

Pneumatic Fenders

ISO17357-1-2014 compliant & manufactured in accordance with PIANC 2002 guidelines

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 Fenders

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.

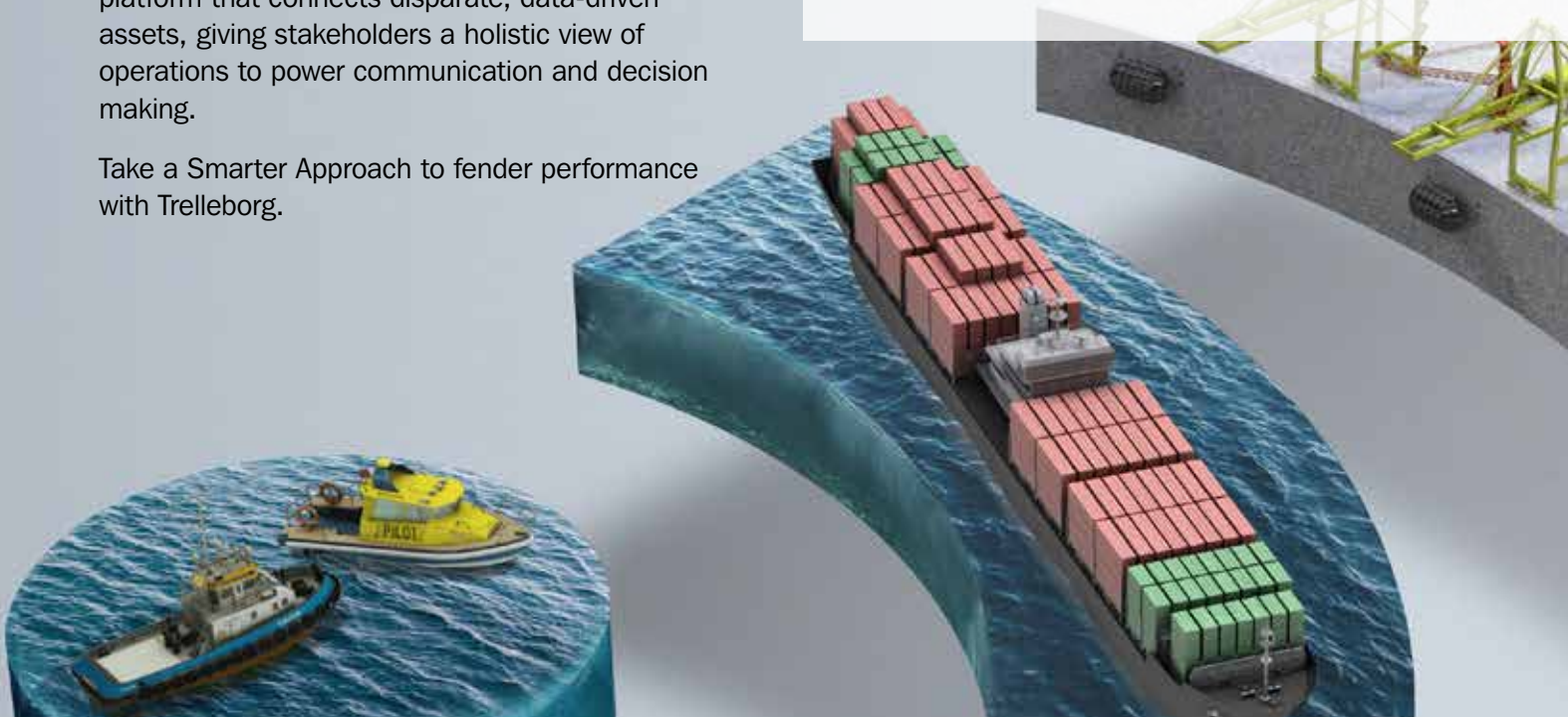
Trelleborg's fender systems can be integrated with SmartPort. SmartPort by Trelleborg is a technology platform that connects disparate, data-driven assets, giving stakeholders a holistic view of operations to power communication and decision making.

Take a Smarter Approach to fender performance with Trelleborg.

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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 minimize 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 6 x 11.5 meter 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 utilize 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.

