TRELLEBORG

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

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TRELLEBORG

Pneumatic Rubber Fender

The Smarter Approach

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

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

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

Pneumatic Rubber Fender

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.

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

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

Take a Smarter Approach to fender performance with Trelleborg.

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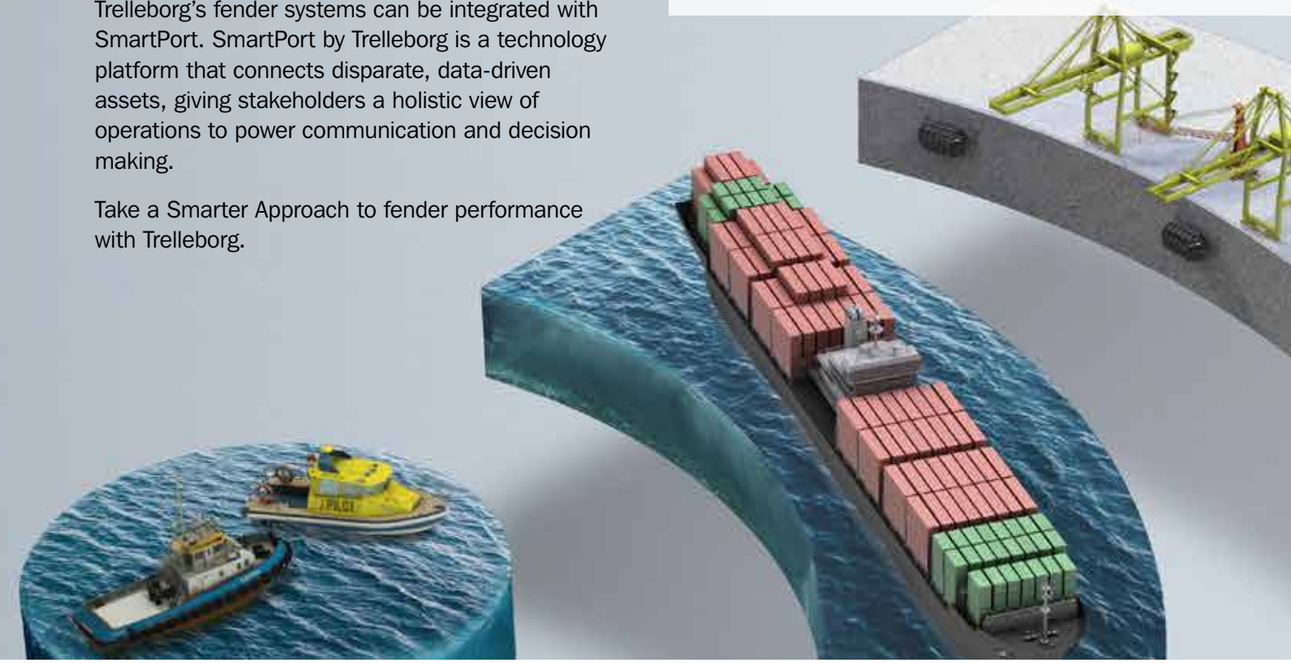
PNEUMATIC RUBBER FENDER



A Smarter Approach at every stage

A smarter approach to…

CONSULTATION

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

CONCEPTS

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

DESIGN

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

MANUFACTURE

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

TESTING

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

INSTALLATION

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

SUPPORT

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

THE FUTURE

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

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

Introduction

Pneumatic rubber fenders have a long and successful history of protecting vessels in mooring operations. They are ideal for permanent and semi-permanent port applications and for offshore ship-to-ship transfers. Tough and resilient, Trelleborg Marine and Infrastructure's fenders are fast and easy to deploy, maintaining large clearances between the hull and the jetty or other vessel. This serves to minimise damage potential during mooring.

Critical properties of rubber fenders are energy absorption, hull pressure and reaction force. In both cases, Trelleborg Marine and Infrastructure products score very highly, with low reaction force and low hull pressure. This means the fender absorbs significant energy, reducing the forces on both the vessel hull and jetty structures.

With the development of ship technology, fenders have evolved to suit newer vessel types such as ULCCs, LNG carriers, bulk carriers, FSOs and FPSOs. As a result, Trelleborg Marine and Infrastructure manufactures a wide range of pneumatic fenders from the large 4.5 x 9 metre down to the 300 x 500 mm baby fenders.

With the backing of Trelleborg's over 140 years of experience in rubber technology, the quality and performance equates to the best available world-wide.

Trelleborg Marine and Infrastructure pneumatic rubber fenders are manufactured in its new manufacturing facility.

SAFETY

Highly resistant to failure, conforming to accepted standards and proven through extensive testing programs.

CONSISTENT PERFORMANCE

Trelleborg pneumatic fenders comply with ISO 17357:2002 requirements for consistent performance.

ANGLED BERTHING

Trelleborg Marine and Infrastructure pneumatic fenders will not lose performance when used with berthing angles up to 15 degrees.

PERFORMANCE IN ROUGH SEAS

Not easily damaged in rough weather and sea conditions.

GOOD BUOYANCY AND SIMPLIFIED HANDLING

Lighter and easier to handle than the conventional solid rubber models due to their hollow construction.

EXCELLENT COMPRESSIBILITY AND ELASTICITY

Pneumatic fenders utilise the compressibility and elasticity of air to absorb energy. Therefore, the energy absorption capacity is substantially increased.

EASE OF INSTALLATION AND REPAIR

Maintenance costs are drastically reduced. Fenders can be moored to the ships and docks with wire or chain line easily.

MAXIMUM PERMISSIBLE SERVICE LIFE

Reinforced with rubberised strong tyre cord and covered with superior rubber compound, fenders are resistant to sunlight, ozone, oxygen, heat and weathering, providing an extremely long service life.

FENDER WITH LOW HULL PRESSURE

Provides lowest and uniform hull pressure.

