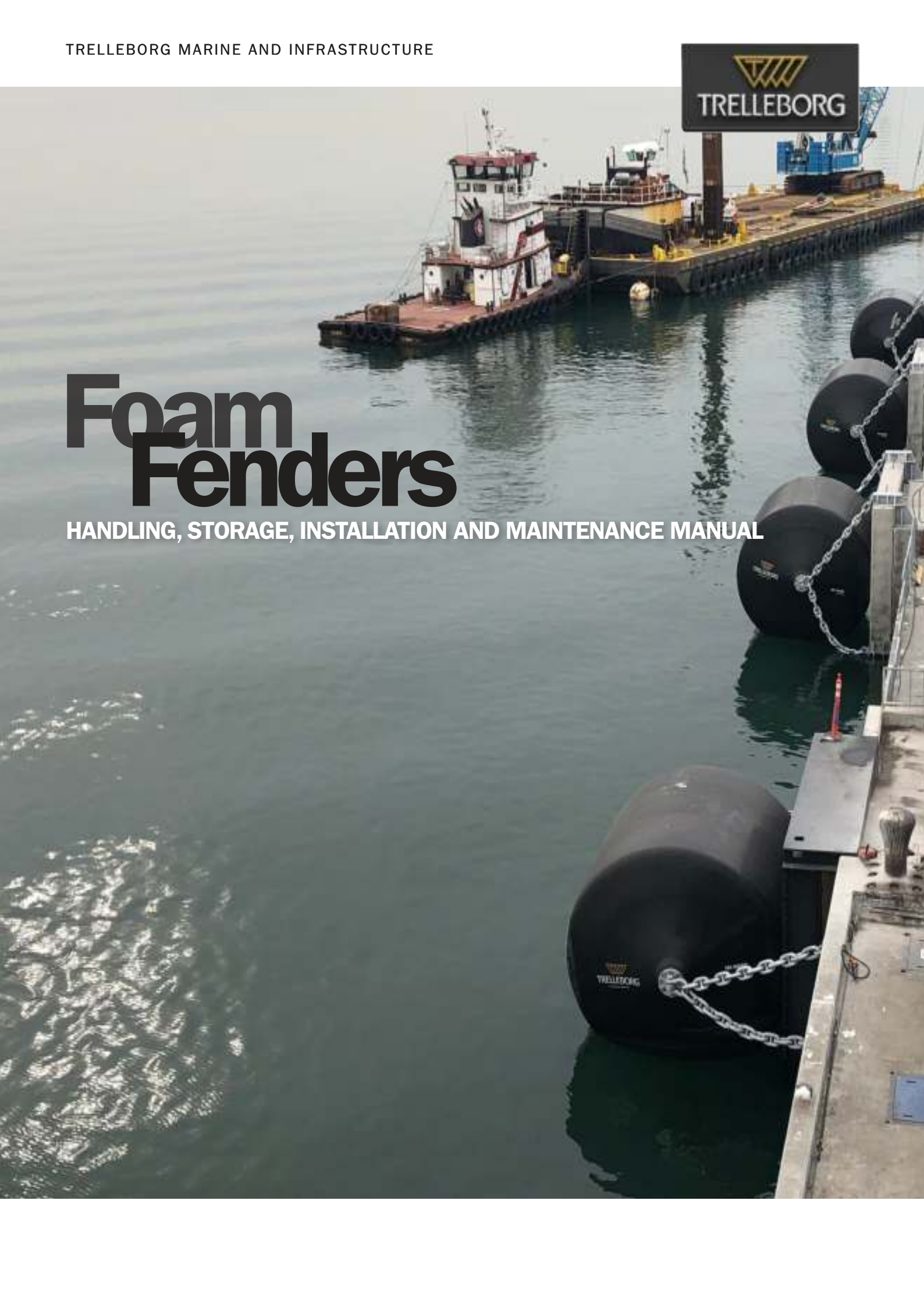


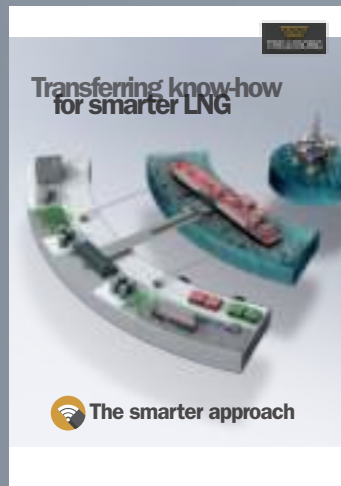


Foam Fenders

HANDLING, STORAGE, INSTALLATION AND MAINTENANCE MANUAL



The Smarter Approach



Connect with The Smarter Approach

By Trelleborg Marine and Infrastructure

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The demanding nature of commercial ports and terminals, means you need a partnership that provides much more than technically superior products and technologies. You need to work with a partner that combines best practice expertise gained through worldwide experience with a deep understanding of local requirements and regulations. At Trelleborg, we call this the Smarter Approach.

Our Smarter Approach combines global reach with feet-on-the-ground local presence, delivering solutions that continually enhance your operations. Smart technologies are at the forefront of improving operational efficiencies. Trelleborg's innovative SmartPort offering deploys the latest in marine technology applications to help ports and terminals optimize their operations.

