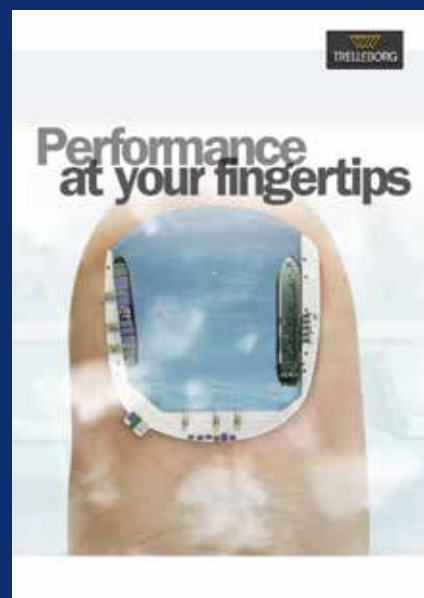


Floating Fenders



Performance People

The demanding nature of commercial ports and terminals means you need to connect with a partner that provides much more than technically superior products and technologies.



You need to work with a partner that combines best practice expertise gained through worldwide experience with a deep understanding of local requirements and regulations.

This global reach combined with feet on the ground local presence helps to make Trelleborg the Performance People that ensure solutions continually enhance your operations.

Connect with a partner that provides Performance Assurance services from conception to completion of every project and beyond to maintain and enhance port and vessel performance.

**Connect with the Performance People,
Trelleborg Marine Systems.**

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Floating Fenders

Super tough Trelleborg floating fenders harness the compressibility and elasticity of air to ensure highly consistent performance. Taking the pressure off in a variety of environments these versatile fenders maintain a large clearance between hull and jetty or other vessels.

Pneumatic designs are fast and easy to deploy and keep costs down through low maintenance. Constructed from several layers of thick rubber, strong nylon fabric and tyre cord they will not deteriorate under cyclic loads and a high level of buoyancy is maintained.

Foam fenders employ a closed cell structure keeping water out. The skin and reinforcement are applied simultaneously giving unrivalled durability – a process unique to Trelleborg.

Be sure with Floating Fender Systems from Trelleborg.



WHAT END-TO-END REALLY MEANS

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.

CONSULTATION

Consultation to assist you at the earliest stage of your project, with full technical support available from our global office network



CONCEPT

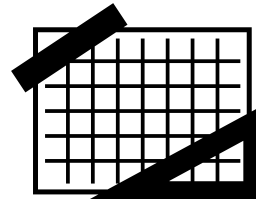
Conceptual design in our local office – with full knowledge of local standards and regulations, delivered in your language

DESIGN

Concepts taken to our global design center in India where our team generates 3D CAD designs, application-engineering drawings, bill of materials, Finite Engineering Analysis and calculations

MANUFACTURE

Designs for all components sent to appropriate Trelleborg manufacturing facilities. Steel fabricated by trusted partner and rubber is manufactured in Trelleborg facilities

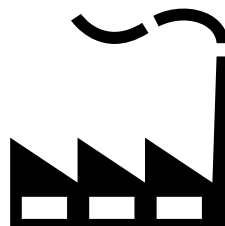


TESTING

Full testing conducted routinely during all stages of manufacture, from laboratory tests on material samples to full scale Factory Acceptance Tests

INSTALLATION

Dedicated project management from solution design right the way through to on site installation support



MAINTENANCE

Full after sales support, including product training, operator training, spare parts and maintenance program

Pneumatic Rubber Fenders (PNE)

Pneumatic rubber fenders are ideal for permanent and semi-permanent port and ship-to-ship transfers requiring minimal maintenance, so costs are kept down.

Driven by the challenges facing port and harbour owners our teams have developed a new range of pneumatic rubber fenders. Fast and easy to deploy, these ISO 17357:2002 compliant fenders ensure large clearances are maintained between the hull and jetty or other vessels. Risk of damage during mooring is minimised, protecting people and cargo.

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

Pneumatic rubber fenders are ideal for permanent and semi-permanent port and ship-to-ship transfers. They support berthing at angles up to 15 degrees and for newer vessel types, such as ULCCs, LNG and bulk carriers, FSOs and FSPOs. Due to the hollow construction these fenders are lighter and easier to handle than solid rubber models.

With over a century innovating rubber technology, Trelleborg Marine Systems have the knowledge and expertise. We design with the harshest conditions and your toughest challenges at the forefront, manufacturing end-to-end in our own production facility. Meaning quality and performance is the best available.

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

Applications

Oil and gas tankers

Fast ferries and aluminium vessels

Temporary and permanent installations

Rapid response and emergencies



Proven in practice

1	4
2	5
3	6
	7
	8



- 1. Italy
- 2. Malta
- 3. Holland
- 4. UAE
- 5. Croatia
- 6. Poland
- 7. Scotland
- 8. Japan



Pneumatic Rubber Fenders

Construction

ISO Standard

All Trelleborg Marine Systems pneumatic rubber fenders are manufactured and 3rd party certified in compliance with ISO 17357:2002. 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 17357:2002 details three major elements of construction: the outer rubber, tyre-cord reinforcing layer and the inner rubber.

