



IOM
MANUAL

SHIBATA**FENDER****TEAM**

▶ | on the safe side

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Fenders are safety-critical systems which protect people, the environment, ships and structures from harm. They need to perform on demand as the designer intended for their entire service life, even in the harshest locations. To do this, fenders must be installed, used and maintained correctly.

ShibataFenderTeam is a world-class designer and manufacturer of fenders and bollards. Our systems are used in ports, harbours and terminals around the world and trusted by the largest and most respected consultants, contractors and operators.

We would like to share our experience from thousands of projects with our customers. This guide provides valuable assistance and advice on the three areas of installation, operation and maintenance. However, not all different and project-specific scenarios can be covered. Therefore, do not hesitate to contact your ShibataFenderTeam representative. Our expertise is available to you at any time, free of charge and without obligation.

This manual is intended to complement any national, international or project-related rules and regulations, which must take precedence.

We want every ShibataFenderTeam product to give trouble-free service and optimum performance for many years to come.

SHIBATAFENDERTEAM

ShibataFenderTeam is headquartered in Germany with regional hubs in the USA, Europe, Middle East, Asia and Australia. Our network of well-established local representatives spans all six continents.

Our Japanese mother company, Shibata Industrial Co. Ltd., has developed and manufactured a vast range of engineered rubber products since 1929, and has been a pioneer in fender design and manufacturing for over 50 years. ShibataFenderTeam owns and operates testing and manufacturing facilities in Japan, Malaysia and Germany, where we produce:

- ▶ Molded and Extruded Rubber Fender units up to single weights of 18.5 t
- ▶ Foam Fenders with diameters up to 4.5 m and 10 m length
- ▶ Buoys for various applications up to 4.5 m diameter
- ▶ Pneumatic Fenders with diameters up to 3.3 m and 9.0 m length
- ▶ HD-PE Sliding Fenders up to 300 mm x 300 mm cross-section and 6 m length
- ▶ Steel constructions with single unit weights up to 30 t
- ▶ Many special products for marine applications which exploit our knowledge of rubber, steel, polyurethane and polyethylene

Our in-house manufacturing facilities and high-quality products at competitive prices have earned ShibataFenderTeam a reputation as a dependable partner in the international port, harbor and waterways markets.

In addition to this outstanding expertise, our team of partners, employees, reputable and approved suppliers have decades of specialist knowledge in the design of safety critical fender systems, protecting people, ships and port infrastructure. Experience that is available to our customers free of charge and without obligation for every project.

CONTENTS

SAFETY

| | |
|----------------------------|----|
| Safety..... | 04 |
| Risk Assessment | 05 |
| Unloading and Storage..... | 06 |
| Lifting | 07 |

INSTALLATION

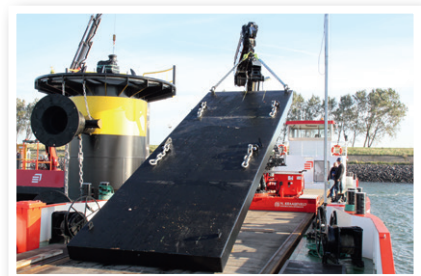
| | |
|---|----|
| Installation Equipment..... | 08 |
| Setting Out..... | 08 |
| Anchors | 09 |
| Grouts | 10 |
| Bolts | 11 |
| SPC Cone and CSS Cell Fenders | 12 |
| FE Element Fenders | 13 |
| V Fenders and Special Element Fenders | 14 |
| Cylindrical Fenders..... | 15 |
| Foam Fenders..... | 16 |
| Donut Fenders | 17 |
| Pneumatic Fenders | 18 |
| Roller and Wheel Fenders | 19 |
| Hydropneumatic Fenders | 19 |

OPERATION

| | |
|--------------------------------------|----|
| Installation Acceptance Report | 20 |
| Operational Limits | 22 |
| Operations Checklist..... | 23 |

MAINTENANCE

| | |
|--------------------------------------|----|
| Maintenance | 24 |
| Maintenance Checklist | 26 |
| Maintenance Inspection Periods | 27 |
| Incident Report Form | 28 |
| Notes | 29 |
| After Sales & Warranty | 30 |



SAFETY

During the installation, operation and maintenance of fenders there are a number of potential hazards. A Safety Management System (SMS) provides the framework for identifying these hazards, assessing the probability they could happen and the consequences or outcome for personnel, the environment, structures and ships. A SMS may also include financial exposures.

Safety management is all about understanding risks and adopting strategies for eliminating, reducing or monitoring them. Many techniques are used to mitigate risks which might otherwise result in unexpected loss or harm. A matrix is commonly used where each hazard, either alone or in possible combinations, is then categorised according to the likelihood it might occur and the outcome or severity of an event. Each hazard is given a “risk score” with suitable measures or procedures to minimise risk and maximise safety.

CONSTRUCTION SITE

Construction work in progress.
Children and animals are not permitted on this construction site.

Unauthorised entry to this site is strictly forbidden.

Safety helmets must be worn.

Protective footwear must be worn.

High visibility clothing must be worn.

Eye protection must be worn.

This is a no smoking site.

No hat? No boots? No entry!

PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) is worn to minimise exposure to serious workplace injuries and illnesses which may result from contact with physical, mechanical, chemical, electrical or other site hazards.

Everyone entering a working area should be properly equipped. A risk assessment should always be carried out to determine the hazards and most suitable PPE.

Depending on the location and type of work additional PPE should be worn such as gloves, safety glasses and shoes, earplugs or ear defenders, hard hats, respirators, coveralls, high visibility vests, safety harnesses and personal flotation devices (PFDs).



RISK ASSESSMENT

| | |
|------------------|-----------------------|
| Project Title: | Risk Assessment Ref.: |
| Task / Activity: | Project No.: |
| | Date Prepared: |

| Hazards | | Likelihood | | | | | Severity | | | | Risk Score |
|---------|--|------------|----------|------------|--------|------------|--------------|---------|----------|-------|-----------------------|
| Ref. | Key hazards associated with this activity/task | Frequent | Probable | Occasional | Remote | Improbable | Catastrophic | Serious | Critical | Minor | Likelihood x Severity |
| | Score > | 5 | 4 | 3 | 2 | 1 | 4 | 3 | 2 | 1 | |
| 1 | Dropped objects | | | X | | | | X | | | 9 |
| 2 | Falling from height | | | | X | | X | | | | 8 |
| 3 | Falling into water | | | X | | | X | | | | 12 |
| 4 | Lifting objects with a crane | | | | X | | X | | | | 8 |
| 5 | Grinding and cutting steel | | X | | | | | | | X | 4 |
| 6 | Fires caused by welding or burning | | | X | | | | | | X | 3 |
| 7 | Collisions with plant or materials | | | | X | | X | | | | 8 |
| 8 | Structural or formwork collapse | | | | | X | X | | | | 4 |
| 9 | Crane collapse or toppling | | | | X | | X | | | | 8 |
| 10 | Slipping or tripping | X | | | | | | | | X | 5 |

| | |
|-------------------|---|
| Frequent | An event likely to occur many times |
| Probable | An event expected to happen several times |
| Occasional | An event that might happen at least once |
| Remote | Unlikely to happen but could at some time |
| Improbable | An event highly unlikely to ever arise |

| | |
|---------------------|---|
| Catastrophic | Death, system loss, or irreversible environmental damage |
| Serious | Severe injury, occupational illness, major system damage, or reversible severe environmental damage |
| Critical | Injury requiring medical attention, illness, system damage, or mitigatable environmental damage |
| Minor | Possible minor injury, minor system damage, or minimal environmental damage |

| | |
|----------------|------|
| Very High Risk | > 10 |
| High Risk | 5–9 |
| Low Risk | 1–4 |

This table is available as an Excel spreadsheet template for ShibataFenderTeam customers.

During fender installation, maintenance and operation, each activity or task should be considered and individual hazards identified. Each hazard should be ranked according to its likelihood. Events may occur in isolation or combine to create another identifiable event. The judgement of likelihood could be based on experience, similar activities or other criteria. Outcomes for people, the environment and property should be considered separately and prioritized.

RISK MATRIX

A matrix is commonly used to assess risks.

| | | | | | | |
|----------|---|------------|---|----|----|----|
| Severity | 4 | 4 | 8 | 12 | 16 | 20 |
| | 3 | 3 | 6 | 9 | 12 | 15 |
| | 2 | 2 | 4 | 6 | 8 | 10 |
| | 1 | 1 | 2 | 3 | 4 | 5 |
| | | 1 | 2 | 3 | 4 | 5 |
| | | Likelihood | | | | |

UNLOADING AND STORAGE

ShibataFenderTeam packs every shipment with the greatest care. Fender components are often transported in 20' and 40' containers. Open-top and flat rack containers may be used to make unloading easier. Any container parts that could obstruct the unloading of goods should be removed or rolled back.

A level, clean and dry area of ground should be prepared in readiness to store the shipment after unloading. Locate all lifting points before beginning to move items, and remove any packing straps.

Parts up to 2.1 m across can be removed vertically from open-top containers. Parts between 2.1 m and 2.3 m in width will need to be extracted via the end opening after first removing any smaller parts in the way. Always use appropriate lifting equipment for each component, taking great care to protect any paintwork or vulnerable parts while lifting.

Smaller parts and assemblies will usually be sent in closed containers. These can be easier to unstuff at the destination port or other nearby facility. Then the goods are sent by truck to site (optionally a flatbed or open-top trailer for better access, on request).

Very large parts, above 2.3 m across, are usually shipped on open flat rack containers which simplify access for lifting.

Please inform ShibataFenderTeam immediately of any damage incurred in transit before goods are unloaded. The shipping insurer will require clear photographs and statements to determine liability and settle claims. In the rare event of serious damage to the cargo, the insurer may choose to send a surveyor to inspect and record the damage.

Minor coating damage due to transport, local handling or installation is typically the contractor's responsibility to touch up, and should be carried out after installation, unless the affected areas will be submerged or hard to access.

If you are in any doubt or have further queries, please contact your ShibataFenderTeam office.



ALWAYS

| | |
|--|---|
| Check if the delivery matches the shipping documents and diagrams. | ✓ |
| Remove and recycle packing and support materials. | ✓ |
| Store goods in a safe enclosure until they are needed. | ✓ |
| Use soft slings with lifting eyes for handling rubber and painted items. | ✓ |
| Check weights and centroids before lifting. | ✓ |
| Support goods on suitable blocking on dry, level ground. | ✓ |
| Avoid damage to paintwork. | ✓ |
| Check if threads and sockets are clean and free from contaminants. | ✓ |

NEVER

| | |
|--|---|
| Unpack before components are needed, except for visual check of quality and quantity on receipt. | ✗ |
| Risk damage by using unnecessary force. | ✗ |
| Move goods with unprotected lift forks or hooks. | ✗ |
| Drag components over the ground. | ✗ |
| Weld, grind, shot-blast or similar near the storage area or assembly site. | ✗ |

SAFE LIFTING

Lifting and manoeuvring large fenders from the shore or from floating platforms is a safety critical operation. Where there are large tides or strong currents the lift must be carefully planned and executed to be completed in a short time window.