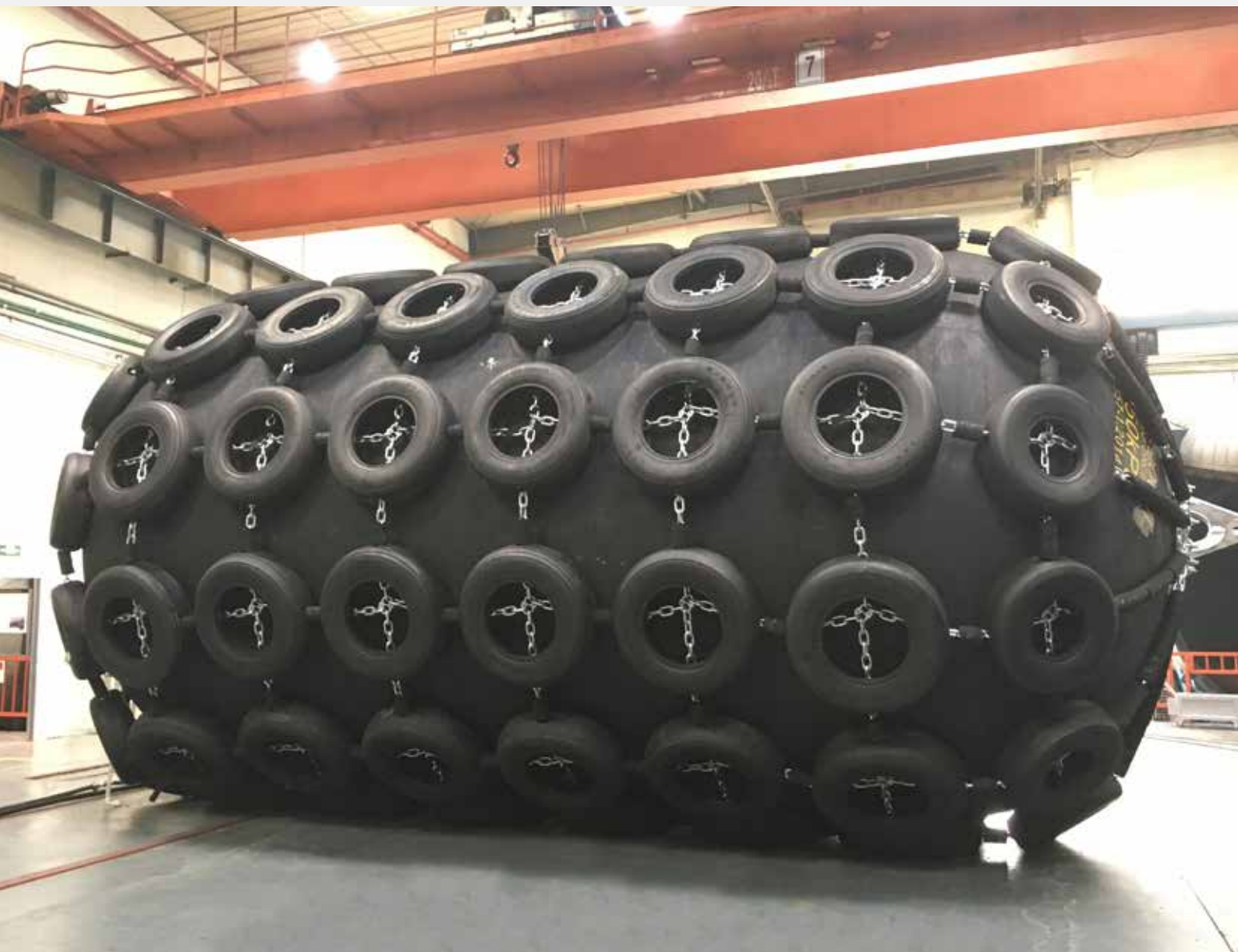
MAXIMUM PERMISSIBLE SERVICE LIFE

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.

FENDERS WITH LOW HULL PRESSURE

Provides lowest and uniform hull pressure.

Pneumatic Fenders Specification



ISO 17357-1:2014 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

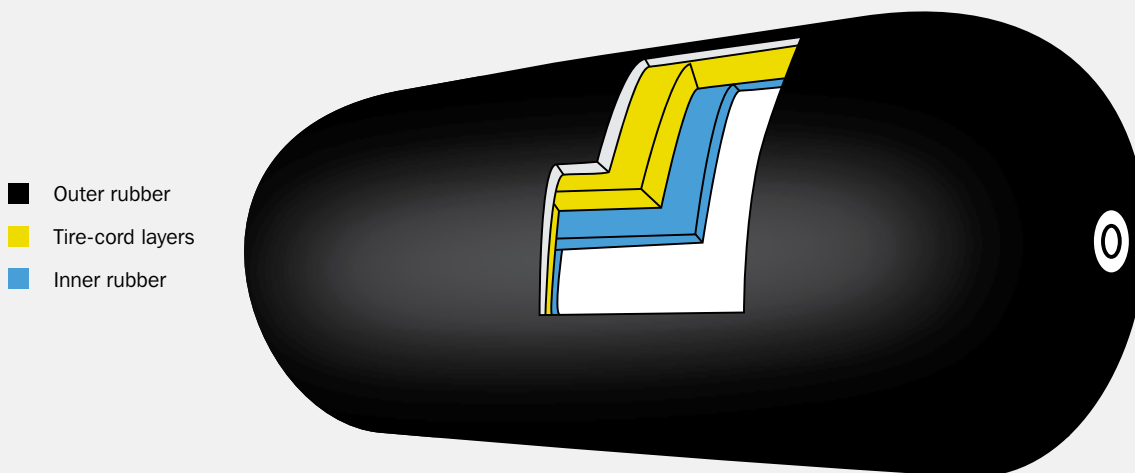
The tough abrasion resistant outer rubber is designed to protect the inner rubber and tire-cord layers from damaging external forces. The material has mechanical properties to withstand the arduous operational conditions for which it is designed. The diagram below shows the actual properties as specified 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.