Tyre-cord Layer

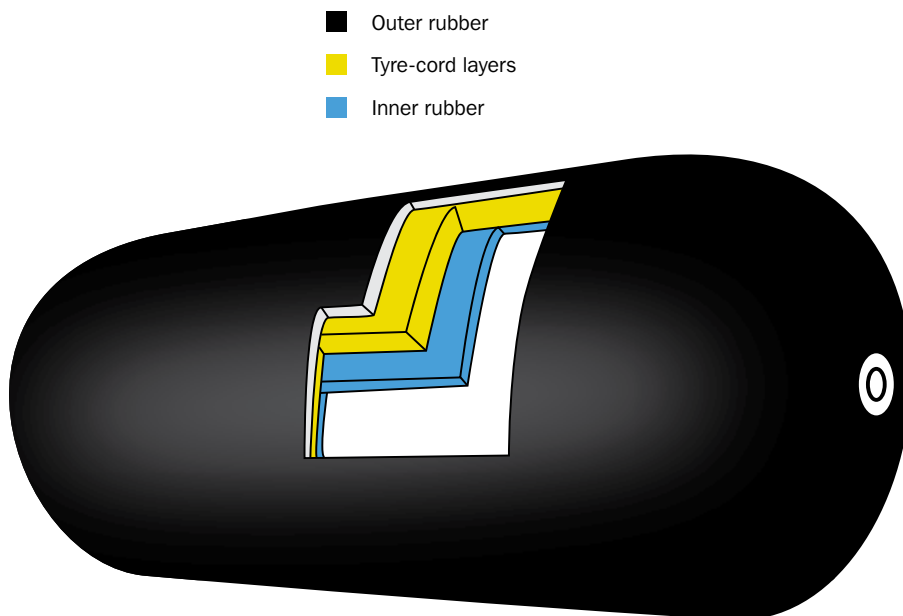
Synthetic tyre-cord layers have proven to be the best option for strong, efficient reinforcement for pneumatic rubber fenders. Each layer is coated with a rubber compound on both sides that prevents contact between the layers, reducing friction and wear during bending, compression and stretching. The 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.

Outer Rubber

The tough abrasion resistant outer rubber is designed to protect the inner rubber and tyre-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. Generally, the outer rubber is black, but other colours such as grey and off-white can be supplied upon request.

Inner Rubber

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



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

Pneumatic Rubber Fenders

Construction

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

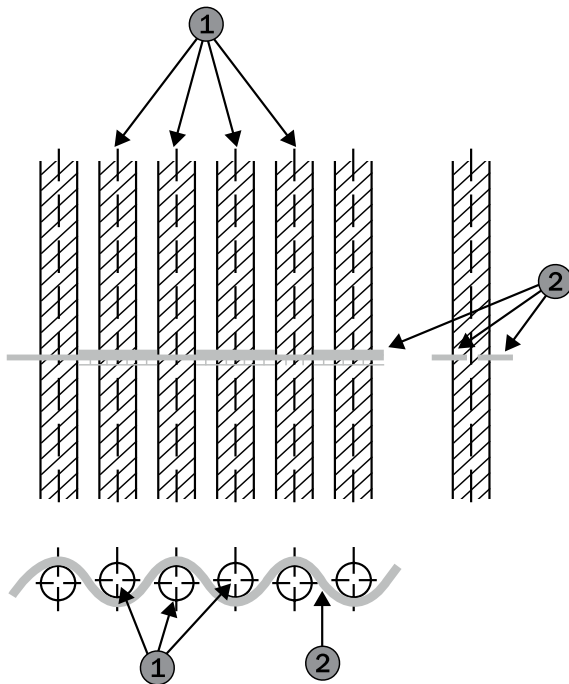
Outer and Inner Rubber Material Properties Requirements

Test item	Test method	Required value	
		Outer rubber	Inner rubber
Before ageing			
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 ppm ¹ at 40°C for 96 h.	No requirement

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

1 ppm: parts of ozone per hundred million of air by volume

Properties of the inner and outer rubber as adapted from ISO 17357: 2002 Ships and Marine Technology –High-pressure Floating Pneumatic Rubber Fenders.



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

Construction of tyre-cord layers as adapted from ISO 17357.

Pneumatic Rubber Fenders

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

Test	Standard	Description	Remarks
Material Testing	ISO 17357/ PIANC Guidelines for design of fender system: 2002	Physical properties of inner and outer rubber	Tensile/elongation/hardness before ageing to be tested once for each order. Rest of the test to be conducted once in 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

Hydrostatic Pressure Test



Fender on the ground



Pressure 250kPa.s



Circumferential and longitudinal mark



Measuring the length

Pneumatic Rubber Fenders

Product Characteristics

Standard Sizes

Regardless of type or pressure, fenders are measured by diameter and length, generally expressed in millimetres (mm). Type I (chain-tyre net) fenders are not

manufactured below 800 x 1200 and all fenders above 2500 mm in diameter are fitted with a pressure relief valve in accordance with ISO 17357.

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

Approximate weights for Trelleborg Marine Systems fenders.

Non-standard Sizes

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

Some applications may require a size of fender that is outside those specified in the standards. Trelleborg Marine Systems can make fenders to customer specifications.



4500 x 9000 mm Type I fender.