Large lifts often require multiple cranes for stable support of large loads. In marine projects where access can be limited, many lifts require a large outreach. Suitable cranes must be selected with care to consider site access and ground conditions. Lifting capacity should be considered at pick-up, swing and set-down radius.

| Critical Lift Plan Mobile Crane | |
|---|---|
| Location: | Date of Lift: |
| Load Description: | |
| Qualified Person-In-Charge: | |
| A. LOAD | F. CRANE PLACEMENT |
| 1. Load Condition New _____ Used _____ | 1. Any deviation from Smooth Solid Foundation? |
| 2. Wt. Empty _____ lbs. | 2. High Voltage or Electrical Hazards? |
| 3. Wt. of Contents _____ lbs. | 3. Obstructions to Lift or Swing? |
| 4. Wt. of Aux. Block _____ lbs. | 4. Travel with Load Required? _____ |
| 5. Wt. of Main Block _____ lbs. | 5. Work Clearance due to Local Traffic? |
| 6. Wt. of Lifting Beam _____ lbs. | 6. Swing Direction? _____ |
| 7. Wt. of Sling/Shackles _____ lbs. | 7. Other _____ |
| 8. Wt. of Jib/Ext. (erected/stowed) _____ lbs. | G. CONSIDERATIONS |
| 9. Wt. of Hoist Rope _____ lbs. | 1. If Lift Exceeds 75% of Crane's Capacity, Attach Additional Special Instructions/Restrictions, Diagrams for Crane, Rig, Lift, etc. Yes _____ No _____ |
| 10. Wt. of Excess Load Material _____ lbs. | 2. Multiple Crane Lifts Require a Separate Plan for each crane |
| 11. Other _____ lbs. | 3. Any Changes in the Crane Configuration, Load, Placement, Rigging, Lifting Scheme or Calculations Require that a New Critical Lift Plan be Developed. |
| Total Weight of all Combined _____ lbs. | H. PRE-LIFT CHECKLIST (COMPLETE PRIOR TO LIFT) |
| Source of Load Wt. Information: (Drawgs, Calcs, etc.) _____ | 1. Crane Inspected _____ 10. Rigger Qualifications _____ |
| Load Weight Confirmed by: _____ | 2. Rigging Inspected _____ 11. Signal System _____ |
| B. CRANE | 3. Crane Set-up _____ 12. Tag Lines _____ |
| 1. Type of Crane _____ | 4. Boom Swept Area _____ 13. Wind/Temperature _____ |
| 2. Maximum Crane Capacity _____ ft. | 5. Hoist Height _____ 14. Safety Spotter _____ |
| 3. Radius at Pick-up _____ ft. | 6. Head Room _____ 15. Traffic _____ |
| 4. Radius at Set-down _____ ft. | 7. Crane Counterweight _____ 16. Tailboard _____ |
| 5. Crane Capacity at Pick-up Radius _____ lbs. | 8. Load Test _____ 17. Site Control _____ |
| 6. Crane Capacity at Swing Radius _____ lbs. | 9. Operator Qualifications _____ 18. Signatures _____ |
| 7. Crane Capacity at Set-down Radius _____ lbs. | I. SIGNATURES / COMMENTS |
| 8. Boom Angle at Pick-up Point _____ deg. | Comments: _____ |
| 9. Boom Angle at Set-down Point _____ deg. | |
| 10. Gross Capacity of Crane at Longest Radius & Lowest Boom Angle for this Lift: _____ lbs. | |
| 11. Gross Load of Crane is _____ lbs. | |
| 12. Lift is _____ % of the Crane's Rated Capacity | |
| C. JIB / EXTENSION | |
| 1. Erected _____ Stowed _____ | |
| 2. Jib/Ext. to be Used: Length _____ | |
| 3. Rated Capacity of Jib/Ext. from _____ | |
| D. HOIST ROPE: Main _____ Aux 1 _____ | |
| 1. Rope Diameter _____ Number of _____ | |
| 2. Lift Capacity based on Parts _____ | |
| E. RIGGING | |
| 1. Hitch Type(s) _____ Size _____ | |
| 2. No. of Slings _____ FW _____ RS _____ | |
| 3. Sling Type WR _____ FW _____ RS _____ | |
| 4. Sling Assembly Rated Capacity _____ | |
| 5. Shackle Size(s) _____ | |
| 6. Shackle Rated Capacity(s) _____ | |
| 7. Shackle Secured to Load by _____ | |
| 8. Shackle to Lifting Lug Mating OK _____ | |

CRITICAL LIFT PLAN

A lift plan should be prepared for every case, taking account of the worst combinations of lifting requirements and potential hazards. The assembled weight of the complete fender system should be checked on-site before the final lift is attempted.

PRE-LIFT CHECKLIST*

| | |
|--|---|
| Is the crane configured according to the lift plan? | ✓ |
| Has the crane been inspected and is its condition acceptable? | ✓ |
| Has the rigging equipment been inspected, secured, and is it in acceptable condition? | ✓ |
| Is the supporting surface stable? | ✓ |
| Are proper crane mats placed under outrigger floats and at a 90-degree angle to the outrigger cylinders? Are crawler cranes on proper crane mats? | ✓ |
| Are outriggers (if applicable) fully extended with tires off the ground? | ✓ |
| Is the crane within 1° of level? Has the levelness of the crane been checked with a 1 m or longer carpenter's level or other acceptable method? The 'target' level in the crane cab can be used for initial leveling but should not be considered reliable for critical lifts. | ✓ |
| Is the exact fender weight known? | ✓ |
| Is the location of the center of gravity of the load known and the crane hook positioned directly above it? | ✓ |
| Was the load radius measured exactly? For heavy lifts, has the potential increasing load radius due to deflections in the boom, tire, and/or carrier been considered? | ✓ |
| Was the boom length determined exactly? | ✓ |
| Was the boom angle determined exactly? | ✓ |
| Are wind conditions acceptable? Typically if wind speeds exceed 40 km/h (25 mph), the lift should not be attempted. Ideally wind speeds should not exceed 20 km/h (12 mph). | ✓ |
| Is the rope reeving balanced to prevent boom twist? | ✓ |
| Is the rigging capacity acceptable? | ✓ |
| Is the weight of the rigging known? | ✓ |
| Has the clearance between the boom and the load been considered and is it sufficient? | ✓ |
| Has the clearance between the boom tip and block been considered and is it sufficient? | ✓ |
| Is the crane operator experienced and qualified? | ✓ |
| Has a qualified crane signal-person been assigned and a method of communication between the crane operator and signal-person established? | ✓ |
| Is someone assigned to control the load with the use of a tag line? | ✓ |
| Is the area clear of obstacles (including power lines, pipelines, and unnecessary personnel)? | ✓ |
| Has there been a pre-lift meeting between the crane operator, signal-person, supervisor, and other relevant people? | ✓ |

* This sample checklist is provided for guidance only. A project-specific checklist should always be prepared by the contractor responsible for fitting the fenders.

INSTALLATION EQUIPMENT

Always use the correct equipment for fender preparation and installation. This is important for safe working and avoids unnecessary damage to the fender.



ALWAYS

| | |
|---|---|
| Use undamaged and certified lifting equipment. | ✓ |
| Use soft slings with lifting eyes for handling rubber and painted items. | ✓ |
| Check weights and centroids before lifting. | ✓ |
| Use suitable shackles when lifting from padeyes. | ✓ |
| Use spreader beams to avoid excessive angles on slings or chains. | ✓ |
| Ensure that components are stable and cannot fall before removing slings. | ✓ |
| Check that ground conditions are firm enough for crane operations. | ✓ |

NEVER

| | |
|--|---|
| Use makeshift tools that were not designed for the job. | ✗ |
| Use unnecessary force which may cause damage. | ✗ |
| Move goods with lift forks or hooks. | ✗ |
| Drag components over the ground. | ✗ |
| Weld, grind, shot-blast or similar near the storage area or assembly site. | ✗ |

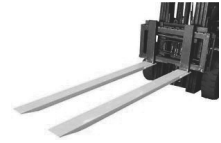
Lifting Chains or Slings

Ensure the correct number, length and capacity of lifting chains or slings are available for each lift.



Fork Protectors

Avoid damage to rubber fenders and paintwork with fork protectors.



Sockets and spanners

Always use the correct size, purpose-made spanners and sockets. Flogging spanners can help when tightening large fixings.



Prybars

Use prybars with care to align fixing holes, or align parts using a centre-pin or dowel.



SETTING OUT

New concrete structures use cast-in anchors to securely mount the rubber fender unit, chain brackets and other assemblies. Existing structures use retrofit anchors bonded into post-drilled holes.

For all structures, it is essential to position the anchors correctly to match the hole locations on the fender assembly. It is also necessary to avoid interferences with obstacles such as reinforcement bars.

Any electrical contact between anchors and reinforcement bars will form a galvanic cell when water is present and this can promote corrosion.

Cast-in anchors should be electrically isolated from other permanently embedded steel in the structure. Retrofit anchors are usually insulated by the resin grout annulus.

TEMPLATES

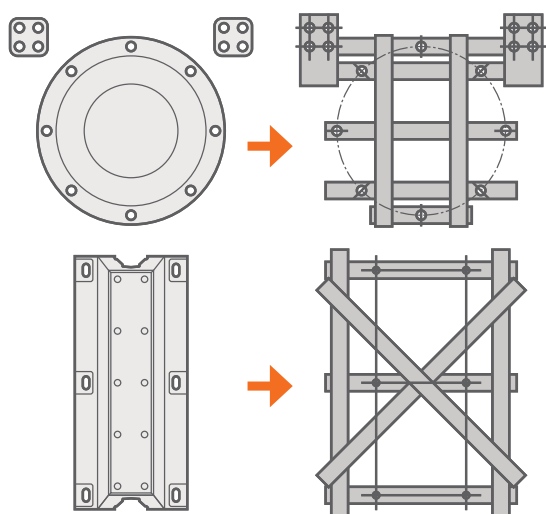
A template should be used to correctly locate anchor bolt positions in the structure. ShibataFenderTeam can also provide templates printed on plastic coated fabrics. These are dimensionally stable and can also be rolled or folded. They are light enough to send by mail or courier.



Templates are not intended to support the weight of anchors. Always refer to the general arrangement drawing when preparing a template (see GA drawing). Templates may be made on site from plywood, sheet metal or flat iron (see following example).