Construction

ISO Standard

All Trelleborg Marine and Infrastructure pneumatic rubber fenders are manufactured and 3rd party certified in compliance with ISO 17357-1:2014. The stringent requirements of this standard ensure that fenders are of a high quality and can withstand the rigorous environments and applications they are designed to operate in. ISO 17357-1:2014 details three major elements of construction: the outer rubber, tire-cord reinforcing layer and the inner rubber.

Outer Rubber

The tough abrasion resistant outer rubber is designed to protect the inner rubber and tire-cord layers from damaging external forces. The material has mechanical properties to withstand the arduous operational conditions for which it is designed. The diagram below shows the actual properties as specified in ISO 17357-1:2014. Generally, the outer rubber is black, but other colors such as grey and off-white can be supplied upon request.

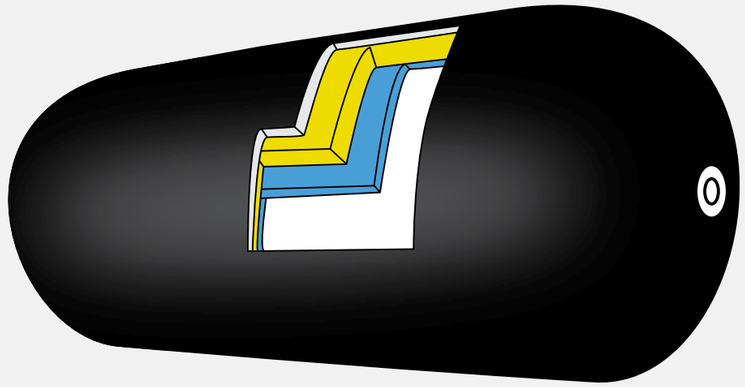
Tire-cord Layer

Synthetic tire-cord layers have proven to be the best option for strong, efficient reinforcement for pneumatic rubber fenders. Each layer is coated with a rubber compound on both sides that prevents contact between the layers, reducing friction and wear during bending, compression and stretching. The same compound isolates each thread within the layer. This greatly improves the ability of the fender to hold pressure, fatigue resistance and endurance life. Other reinforcing layer materials such as canvas have wear points that significantly reduce the life off the fender. A schematic of the construction is shown below.

Inner Rubber

The inner rubber seals pressurized air inside the fender. It is usually constructed of a compound similar to that of an inner tube in a truck or car tire to ensure a good level of air tightness.

- Outer rubber
- Tire-cord layers
- Inner rubber



The main elements of pneumatic fender construction. The number of tire-cord layers is dependent on the application.

Construction

The material tests of the outer and inner rubber shall be conducted in accordance with the specification given in the table below.

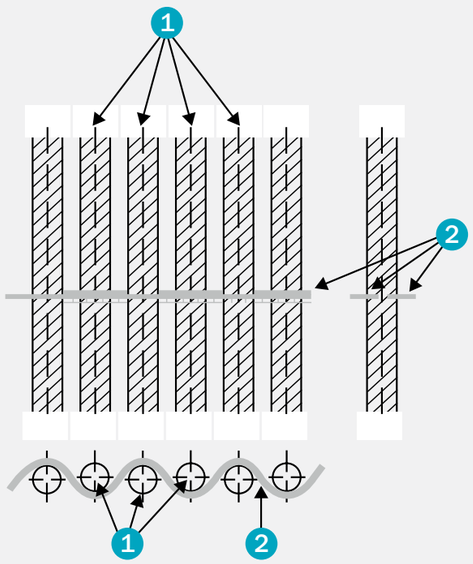
OUTER AND INNER RUBBER MATERIAL PROPERTIES REQUIREMENTS

TEST ITEM	TEST METHOD	REQUIRED VALUE	
		OUTER RUBBER	INNER RUBBER
Before ageing		Original	Original
Tensile strength	BS ISO 37	18 Mpa or more	10 Mpa or more
Elongation	BS ISO 37	400% or more	400% or more
Hardness	ISO 7619	60 +/- 10 (durometer hardness test type A)	50 +/- 10 (durometer hardness test type A)
After ageing	ISO 188	Air oven ageing. 70ºC +/- 1ºC. 96 h	Air oven ageing. 70ºC +/- 1ºC. 96 h
Tensile strength	BS ISO 37	Not less than 80% of the original property	Not less than 80% of the original property
Elongation	BS ISO 37	Not less than 80% of the original property	Not less than 80% of the original property
Hardness	ISO 7619	Not to exceed the original property by more than 8	Not to exceed the original property by more than 8
Tear	BS ISO 34-1	400 N/cm or more	No requirement
Compression set	ISO 815	30% (70ºC +/-1ºC for 22h) or less	No requirement
Static ozone resistance	ISO 1431-1	No cracks after elongation by 20% and exposure to 50 pphm[1] at 40ºC for 96 h.	No requirement

NOTE: if the color of the outer rubber is not black, the material requirements will differ from those in this table.

1 pphm: parts of ozone per hundred million of air by volume.

Properties of the inner and outer rubber as adapted from ISO 17357-1:2014 Ships and Marine Technology – High-pressure Floating Pneumatic Rubber Fenders.



Construction of tire-cord layers as adapted from ISO 17357-1:2014.

1. Warp threads that run vertically through the synthetic tire-cord pattern.
2. Weft threads that run perpendicular to the warp threads.

Construction

STANDARD SIZES

Regardless of type or pressure, fenders are measured by diameter and length, generally expressed in millimetres (mm). Type I (chain-tire net) fenders are not available below 800 x 1200. All fenders with diameter 2500 mm and above are fitted with a pressure relief valve in accordance with ISO 17357-1:2014.