Connect with a partner that combines smart solutions, proven product capability and industry expertise to maintain and enhance port and vessel performance. Take a Smarter Approach, with Trelleborg Marine and Infrastructure.

Foam Fenders Handling, Storage, Installation and Maintenance Manual

Trelleborg Marine and Infrastructure 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.

Our high performance solutions combine low reaction force and hull pressure with good angular performance and rugged construction.

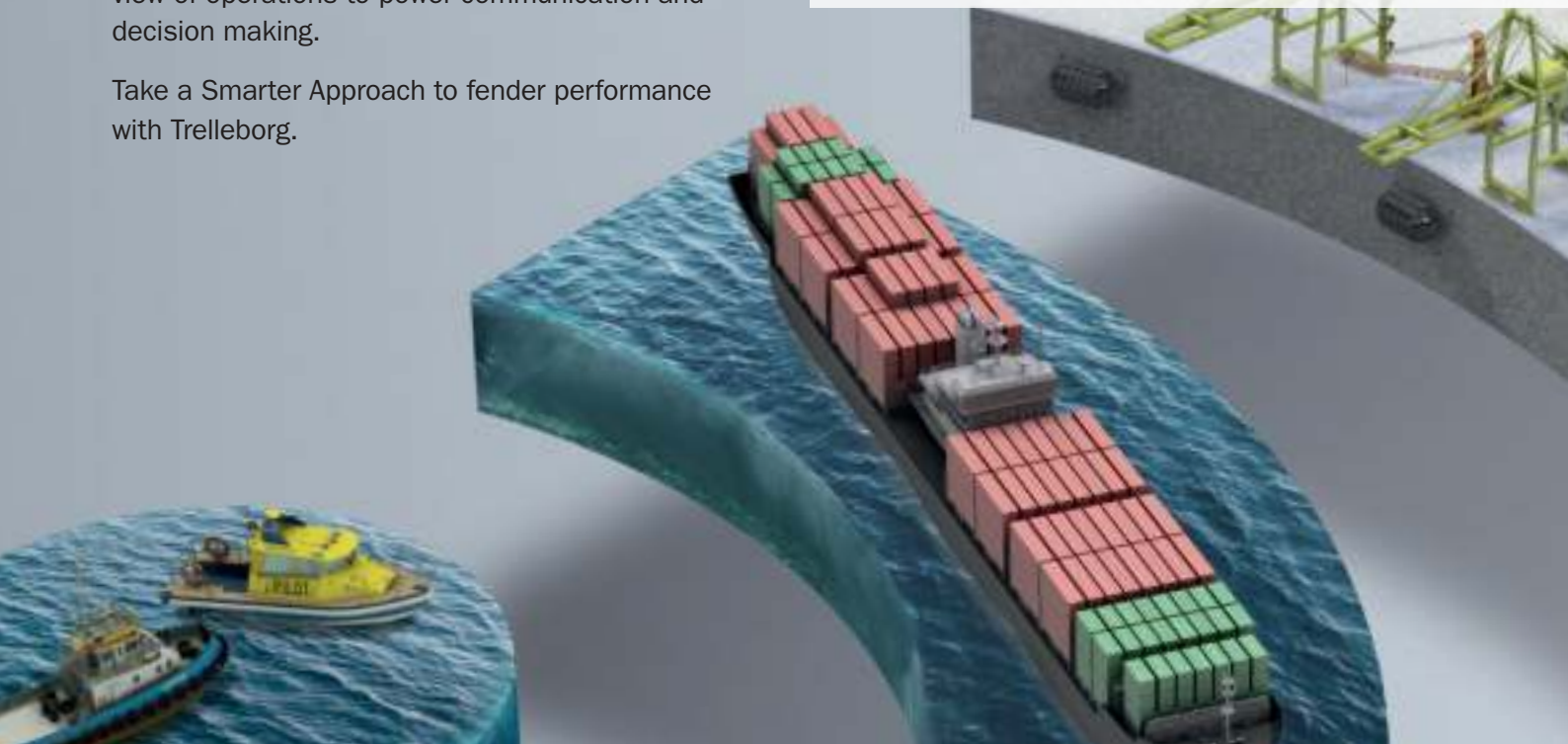
Trelleborg's fender systems can be integrated with SmartPort. SmartPort by Trelleborg is a technology platform that connects disparate, data-driven assets, giving stakeholders a holistic view of operations to power communication and decision making.