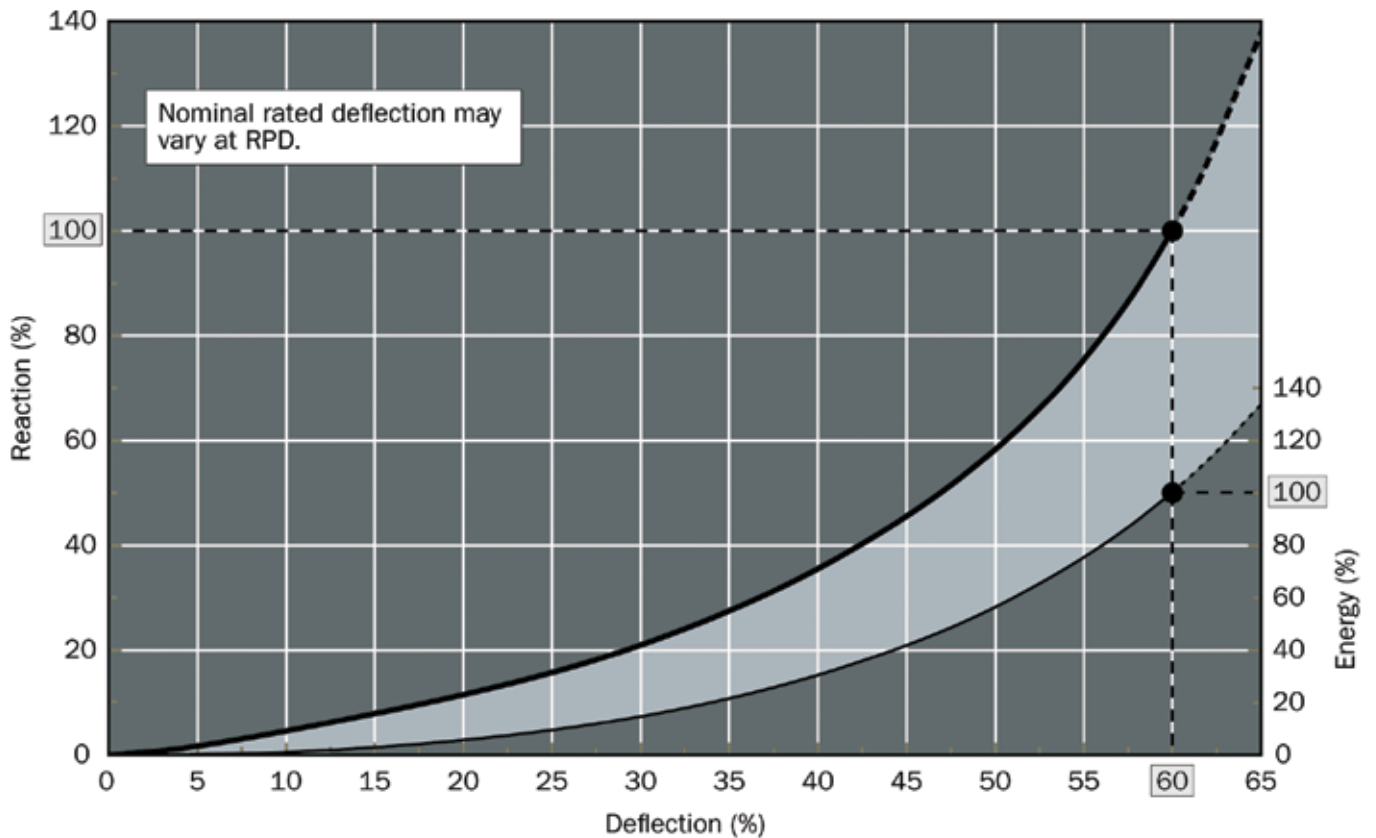
Pneumatic Rubber Fenders

Product Characteristics

Performance Data

Initial Pressure	50kPa = 0.5kgf/cm ² = 7.1psi			80kPa = 0.8kgf/cm ² = 11.4psi		
Size (OD x L) (mm)	Energy (kNm)	Reaction (kN)	Pressure (kN/m ²)	Energy (kNm)	Reaction (kN)	Pressure (kN/m ²)
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



Note: Standard manufacturing and performance tolerance:
 Energy: 100%, Reaction: 100 ± 10%, Deflection: 60 ± 5%

Pneumatic Rubber Fenders



Measuring the length

2500mm x 4000mm fender



Measuring the circumference

Parallel Compression Test



Pressure 80kPa



Parallel compression test



Parallel compression test 60%

Pneumatic Fender size: 1000mm diameter x 1500mm length

Pneumatic Rubber Fenders

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 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	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

Pneumatic Rubber Fenders

Types of Fenders

There are two basic types of pneumatic fenders that comply with the international standard ISO 17357: Type I (net type) and Type II (sling type). The most appropriate type for a given application will depend upon how it is to be used and what the requirements of the facility are.

Type I

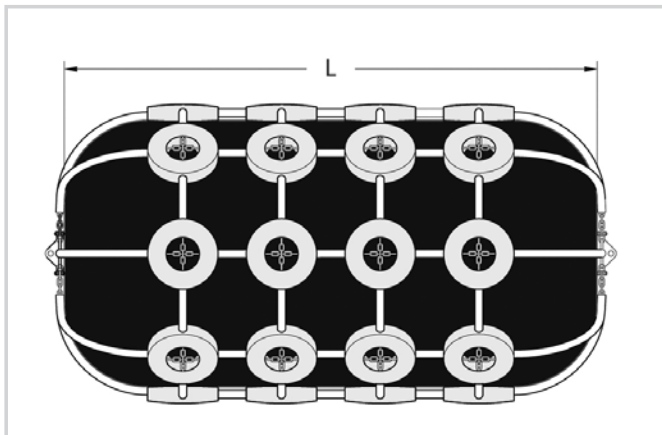
Trelleborg Type I fenders are fitted with a chain-tyre net (CTN). This is a lattice of used tyres connected by a network of horizontal and vertical chains, which adds further protection to the fender body. The chains are galvanised for greater corrosion resistance and covered by rubber sleeves to prevent abrasive damage to the outer

rubber. The horizontal chains are fastened at each end to a ring shackle. CTNs are not available on fender sizes below 800 x 1200 mm.

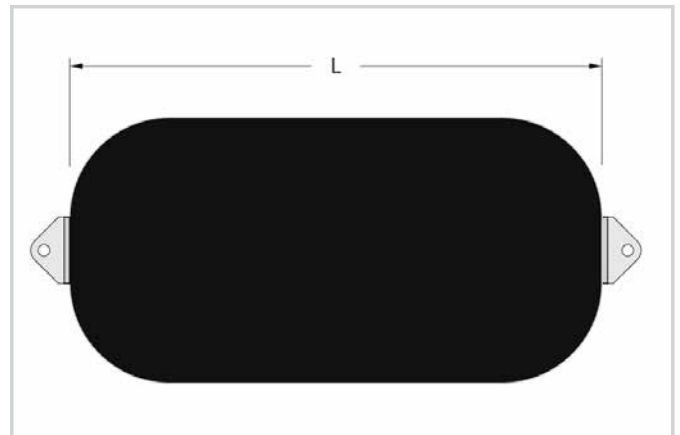
Type I fenders are the most common in use.