SIZE (OD X L) (mm)	BODY MASS (kg)	CTN MASS (kg)	TOTAL MASS (kg)	CHAIN (mm)
500 × 1000	35	–	35	13
1000 × 1500	140	170	310	16
1000 × 2000^	170	200	370	16
1200 × 2000	200	220	420	18
1350 × 2500	270	260	530	20
1500 × 3000*	350	440	790	22
2000 × 3500*	650	920	1570	28
2500 × 4000	1100	1510	2610	32
2500 × 5500*	1350	1620	2970	36
3300 × 4500	1800	2360	4160	38
3300 × 6500^	2250	3120	5370	44
3300 × 10600	2800	4050	6850	48
4500 × 9000*	4950	6200	11150	50

^ Fast deliveries available ex-stock from China, USA and Middle East
* Fast deliveries available ex-stock from China
3300 x 4500 and 4500 x 7000 and other bespoke sizes are available on request.

NON-STANDARD SIZES

SIZE (OD X L) (mm)	SIZE (OD X L) (mm)
300 × 500	1700 × 3000
300 × 600	1700 × 7200
500 × 800	2000 × 3000
800 × 1200	2000 × 6000
800 × 1500	3000 × 5000
1200 × 1800	4500 × 7000
1500 × 2500	

Some applications may require sizes outside of those specified in the standards. We can customize fenders to meet your specifictions.

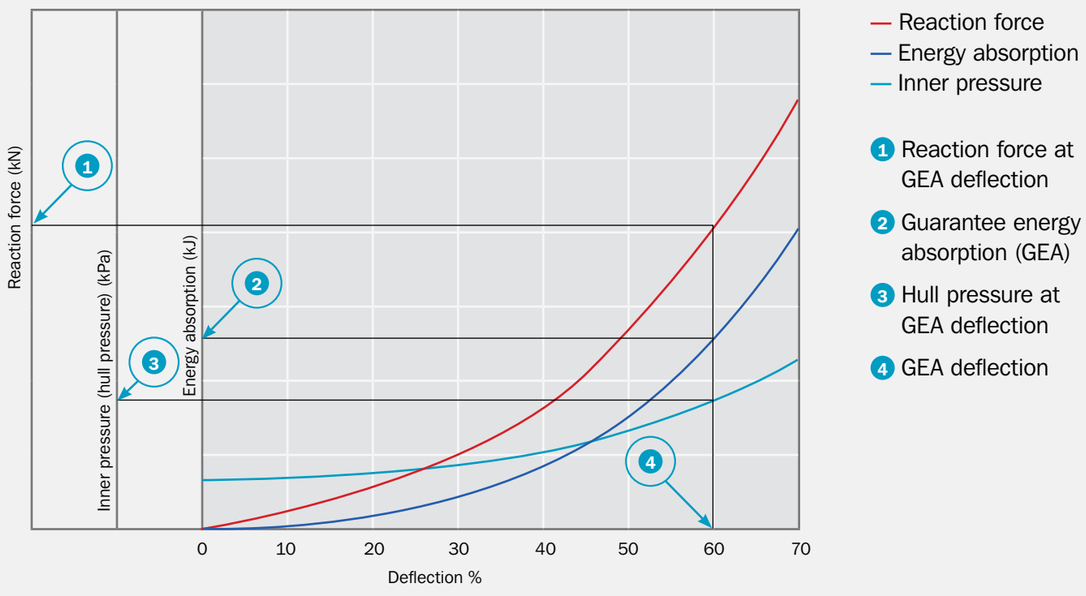
Construction

PRODUCT CHARACTERISTICS

Performance Data

INITIAL INTERNAL PRESSURE	50kPa			80kPa		
NOMINAL SIZE DIAMETER × LENGTH (mm)	GUARANTEED ENERGY ABSORPTION (GEA)	REACTION FORCE AT GEA DEFLECTION (R)	HULL PRESSURE (INTERNAL PRESSURE) AT GEA DEFLECTION (P)	GUARANTEED ENERGY ABSORPTION (GEA)	REACTION FORCE AT GEA DEFLECTION (R)	HULL PRESSURE (INTERNAL PRESSURE) AT GEA DEFLECTION (P)
	MINIMUM VALUE AT DEFLECTION 60 ± 5 % kj	TOLERANCE ±10 % kN	REFERENCE VALUE kPa	MINIMUM VALUE AT DEFLECTION 60 ± 5 % kj	TOLERANCE ±10 % kN	REFERENCE VALUE kPa
500 x 1000	6	64	132	8	85	174
1000 x 1500	32	182	122	45	239	160
1000 x 2000	45	257	132	63	338	174
1200 x 2000	63	297	126	88	390	166
1350 x 2500	102	427	130	142	561	170
1500 x 3000	153	579	132	214	761	174
2000 x 3500	308	875	128	430	1150	168
2500 x 4000	663	1381	137	925	1815	180
2500 x 5500	943	2019	148	1317	2653	195
3300 x 4500	1175	1884	130	1640	2476	171
3300 x 6500	1814	3015	146	2532	3961	191
3300 x 10600	3067	5257	158	4281	6907	208
4500 x 9000	4752	5747	146	6633	7551	192

Performance Curve



— Reaction force
— Energy absorption
— Inner pressure

1. Reaction force at GEA deflection
2. Guarantee energy absorption (GEA)
3. Hull pressure at GEA deflection
4. GEA deflection

Construction

TEST AND INSPECTION REQUIREMENTS

Acceptance testing and inspection for purchased fenders shall be based on the tests and inspections indicated in the following table:

Test and inspection requirements for commercial fenders as per ISO 17357-1:2014

TEST	STANDARD	DESCRIPTION	REMARKS
Confirmation from material certificate that tire cord is used	ISO 17357-1:2014/PIANC Guidelines for design of fender system: 2002	Synthetic-tire-cord layers have been proven to provide strong efficient reinforcement layers in fenders. Each single layer is coated with rubber compound on both sides as well as in between synthetic-tire-cord threads, hence isolating all cords from each other.	If alternative reinforcement methods to tire cord are used, test certificates proving that strength and durability are designed and proven to be equal or superior to the tire cord after exhaustive trials, shall be evaluated and certified by a major classification society as well as a material certificate used for the ordered fenders.
Material testing		Physical properties of inner and outer rubber.	Tensile / elongation / hardness before ageing to be tested once for each order. The rest of the tests should be conducted once a year.
Dimensional inspection		Length: +10%, -5% Diameter: +10%, -5%	Dimensional inspection to be carried out at initial internal pressure (working pressure).
Air leakage		The air leakage test shall be conducted at initial informal pressure for more than 30 minutes.	All fenders to be tested for each and every order.
Hydrostatic test		Test shall be preformed for 10 minutes at hydrostatic pressure shown in ‘Pressure Rating’ table. Maximum circumferential and longitudinal temporary elongation: 10%	The frequency of test shall be one in 20 fenders for each size and pressure.
Witness and confirmation of marking		Each fender shall have markings to indicate the following: ▌International standard applicable year ▌Size ▌Initial internal pressure ▌Date of manufacture ▌Name of manufacturer ▌Individual serial number ▌Type of reinforcement layer	The identification system shall be designed to last throughout the fender’s life.

PARALLEL COMPRESSION TEST

1. MEASURING THE LENGTH (2500mm X 4000mm FENDER)
2. MEASURING THE CIRCUMFERENCE
3. PRESSURE 80kPa
4. PARALLEL COMPRESSION TEST
5. PARALLEL COMPRESSION TEST 60% (PNEUMATIC FENDER SIZE: 1000mm DIAMETER X 1500mm LENGTH)

1

2

3

4

5

Construction

PRESSURE RATINGS

Trelleborg Marine and Infrastructure manufactures fenders with two inital pressures: 50 kPa (Pneumatic 50) and 80 kPa (Pneumatic 80). Design values are given below.

PNEUMATIC 50 SIZE (OD x L) (mm)	INTERNAL PRESSURE (kPa)		MIN. ENDURABLE PRESSURE (kPa)		SAFETY VALVE PRESSURE SETTING (kPa)	TEST PRESSURE AT 0% DEFLECTION (kPa)
	AT 0% DEFLECTION	AT 60% DEFLECTION	AT 0% DEFLECTION	AT 60% DEFLECTION		
500 x 1000	50	132	300	462	–	200
1000 x 1500	50	122	300	427	–	200
1000 x 2000	50	132	300	462	–	200
1200 x 2000	50	126	300	441	–	200
1350 x 2500	50	130	300	455	–	200
1500 x 3000	50	132	300	462	–	200
2000 x 3500	50	128	300	448	–	200
2500 x 4000	50	137	350	480	175	250
2500 x 5500	50	148	350	518	175	250
3300 x 4500	50	130	350	455	175	250
3300 x 6500	50	146	350	511	175	250
3300 x 10600	50	158	350	553	175	250
4500 x 9000	50	146	350	511	175	250

PNEUMATIC 80 SIZE (OD x L) (mm)	INTERNAL PRESSURE (kPa)		MIN. ENDURABLE PRESSURE (kPa)		SAFETY VALVE PRESSURE SETTING (kPa)	TEST PRESSURE AT 0% DEFLECTION (kPa)
	AT 0% DEFLECTION	AT 60% DEFLECTION	AT 0% DEFLECTION	AT 60% DEFLECTION		
500 x 1000	80	174	480	609	–	250
1000 x 1500	80	160	480	560	–	250
1000 x 2000	80	174	480	609	–	250
1200 x 2000	80	166	480	581	–	250
1350 x 2500	80	170	480	595	–	250
1500 x 3000	80	174	480	609	–	250
2000 x 3500	80	168	480	588	–	250
2500 x 4000	80	180	560	630	230	300
2500 x 5500	80	195	560	683	230	300
3300 x 4500	80	171	560	599	230	300
3300 x 6500	80	191	560	669	230	300
3300 x 10600	80	208	560	728	230	300
4500 x 9000	80	192	560	672	230	300

Construction

TYPES OF FENDERS

There are two basic types of pneumatic fenders that comply with the international standard ISO 17357-1:2014: Type I (net type) and Type II (sling type). The most appropriate type for a give application is dependent on how the fender is used and the facility's requirements.

Type I

Trelleborg Type I fenders are fitted with a chain-tire net (CTN). This is a lattice of used tires connected by a network of horizontal and vertical chains, which adds further protection to the fender body. The chains are galvanized for greater corrosion resistance and covered by rubber sleeves to prevent abrasive damage to the outer rubber. The horizontal chains are fastened at each end to a tow ring. CTNs are not available for fender sizes below 800 x 1200 mm.

Type I fenders are the most common in use.

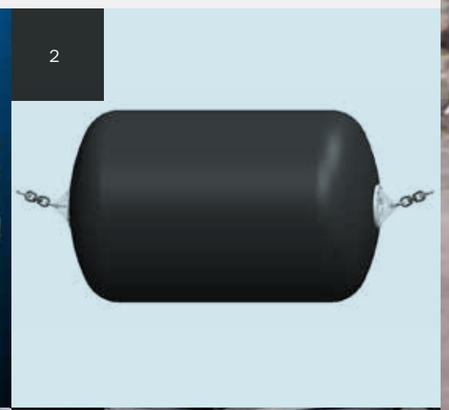
Type II

Sling or hook type fenders are effectively a Type I fender without the CTN and the tow ring. A lifting eye is fitted to each end and the fender is slung by chain or wire rope. Type II fenders are available across the whole size range.

To complete Trelleborg's range of Pneumatics Fenders the Hydro-Pneumatic fender can also be supplied. This unique type of fender is extensively employed throughout the world where submerged marine applications require a fendering system which caters for below the waterline function, typically sub-marine berths or semi-submersible oil rigs.