FENDER SYSTEM

BOLTING TEMPLATE



CHECKLIST

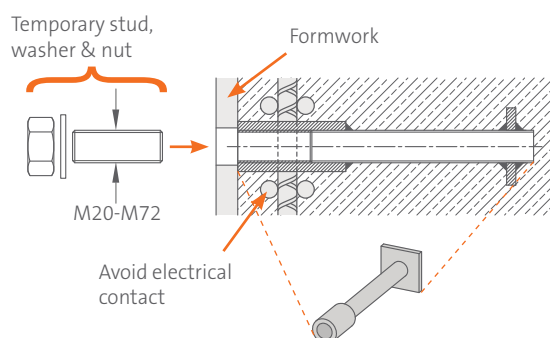
| | |
|---|---|
| "Measure twice, drill once". | ✓ |
| Clean threads and sockets thoroughly. | ✓ |
| Avoid electrical contact between anchors and concrete reinforcements. | ✓ |
| Ensure anchors are straight and level. | ✓ |
| Check hole diameters and depths for retrofit anchors to avoid insufficient or excess grout. | ✓ |

TEMPLATE HOLE SIZES

The correct hole size should be used in templates. It is common to drill a smaller hole as a 'pilot' to identify the position of the anchor and guide the drill for the full-size hole. After the template is removed, the correct diameter hole can be drilled.

CAST-IN ANCHORS

Most new concrete structures use cast-in anchors. These should be placed in the correct location and secured to prevent movement during concrete pours. A temporary bolt or stud (slave bolt) is preferred for holding the cast-in anchor into formwork and avoids the permanent assembly bolt from being lost or damaged.



NAIL PLATES

Nail plates are a simple and effective way to position cast-in anchors. The permanent bolt may need to be longer to allow for the recess caused by the nail plate's thickness.



Longer screws may be required. The load capacity of the nail plates is limited, without additional support they are only suitable for anchors up to M30. Any direct contact with the concrete reinforcement must be avoided.

RETROFIT ANCHORS

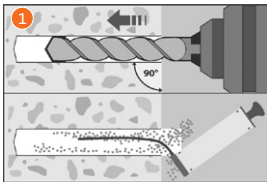
Existing structures may require retrofit anchors. These are threaded studs which are bonded into drilled holes using high-strength resin grout.

Always refer to the ShibataFenderTeam drawings to confirm details of hole depth and diameter, and for the grout volume required per hole.

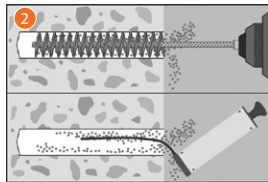
CARTRIDGE GROUT SYSTEMS

Cartridge grout systems are available in standard and express (fast cure) grades, in different cartridge sizes and in coaxial or standard tubes.

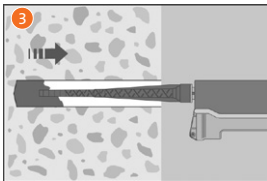
Manual, pneumatic, electric and battery-powered cartridge guns are available depending on the size of the job and grout volume per hole.



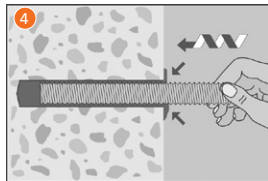
Drill a perpendicular hole of the correct diameter and depth. Blow out debris.



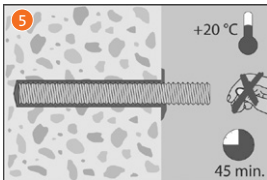
Clean the hole with a nylon brush and blow out any remaining debris.



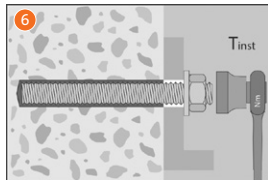
Inject the correct volume of grout. Refer to manufacturer instructions on temperatures.



Push and rotate the anchor stud into the hole. Clean any grout leakage immediately.



Allow the grout to cure. Refer to table for cure times at different temperatures.



Fenders or brackets should only be connected after the grout is properly cured.

Grouts will not cure if the temperature is too low, or they will cure too fast at high temperatures. The temperature of the concrete is also critical.

When damp conditions are expected, please inform ShibataFenderTeam so that the correct grout can be supplied. Not all grouts are suitable for installation in wet or damp locations.

TYPICAL CURING TIME (Standard Grade)

| Temperature of concrete | Processing time | Dry concrete | Wet concrete |
|-------------------------|-----------------|--------------|--------------|
| +5 °C to +10 °C | 2 h | 40 h | 80 h |
| +11 °C to +20 °C | 30 min | 18 h | 36 h |
| +21 °C to +30 °C | 14 min | 10 h | 20 h |
| +31 °C to +40 °C | 7 min | 5 h | 10 h |

TYPICAL CURING TIME (Express Grade)

| Temperature of concrete | Processing time | Dry concrete | Wet concrete |
|-------------------------|-----------------|--------------|--------------|
| +5 °C to +10 °C | 6 min | 30 min | 1 h |
| +11 °C to +20 °C | 3 min | 20 min | 40 min |
| +21 °C to +30 °C | 1 min | 5 min | 10 min |
| +31 °C to +40 °C | 1 min | 3 min | 6 min |

If it is necessary to process the grout at temperatures below +5 °C, please contact a qualified grout manufacturer or ShibataFenderTeam.

CAPSULE GROUT SYSTEMS (M30 max.)

Glass grout capsules are also available. There is minimal waste but the capsules are easily broken if mishandled. They are best suited to smaller anchors, recommended up to M30 size only.



ALWAYS

| | |
|--|---|
| Check and confirm the required grout volume for each anchor hole. | ✓ |
| Verify that the drilled hole depth and diameter is within tolerance. | ✓ |
| Check the inside temperature of the concrete and consider cure times. | ✓ |
| Support anchors centrally in the hole and prevent grout leakage with a seal. | ✓ |

NEVER

| | |
|--|---|
| Use broken or damaged glass grout capsules. | ✗ |
| Use cartridges after grout has begun to cure. | ✗ |
| Install anchors when temperatures are too low for the grout to cure. | ✗ |

BOLT TIGHTENING

The following procedure is generic for tightening fender fixing bolts. Too loose and they will undo, too tight and they may fail. There is, however, no absolute bolt torque for every case. Which components shall be bolted together, which material are these made of, are threads dry or lubricated, is cold welding likely to happen, are the surfaces even and flush? All these are factors with major implications on the torque to be selected.

THREAD LOCKING

Chemical thread locking is recommended for all bolted connections to stop fixings from loosening in service. It is best applied to threads already during assembly. The thread locker (medium grade) shall be applied according to manufacturer's instructions and cures from exposure to oxygen. Connections can be untightened by applying reasonable force. ShibataFenderTeam recommends Weiconlock® products. Other possible locking methods include tab washers, locking pins and tack-welding. For further advice please contact ShibataFenderTeam.

BOLTED CONNECTION ON RUBBER FENDERS

There is no given torque for the various types of connections to rubber fenders. Embedded sockets/inserts must be degreased and cleaned thoroughly. Connection should be snug tight until rubber fender and counterpart are flush. Then use a flogging hammer to apply ¼ turn to the bolt head. When fender flanges (e.g. CSS Fenders) are being fixed, a special washer is used to spread the clamping forces in the rubber. The bolt should be tightened until the washer embeds 2–3 mm into the rubber.

RIGID CONNECTIONS

Industry common practice is to use no preload i.e. tighten snug tight only in connections between rigid materials, such as chain brackets to concrete. In case a preload is desired, the table below can be used as guidance but without liability. Always apply preload with care and note that lubrication will result in higher preload. Be aware: material grades other than indicated require different torques. Gaps and voids between bolted components should be filled with suitable filling material such as Weicon HB 300 to allow proper load transfer and avoid corrosion.

| Material grade | Lubrication | Preload | Friction | | Torque (Newton meters or Nm) | | | | | | | |
|----------------|------------------|--------------------|----------|------|------------------------------|-----|-----|-----|-------|-------|-------|-------|
| | | | Bolt | Head | M16 | M20 | M24 | M30 | M36 | M42 | M48 | M56 |
| Grade 8.8 | Dry | 0.3*f _u | 0.18 | 0.18 | 78 | 152 | 263 | 523 | 915 | 1.464 | 2.199 | 3.536 |
| | Oiled/Greased | | 0.17 | 0.17 | 74 | 144 | 249 | 494 | 864 | 1.383 | 2.077 | 3.339 |
| | MoS ₂ | | 0.12 | 0.12 | 52 | 102 | 175 | 349 | 610 | 976 | 1.466 | 2.357 |
| A4-50 (316A) | Dry | 0.3*f _u | 0.50 | 0.5 | 135 | 264 | 457 | 908 | 1.588 | 2.542 | 3.818 | 6.139 |
| | MoS ₂ | | 0.45 | 0.35 | 122 | 238 | 411 | 817 | 1.429 | 2.288 | 3.437 | 5.525 |
| | A-Galling-Paste | | 0.23 | 0.12 | 62 | 122 | 210 | 418 | 730 | 1.169 | 1.756 | 2.824 |

Best practice for additional corrosion protection: It is recommended to apply a layer of epoxy coat on the chains and especially all threaded items after installation and tightening – as the load conditions allow.

THREAD LUBRICATION (GALVANIZED FIXINGS)

Galvanized bolts should be lubricated with a Molybdenum Disulphide (MoS₂) paste. Oiling or greasing is also possible but degrades in marine environment and may make future dismantling difficult.

THREAD LUBRICATION (STAINLESS STEEL FIXINGS)

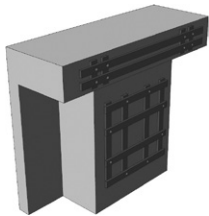
Without lubrication, stainless steel bolts badly suffer galling or 'cold welding' and can no longer be tightened or dismantled. The use of anti-galling paste is therefore compulsory. Other greases, even if copper based, are unsuitable.



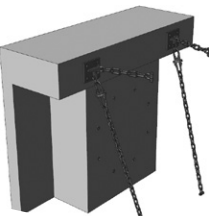
Note: Anti-galling paste and thread locking adhesives are not compatible. Experience has shown that Weiconlock AN 302-45 plus activator is an effective solution. Combining thread lubrication during bolt tightening mitigates galling and effective thread locking once cured.

SPC CONE AND CSS CELL FENDERS

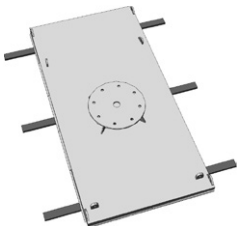
The following procedure is generic for the assembly and installation of SPC Cone and CSS Cell Fender systems. Depending on the actual fender design, adoptions may be necessary. ShibataFenderTeam is available to assist with defining an individual and safe work sequence to ensure a successful job. Prepare an even and large enough working area to preassemble fenders, well away from any cutting, grinding or shot blasting.