Type II

Sling or hook type fenders are effectively a Type I fender without the CTN and the ring shackles. 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.



Type I fender showing the chain-tyre net (CTN)



Type II fender showing the lifting eyes at both ends



Type II fender in operation



CTN chains connected to the ring shackle on a Type I fender

Pneumatic Rubber Fenders

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

Type 2 Fender (sling)		First Shackle Diameter (mm)	Swivel Diameter (mm)	Other Shackle Diameter (mm)	Guy Rope Diameter (mm)	Guy Chain Diameter (mm)	Anchor Diameter (mm)
Size (OD x L) (mm)	Initial Pressure (kPa)						
500 x 1000	50	16	16	22	16	16	25
1000 x 1500	50	16	19	22	16	16	25
1000 x 2000	50	16	19	22	16	16	25
1200 x 2000	50	16	19	22	16	16	25
1350 x 2500	50	18	19	22	18	16	25
1500 x 3000	50	18	22	24	20	19	32
2000 x 3500	50	20	28	26	24	22	32
2500 x 4000	50	28 (2)	32	32	30	26	42
2500 x 5500	50	32 (2)	38	34	34	32	44
3300 x 4500	50	32 (2)	38	36	34	30	44
3300 x 6500	50	40 (2)	44	44	42	38	55
3300 x 10600	50	Special towing ring 70 mm		60	52	48	75
500 x 1000	80	16	16	22	16	16	25
1000 x 1500	80	16	19	22	16	16	25
1000 x 2000	80	16	19	22	18	16	25
1200 x 2000	80	16	19	22	18	16	25
1350 x 2500	80	18	19	22	20	16	25
1500 x 3000	80	20	25	24	24	20	32
1700 x 3000	80	20	25	24	24	20	32
2000 x 3500	80	24	28	28	28	24	36
2500 x 4000	80	30 (2)	38	34	32	30	42
2500 x 5500	80	36 (2)	44	40	40	36	50
3300 x 4500	80	34 (2)	44	40	38	34	50
3300 x 6500	80	44 (2)	50	48	46	42	60
3300 x 10600	80	Special towing ring 70 mm		65	60	54	75

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

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 pressurised 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

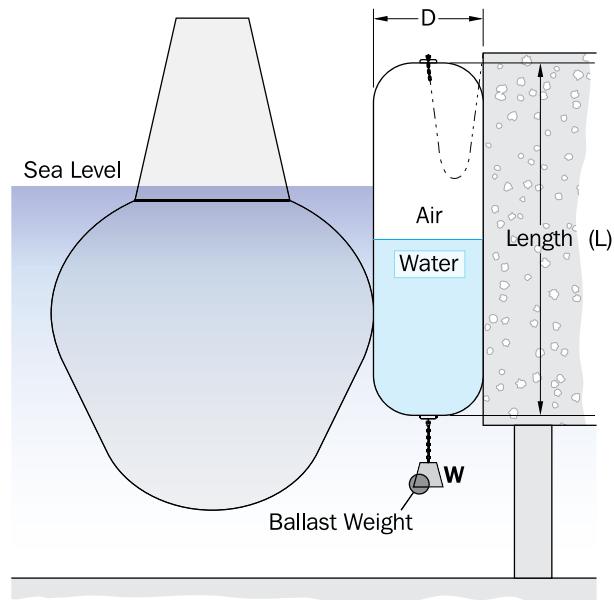
Prevents acoustic tile damage

Applications

Submarines

Some fast ferries

Semi-submersible oil rigs



Fender		Water (%)	D (%)	Initial Pressure 0.5bar (7.1psi)	
Diameter D(mm)	Length L(mm)			Energy (kNm)	Reaction (kN)
1700	7200	65	45	134	611
		0	60	592	1813
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	10500	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.

Foam Fenders

Trelleborg foam fenders absorb impacts whilst the skin resists wear and tear in an aggressive environment.

The Foam Fenders –SeaGuard, SeaCushion and Donut Fender share a construction technology centred on a closed-cell polyethylene foam core and an outer skin of reinforced polyurethane elastomer. The closed cell foam structure makes punctures a thing of the past. Every cell is separate and so water cannot migrate into the foam. Even after many years active service, the foam core can be returned to the factory, re-skinned and made ready for a new lease of life.

Fender	Features	Application
*SeaGuard®	Fully compliant with US Navy specifications Wide range of standard and custom sizes Low reaction and high energy options Operate floating or suspended No chain/tyre net required Non-marking even against white hulls Unsinkable design	Cruise ships Container vessels Bulk cargo RoRo and ferries Oil and gas tankers General cargo Navy berths Ship-to-ship transfers
SeaCushion®	Ultra-tough, unsinkable design Wide range of standard and custom sizes Low reaction and high energy options Low hull pressures Maintains safe stand-off distances Low maintenance Well proven design	LNG and oil terminals Ship-to-ship operations Offshore boat landings Shipyards Military applications
Donut Fenders	Freely rotates around a pile Rises and falls with water level Fast to install Requires minimal maintenance High performance Low hull pressures Will not mark ship hulls	Corner protection Turning structures Lead-in jetties Simple breasting dolphins Bridge protection RoRo berths



* SeaGuard® Fenders are ABS Type approved based on ABS rules and ASTM standard. It is voluntary and denotes excellence in manufacturing quality and performance.