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

Types of Fenders

The two most common types of pneumatic fenders that are compliant with the international standard ISO 17357-1:2014 are type I – chain-tire-net (CTN) type fenders and type II – sling type fenders.

The type of fender to be used depends on its application, usage and the requirements of the facility.

TYPE I: CHAIN-TIRE-NET (CTN) TYPE

We are using hammerlock not shackle at intersection.

CTN is a lattice of tires connected by a network of longitudinal and lateral chains for extra protection to the fender body. Trelleborg's Type 1 fenders use galvanized chains for greater corrosion resistance.

Rubber sleeves are inserted over the chains to prevent abrasion of the rubber surface of the fenders. The chains are fastened with hammerlock at each intersection.

High Protection CTN has extra rolls of tires on the shoulders of the fenders while Standard Protection CTN is equipped with rubber sleeves on the shoulder chains.



Type I Standard Protection Fender showing the CTN



Type I High Protection Fender showing the extra rolls of shoulder tires

TYPE II: SLING OR HOOK TYPE

Sling or hook type fenders are effectively Type I fenders with lifting / towing eyes fitted to each end without the CTN. The fenders can be slung by chains or wire ropes during operation. Type II fenders are available across the entire range of sizes.



Type II Sling Type Fender with lifting eye at both ends

Construction

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

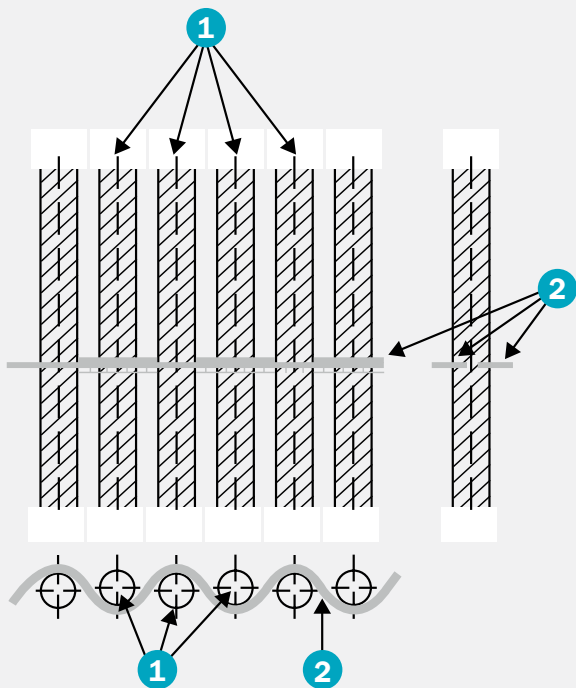
OUTER AND INNER RUBBER MATERIAL PROPERTIES REQUIREMENTS

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. 70°C +/- 1°C. 96 h	Air oven ageing. 70°C +/- 1°C. 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% (70°C +/- 1°C 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 40°C 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.



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

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

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.

FENDER SIZE	INNER PRESSURE	AVERAGE BODY WEIGHT (kg)	CTN WEIGHT (TTSP) (kg)	CTN WEIGHT (ATSP) (kg)	CTN WEIGHT (TTHP) (kg)	CTN WEIGHT (ATHP) (kg)
1000 × 1500	50Kpa	95	167	215		
	80Kpa	130				
1000 × 2000*	50Kpa	120	176	224		
	80Kpa	136				
1200 × 2000	50Kpa	125	216	276		
	80Kpa	155				
1350 × 2500	50Kpa	210	327	417		
	80Kpa	245				
1500 × 3000*	50Kpa	305	374	416	555	688
	80Kpa	365				
1700 × 3000	50Kpa	380	399	507	514	682
	80Kpa	380				
2000 × 3500*	50Kpa	530	580	661	791	903
	80Kpa	600				
2500 × 4000	50Kpa	850	961	1094	1401	1625
	80Kpa	980				
2500 × 5500*	50Kpa	1150	1153	1251	1507	1731
	80Kpa	1320				
3300 × 4500	50Kpa	1250	1439	1551	1910	2099
	80Kpa	1470				
3300 × 6500*	50Kpa	1600	2263	2487	2821	3136
	80Kpa	1965				
3300 × 10600	50Kpa	2605	3807	4199	4948	5515
	80Kpa	2965				
4500 × 9000*	50Kpa	3750	4297	4717	5326	5914

Weights may vary slightly dependent on Fender Type I or II, and/or within the weight deviation tolerances accepted within ISO17357-1:2014 standards.