1. TYPE I FENDER SHOWING THE CHAIN-TIRE NET (CTN)
2. TYPE II FENDER SHOWING THE LIFTING EYES AT BOTH ENDS
3. TYPE II FENDER IN OPERATION
4. CTN CHAINS CONNECTED TO THE TOW RING ON A TYPE 1 FENDER


1


2


3


4

Construction

END FITTINGS

Pneumatic fenders are often suspended using chains, shackles. Recommended dimensions of the standard fittings are given in the table below.

Fender Fixing Accessories (50 kPa Initial Pressure)

TYPE 2 FENDER (SLING)		FIRST SHACKLE DIAMETER mm (inch)	SWIVEL DIAMETER mm (inch)	OTHER SHACKLE DIAMETER mm (inch)	GUY ROPE DIAMETER mm (inch)	GUY CHAIN DIAMETER mm (inch)	ANCHOR DIAMETER mm (inch)
SIZE (OD X L) (mm)	INITIAL PRESSURE (kPa)						
1000 x 1500	50	19 (3/4)	19 (3/4)	19 (3/4)	16 (5/8)	16 (5/8)	25 (1)
1000 x 2000	50	19 (3/4)	19 (3/4)	19 (3/4)	16 (5/8)	16 (5/8)	25 (1)
1200 x 1800	50	19 (3/4)	19 (3/4)	19 (3/4)	16 (5/8)	16 (5/8)	25 (1)
1200 x 2000	50	19 (3/4)	19 (3/4)	19 (3/4)	16 (5/8)	16 (5/8)	25 (1)
1350 x 2500	50	22 (7/8)	22 (7/8)	22 (7/8)	18 (11/16)	16 (5/8)	25 (1)
1500 x 2500	50	22 (7/8)	22 (7/8)	22 (7/8)	20 (13/16)	19 (3/4)	32 (1-1/4)
1500 x 3000	50	22 (7/8)	22 (7/8)	22 (7/8)	20 (13/16)	19 (3/4)	32 (1-1/4)
1700 x 3000	50	25 (1)	25 (1)	25 (1)	24 (15/16)	22 (7/8)	32 (1-1/4)
2000 x 3000	50	25 (1)	25 (1)	25 (1)	24 (15/16)	22 (7/8)	32 (1-1/4)
2000 x 3500	50	25 (1)	25 (1)	25 (1)	24 (15/16)	22 (7/8)	32 (1-1/4)
2000 x 6000	50	32 (1-1/4)	32 (1-1/4)	32 (1-1/4)	30 (1-3/16)	26 (1)	36 (1-7/16)
2500 x 4000	50	32 (1-1/4)	32 (1-1/4)	32 (1-1/4)	30 (1-3/16)	26 (1)	42 (1-5/8)
2500 x 5500	50	32 (1-1/4)	32 (1-1/4)	32 (1-1/4)	34 (1-3/8)	32 (1-1/4)	44 (1-3/4)
3000 x 5000	50	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	34 (1-3/8)	30 (1-3/16)	44 (1-3/4)
3300 x 4500	50	44 (1-3/4)	38 (1-1/2)	44 (1-3/4)	34 (1-3/8)	30 (1-3/16)	44 (1-3/4)
3300 x 6500	50	44 (1-3/4)	38 (1-1/2)	44 (1-3/4)	42 (1-5/8)	38 (1-1/2)	55 (2-3/16)
4500 x 9000	50	44 (1-3/4) (2 Qty)	44 (1-3/4)	44 (1-3/4)	42 (1-5/8)	38 (1-1/2)	55 (2-3/16)

Fender Fixing Accessories (80 kPa Initial Pressure)

TYPE 2 FENDER (SLING)		FIRST SHACKLE DIAMETER mm (inch)	SWIVEL DIAMETER mm (inch)	OTHER SHACKLE DIAMETER mm (inch)	GUY ROPE DIAMETER mm (inch)	GUY CHAIN DIAMETER mm (inch)	ANCHOR DIAMETER mm (inch)
SIZE (OD X L) (mm)	INITIAL PRESSURE (kPa)						
1000 x 1500	80	19 (3/4)	19 (3/4)	19 (3/4)	16 (5/8)	16 (5/8)	25 (1)
1000 x 2000	80	19 (3/4)	19 (3/4)	19 (3/4)	18 (11/16)	16 (5/8)	25 (1)
1200 x 1800	80	19 (3/4)	19 (3/4)	19 (3/4)	18 (11/16)	16 (5/8)	25 (1)
1200 x 2000	80	19 (3/4)	19 (3/4)	19 (3/4)	18 (11/16)	16 (5/8)	25 (1)
1350 x 2500	80	22 (7/8)	22 (7/8)	22 (7/8)	20 (13/16)	19 (3/4)	25 (1)
1500 x 2500	80	22 (7/8)	22 (7/8)	22 (7/8)	20 (13/16)	19 (3/4)	32 (1-1/4)
1500 x 3000	80	22 (7/8)	22 (7/8)	22 (7/8)	20 (13/16)	19 (3/4)	32 (1-1/4)
1700 x 3000	80	25 (1)	25 (1)	25 (1)	24 (15/16)	22 (7/8)	32 (1-1/4)
2000 x 3000	80	25 (1)	25 (1)	25 (1)	24 (15/16)	22 (7/8)	36 (1-7/16)
2000 x 3500	80	25 (1)	25 (1)	25 (1)	24 (15/16)	22 (7/8)	36 (1-7/16)
2000 x 6000	80	32 (1-1/4)	32 (1-1/4)	32 (1-1/4)	30 (1-3/16)	26 (1)	42 (1-5/8)
2500 x 4000	80	32 (1-1/4)	32 (1-1/4)	32 (1-1/4)	30 (1-3/16)	26 (1)	42 (1-5/8)
2500 x 5500	80	32 (1-1/4)	32 (1-1/4)	32 (1-1/4)	34 (1-3/8)	32 (1-1/4)	44 (1-3/4)
3000 x 5000	80	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	34 (1-3/8)	30 (1-3/16)	44 (1-3/4)
3300 x 4500	80	44 (1-3/4)	38 (1-1/2)	44 (1-3/4)	38 (1-1/2)	34 (1-3/8)	50 (2)
3300 x 6500	80	44 (1-3/4)	38 (1-1/2)	44 (1-3/4)	46 (1-13/16)	42 (1-5/8)	60 (2-3/8)
4500 x 9000	80	44 (1-3/4) (2 Qty)	44 (1-3/4)	44 (1-3/4)	42 (1-5/8)	38 (1-1/2)	60 (2-3/8)

Recommended sizes of shackles and chains for all sizes of Type 2 fenders.