Proven in practice

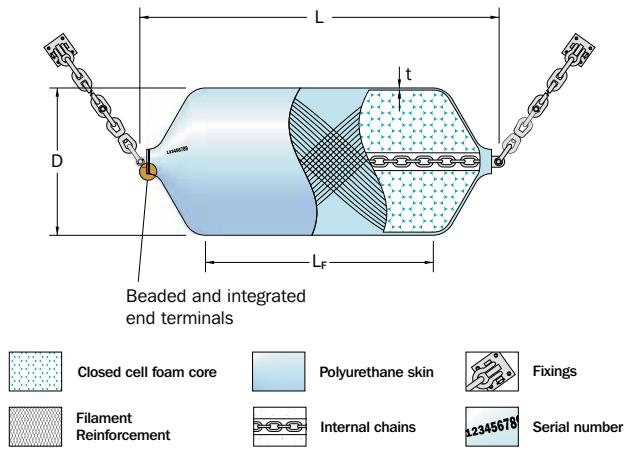
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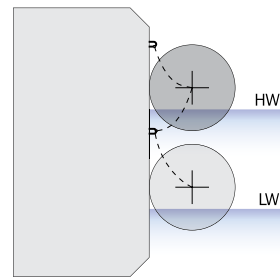
- 1. France
- 2. Japan
- 3. USA
- 4. Netherlands
- 5. USA
- 6. Norway
- 7. UAE
- 8. China



Foam Fenders – SeaGuard®

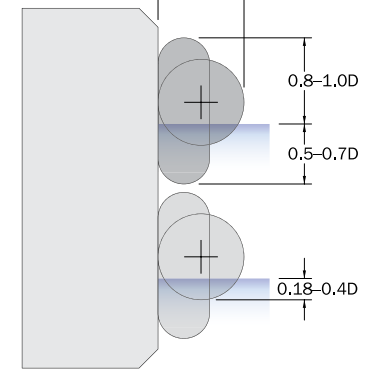


Mooring applications

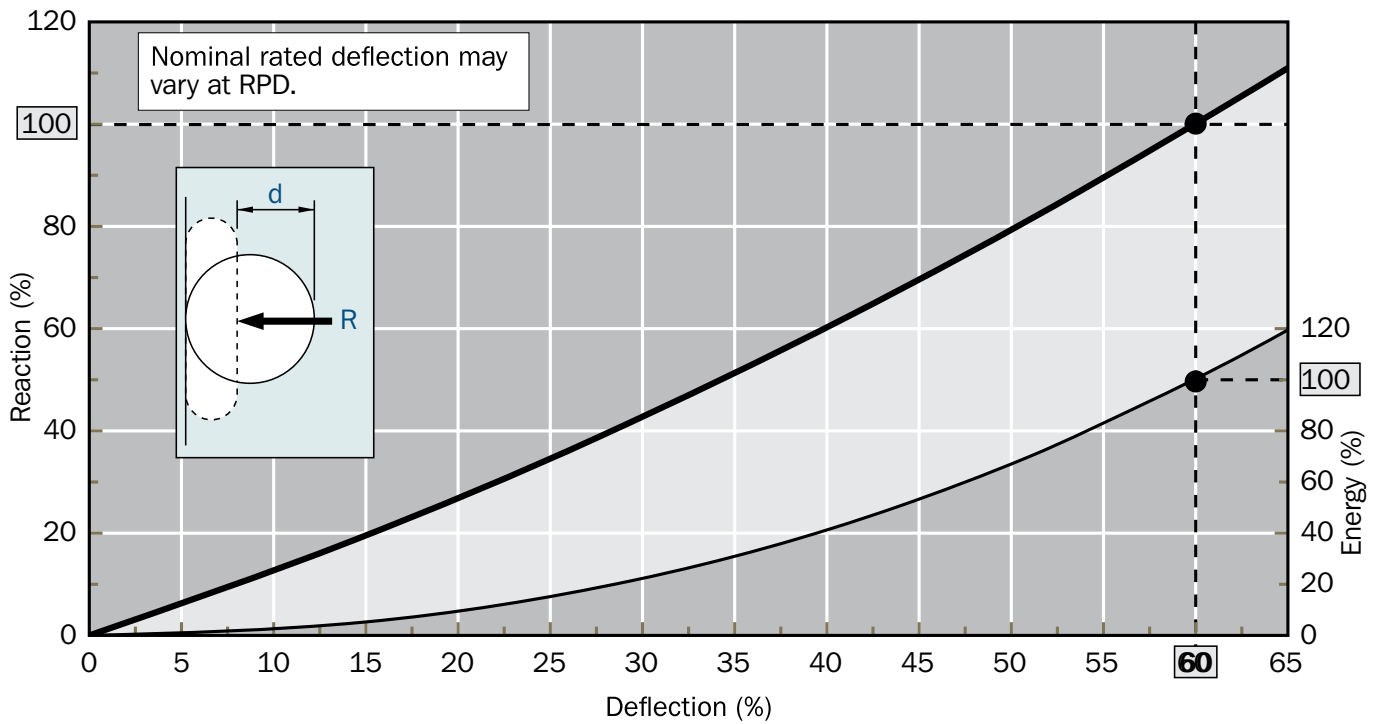


Floating or suspended

Mounting area



Supporting structures must be large enough to cope with tides and the fender footprint when compressed.



Note: Standard manufacturing and performance tolerance:
Energy: 100%, Reaction: 100%, Tolerance: $\pm 15\%$



USA



Puerto Rico

Standard manufacturing and performance tolerances apply. Refer to Design and Testing Manual.