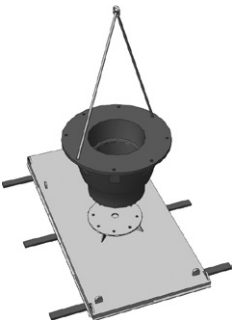
- ▶ Check the template against the fender bolt pattern, brackets and other bolted parts, alternatively accurately locate the anchors on the structure according to the GA drawing design.
- ▶ Template drawings or ready-to-use templates are available from ShibataFenderTeam.



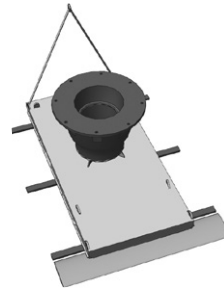
- ▶ Prior to placing the main fender system, it is suggested to install ancillary items like brackets. Chains may be connected to the panel or structure first.
- ▶ Before installing the fender all sockets need to be cleaned out and all threads need to be checked for compatibility. Ensure all needed fixings are available.



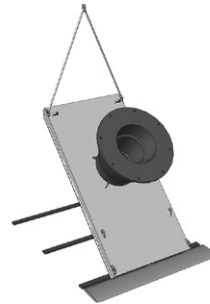
- ▶ Place the fender panel face down, supporting it on suitable blockings to protect PE pads and paintwork.



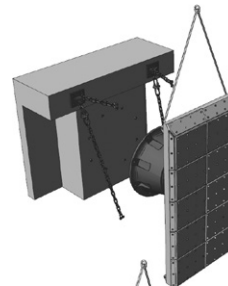
- ▶ Use only soft slings or eyebolts to lift SPC and CSS fenders into position. Take care not to damage the rubber.
- ▶ Fit all bolts and washers through the fender panel flange.*
- ▶ CSS Fenders only: Tighten bolts diametrically until the washer embeds 2–3 mm into the rubber.*



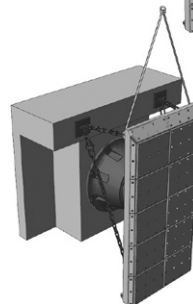
- ▶ Fit suitable lifting equipment to the lifting points on the panel. Component weights are indicated on the drawings or are available from ShibataFenderTeam.
- ▶ Properly protect the edge of the fender panel to avoid damages to the UHMW-PE and coating while lifting the panel.



- ▶ Ensure the lifting area is clear and that it is safe to slowly start the lift and rotate the panel across the lower edge until it is vertical.
- ▶ Long panels may require a double lift using a second crane.



- ▶ Make certain that all fixing points are accessible, particularly where there are large tides or waves.
- ▶ Use tag lines helping to guide the fender into position. Avoid damage to rubber and coating.



- ▶ Align the bolt holes between fender and structure so bolts (with washers) can easily be placed and loosely assembled. Afterwards tighten fixings equally, working diametrically until the washer embeds 2–3 mm into the rubber.*
- ▶ When using an adhesive thread locker, each bolt first needs to be removed again and the thread locker need to be applied acc. to the manufacturer's instructions.
- ▶ It is mandatory that the crane supports the fender systems weight until all chains are connected and tensioners are properly adjusted.

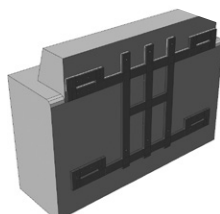
ALWAYS

| | | | |
|---|---|---|---|
| Check anchor positions before fitting fenders. | ✓ | Use the correct fixings and washers. | ✓ |
| Provide a safe working area for assembly using only safe lifting equipment. | ✓ | Protect paintwork and UHMW-PE from damage during lifts. | ✓ |
| Clean sockets and test bolts for fit. | ✓ | Loosely assemble all bolts before finally tightening diametrically. | ✓ |

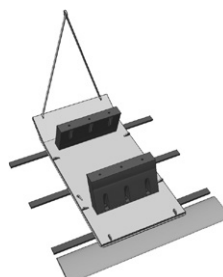
* Please pay attention to details on page 11 with regards to torque and thread locking.

FE ELEMENT FENDERS

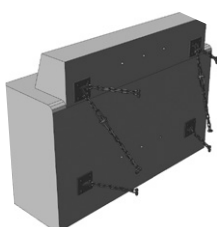
The following procedure is generic for the assembly and installation of FE Element Fender systems. Depending on the actual fender design, adoptions may be necessary. ShibataFenderTeam is available to assist with defining an individual and safe work sequence to ensure a successful job. Prepare an even and large enough working area to preassemble fenders, well away from any cutting, grinding or shot blasting.



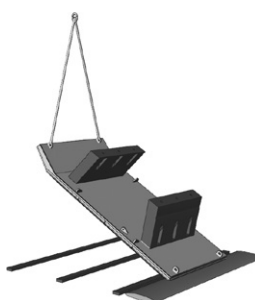
- ▶ Check the template against the fender bolt pattern, brackets and other bolted parts, alternatively accurately locate the anchors on the structure according to the GA drawing design.
- ▶ Template drawings or ready-to-use templates are available from ShibataFenderTeam.



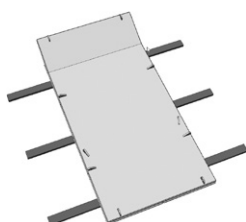
- ▶ Fit suitable lifting equipment to the lifting points on the panel. Component weights are indicated on the drawings or are available from ShibataFenderTeam.
- ▶ Properly protect the edge of the fender panel to avoid damages to the UHMW-PE and coating while lifting the panel.



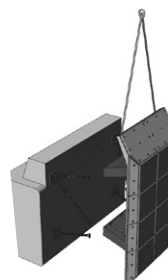
- ▶ Prior to placing the main fender system, it is suggested to install ancillary items like brackets. Chains may be connected to the panel or structure first.
- ▶ Before installing the fender, all sockets need to be cleaned out and all threads need to be checked for compatibility. Ensure all needed fixings are available.



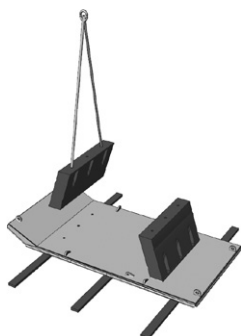
- ▶ Ensure the lifting area is clear and that it is safe to slowly start the lift and rotate the panel across the lower edge until it is vertical.
- ▶ Long panels may require a double lift using a second crane.



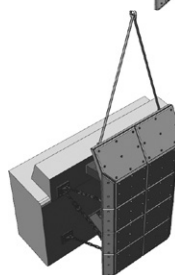
- ▶ Place the fender panel face down, supporting it on suitable blockings to protect PE pads and paintwork.



- ▶ Make certain that all fixing points are accessible, particularly where there are large tides or waves.
- ▶ Use tag lines helping to guide the fender into position. Avoid damage to rubber and coating.



- ▶ Use only soft slings or eyebolts to lift FE elements into position and secure against tipping. Take care not to damage the rubber.
- ▶ Fit all bolts and washers through the fender flange and tighten bolts until the washer embeds 2–3 mm into the rubber.*



- ▶ Align the bolt holes between fender and structure so bolts (with washers) can easily be placed and loosely assembled. Afterwards tighten fixings equally until the washer embeds 2–3 mm into the rubber.*

- ▶ When using an adhesive thread locker, each bolt first needs to be removed again and the thread locker need to be applied acc. to the manufacturer's instructions.
- ▶ It is mandatory that the crane supports the fender systems weight until all chains are connected and tensioners are properly adjusted.

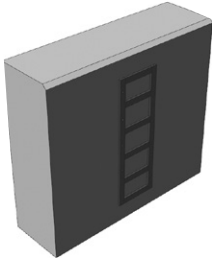
ALWAYS

| | | | |
|---|---|---|---|
| Check anchor positions before fitting fenders. | ✓ | Use the correct fixings and washers. | ✓ |
| Provide a safe working area for assembly using only safe lifting equipment. | ✓ | Protect paintwork and UHMW-PE from damage during lifts. | ✓ |
| Clean sockets and test bolts for fit. | ✓ | Loosely assemble all bolts before final tightening. | ✓ |

* Please pay attention to details on page 11 with regards to torque and thread locking.

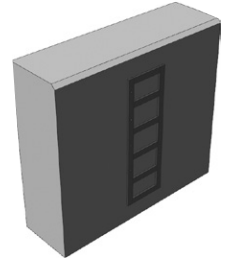
V FENDERS AND SPECIAL ELEMENT FENDERS

The following procedure is generic for the assembly and installation of V Fenders (SX, SX-P and SH) as well as Special Element Fenders (FE-S). Depending on the actual fender design, adaptations may be necessary. ShibataFenderTeam is available to assist with defining an individual and safe work sequence to ensure a successful job. Prepare an even and large enough working area to preassemble fenders, well away from any cutting, grinding or shot blasting.



FOR V FENDERS AND FE-S FENDERS

- ▶ Check the template against the fender bolt pattern, alternatively accurately locate the anchors on the structure according to the GA drawing design.
- ▶ Before installing the fender all sockets need to be cleaned out and all threads need to be checked for compatibility. Ensure all needed fixings are available.
- ▶ Make sure that all fixing points are accessible, particularly where there are large tides or waves.



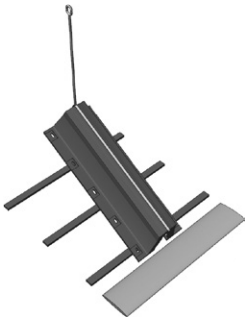
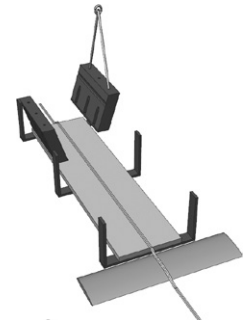
V FENDERS ONLY

- ▶ Place V Fenders on their flanges and on suitable blockings.



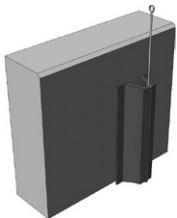
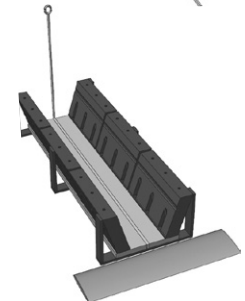
FE-S FENDERS ONLY

- ▶ FE-S Fenders are best assembled in a wooden cradle to keep elements in position and avoid tipping.
- ▶ Place the PE shield centrally inside the cradle, front face down. Make sure all bolt positions are accessible and there is sufficient space underneath the PE shield to pass through the bolts.
- ▶ Position the fender legs one by one on the rear face of the PE shield, pass bolts and washers through the PE shield and install the nuts and washers on the element inside.