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 systems and marine technology solutions are specified, with complete technical support from our global offices.



CONCEPT

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 in India 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, which is why every aspect of our product development and design is centered on quality. 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 lifecycle and performance of our entire product range meets your specifications, and more.



INSTALLATION

Dedicated project management, from solution design all the way through to on-site installation support. We design products and solutions with an 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.

General Information



1.1 Introduction

This manual provides a description of Trelleborg foam fenders, and includes information on their handling, installation, storage, and maintenance. To ensure the safety of all personnel and equipment, please read and understand all the “Precautions” noted in Section 2 of this manual.

Trelleborg foam fenders are designed to absorb the kinetic berthing energy of a ship when positioned along a dock wall or alongside other vessels or structures. After the initial berthing contact, the fenders offset the vessel from the structure and resist mooring loads. The fenders typically float with a large portion of the fender body above the vessel’s waterline. The fenders are attached to the pier using chains which are connected to end fittings built into the fender.

The fenders require very little maintenance, although periodic inspections are required to observe for damage or abnormal wear. Details of inspections, maintenance, operations and care are contained in the following sections of this manual.

The following sections detail all steps to ensure safe and effective operations of the fenders provided. All details should be thoroughly examined prior to installing, operating, removing or maintaining the fenders. If questions of any nature arise, please contact the Trelleborg sales office for complete details and answers to questions prior to commencing an operation.



1.2 Precautions

Foam fenders are items of substantial size and weight. Caution must be exercised in handling these items as follows:

- a. Verify that overhead lifting equipment and all rigging hardware including chains, cables, shackles, etc. possess safe working loads which exceed the weights to be lifted.
- b. Confirm that all personnel are experienced in such operations and are supervised adequately by individuals who have familiarized themselves with all sections of this manual.
- c. Ensure that the sequence of operations are followed as outlined in this manual.
- d. Only lift the fender by either the end fitting lifting eyes, or with nylon straps secured around the body of the fender. Do not lift the fender with cables or wire lines against the elastomer skin, and do not drag the fender across any surface.
- e. The fender’s elastomer skin will burn slowly if subjected to an open flame or very hot objects. For this reason, extensive caution should be taken when welding, cutting, etc. in the vicinity of the fender skin.
- f. Avoid purging or allowing steam or hot exhaust gasses to come into contact with the fender skin. Initial exposure to steam or hot gas will cause cosmetic damage to the skin, and extensive or prolonged exposure could jeopardize the fender’s performance and safety overload capabilities.
- g. Do not let the fender come into contact with sharp objects or debris. The fender backing surface (against which the fender will react during compression) should be smooth.
- h. Remove fenders from service in the event of severe ice formation, floating ice or other large floating debris, as the fender skin and components may be damaged by such sharp impacts. Generally, the fenders should be removed from service during severe winter months if not required for vessel berthing.

Handling



2.1 Unpacking

Fenders are most often shipped over land on flat-bed truck trailers, secured with nylon straps around the fender body and/or by chains/straps connected to the fender end fittings. The fenders should also be chocked with rounded-edged wooden blocks or other suitable dunnage to prevent them from rolling when the line attachments are released.