Construction

INSTALLATION DIMENSIONS

Pneumatic fenders must be installed onto a solid structure or reaction panel to ensure that they are properly supported during impacts.

CHAIN TIRE NET (CTN) FENDERS

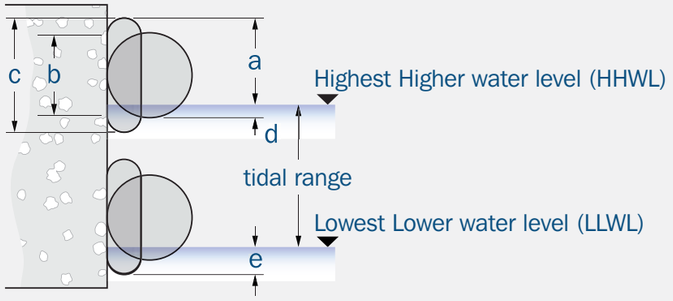
FENDER SIZE		a	b	c	d	e	W
DIAMETER	LENGTH						
1000	1500	825	940	1340	345	515	1950
1200	2000	1100	1130	1610	305	510	2600
1500	2500	1485	1410	2010	270	525	3250
2000	3500	1965	1880	2680	375	715	4550
2500	4000	2495	2355	3355	430	855	5200
3300	6500	3365	3110	4430	500	1065	8450
4500	9000	4605	4240	6040	665	1435	11700

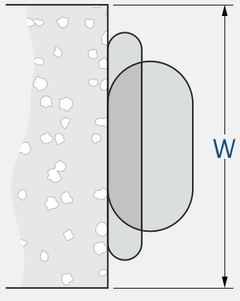
[Units: mm]

SLING FENDERS

FENDER SIZE		a	b	c	d	e	W
DIAMETER	LENGTH						
1000	1500	1020	940	1340	150	320	1950
1200	2000	1265	1130	1610	140	345	2600
1500	2500	1575	1410	2010	180	435	3250
2000	3500	2125	1880	2680	215	555	4550
2500	4000	2675	2355	3355	250	675	5200
3300	6500	3605	3110	4430	260	825	8450
4500	9000	4935	4240	6040	335	1105	11700

[Units: mm]





Hydro Pneumatic Fenders

Submarines and other vessels which contact fenders below waterline require a unique solution. Hydro pneumatic fenders are specially adapted to this application.

The fender body is partially water-filled, then pressurized with air and ballasted to make it stand vertically. Fender draft and performance can be tuned by altering the water : air ratio and inflation pressure.

FEATURES

Sub-surface contact face

Very low hull pressures

Variable draft

Prevents acoustic tile damage

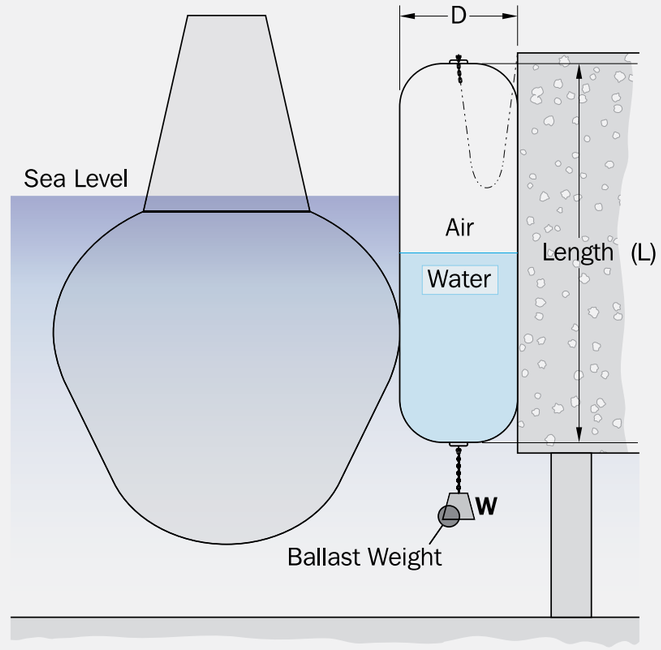
APPLICATIONS

Submarines

Some fast ferries

Semi-submersible oil rigs

Hydro Pneumatic Fenders



FENDER		WATER (%)	D (%)	INITIAL PRESSURE 0.5BAR (7.1psi)	
DIAMETER D(mm)	LENGTH L(mm)			ENERGY (kNm)	REACTION (kN)
2000	6000	65	45	155	599
		0	60	647	1766
2500	5500	65	45	223	687
		0	60	928	2037
3300	6500	60	45	616	1247
		0	60	1913	3169
3300	10600	55	45	589	1275
		0	60	3120	5170

Due to the very specialist nature of Hydro-pneumatic fenders, it is strongly advised that a detailed study be carried out for each case. Please ask for assistance with this.

Lightweight Fender

Reverting to first principals, Trelleborg have, in accordance with the requirement of OCIMF and ISO 17537-1:2014 set about to totally revolutionize the performance and weight of the pneumatic fender range.

Taking proven technologies in aramid fibre and synthetic chains the weight of the pneumatic fender range is significantly reduced without compromise to performance.