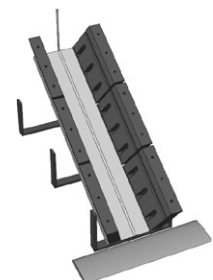


FOR V FENDERS AND FE-S FENDERS

- ▶ Pass a soft sling around the front and inside face of the fender shield, keep fender flanges free for mounting.
- ▶ The assembly weights are indicated on the GA drawing, in case of doubt consult ShibataFenderTeam. Raise the assembled fender carefully from the cradle using the sling until it levitates vertically. Place protective materials under the end of the FE-S Fender where it rotates. Take care not to damage the rubber or PE shield.



- ▶ Align the bolt holes and loosely assemble the bolts (or nuts) using the special washers provided. Afterwards tighten fixings equally until the washer embeds 2–3 mm into the rubber.*
- ▶ When using an adhesive thread locker, each bolt first needs to be removed again and the thread locker need to be applied acc. to the manufacturer's instructions.



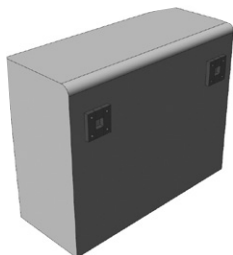
ALWAYS

| | | | |
|---|---|---|---|
| Check anchor positions before fitting fenders. | ✓ | Use the correct fixings and washers. | ✓ |
| Provide a safe working area for assembly using only safe lifting equipment. | ✓ | Protect paintwork and UHMW-PE from damage during lifts. | ✓ |
| Clean sockets and test bolts for fit. | ✓ | Loosely assemble all bolts before final tightening. | ✓ |

* Please pay attention to details on page 11 with regards to torque and thread locking.

CYLINDRICAL FENDERS

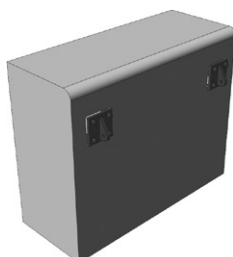
The following procedure is generic for the assembly and installation of Cylindrical Fenders. Depending on the actual fender design, adoptions may be necessary. ShibataFenderTeam is available to assist with defining an individual and safe work sequence to ensure a successful job. Prepare an even and large enough working area to preassemble fenders, well away from any cutting, grinding or shot blasting.



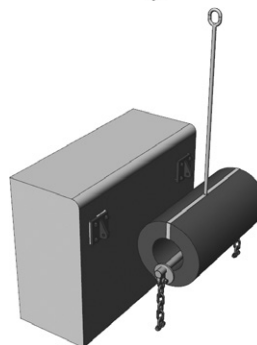
- ▶ Once unloaded and placed on an even and large enough working area, secure fenders with chocks to prevent rolling.
- ▶ Check the template against the fender bolt pattern of the fender suspension, alternatively accurately locate the anchors on the structure according to the GA drawing design.
- ▶ Template drawings or ready-to-use templates are available from ShibataFenderTeam.



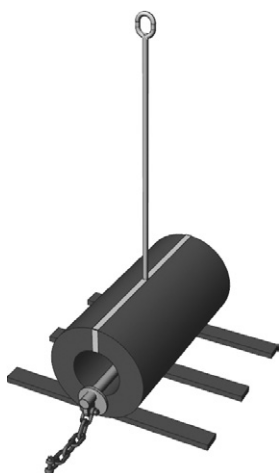
- ▶ The assembly weights are indicated on the GA drawing, in case of doubt consult ShibataFenderTeam.
- ▶ Slowly lift the fender assembly and move it to the dedicated position.



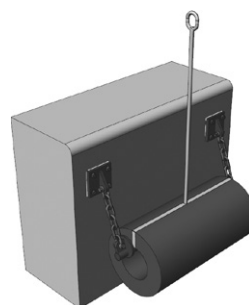
- ▶ Before installing the fender all sockets need to be cleaned out and all threads need to be checked for compatibility. Ensure all needed fixings are available.
- ▶ Install brackets to the substructure first.



- ▶ Connect the suspension chain to the support brackets using the shackles, not forgetting to insert the split pins.



- ▶ Pass the support chain, bar or bracket through the fender bore and install suspension chains at both ends. Lift the Cylindrical Fender assembly by passing a wide sling through the fender bore. Very long fenders may require a spreader beam. Take care not to damage the rubber.



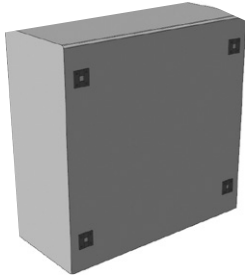
- ▶ Slowly lower the Cylindrical Fender until its chains are tight and the fender is aligned with the back structure. Check that the chain angle is equal on both sides of the fender.

ALWAYS

| | | | |
|---|---|---|---|
| Check anchor positions before fitting fenders. | ✓ | Use correct fixings only. | ✓ |
| Provide a safe working area for assembly using only safe lifting equipment. | ✓ | Protect rubber and paintwork from damages. | ✓ |
| Clean sockets and test bolts for fit. | ✓ | Loosely assemble all bolts before final tightening. | ✓ |

FOAM FENDERS

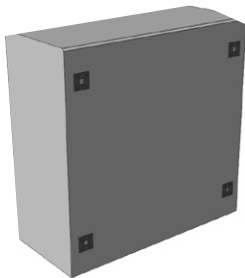
The following procedure is generic for the assembly and installation of Ocean Guard Fenders and Ocean Cushion Fender systems. Depending on the actual fender design, adoptions may be necessary. ShibataFenderTeam is available to assist with defining an individual and safe work sequence to ensure a successful job. Prepare an even and large enough working area to preassemble fenders, well away from any cutting, grinding or shot blasting.



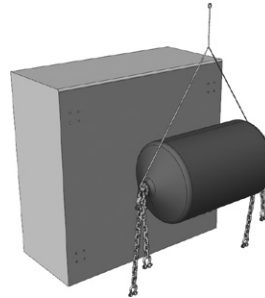
- ▶ Once unloaded and placed on an even and large enough working area, secure fenders with chocks to prevent rolling.
- ▶ Check the template against the fender bolt pattern of the fender suspension, alternatively accurately locate the anchors on the structure according to the GA drawing design.
- ▶ Template drawings or ready-to-use templates are available from ShibataFenderTeam.



- ▶ The assembly weights are indicated on the GA drawing, in case of doubt consult ShibataFenderTeam.
- ▶ Slowly lift the fender assembly using soft slings and move it to the dedicated position. Take care not to damage the fender skin. Very long fenders may require a spreader beam.



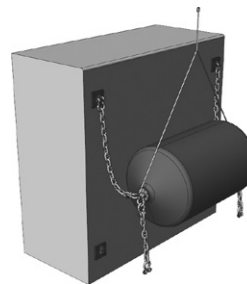
- ▶ Before installing the fender all sockets need to be cleaned out and all threads need to be checked for compatibility. Ensure all needed fixings are available.
- ▶ Install brackets to the substructure first.



- ▶ Connect the upper suspension chain to the support brackets using the shackles, not forgetting to insert the split pins. Very long or large chains may require extra crantage to support the weight assist connection.



- ▶ Install suspension chains at both end fittings of the fender. In case of more than one chain per fender end we recommend marking the chains and their later position in order to avoid a mix-up during installation.
- ▶ Constant movements of the fender due to wind and wave action cause vibrations. Shackle bolts, split pins, screw or bolted connections may come loose up to the point of total failure. The only remedy is to use suitable bolt locks such as locking nuts, tack welds or Weiconlock (see page 11), as well as to perform regular checks.



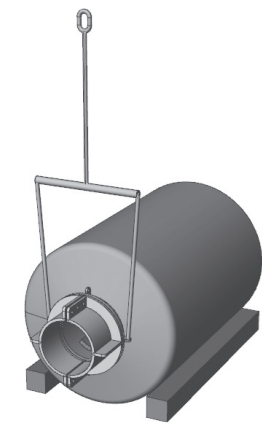
- ▶ Slowly lower the fender until the upper support chains are tight and the fender has aligned with the back structure. Now install any further chains. Check that the chain angle is equal on both sides of the fender.

ALWAYS

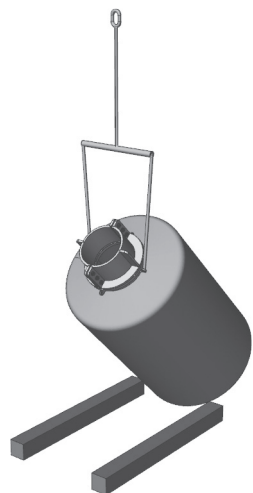
| | |
|--|---|
| Secure Ocean Guard Fenders with chocks to prevent rolling. | ✓ |
| Provide a flat, even and smooth back structure for the fender over the entire designated contact area to avoid excessive skin abrasion. If required, mount UHMW-PE sliding strips. | ✓ |
| Consider adding ballast (chains, weights, etc.) on exposed floating installations to dampen fender motion from waves. | ✓ |
| Consider asymmetric chain lengths to maintain fender position if long mooring chains are used. | ✓ |
| Secure all fixings against excessive wear and loss due to wave movements. | ✓ |

DONUT FENDERS

The following procedure is generic for the assembly and installation of Donut Fenders. Depending on the actual fender design, adoptions may be necessary. ShibataFenderTeam is available to assist with defining an individual and safe work sequence to ensure a successful job. Prepare an even and large enough working area to preassemble fenders, well away from any cutting, grinding or shot blasting.



- ▶ Place unloaded fenders on an even and large enough storage space and use chocks to prevent rolling.



- ▶ Use a suitable spreader bar or long leg sling to lift the fender (sling length larger than pile length above water level).
- ▶ Fender weights are indicated on the drawings or are available from ShibataFenderTeam.
- ▶ Lift the Donut Fender using the sling, taking care not to damage paintwork or the skin. Ensure that the Donut Fender is hanging vertically before lowering onto the pile.
- ▶ Use a tag line to guide the Donut tube over the pile and lower it slowly.



- ▶ Once the Donut Fender slides over the pile, ensure that the PE bearings inside the Donut tube do not snag on the end of the pile.
- ▶ Continue lowering until the Donut Fender floats and the sling can be safely removed.
- ▶ Once lifting equipment is detached, check that the Donut Fender is free to rotate, rise and fall with the tide.

SPIRALLY WELDED PILES

When Donut Fenders are mounted onto spirally welded piles, the external weld should be ground flat in the area contacted by the Donut bearings from the lowest to highest tide levels. Protruding welds may increase wear on the bearings and, in some cases, can cause the Donut Fender to seize on the pile.



After installation, check the Donut Fender is free to rotate, rise and fall with the tide.