Fenders are most often shipped over water inside ocean-going containers when the size permits or on an ocean-going flat rack when over-sized. The fenders should be secured with nylon straps around the fender body and/or by chains/straps connected to the fender end fittings. The inside of shipping containers should be padded with foam or cardboard packing around the fender area to resist sliding damage to the fender skin.

Flat-bed truck trailers: Take care when releasing the tension from load binders on straps or chains. After the tension is released, the shipping lines may be removed. Two lifting lines may then be attached to the fender, one on each end fitting, by connecting each lifting line to a suitably sized shackle. A shackle is then attached to each end fitting, and the fender can then be lifted from the trailer and placed on the ground, or lowered into the water for installation. Lay the fender on a surface that will not cause marking or abrasion to the elastomer skin of the fender. Fenders laid on the ground should be chocked to prevent them from rolling, or moving due to incidental contact.

Ocean Flat racks: Follow the same procedure as for flat bed truck trailers.

Ocean closed-top cargo containers: Open the doors of the cargo container in a manner that will not expose anyone in the unlikely event that the contents of the container have shifted during transport. After opening the doors, remove any dunnage that protected the ends of the fenders from contact with the doors. Remove any chocks or dunnage from the first fender in sequence and attach a line to the fender end fitting. Gently pull the fender out of the container by sliding, using the foam or cardboard packing. Ensure that the skin of the fender does not abrade against the edges of the cargo container while removing the fender from the container. Some minor scuffing of the skin caused by handling or transportation may be unavoidable and can often be buffed or cleaned.

Always note the serial number of the fender, and inspect for damage that may have occurred during shipment, and document with photographs.



Foam fenders with cardboard packing, ocean container transport



Foam fenders with wood pallet, ocean container transport

2.2 Transporting

Once unpacked, the fenders should be transported to the storage or installation site by one of the following methods.

Crane or hoist: Attach a lifting line to a shackle at each of the fender end fittings (one shackle at each end fitting). Ensure that the lifting lines are near to 90 degrees of the fender ends, such that the lines do not cut or damage the fender body. Lifting lines may also be attached to nylon straps around the fender body or ends, ensuring the straps are secure and do not allow the fender to slip. Lift the fender, keeping it level, and set it down gently on a level surface. Insert chocks or stops on both sides of the fender to keep it from rolling before unhooking the lifting lines from the fender. Always ensure the crane or hoist capacity is adequate for the weight of the fender.

Forklift: If a forklift is used, great care must be taken to ensure the fender skin is not damaged by the forks. Forks need to be long enough to extend across the full diameter of the fender. The ends of

the forks must not be allowed to contact or puncture the fender body. Ensure the forklift capacity is adequate to handle the weight of the fender, with consideration given to the center of the load when the fender is lifted and moved. When lowering the fender to lay it on the ground, make provisions to ensure it does not roll after leaving the forks.

Flatbed truck trailer: Lay the fender on the bed of the truck, after inspecting the bed to ensure there are no sharp projections or rough surfaces present. Chock the fender into position before removing the lifting lines from the fender end fittings. Secure the fender to the truck bed by attaching wire rope or chain to the fender end fittings, and securing these to the truck bed. Nylon straps may be used around the body of the fender, and tightened to keep the fender secured to the bed. Securing lines must be frequently checked for tightness, chocking verified, and the load must be inspected for shifting during transport.

AVOID:

- ❗ Rolling the fender on the ground or any rough surface.
- ❗ Any contact with sharp objects.
- ❗ Any contact or proximity to high heat, steam, or sparks.
- ❗ Lifting the fender by one end.
- ❗ Dragging the fender along the ground or rough surface.
- ❗ Contact of the fender with the wheels of the transport vehicle.



Storage



Foam fender storage configuration

Store the fenders on level ground and secure them from moving by chocking them in position. Use chocks with rounded edges to prevent damage to the skin.

Avoid oil and grease from contaminating the skin of the fenders. Keep the fenders away from locations where high temperature work operations are performed (torch cutting, welding, brazing, steam cleaning, heavy equipment exhaust).

Trelleborg recommends covering the fenders during storage, if the storage period will exceed 30 days. A white tarp should be used, to prevent excessive heat buildup on black or dark colored fenders. Do allow for good ventilation under any cover used in hot climates.

If the fenders are stacked, use adequate chocking. Do not stack over two units high.