* Fast deliveries available ex-stock from Trelleborg.

NON-STANDARD SIZES

SIZE (OD X L) (mm)	SIZE (OD X L) (mm)
300 x 500	1700 x 7200
300 x 600	2000 x 3000
500 x 800	2000 x 6000
500 x 1000	3000 x 5000
700 x 1500	4500 x 6400
1200 x 1800	4500 x 7000
1500 x 2500	4500 x 12000

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

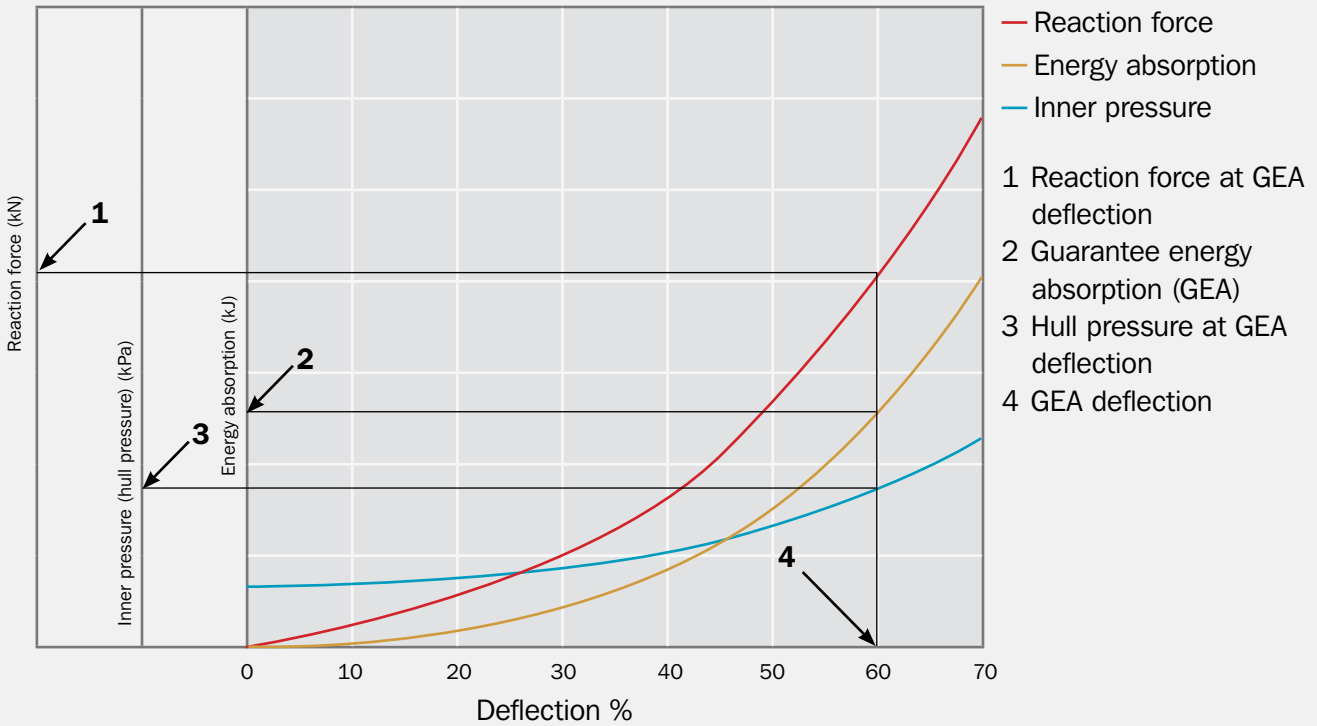


Product Characteristics

PERFORMANCE DATA

DIAMETER × LENGTH (mm)	50kPa			80kPa		
	PERFORMANCE DATA			PERFORMANCE DATA		
	HULL PRESSURE AT GEA / kN / m ²	RF AT GEA / kN	GEA / kNm	HULL PRESSURE AT GEA / kN / m ²	RF AT GEA / kN	GEA / kNm
1000 x 1500	122	182	32	160	239	45
1000 x 2000	132	257	45	174	338	63
1200 x 2000	126	297	63	166	390	88
1350 x 2500	130	427	102	170	561	142
1500 x 3000	153	579	153	174	761	214
1700 x 3000	128	639	191	168	840	267
2000 x 3500	128	875	308	168	1150	430
2500 x 4000	137	1381	663	180	1815	925
2500 x 5500	148	2019	943	195	2653	1317
3300 x 4500	130	1884	1175	171	2476	1640
3300 x 6500	146	3015	1814	191	3961	2532
3300 x 10600	158	5257	3067	208	6907	4281
4500 x 9000	146	5747	4752	192	7551	6633