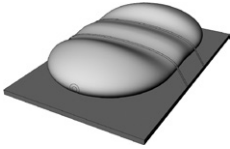
ALWAYS

| | |
|---|---|
| Chock the Donut Fender when stored. | ✓ |
| Grind welds flush on the piling exterior. | ✓ |
| Guide the fender bearings over the piles to avoid snagging. | ✓ |

PNEUMATIC FENDERS

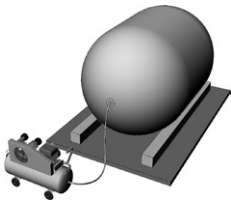
The initial inflation process is simple and comparable with inflating a car tire. However, the following rules must be observed:

UNPACK



- ▶ Prepare an even and large enough working area to unpack fenders that is wind protected and well away from any cutting, grinding or shot blasting.
- ▶ Release the straps which hold the fender onto the pallet or skid and unroll the fender so it is free to inflate. Keep fender away from sharp objects to avoid damage.
- ▶ Keep chocks available to stop the fender from rolling as it inflates.

INFLATION

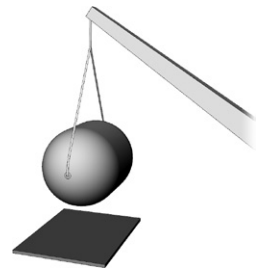


- ▶ The initial inflation pressure (0.5 or 0.8 kg/cm²) is printed on the outside of the fender body.
- ▶ Use a calibrated pressure gauge and ensure the compressor has a dryer – don't fill the fender with moist air. Depending on the fender size there are two different valve options, see below.
- ▶ Connect the air hose (5) with the fender valve (1 or 7) and depending on the valve option connect a second pressure gauge (3) with the pressure control valve (6). Attention: air leaks result in pressure misreading.
- ▶ Start the inflation process and continuously monitor the internal pressure until the initial pressure of 0.5 resp. 0.8 kg/cm² plus 0.01 kg/cm² is reached.
- ▶ Stop air flow and wait for around 15 minutes. It is not unusual that the pressure slightly drops as the fender unfolds. Fill up air until initial pressure of 0.51 resp. 0.81 kg/cm² is reached again.
- ▶ Release the hose coupling from the valve and install the valve cap.

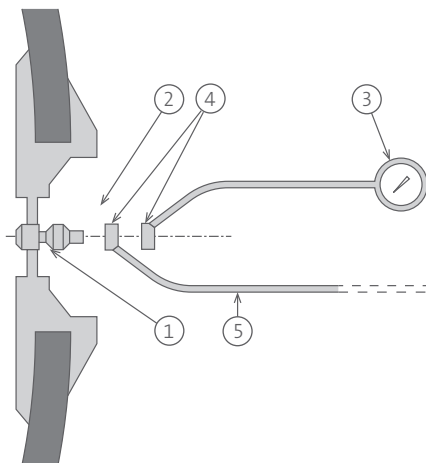


INSTALLATION

- ▶ Use fork protectors when moving the fender with a forklift.
- ▶ To lift the fender, connect the chains only to the fender end fittings or chain & tire net.
- ▶ Strictly avoid contact with sharp objects.

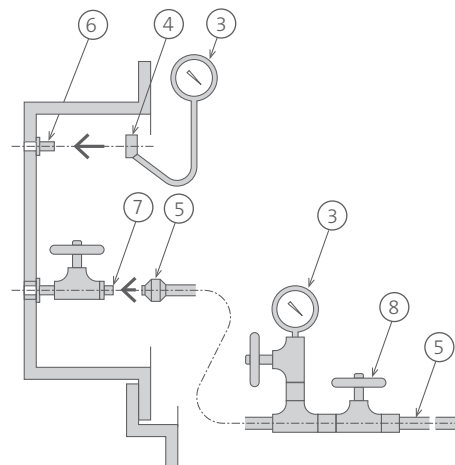


SMALL AND MEDIUM FENDER SIZES ($\leq \varnothing 2.5$ M)



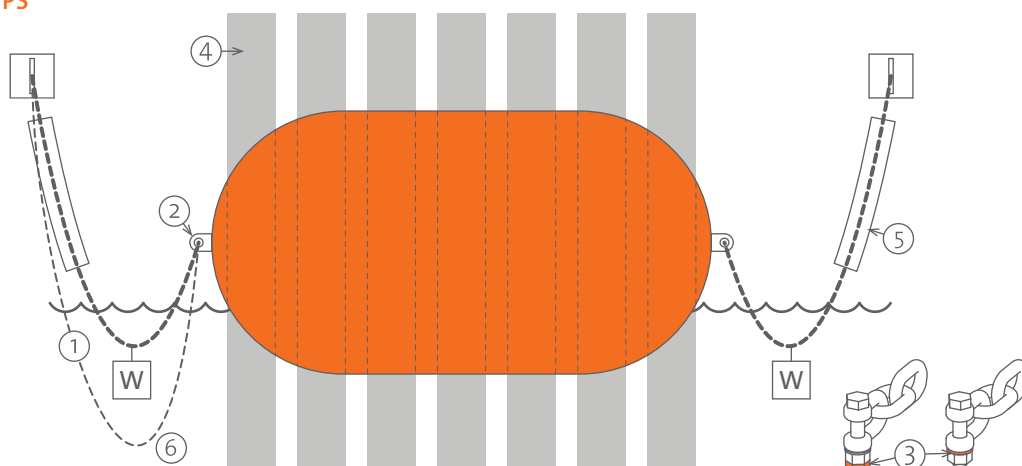
- | | |
|--------------------------|---------------------------|
| 1. Small inflation valve | 5. Air hose to compressor |
| 2. Valve cap | 6. Pressure check valve |
| 3. Pressure gauge | 7. Large inflation valve |
| 4. Small hose connector | 8. Air control valve |

LARGE FENDER SIZES ($> \varnothing 2.5$ M)



Fenders with a diameter larger than 2.5 m are generally equipped with a safety valve. Overinflating Pneumatic Fenders is very dangerous. Use precise or calibrated gauges only. Pressure gauges used to inflate car tires are not suitable. Make sure reading units and conversion factors are correct. Continuously check pressure during the inflation process.

FENDER MOORING TIPS



1. Pneumatic Fenders, especially those without chain & tire net, are relatively light and therefore particularly exposed to wind and wave action. Oversized chains and additional ballast weights on the chains can help to reduce fender movement, especially in strong waves or exposed installations on the open sea.
2. Only connect chains to the fender end fittings, never to the chain net or other parts of the fender.
3. Constant movements of the fender due to wind and wave action cause vibrations. Shackle bolts, split pins, screw or bolted connections may come loose up to the point of total failure. The only remedy is to use suitable bolt locks such as locking nuts, tack welds or Weiconlock (see page 11), as well as to perform regular checks.
4. Where the structure could abrade the fender body, it should be fitted with PE pads or timber rubbing strips to reduce wear and tear.
5. Where mooring chains contact the corner edge of a structure, rubber tubes should be fitted around the chains to prevent them from abrading the concrete and to help protect the galvanized finish.
6. To reduce sideways drift of fenders with long mooring chains at high tides (when the mooring chains are slack), make one chain longer or add some ballast to one side.

ALWAYS

| | |
|--|---|
| Leave some chain slack to allow for tides. | ✓ |
| Operate the fender at the correct pressure. | ✓ |
| Check for sharp edges that could damage the fender body. | ✓ |
| Ensure at least two fenders are in contact with the moored ship. | ✓ |
| Inflate the fender with dry air. | ✓ |

NEVER

| | |
|--|---|
| Allow the fender to 'walk' up the berth and onto the top of structure. | ✗ |
| Permit excessive fender motion, which may cause 'snatch' in moorings. | ✗ |
| Permit non-essential personnel near fenders during berthing. | ✗ |

ROLLER AND WHEEL FENDERS

Owing safety regulations during transport, inflatable Roller Fenders and Wheel Fenders are shipped deflated. Inflation to nominal working pressure needs to be done on site by the installing contractor. Appropriate instructions are available from ShibataFenderTeam.

HYDROPNEUMATIC FENDERS

To achieve the desired immersion depth of Hydropneumatic Fenders, some special features apply. ShibataFenderTeam has separate installation instructions. Please request these instructions BEFORE starting to work. We also provide on-site training and technical assistance as needed.



INSTALLATION ACCEPTANCE REPORT

When installation is complete, ShibataFenderTeam requires an Installation Acceptance Report (IAR) to initiate the warranty period. Failure to provide an IAR may invalidate or delay warranty claims.

| | | | |
|------------------|---------|--------------|-----------|
| Project Name: | | Ref.: | Location: |
| Fender Quantity: | | Fender Type: | |
| Delivery Date: | | | |
| Warranty Period* | Starts: | Ends: | |

*according to warranty certificate

| INSPECTION OF | Contractor | ShibataFenderTeam |
|--|------------|-------------------|
| Setting out dimensions | | |
| Fender spacing | | |
| Fixings correctly installed, tightened and secured against loosening | | |
| Droop and sag of fenders within limits | | |
| Fender positions, serial numbers recorded | | |
| Face pads and fixings undamaged | | |
| All paint damage touched up | | |
| Spare parts inventory checked | | |

| SNAGGING LIST | Contractor | ShibataFenderTeam |
|----------------------------------|------------|-------------------|
| Damage noted to: | | |
| Rubber | | |
| Steel fabrications | | |
| Paintwork | | |
| PE Pads | | |
| Brackets | | |
| Chains and accessories | | |
| Anchors, bolts and other fixings | | |
| Actions | | |
| Responsibility | | |
| Timeline | | |

| SIGN-OFF | |
|-------------|---------------------------|
| Contractor: | Vendor: ShibataFenderTeam |
| Name: | Name: |
| Signature: | Signature: |
| Date: | Date: |



Ports should have clear operating practices and procedures. This is especially important for the safety-critical berthing, mooring and departure process. It is vital that all berth users are made aware of the performance limits of fenders and operate safely within these.

Safe practices and procedures should be developed for each port and, where applicable, for each berth or terminal within the port. With respect to fenders this should include:

- ▶ Identifying hazard(s) to personnel, vessels and port structures;
- ▶ The likelihood of a hazard arising;
- ▶ Reviewing the consequences and outcome should an identified hazard occur;
- ▶ Preparing a risk analysis;
- ▶ Mitigating these risks where possible;
- ▶ Ongoing training of all personnel who are unavoidably exposed to any degree of risk;
- ▶ Regular operational reviews to identify new or changing risks.

Fenders need to perform faultlessly when called upon to protect a port structure.

