated considering k = 0.18.

■ Above 'k' values are for reference only. Appropriate 'k' values shall be considered as per lubricant manufacturer datasheet.

■ If a digital torque wrench is not available, measure the initial clamping thickness and allow the rubber to compress not more than 2-3 mm.

References

This section contains references of other associated installation and maintenance manuals as mentioned below.

DOCUMENT NO.	DESCRIPTION
MN-I&M-FEN-SYS-v1.0-EN, 2017	Handling, Storage, Installation, Inspection & Maintenance Manual for Fender system.
MN-I&M-RUB-SCN&SCK-v1.0-EN, 2017	Handling, Storage, Installation, Inspection & Maintenance Manual for SCN/SCK Rubber Fender.
MN-I&M-RUB-MV&UE-v1.0-EN, 2017	Handling, Storage, Installation, Inspection & Maintenance Manual for MV/UE Rubber Fender.
MN-I&M-ANCHOR-v1.0-EN, 2017	Handling, Storage, Installation, Inspection & Maintenance Manual for Anchors.



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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