M1100-S01-V1-3-EN © Trelleborg AB, 2014

Foam Fenders – SeaGuard®

Performance at 60% deflection

	Diameter x length		Standard capacity			
	(ft)	(m)	Energy (kNm)	Reaction (kN)	Energy (ft-kip)	Reaction (kip)
Metric	2.3 x 4.9	0.7 x 1.5	26	133	19	30
	3.3 x 4.9	1.0 x 1.5	47	173	35	39
	3.3 x 6.6	1.0 x 2.0	68	254	50	57
	3.9 x 6.6	1.2 x 2.0	91	280	67	63
	4.4 x 8.2	1.4 x 2.5	152	418	112	94
	5 x 10	1.5 x 3.0	244	596	180	134
	5.6 x 9.8	1.7 x 3.0	282	618	208	139
	6.6 x 11.5	2.0 x 3.5	454	845	335	190
	6.6 x 13.1	2.0 x 4.0	540	1005	398	226
	6.6 x 14.8	2.0 x 4.5	624	1161	460	261
	7.2 x 11.5	2.2 x 3.5	541	915	399	206
	7.2 x 13.1	2.2 x 4.0	643	1088	474	245
	7.2 x 14.8	2.2 x 4.5	746	1263	550	284
	7.2 x 16.4	2.2 x 5.0	847	1437	625	323
	7.2 x 19.7	2.2 x 6.0	1052	1784	776	401
	10 x 16	3.0 x 4.9	1464	1788	1080	402
	10 x 20	3.0 x 6.1	1946	2375	1435	534
	10.8 x 14.8	3.3 x 4.5	1498	1690	1105	380
10.8 x 21.3	3.3 x 6.5	2421	2731	1786	614	
Imperial	2 x 4	0.6 x 1.2	15	89	11	20
	2 x 6	0.6 x 1.8	24	147	18	33
	2 x 8	0.6 x 2.4	34	209	25	47
	2 x 10	0.6 x 3.0	43	267	32	60
	3 x 5	0.9 x 1.5	42	169	31	38
	3 x 6	0.9 x 1.8	53	214	39	48
	3 x 8	0.9 x 2.4	75	302	55	68
	3 x 10	0.9 x 3.0	96	391	71	88
	3 x 12	0.9 x 3.7	118	480	87	108
	3 x 14	0.9 x 4.3	140	569	103	128
	4 x 6	1.2 x 1.8	83	254	61	57
	4 x 8	1.2 x 2.4	121	369	89	83
	4 x 10	1.2 x 3.0	160	489	118	110
	4 x 12	1.2 x 3.7	198	605	146	136
	4 x 16	1.2 x 4.9	275	841	203	189
	4 x 20	1.2 x 6.1	353	1076	260	242
	5 x 8	1.5 x 2.4	184	449	136	101
	5 x 10	1.5 x 3.0	244	596	180	134
	5 x 12	1.5 x 3.7	304	743	224	167
	5 x 14	1.5 x 4.3	365	890	269	200
	5 x 16	1.5 x 4.9	424	1036	313	233
	5 x 18	1.5 x 5.5	484	1183	357	266
	6 x 12	1.8 x 3.7	407	827	300	186
	6 x 16	1.8 x 4.9	579	1179	427	265
	6 x 18	1.8 x 5.5	665	1354	491	305
	6 x 20	1.8 x 6.1	751	1530	554	344
	7 x 14	2.1 x 4.3	660	1152	487	259
	7 x 16	2.1 x 4.9	778	1357	574	305
	7 x 18	2.1 x 5.5	895	1561	660	351
	7 x 20	2.1 x 6.1	1013	1766	747	397
	8 x 14	2.4 x 4.3	839	1281	619	288
	8 x 16	2.4 x 4.9	994	1517	733	341
	8 x 18	2.4 x 5.5	1148	1753	847	394
8 x 20	2.4 x 6.1	1303	1988	961	447	
8 x 22	2.4 x 6.7	1458	2224	1075	500	
9 x 16	2.7 x 4.9	1205	1637	889	368	
9 x 18	2.7 x 5.5	1399	1899	1032	427	
9 x 20	2.7 x 6.1	1593	2162	1175	486	
9 x 22	2.7 x 6.7	1787	2424	1318	545	
10 x 16	3.0 x 4.9	1464	1788	1080	402	
10 x 18	3.0 x 5.5	1704	2082	1257	468	
10 x 20	3.0 x 6.1	1946	2375	1435	534	
10 x 22	3.0 x 6.7	2187	2669	1613	600	
10 x 24	3.0 x 7.3	2427	2963	1790	666	
11 x 18	3.4 x 5.5	2009	2229	1482	501	
11 x 20	3.4 x 6.1	2299	2551	1696	573	
11 x 22	3.4 x 6.7	2590	2874	1910	646	
12 x 24	3.7 x 7.3	3518	3781	2595	850	
13 x 26	4.0 x 7.9	4393	4381	3240	985	