PERFORMANCE CURVE



Product Characteristics

PRESSURE RATINGS

Trelleborg Marine Systems manufactures fenders with two initial 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

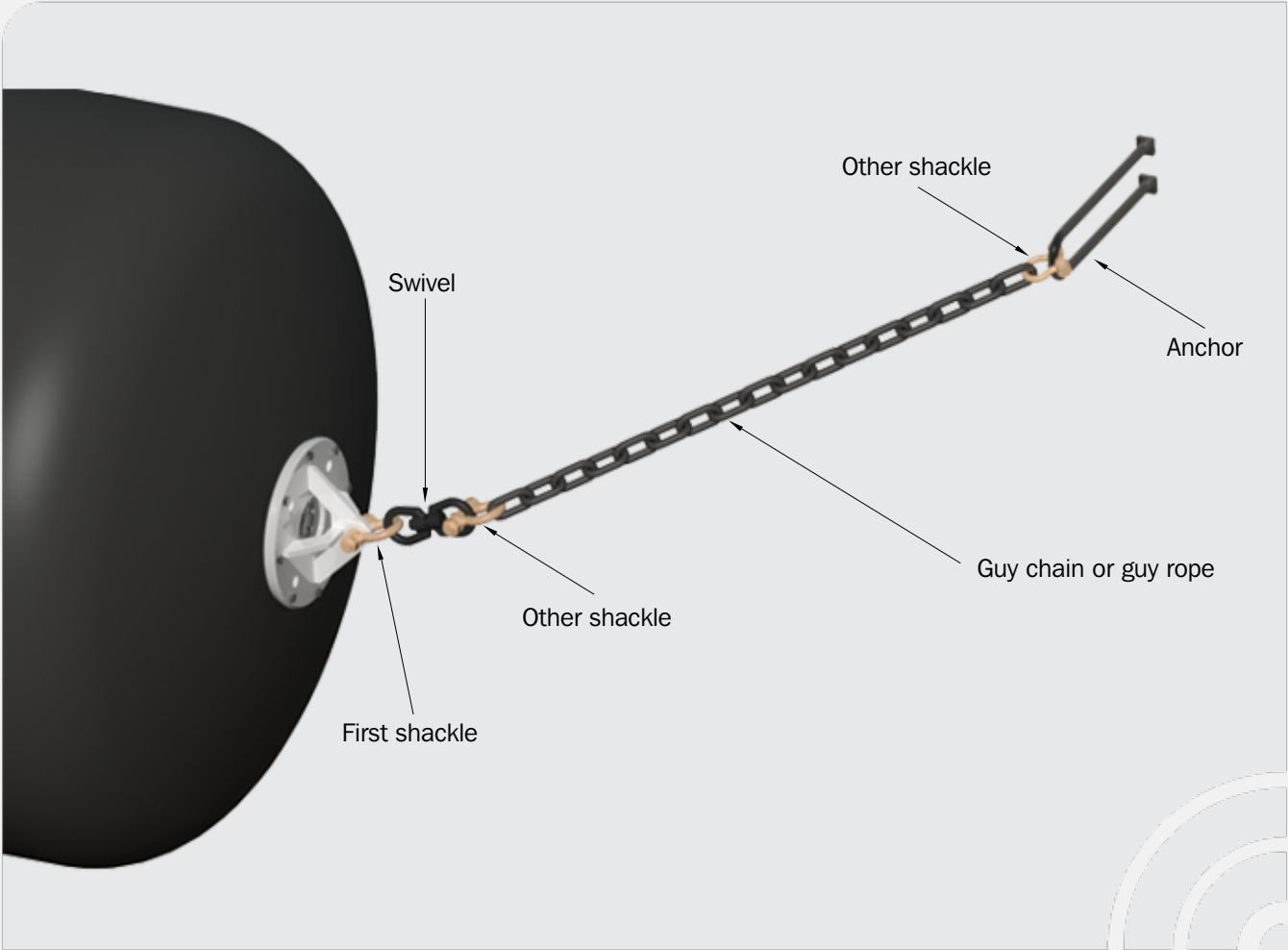
Test and Inspection Requirements

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: <ul style="list-style-type: none"> ■ 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.