With the constant drive to provide increased productivity throughout the Marine Industry lightweight supplementary equipment will support the drive to reduce emissions, limit consumption and increase deck space.

PNE Ø 3.3 X 6.6 L LIGHT WEIGHT FENDER SYSTEM

PART NO.	DESCRIPTION	QTY/SYSTEM	SIZE		WEIGHT	TOTAL WEIGHT
1	Rubber Sleeve	140 mtr	OD 150 x ID 130		4.3 kg/mtr	602
2	Bow Shackle	48 Nos.	16mm		1.15 kg/unit	55.2
3	D Shackle	24 Nos.	7/8" (G-210)		1.62 kg/unit	38.88
4	Towing Lug	2 Nos.	PNE2500-PNE3300		38 kg/unit	76
5	Synthetic Chain	140 mtr	Inner Dim (100mm L x 25mm W)	Cross section (25mm W x 15mm T)	0.65 kg/mtr	91
6	Bow Shackle	4 Nos.	1 -3/4" (G-2130)		14.29 kg/unit	57.16
7	Swivel	2 Nos.	44mm, GR U3		20.5 kg/unit	41
					Total Approx. Weight	961.24

LIGHTWEIGHT FENDER COMPARISON

Internal Pressure: 50 kPa

SIZE (Od x L) mm	STANDARD PNE WEIGHT (kg)	LIGHTWEIGHT PNE WEIGHT (kg)	WEIGHT SAVING (kg)
3300 x 6500	4003	3040	963
3300 x 10600	6412	4805	1607
4500 x 7000	6412	5340	1081
4500 x 9000	8127	6330	1797
4500 x 12000	10913	8145	2768

Internal Pressure: 80 kPa

SIZE (Od x L) mm	STANDARD PNE WEIGHT (kg)	LIGHTWEIGHT PNE WEIGHT (kg)	WEIGHT SAVING (kg)
3300 x 6500	4228	3265	963
3300 x 10600	6772	5165	1607
4500 x 7000	6771	5690	1081
4500 x 9000	8557	6760	1797
4500 x 12000	11483	8715	2768

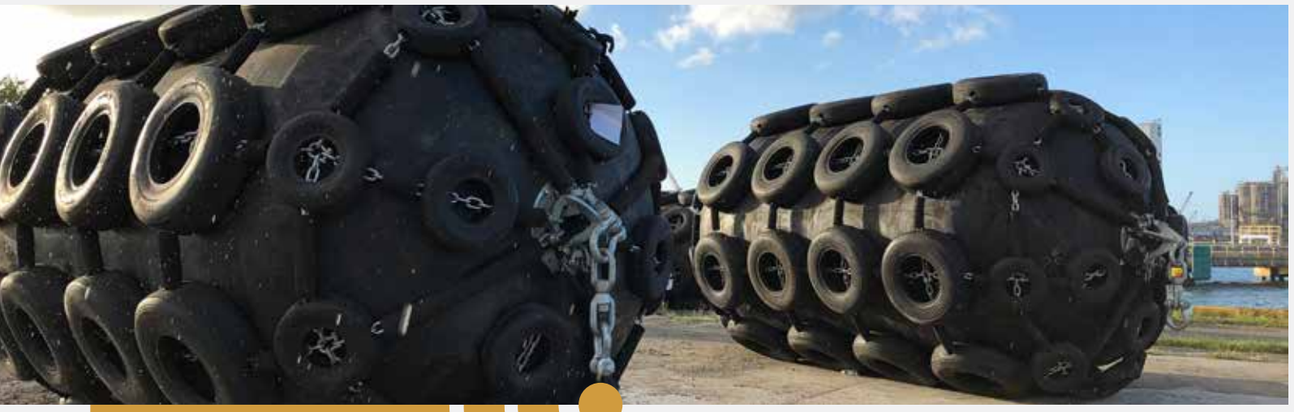
* Fender body weight variability subject to improved technical process.

* CTN weight variability subject to more available tire model in the market and it changes without prior notice.

Weight savings can be categorised into several different benefits:

- Less fuel consumptions, during both operations and installation
- Easier handling, safer operations on board handling vessels
- Reduced davit capacity and therefore on deck footprint
- Ease of shipping and folding through reduced body thickness
- Significant reduction in whole life cost and total cost of ownership

SmartFender



The SmartFender system can be retrofitted to an existing fender body or supplied with a new product. It allows monitoring of critical performance data during operational activity.

Data is transferred via wireless networks and cloud technology to a mobile or desktop device, and can then be used to improve operational efficiency. In berthing, mooring and transfer operations, preventative maintenance, berthing management, and vessel throughput.

BENEFITS OF USING SMARTFENDER

SmartFender uses the latest technology to help improve the operational efficiency of port and terminal mooring and STS transfer operations including:

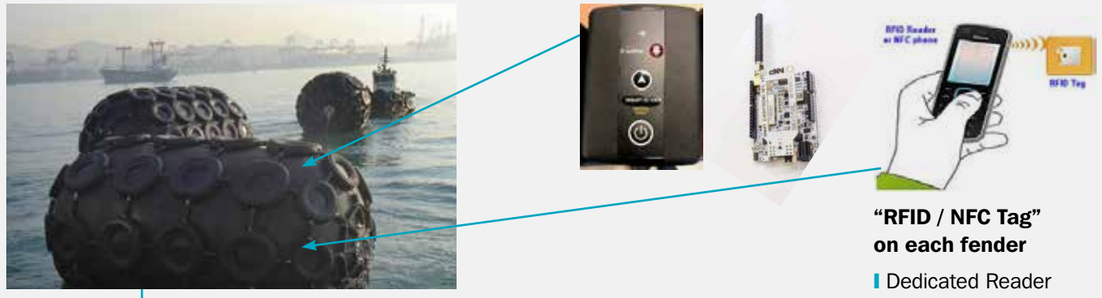
- Preventative maintenance to optimize fender performance and extend asset life.
- Improved asset allocation and management to increase throughput rates.
- Lower incidence of STS incidents.
- Accurate assessment of vessel berthing within STS design parameters.
- Better understanding of fender infrastructure to optimize investment requirements.
- Long-term trend analysis including time spent and berthing velocity.
- Real time data analysis during STS operations.