Periodic rotation of the fenders may be desirable if storage will be for extended periods of time.

Installation



Installation must be accomplished in accordance with the site plans at any location that fenders are used. Instructions herein are general in nature, and must be modified as necessary to comply with the requirements at the installation site. It is the responsibility of the purchaser of the fender to comply with approved site plans when required, or to contact Trelleborg for instructions in the absence of such site plans. Transport the fender to the location where it will be installed, as noted in Section 2.

Make sure the fender has adequate backing surface to prevent damage and ensure proper performance. The backing surface should be smooth and free of protrusions that may cut or damage the fender. The backing surface should be of adequate size to allow the compressed fender footprint to completely bear on the backing surface under the full fender design compression. Make fender connections in accordance with approved contract documents, using approved connecting shackles, chains and ropes.

4.1 Mounting

Fenders are typically hung using a two-point or four-point configuration. A two-point configuration uses two brackets or mounting points to secure the fender. A four-point configuration uses four brackets or mounting points.

Two-point mounting configuration - Used when the fender is required to float during tidal variations or when the fender will hang above the water level during tidal variations. The configuration should be used only when the fender will not rise above the deck level during high tides or because of wind and wave forces.

Four-point mounting configuration – Used when the fender is not required to float during tidal variations or to keep the fender from rising above the deck level during high tides or because of wind and wave forces. This configuration holds the fender at a relative elevation when in service.



Typical two-point mounting configuration



Typical four-point mounting configuration

4.2 Mounting Considerations

- Fender mounting points should be oriented to project the mounting chain away from the fender to resist damage due to scrapes on the skin or adverse pulling effects on the fender body. Typical fender mountings orient the chains at a 45 degree angle away from the fender ends. The chains should never be positioned to pull the fender ends toward each other, as the fender body may be damaged.
- Foam fenders rely on the friction created between the urethane skin and a concrete backing surface to resist much of the shear forces when a steel vessel hull slides along the surface of a compressed fender when in service. This friction force on the backing surface reduces the amount of resistance required by the fender end fittings. When a fender is mounted to a steel or UHMW-PE backing surface instead of concrete, the end forces on the fender may be higher, requiring a larger fender end fitting and/or chain mounting system. Contact Trelleborg for specific design assistance.

Note: Chain tensioners should be used with caution and only for chain length adjustment. The fender should not be compressed tight against the backing surface prohibiting proper rotation.



Fender with chains oriented incorrectly. Note damage to the fender ends.



Alternate backing surface requiring larger fender end fittings

4.3 Hardware

If the mounting hardware is supplied by Trelleborg, always refer to the approved design general arrangement drawings and specifications when applicable. For other questions regarding proper installation or typical mounting installations, contact the Trelleborg sales office -marine_infra@trelleborg.com.

Make sure that all installations conform to the contract documents when available.

If the mounting hardware was not supplied by Trelleborg, refer to the project contract documents, including drawings and specifications.



4.4 Placement

For placement, the fender must be lowered into place from above using a crane or towed into place from the water. Do not drop the fender into position while lines are secured to its end fittings.

Crane or hoist: Attach the fender mounting hardware as required to each fender end fitting and attach a lifting line to each fender end shackle. Ensure that the lifting lines are near to 75 to 90 degrees of the fender ends, such that the lines do not cut or damage the fender body. Lifting lines may also be attached to nylon straps around the fender body or ends, ensuring the straps are secure and do not allow the fender to slip. Lift the fender, keeping it level, and place it at the required position in the water or at the proper dock wall elevation. Hold the fender in place and connect the remaining mounting hardware. When the fender is securely mounted, unhook and remove the lifting lines.

Always ensure the crane or hoist capacity is adequate for the weight of the fender.



Fender with chains oriented incorrectly. Note damage to the fender ends.