End Fittings



Pneumatic fenders are often suspended using chains and shackles. Please refer to the table below for our recommended dimensions.

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 CHAIN DIAMETER mm (inch)	GUY ROPE DIAMETER mm (inch)	ANCHOR DIAMETER mm (inch)
SIZE (OD X L) (mm)	INITIAL PRESSURE (kPa)						
1000 x 1500	50	22 (7/8)	19 (3/4)	22 (7/8)	22 (7/8)	16 (5/8)	25 (1)
1000 x 2000	50	22 (7/8)	19 (3/4)	22 (7/8)	22 (7/8)	16 (5/8)	25 (1)
1200 x 1800	50	25 (1)	22 (7/8)	25 (1)	25 (1)	18 (11/16)	25 (1)
1200 x 2000	50	25 (1)	22 (7/8)	25 (1)	25 (1)	18 (11/16)	25 (1)
1350 x 2500	50	25 (1)	22 (7/8)	25 (1)	25 (1)	18 (11/16)	25 (1)
1500 x 2500	50	25 (1)	25 (1)	25 (1)	25 (1)	20 (13/16)	32 (1-1/4)
1500 x 3000	50	25 (1)	25 (1)	25 (1)	25 (1)	20 (13/16)	32 (1-1/4)
1700 x 3000	50	25 (1)	25 (1)	25 (1)	25 (1)	22 (7/8)	32 (1-1/4)
2000 x 3000	50	25 (1)	32 (1-1/4)	25 (1)	25 (1)	24 (15/16)	32 (1-1/4)
2000 x 3500	50	25 (1)	32 (1-1/4)	25 (1)	25 (1)	24 (15/16)	32 (1-1/4)
2000 x 6000	50	35 (1-3/8)	38 (1-1/2)	35 (1-3/8)	35 (1-3/8)	35(1-3/8)	42 (1-5/8)
2500 x 4000	50	32 (1-1/4)	38 (1-1/2)	32 (1-1/4)	32 (1-1/4)	30(1-3/16)	42 (1-5/8)
2500 x 5500	50	35 (1-3/8)	38 (1-1/2)	35 (1-3/8)	35 (1-3/8)	35(1-3/8)	44 (1-3/4)
3000 x 5000	50	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	35(1-3/8)	44 (1-3/4)
3300 x 4500	50	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	35(1-3/8)	44 (1-3/4)
3300 x 6500	50	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	38 (1-1/2)	42(1-5/8)	55 (2-3/16)
4500 x 9000	50	50 (2)	64 (2-1/2)	50 (2)	50 (2)	54(2-1/8)	75 (3)

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 CHAIN DIAMETER mm (inch)	GUY ROPE DIAMETER mm (inch)	ANCHOR DIAMETER mm (inch)
SIZE (OD X L) (mm)	INITIAL PRESSURE (kPa)						
1000 x 1500	80	22 (7/8)	19 (3/4)	22 (7/8)	22 (7/8)	16 (5/8)	25 (1)
1000 x 2000	80	22 (7/8)	19 (3/4)	22 (7/8)	22 (7/8)	16 (5/8)	25 (1)
1200 x 1800	80	25 (1)	22 (7/8)	25 (1)	25 (1)	18 (11/16)	25 (1)
1200 x 2000	80	25 (1)	22 (7/8)	25 (1)	25 (1)	18 (11/16)	25 (1)
1350 x 2500	80	25 (1)	22 (7/8)	25 (1)	25 (1)	20 (13/16)	25 (1)
1500 x 2500	80	25 (1)	25 (1)	25 (1)	25 (1)	24 (15/16)	32 (1-1/4)
1500 x 3000	80	25 (1)	25 (1)	25 (1)	25 (1)	24 (15/16)	32 (1-1/4)
1700 x 3000	80	25 (1)	25 (1)	25 (1)	25 (1)	24 (15/16)	32 (1-1/4)
2000 x 3000	80	28 (1-1/8)	32 (1-1/4)	28 (1-1/8)	28 (1-1/8)	28(1-1/8)	36 (1-7/16)
2000 x 3500	80	28 (1-1/8)	32 (1-1/4)	28 (1-1/8)	28 (1-1/8)	28(1-1/8)	36 (1-7/16)
2000 x 6000	80	38(1-1/2)	44(1-3/4)	38(1-1/2)	38(1-1/2)	40(1-9/16)	42 (1-5/8)
2500 x 4000	80	35(1-3/8)	38(1-1/2)	35(1-3/8)	35(1-3/8)	32(1-1/4)	42 (1-5/8)
2500 x 5500	80	38(1-1/2)	44(1-3/4)	38(1-1/2)	38(1-1/2)	40(1-9/16)	44 (1-3/4)
3000 x 5000	80	38(1-1/2)	44(1-3/4)	38(1-1/2)	38(1-1/2)	38(1-1/2)	44 (1-3/4)
3300 x 4500	80	38(1-1/2)	44(1-3/4)	38(1-1/2)	38(1-1/2)	38(1-1/2)	50 (2)
3300 x 6500	80	48 (1-7/8)	50 (2)	48 (1-7/8)	48 (1-7/8)	46(1-13/16)	60 (2-3/8)
4500 x 9000	80	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)	64 (2-1/2)	65(2-9/16)	75 (3)