ALWAYS

| | |
|--|---|
| Make a visual check of fenders before a ship arrives at the berth. | ✓ |
| Check that the arriving ship is within the design limits of the fender. | ✓ |
| Ensure that the Master and pilot are aware of safe berthing speeds and angles. | ✓ |
| Make provision for escalating events such as deteriorating weather. | ✓ |
| Monitor fenders and moorings regularly whilst a ship is on the berth. | ✓ |

NEVER

| | |
|--|---|
| Allow mooring lines or hull protrusions to snag on fenders. | ✗ |
| Allow ships to berth on damaged or worn out fenders. | ✗ |
| Permit non-essential personnel near fenders during berthing. | ✗ |

OPERATIONAL LIMITS

Fender and mooring operating parameters should be made available to all berth users: pilots, linesmen, Harbour Masters, arriving vessels and others involved in the berthing and mooring process. These parameters should identify the safe limits of fenders, bollards and other dock furniture. The table below is a suggested template for summarising this information.

| | |
|----------------------|----------------------|
| Port: | Berth Name: |
| Harbour Master Tel.: | Port Operation Tel.: |
| Tugs Tel.: | Pilots Tel.: |
| VTIS/VTIS Tel.: | Linesmen Tel.: |

| VESSELS | Min. Ship | Max. Ship | Other Ships |
|------------------------|-----------|-----------|-------------|
| Type/class | | | |
| Deadweight | | | |
| Displacement (t) | | | |
| Length overall (m) | | | |
| Breadth (m) | | | |
| Laden draft (m) | | | |
| Air draft (m) | | | |
| Bow flare (deg.) | | | |
| Beltings | | | |
| Special features | | | |
| Berthing speed (m/s) | | | |
| Berthing angle (deg.) | | | |
| Draft limited approach | | | |

| | | | |
|----------------------|------|----------------------|------|
| Tide (min.) | m CD | Tide (max.) | m CD |
| Deck level | m CD | Dredged depth | m CD |
| Berth direction | deg. | Berth construction | * |
| Maximum current | kts | Current direction | deg. |
| Berthing wind speed | kts | Operating wind speed | kts |
| Cease operation wind | kts | Depart berth | kts |

* closed/part-closed/open

| | | | |
|-------------------|-------------------|--------------------|----|
| Fender type | | Fender size | |
| Rubber grade | | Fender spacing | m |
| Fender projection | m | Fender drawing no. | |
| Hull pressure | kN/m ² | Reaction force | kN |

| | | | |
|--------------------|------|---------------------|---|
| Bollard type | | Bollard model | |
| Bollard capacity | t | Bollard spacing | m |
| Maximum line angle | deg. | Bollard drawing no. | |

The form can be downloaded from our website [🔗](#).

OPERATIONS CHECKLIST

It is advisable to carry out a berth inspection before vessel arrival and after departure. The table below is a suggested template for collecting this information. In the event that fender damage is identified, please contact ShibataFenderTeam for advice.

| | |
|-------|-------------|
| Port: | Berth Name: |
| Date: | Time: |
| Name: | Signature: |

| PRE-ARRIVAL INFORMATION | | | |
|-------------------------|------|-------------------|------|
| Vessel name: | | Vessel IMO: | |
| Dimensions (L × B × D) | L m | B m | D m |
| Vessel type | | Deadweight | t |
| Arrival draft | m | Arrival air draft | m |
| Pilot | | Master | |
| Tug names | (1) | (2) | (3) |
| Tide on arrival | m CD | Current | kts |
| Wind speed | kts | Wind direction | deg. |

| PRE-ARRIVAL BERTH INSPECTION | | | |
|--------------------------------|--------------|---------------|-----------------|
| Damage location | (1) | (2) | (3) |
| Damage description | | | |
| Identified hazards | | | |
| Warnings issued | Pilot yes/no | Vessel yes/no | Linesmen yes/no |
| Risk mitigation measures taken | | | |

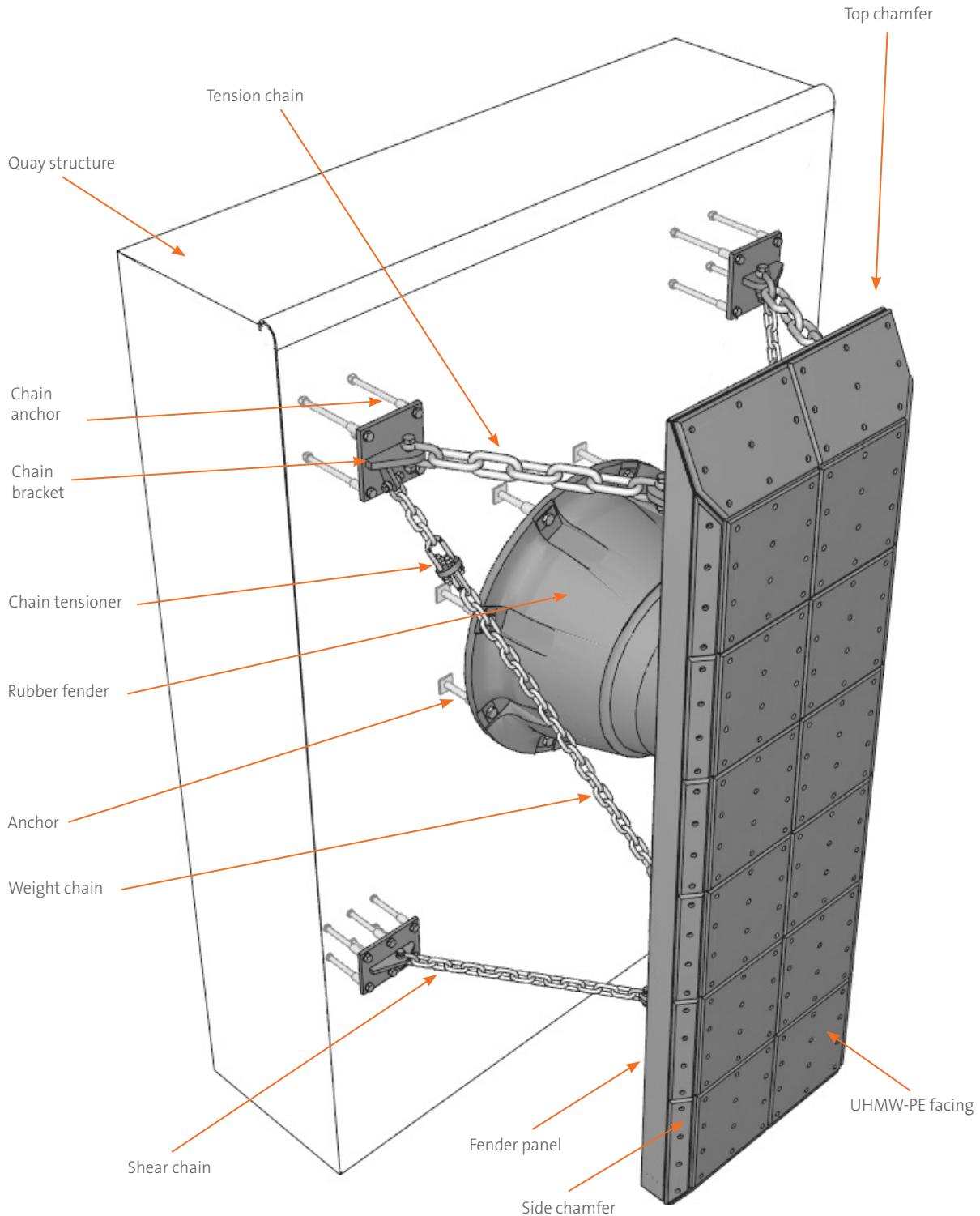
| POST-DEPARTURE BERTH INSPECTION | | | |
|---------------------------------|--------|--------|--------|
| Damage location | (1) | (2) | (3) |
| Damage description | | | |
| Cause | | | |
| Consequence | | | |
| Photos taken | yes/no | yes/no | yes/no |
| Vessel/agent informed | yes/no | yes/no | yes/no |
| ShibataFenderTeam informed | yes/no | yes/no | yes/no |

The form can be downloaded from our website [🔗](#).

MAINTENANCE

When maintaining a fender system it is important to use the correct terminology. This avoids confusion when ordering spares. The full parts list is provided on the fender general arrangement drawing. Please refer to this if possible when discussing spare parts with ShibataFenderTeam.

All moulded rubber fender units and steel panels are identified with a job specific serial number. These should also be identified when ordering spare parts.





THE REASONS FOR PREVENTATIVE MAINTENANCE:

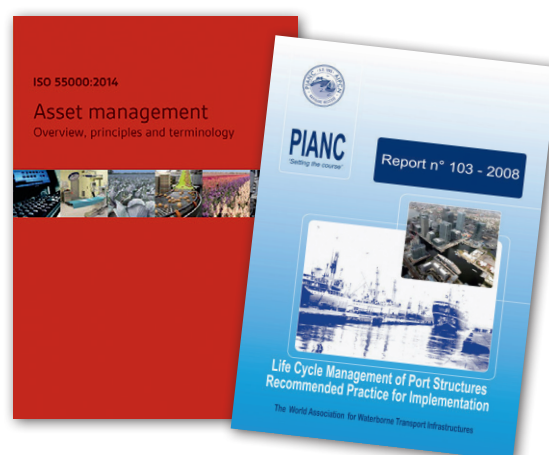
- ▶ Safety and reduced risks
- ▶ Early identification of damage
- ▶ Reduced operational costs
- ▶ Less berth disruption
- ▶ Warranty remains valid
- ▶ Fewer claims and less aggravation
- ▶ Extended service life

The goal of any maintenance programme is to avoid or reduce the consequences of failure of equipment whilst maintaining safety at all times and achieving this at the lowest cost. This can be achieved by preventing a failure before it occurs with planned inspections and replacements.

By routinely recording equipment wear and tear it is possible to replace or repair worn components before they cause a system failure. An ideal preventive maintenance program would ensure zero downtime.

Well maintained fenders will remain safe, last longer and cost far less than the disruption caused by loss of use or claims following a breakage.

Asset management is a systematic process of operating, maintaining, upgrading, and disposing of assets cost-effectively in a manner which benefits all users by adopting a long term philosophy. The foundations of an asset management system are defined in ISO 55000.



MAINTENANCE CHECKLIST

It is advisable to prepare a checklist for routine preventative maintenance. The table below is a suggested template for collecting this information. In the event that fender damage is identified during a maintenance inspection, please contact ShibataFenderTeam for advice.

| | |
|-------|-------------|
| Port: | Berth Name: |
| Date: | Time: |
| Name: | Signature: |

| | |
|--|-----------------------|
| GENERAL | |
| Fender location: | Last inspection date: |
| General condition: Excellent / Good / Average / Poor / Very Poor | |

| RUBBER | | FENDER PANEL | |
|------------------------|-----------------------------|-------------------------|-----------------|
| Ozone cracks | yes/no (photos, size) | Paint condition, damage | yes/no (photos) |
| Fixings tight, secure | yes/no (photos) | Dents, bends | yes/no (photos) |
| Cuts or abrasions | yes/no (photos, size) | Brackets | |
| Spillages (paint, oil) | none/minor/major | Corrosion, scratches | yes/no (photos) |
| Marine growth | yes/no (vents blocked?) | Welds, cracks | yes/no (photos) |
| Tidal operations | yes/no (hydraulic locking?) | Accident damage | yes/no (photos) |

| UHMW-PE FACE PADS | | CHAINS | | | |
|--------------------------|-----------------|----------------------|--------|--------|--------|
| Original thickness | | Weight/tension/shear | W | T | S |
| Current thickness | | Slack | yes/no | yes/no | yes/no |
| Evenly worn | yes/no (photos) | Diameter loss | yes/no | yes/no | yes/no |
| Cuts, gouges | yes/no (photos) | Shackle or link wear | yes/no | yes/no | yes/no |
| Missing pads | yes/no (photos) | Bracket damage | yes/no | yes/no | yes/no |
| Fixings loose, missing | yes/no (photos) | Split pins fitted | yes/no | yes/no | yes/no |

| COMMENTS | PHOTOS (file names) |
|-------------------------|----------------------------|
| | |

| FOLLOW-UP | | | |
|----------------------------|--------|---------------------------|--------|
| Refer to ShibataFenderTeam | yes/no | Warranty issue | yes/no |
| Date referred | | ShibataFenderTeam contact | |

The form can be downloaded from our website [🔗](#).