4.5 Inspection

- **General:** Before and after installation, inspect the fender body and external steel end fittings, external hardware connections including chain, rope, shackles, brackets, anchor bolts, and the overall site for any damage that may have occurred during transport or handling. Inspect after installation for compliance to approved design drawings and contract site plans.
- **Galvanizing:** All external mounting hardware, and the fender end fittings, have been hot dipped galvanized in accordance with the requirements of ASTM A-123. It is common for galvanized steel components to have some visible scrapes, abrasion, or pitting of the zinc coating surface. Light damage to the coating will have little effect on the life of the component and does not require immediate repair. More severe damage may be repaired using standard galvanizing repair procedures.
- **Ropes:** External mounting ropes may be galvanized steel, stainless steel, or HMPE coated fiber, Class II, with standard end splice and connecting thimbles. The end splice and thimble allows for connection to a standard BTA (bow-type) shackle. Before installation, thoroughly examine all rope components for any damage, including loose or missing parts.
- **Chain or Rope Length:** Verify that mounting chain or rope lengths are correct and will provide for proper positioning of the fender with changing water levels (tides). It is important that the chain or rope length installation considers preventing the fender from floating up and over the top of the pier, wharf or dock during high water conditions or wave action. The fender mounting chains or ropes are intended to restrain the fender enough to maintain its proper positioning for berthing operations.

Refer to Trelleborg approved general arrangement drawings or the contract site plans for proper mounting details. For any questions or to resolve nonconforming issues, consult the Trelleborg sales office for further information.
- **Skin Appearance:** Before and after installation, visually inspect the fender bodies to ensure that there was no damage during transport or handling, requiring further review. Note that after production of the fender, it is common for the fender skin at the steel end fittings to shrink and pull away slightly from the galvanized steel core. This stretching of the skin is normal and does not affect performance or the service life of the fender.



Fender testing example

■ **Factory Defects:** Note that all fenders are fully inspected for defects before leaving the factory. Any fender found to have problems with materials, parts or workmanship are rejected or repaired prior to shipping.

■ **Skin Testing:** Fenders from the production lot may have random skin thickness testing according to the project specifications or a TMI Internal Test Plan (ITP). The thickness is tested by drilling a small core hole at locations along the fender mid-body or conical ends and measuring the core samples. The holes are then patched with similar elastomeric skin material. In some cases, the patched areas may be slightly visible. However, these areas are only cosmetic and will have no effect on the fender's service life.

■ **Fender Testing:** Some fenders from the production lot may have had full-scale performance testing according to the project specifications or a TMI Internal Test Plan (ITP). These fenders may arrive on site showing typical residual effects from the testing, including some remnant compression deformation on the body and wrinkles or folds on the skin. These effects are cosmetic, do not require maintenance or repair, and are considered part of the normal fender performance and service life.



Maintenance



5.0 Maintenance and Inspection

Trelleborg marine fenders are designed to withstand the impact and wear due to normal service conditions in moderate to harsh marine environments. The fenders generally require very little maintenance. However, Trelleborg does recommend the following inspection and maintenance procedures be performed. The frequency of inspections is determined by the frequency and severity of fender use, and environmental site conditions such as adverse wind and wave action. The user of the fenders should establish the required inspection interval considering these factors. At a minimum, Trelleborg recommends a visual examination of the fenders at 3 month intervals.



Visual Inspection

- Inspect for damage to the fender skin. Cuts, gouges, or cracks should be repaired as soon as possible. Any cut that goes through the skin to reveal the foam core of the fender needs immediate repair. Standard field repair kits are available for minor damage. Contact Trelleborg for specific advice and instructions for field repairs.
- Check the mounting shackles on the fender and dock face, and the mounting chain or ropes. Ensure all required bolt pins and cotter pins in bolt-type anchor shackles are in place.
- Check all fender mounting brackets and anchors for wear.
- Check all rope end connections, splices, and thimbles for wear.
- Any hardware items that show damage or severe deterioration should be replaced. Contact Trelleborg for specific advice and replacement parts.
- Inspect for marine growth that has attached itself to the fender body. When the amount of growth becomes unsightly, or when it appears to be detrimentally affecting the flotation, stability, or rotation of the fender, it can be removed. Clean the excess marine growth from the fender body by scraping lightly, followed by a vigorous wipe with mineral spirits or number 2 fuel oil, followed by washing with a warm water solution of trisodium phosphate or other detergent, followed by a clean water rinse. Pressure washing can also be used cautiously so as not to damage the skin of the fender. Follow all state, local, and governmental environmental regulations.

DISCLAIMER

Trelleborg AB has made every effort to ensure that the technical specifications and product descriptions in this manual 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 manual supersedes the information provided in all previous editions. If in doubt, please check with Trelleborg Marine and Infrastructure.

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