Product Overview

Powered By SmartPort

“Smart Fender” Box

- GPS Location / Tracking *
- Alarm / Geo-fencing
- Pressure
- Regular reading
- High / Low event alarm
- Temperature
- System health check
- Battery voltage / low battery alarm
- Broken sensors etc
- Maintenance log / manual
- Integrates with Safepilot, Pro Navigational Piloting Software



“RFID / NFC Tag” on each fender

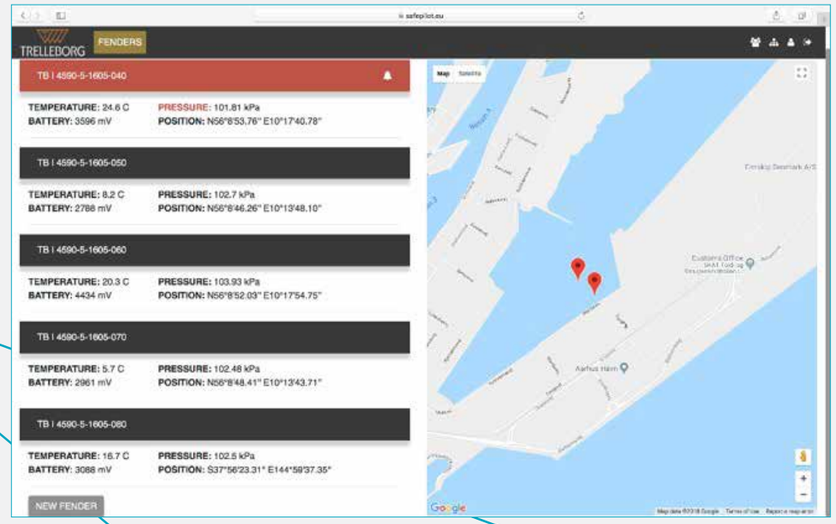
- Dedicated Reader available for purchase
- Or reader access from mobile device

LPWAN

TMS Cloud Apps

3G/4G Ethernet etc.

Geo-Fencing / Asset Protection



Desktop access

Integrate with Safepilot

Mobile & App

Pneumatic Fenders Purchase or Rental Options

Pneumatic Fenders are ideal for permanent and semi-permanent port applications and for offshore ship-to-ship transfers.

Trelleborg's ISO 17357-1:2014 quality assured fenders ensure large clearances are maintained between the hull and jetty or other vessels. Risk of damage during mooring is minimized, protecting people and cargo.

FEATURES

- Easy and fast to deploy
- Very low reaction and hull pressure
- Suitable for small and large tidal ranges
- Maintains large clearances between hull and structure
- ISO 17357-1:2014 compliant

APPLICATIONS

- LNG
- FSU/FSRU vessels
- Bunkering vessels
- Oil and gas tankers
- Fast ferries and aluminum vessels
- Temporary and permanent installationsl
- Rapid response and emergencies

Pneumatic fenders' unique offering extends to enhanced commercial support.

Trelleborg pneumatic fenders offering include options to either buy or rent, so that operators can align solutions to their operations and financial situation, selecting whichever option best fits their overall needs.

- Customers can buy or rent from globally available stock.
- Rental can either be on a long or short-term basis.
- Trelleborg also offers a 'buy-back' option, and in select cases customers can even buy previously used fenders.
- If a bespoke fender size or type is required, the Trelleborg factory will design and manufacture a project-specific solution in a timely and cost-effective way.

This commercial flexibility is intended to help owners and operators maintain efficient logistics and improve supply chain excellence, while ensuring the highest quality standards to operate safely and efficiently.

Unique servicing and support

Trelleborg is committed to providing the highest quality standards, to ensure safe and efficient operations, from product supply to supporting services.

Our offering provides customers with a single point of contact for consulting and supply, from product specification, to delivery, through to comprehensive field services.

SUPPORT SERVICES INCLUDE:

- Fender selection
- Specification advice
- Chain tire net fitting
- Mobilization
- Certification & documentation
- Maintenance & repair

Support wherever you need it

Whatever the cargo being transferred, ship-to-ship mooring demands exceptional levels of safety, reliability and responsiveness to guarantee efficient and cost-effective operations across the world.

That means selecting and maintaining an appropriate fender system, and being able to mobilize it quickly. With Trelleborg pneumatic fenders, we hold new stock in three strategic locations, ensuring fast global delivery through our comprehensive transport and logistics network.

3 Strategic Stock Locations

Fast and easy to deploy, the ISO 17357-1:2014 compliant Trelleborg pneumatic fenders ensure clearance is maintained between the hull and jetty or other vessels. Risk of damage during mooring is minimized, protecting people and cargo.

Trelleborg pneumatic fenders require minimal maintenance, so costs are kept down. Constructed of several layers of thick rubber and strong tire cord reinforcement, they will not deteriorate under cyclic loads and a high level of buoyancy is maintained. Air has consistent elasticity and compressibility, ensuring continual performance.

Ideal for permanent and semi-permanent port and ship-to-ship transfers. They support berthing at angles up to 15 degrees for advanced vessel types such as ULCC, FLNG, FSRU, FSU, FSO, FPSO, LNG and bulk carriers. Due to the hollow construction, these fenders are lighter and easier to handle than solid rubber models.

The new design meets even the harshest conditions and toughest challenges. All products are manufactured by Trelleborg in-house, ensuring full control over quality at every stage of production.

DISCLAIMER

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

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

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