MAINTENANCE INSPECTION PERIODS

An inspection and maintenance programme is needed to identify maintenance, wear and damage as well as the likely causes at an early stage. Three levels of inspection and maintenance are recommended. The table gives average periods for temperate climates. These should be more often in harsh environments such as the tropics. If you are uncertain about any aspect of inspection or maintenance, please consult ShibataFenderTeam.

| Inspection and Maintenance program | LEVEL 1 Close visual inspection | LEVEL 2 Interim maintenance | LEVEL 3 Major maintenance or overhaul | Notes |
|--------------------------------------|------------------------------------|--------------------------------|--|------------|
| Rubber fenders | Every year | 4–6 years | 15–25 years | 1, 2, 8 |
| Steel panels (frames) | Every year | 4–6 years | 15–25 years | 1, 3, 8, 9 |
| Other fender steelwork | Every year | 4–6 years | 15–25 years | 1, 3, 8, 9 |
| Corrosion protection systems | Every year | 4–6 years | 10–15 years | 1, 3, 8, 9 |
| UHMW-PE face pads | Every year | 4–6 years | 15–25 years | 1, 4, 8 |
| Anchors & bolts | Every year | 4–6 years | 15–25 years | 1, 5, 8 |
| Chain, shackles & tensioners | Every year | 2–4 years | 5–10 years | 1, 6, 8 |
| Initial pressure (Pneumatic Fenders) | Every month | N/A | N/A | 7 |
| Valves and end fittings | Every six months | 4–6 years | 5–10 years | 10, 11 |
| Marine growth | Every six months | 1–2 years | N/A | 12 |

NOTES

1. A close inspection should also be made after any incident which may have damaged the fenders or supporting structure. Always record the event, cause and consequences immediately. Where there is clear damage this should be reported to ShibataFenderTeam immediately using the form on page 28.
2. Interim maintenance will include, but is not limited to, the repair of any cuts and surface damage to the rubber. Paint spills should be removed by water jetting. Accidentally damaged rubber units with deep cuts or clear signs of overload should be immediately replaced. Please consult ShibataFenderTeam for advice.
3. Interim maintenance will include touching up of paintwork where underlying steel or primer is exposed according to paint manufacturers' instructions. Close attention should be paid to edges where ropes may abrade, also around chain brackets. Bird droppings can aggressively attack paint and, if this is an ongoing issue, bird spikes or similar should be fitted. Repairs to dents and other minor damage should be carried out with careful attention paid to cause and possible loss of strength as a result.
4. Interim maintenance will include replacement of worn UHMW-PE pads, in particular all pads with remaining wear allowance insufficient to last until the next scheduled maintenance. Close attention should be given to cuts and heavy localised wear, often caused by inappropriate or poorly maintained ships. Pad fixings should be renewed when new pads are fitted, taking care to use the correct size and material grade of bolts, nuts and washers.
5. Interim maintenance will include retightening of loose bolts and anchors. Any missing locknuts, locking tabs or split pins should be replaced at the same time. The correct preload should be applied to fixings. The effects of surface corrosion on friction and bolt torques should be considered. If in doubt then consult ShibataFenderTeam for advice.
6. Interim maintenance will include measurement of chain link and shackle diameter, particularly in the inter-tidal zone. Reference should be made to design corrosion allowances. Components must be changed if diameter is likely to reduce below permitted minimum before the next scheduled

maintenance. Special attention should be given to "weak" links, where fitted, as these are smaller diameter and must protect other parts of the chain system from damage in the event of overloads.

7. The initial inflation pressure of pneumatics should be monitored and adjusted every month. If pressure drops gradually or unexpectedly this can indicate a leaking valve or small puncture which should be replaced or repaired immediately. Please consult ShibataFenderTeam for detailed procedures.
8. Full maintenance should be carried out when paint coatings, corrosion or damage demand removal of the fender systems for a more thorough overhaul. The opportunity should be used to dismantle the fender system, replace worn components, repair damage, and to shot blast and repaint all steelwork. Special attention should be paid to the rubber fender units, in particular any signs of ozone cracking. Overhauls also provide the opportunity to rotate fenders on the berth, moving heavily used systems to areas which are less used and vice versa. Please consult ShibataFenderTeam for advice on major maintenance and overhaul to confirm spare parts availability and the optimum scope of works. A ShibataFenderTeam engineer will visit site if required.
9. Most design specifications do not include corrosion allowances. Therefore the deterioration of paint or galvanising coatings will inevitably increase steel stresses.
10. Interim maintenance should include the replacement of the inflation valve and cap. This can usually be done in-situ with the appropriate tool and without first deflating the fender.
11. Major maintenance of pneumatic fenders includes dismantling of the end fittings, valves and replacing these components. Chain and tire nets should also be overhauled or replaced.
12. Marine growth can hide or even cause maintenance issues. In areas prone to heavy marine growth and strong currents or tides, marine growth can increase drag forces or substantially increase the air weight of the fender system. Always remove heavy growth for inspection. Also make full allowance for increased fender weight due to marine growth when lifting out for major maintenance.

INCIDENT REPORT FORM

If any damage is caused to your ShibataFenderTeam fender system, regardless of cause, then this must be reported to ShibataFenderTeam immediately. Failure to do so may affect warranty terms. Please provide all relevant information as well as photographs and maintenance records where applicable (see page 26).

| | |
|--------------|-------------|
| Port: | Berth Name: |
| Reported by: | Position: |
| Phone: | Email: |

| | |
|------------------|-----------------------|
| GENERAL | |
| Incident date: | Last inspection date: |
| Fender location: | Fender number: |
| Suspected cause: | |

| | |
|------------------------|--|
| RUBBER DAMAGE | FENDER PANEL DAMAGE |
| | |
| FACE PAD DAMAGE | CHAIN SYSTEM DAMAGE |
| | |
| OTHER COMMENTS | PHOTOS (file names) |
| | Please take overview and close-up photos, submit in high resolution where possible. Indicate the file name(s) and respective fender position(s). |

The form can be downloaded from our website [🔗](#).

AFTER SALES & WARRANTY

ShibataFenderTeam is committed to providing support and assistance during commissioning and long into the future. With our own installation and maintenance team based in Germany, we can offer assistance during the installation and/or maintenance works. We support customers with routine overhauls and upgrades, or to recover quickly in the event of accidental damages. Standard and extended warranties are available, as well as guidance on inspection and maintenance regimes to ensure our fender systems always provide the best performance and protection.

The standard warranty period is 12 months from installation or 18 months from shipping date, what ever comes first. Extended warranty periods or warranty extensions, for example for corrosion protection, can be agreed upon in special cases upon request. In all cases ShibataFenderTeam warranties are subject to berth operators conducting periodic inspections according to our recommendations, as well as timely submission of reports and photographs. This allows any issues arising to be detected early, then rectified and monitored.

Warranties do not cover accidental damage, normal wear and tear, visual appearance or the effects of environmental degradation over time. In the unlikely event of a claim for faulty materials and/or workmanship, ShibataFenderTeam will repair or replace the defective components at its discretion. Compensation values cannot exceed the cost of supplied materials, less any reduction for normal use, and in no circumstances are costs of removal or reinstallation, or any consequential costs, losses or liabilities accepted. ShibataFenderTeam recommends that users adopt an asset management system based on ISO 55000 (or PAS-55).

DISCLAIMER

These instructions have been prepared with the greatest possible care and to the best of our knowledge and belief. All technical specifications, product descriptions and planning principles used are correct at the time of going to press. ShibataFenderTeam AG, its subsidiaries, agents and associates do not accept the responsibility or liability for any errors and omissions for whatsoever reason. When using this technical manual to develop a design, customers are strongly recommended to request a detailed specification, calculations and certified drawings from our specialists prior to construction and/or manufacture. ShibataFenderTeam constantly strives to improve the quality and performance of products and systems. We reserve the right to change specification without prior notice. All dimensions, material properties and performance values quoted are subject to normal production tolerances. This manual supersedes the information provided in all previous editions. It should always be used in conjunction with our current product catalogue. If in doubt, please consult ShibataFenderTeam.

FLAG

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SFT CATALOGUES AND MANUALS

The SFT Group provides several catalogues, manuals and brochures as hardcopy or convenient download.



PRODUCTS

Overview about the entire product range at SFT including fender performance data, dimensions, characteristics and applications.



COMPANY PROFILE

Introduction of the full services range of SFT: Consulting, Engineering, Manufacturing, After Sales Service and Testing/Quality Control, including an overview of the SFT product range.



DESIGN MANUAL

Concise resource to assist designers and specifiers to identify the key input criteria, to calculate berthing energies and to select the optimal fender type.



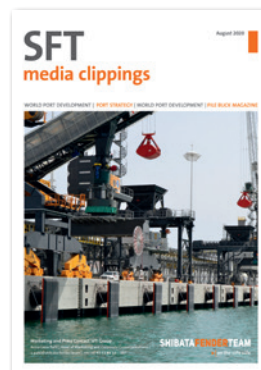
PNEUMATIC FENDER MANUAL

Focus on the design and quality requirements of Pneumatic Fenders to present unbiased information about the two conventional manufacturing methods wrapping and molding.



WHITE PAPER SERIES

Four-part SFT White Paper Series to explore the production steps of rubber compounding, mixing, manufacturing & curing, and testing in order to provide an unbiased view of “what exactly makes a high-quality fender”.



MEDIA CLIPPINGS

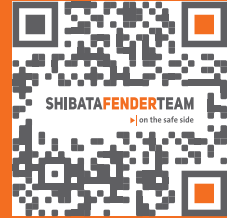
Some recent in-depth and cutting-edge articles from internationally renowned trade magazines about the SFT Group's market approach and opinion on fender-related topics.



For other languages or formats, please go to:
<https://www.shibata-fender.team/en/downloads.html>



OUR OFFICES.



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