Foam Fenders – SeaGuard®

Performance at 60% deflection

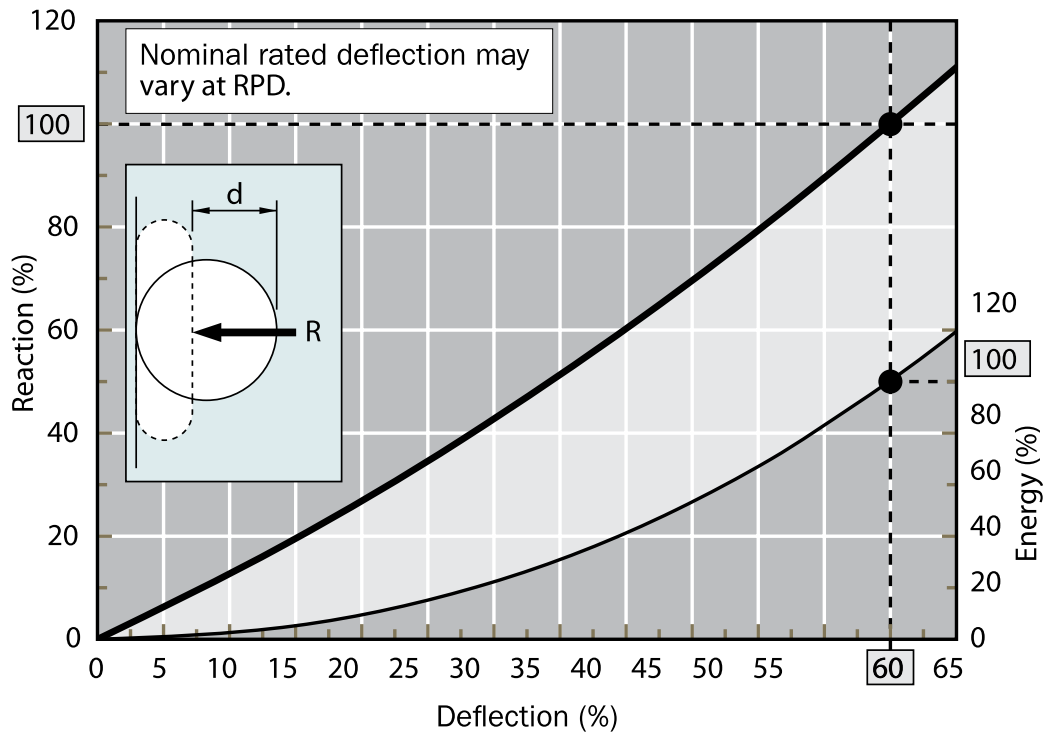
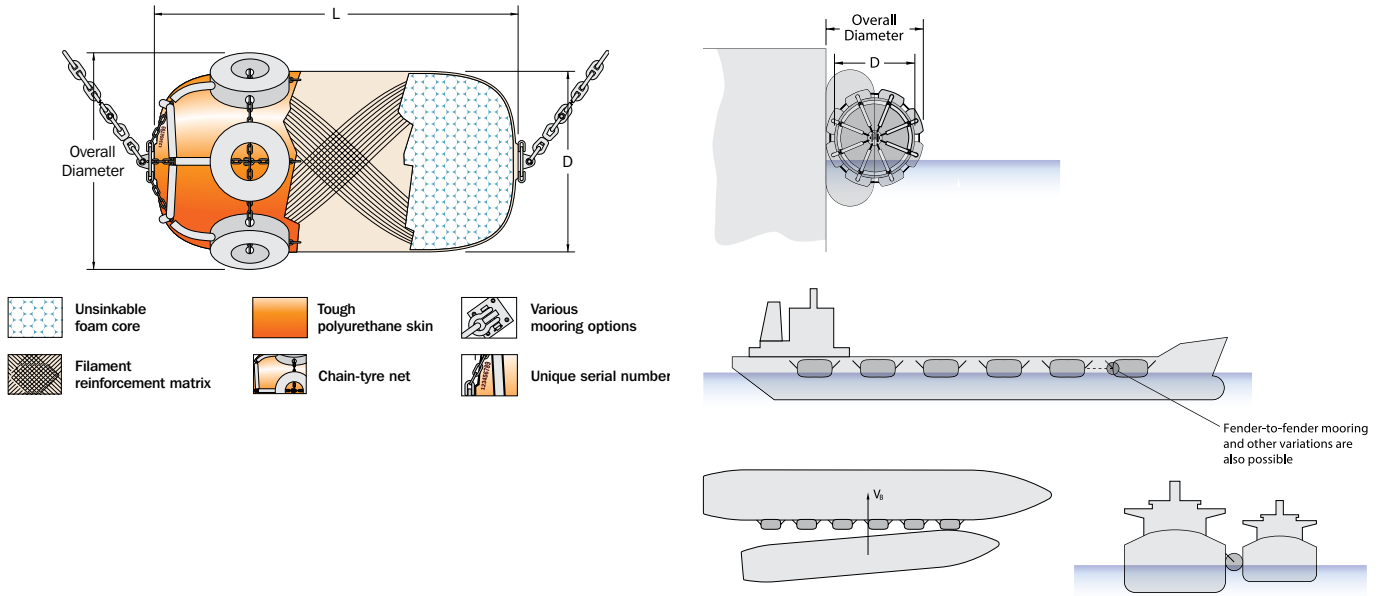
Metric	Diameter x length		Low reaction				High capacity			
	(ft)	(m)	Energy (kNm)	Reaction (kN)	Energy (ft-kip)	Reaction (kip)	Energy (kNm)	Reaction (kN)	Energy (ft-kip)	Reaction (kip)
Metric	2.3 x 4.9	0.7 x 1.5	15	80	11	18	33	173	24	39
	3.3 x 4.9	1.0 x 1.5	28	102	21	23	61	227	45	51
	3.3 x 6.6	1.0 x 2.0	41	151	30	34	88	329	65	74
	3.9 x 6.6	1.2 x 2.0	54	169	40	38	118	365	87	82
	4.4 x 8.2	1.4 x 2.5	91	249	67	56	197	543	145	122
	5 x 10	1.5 x 3.0	146	356	108	80	317	774	234	174
	5.6 x 9.8	1.7 x 3.0	169	369	125	83	366	801	270	180
	6.6 x 11.5	2.0 x 3.5	273	507	201	114	591	1099	436	247
	6.6 x 13.1	2.0 x 4.0	324	601	239	135	701	1303	517	293
	6.6 x 14.8	2.0 x 4.5	374	698	276	157	811	1508	598	339
	7.2 x 11.5	2.2 x 3.5	324	549	239	123	703	1189	518	267
	7.2 x 13.1	2.2 x 4.0	386	653	285	147	836	1415	617	318
	7.2 x 14.8	2.2 x 4.5	447	757	330	170	969	1640	715	369
	7.2 x 16.4	2.2 x 5.0	509	861	375	194	1102	1865	813	419
	7.2 x 19.7	2.2 x 6.0	632	1069	466	240	1368	2316	1009	521
	10 x 16	3.0 x 4.9	879	1072	648	241	1904	2326	1404	523
	10 x 20	3.0 x 6.1	1167	1423	861	320	2530	3087	1866	694
	10.8 x 14.8	3.3 x 4.5	899	1014	663	228	1948	2193	1437	493
	10.8 x 21.3	3.3 x 6.5	1452	1637	1071	368	3148	3550	2322	798
	Imperial	2 x 4	0.6 x 1.2	9	53	7	12	19	116	14
2 x 6		0.6 x 1.8	15	89	11	20	31	191	23	43
2 x 8		0.6 x 2.4	20	125	15	28	45	271	33	61
2 x 10		0.6 x 3.0	26	160	19	36	56	347	42	78
3 x 5		0.9 x 1.5	25	101	19	23	55	220	40	49
3 x 6		0.9 x 1.8	31	129	23	29	69	276	51	62
3 x 8		0.9 x 2.4	45	182	33	41	98	391	72	88
3 x 10		0.9 x 3.0	58	236	43	53	125	507	92	114
3 x 12		0.9 x 3.7	71	288	52	65	153	625	113	140
3 x 14		0.9 x 4.3	84	342	62	77	182	740	134	166
4 x 6		1.2 x 1.8	49	151	36	34	107	329	79	74
4 x 8		1.2 x 2.4	72	222	53	50	157	480	116	108
4 x 10		1.2 x 3.0	96	294	71	66	207	632	153	142
4 x 12		1.2 x 3.7	119	365	88	82	258	787	190	177
4 x 16		1.2 x 4.9	165	504	122	113	358	1093	264	246
4 x 20		1.2 x 6.1	212	646	156	145	458	1399	338	315
5 x 8		1.5 x 2.4	111	271	82	61	240	583	177	131
5 x 10		1.5 x 3.0	146	356	108	80	317	774	234	174
5 x 12		1.5 x 3.7	183	445	135	100	396	965	292	217
5 x 14		1.5 x 4.3	218	534	161	120	473	1157	349	260
5 x 16		1.5 x 4.9	254	622	188	140	551	1347	407	303
5 x 18		1.5 x 5.5	290	710	214	160	629	1538	464	346
6 x 12		1.8 x 3.7	244	498	180	112	529	1076	390	242
6 x 16		1.8 x 4.9	347	707	256	159	752	1535	555	345
6 x 18		1.8 x 5.5	399	813	294	183	865	1761	638	396
6 x 20		1.8 x 6.1	450	916	332	206	976	1988	720	447
7 x 14		2.1 x 4.3	396	689	292	155	858	1499	633	337
7 x 16		2.1 x 4.9	466	814	344	183	1010	1766	745	397
7 x 18		2.1 x 5.5	537	937	396	211	1163	2030	858	456
7 x 20		2.1 x 6.1	607	1059	448	238	1317	2295	971	516
8 x 14		2.4 x 4.3	503	770	371	173	1091	1664	805	374
8 x 16		2.4 x 4.9	597	912	440	205	1292	1971	953	443
8 x 18		2.4 x 5.5	689	1052	508	236	1493	2278	1101	512
8 x 20		2.4 x 6.1	782	1192	577	268	1693	2584	1249	581
8 x 22		2.4 x 6.7	875	1334	645	300	1895	2891	1398	650
9 x 16		2.7 x 4.9	723	982	533	221	1567	2128	1156	478
9 x 18		2.7 x 5.5	839	1139	619	256	1820	2469	1342	555
9 x 20		2.7 x 6.1	956	1297	705	292	2071	2810	1528	632
9 x 22		2.7 x 6.7	1072	1455	791	327	2323	3154	1713	709
10 x 16		3.0 x 4.9	879	1072	648	241	1904	2326	1404	523
10 x 18	3.0 x 5.5	1022	1250	754	281	2217	2705	1635	608	
10 x 20	3.0 x 6.1	1167	1423	861	320	2530	3087	1866	694	
10 x 22	3.0 x 6.7	1312	1601	968	360	2842	3470	2096	780	
10 x 24	3.0 x 7.3	1456	1778	1074	400	3155	3851	2327	866	
11 x 18	3.4 x 5.5	1205	1339	889	301	2611	2896	1926	651	
11 x 20	3.4 x 6.1	1380	1530	1018	344	2989	3316	2205	745	
11 x 22	3.4 x 6.7	1554	1726	1146	388	3367	3737	2483	840	
12 x 24	3.7 x 7.3	2111	2269	1557	510	4575	4915	3374	1105	
13 x 26	4.0 x 7.9	2636	2629	1944	591				Not Available	