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



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.

To complete Trelleborg's range of pneumatics fenders the Hydro-pneumatic fenders 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.

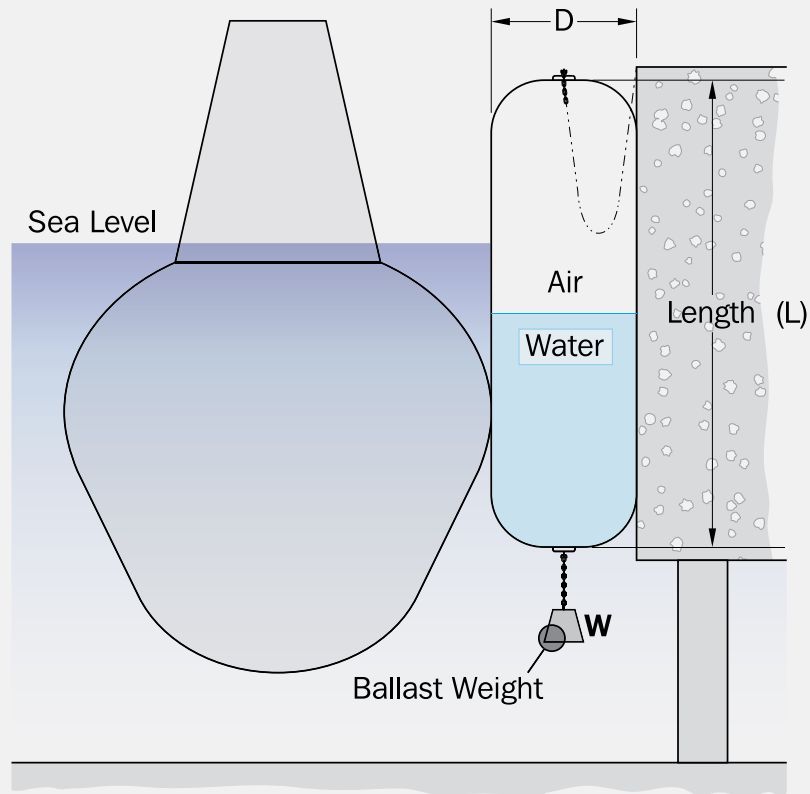
FEATURES

- 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 Fenders



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 FENDER WEIGHT (kg)	LIGHTWEIGHT FENDER 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 FENDER WEIGHT (kg)	LIGHTWEIGHT FENDER 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

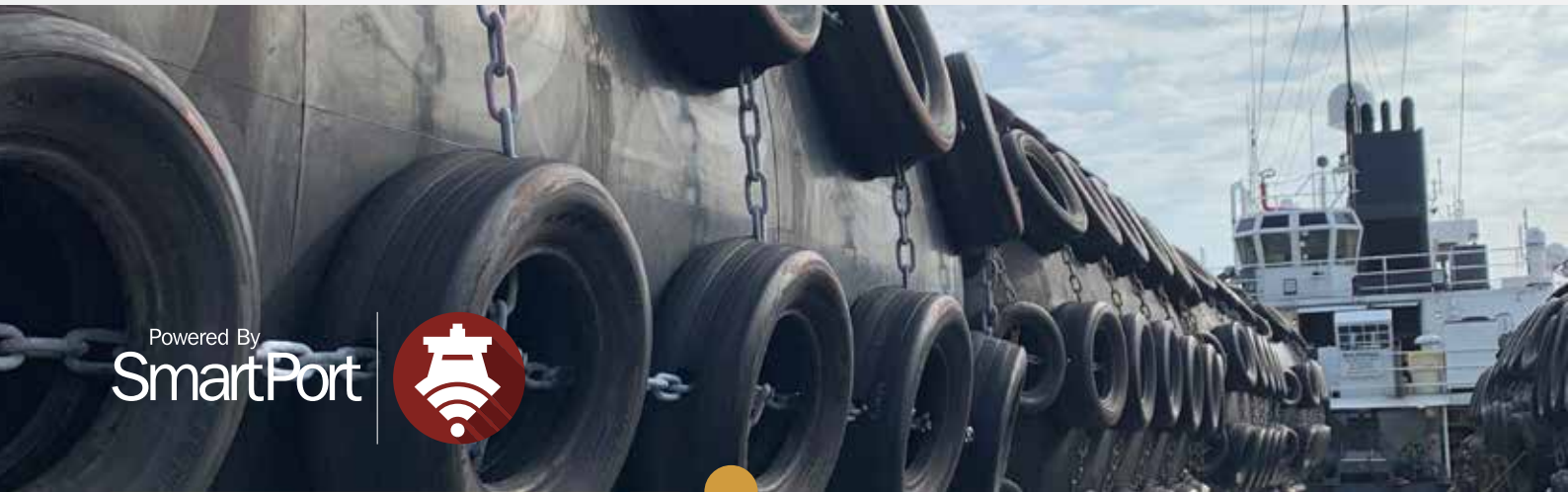
* Fender body weight variability subject to improved technical process.

* 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

Pneumatic SmartFenders



Powered By
SmartPort



Pneumatic SmartFender can help extend asset life, prevent downtime and optimize maintenance schedules.

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 SMARTFENDERS

SmartFenders help improve the operational efficiency of offshore mooring and transfer operations by:

- Ensuring asset operability, avoiding downtime linked to misplacement or insufficient pressure
- Assessing fender status, facilitating preventative maintenance to optimize fender utilization and extend asset life
- Augmenting situational awareness in remote offshore operations
- Providing insight in fender occupancy, building an understanding of infrastructure utilization and future investment optimization
- Digitizing and simplifying asset records, enabling easy access to material specifications, drawings and other statutory information.

PNEUMATIC SMARTFENDERS

The pneumatic SmartFenders continuously monitor fender location and performance, providing valuable insights that can help extend asset life, prevent downtime and optimize maintenance schedules.

The connected fender monitors internal pressure, temperature and geographical location, ensuring asset operability in even the most remote locations.

Generated data is wirelessly sent to the SmartPort cloud, where it is processed and stored. Using the SmartPort user interface accessed on a smartphone or tablet, users can be made aware of unnatural fender behavior and have an instant fender status update.

The pneumatic SmartFenders by Trelleborg are powered by SmartPort technology and can be integrated with other products in the SmartPort portfolio. The assets are connected through the SmartPort cloud, providing a complete overview of the port and vessel interface in one common user interface.

HOW DO SMARTFENDERS WORK?

Pneumatic SmartFenders are equipped with sensors, tracking internal pressure, temperature and geographic positioning. Data is then wirelessly transferred to the SmartPort cloud, where it's processed and stored. Using a smartphone, tablet or desktop, the user interface can be accessed, and data assessed and analyzed. Customized alarms can further be added, ensuring that any anomalies are highlighted and dealt with.

KEY FEATURES

Real-time interface

Delivered via an iOS or Android downloadable app, the SmartFenders' intuitive interface makes fender performance monitoring easy to access and interpret. It is compatible with, and integrates into, existing third-party systems for further ease of use.

Customizable functionality

Pneumatic SmartFenders offer customizable functionality to suit specific port and terminal requirements. Abnormal performance is easily identified using the alarm function, providing immediate preventative maintenance benefits. Any abnormal events can be revisited and assessed.

Digital asset registers

The SmartFender software comprises statutory information and logs for each individual unit. Certifications, technical information and maintenance logging for each individual fender can now be accessed through one common platform.

Purchase and 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 installations

Rapid response and emergencies

Pneumatic fenders' unique offering extends to enhanced commercial support.

Trelleborg pneumatic fender 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.

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.

Fender Online Tool

Try our fender online tool, with enhanced features, including specification generators for fenders and bollard and a fender system selector for ship-to-ship applications.



Ensure fender selection meets required berthing energy specifications and deliver best in class, compliant solutions with Trelleborg's fender online tool. Developed in accordance with PIANC guidelines and British Standards, the tool uses innovative modelling technology to reduce a task that would typically take hours of manual calculation to just a few simple clicks.

Designed to allow specifiers to select and specify the most appropriate fender for their application, the tool's capabilities include:

- A Fender System Selector for Ship-to-Ship Applications
- A Vessel Berthing Energy Calculator
- A Fender Selection Tool
- A Fender Specification Generator
- A Bollard Specification Generator

Users receive a number of fender system options, allowing them to further refine their inputs using different filters to arrive at the most appropriate solution.

To explore the tool, visit:



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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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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