Foam Fenders – SeaGuard®

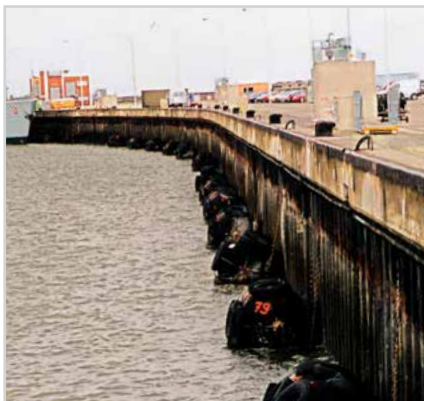
Performance at 60% deflection

	Diameter x length		Extra high capacity				Super high capacity			
	(ft)	(m)	Energy (kNm)	Reaction (kN)	Energy (ft-kip)	Reaction (kip)	Energy (kNm)	Reaction (kN)	Energy (ft-kip)	Reaction (kip)
Metric	2.3 x 4.9	0.7 x 1.5	47	249	35	56	65	343	48	77
	3.3 x 4.9	1.0 x 1.5	89	329	66	74	122	449	90	101
	3.3 x 6.6	1.0 x 2.0	129	480	95	108	178	658	131	148
	3.9 x 6.6	1.2 x 2.0	172	534	127	120	236	734	174	165
	4.4 x 8.2	1.4 x 2.5	287	792	212	178	393	1085	290	244
	5 x 10	1.5 x 3.0	464	1130	342	254	635	1548	468	348
	5.6 x 9.8	1.7 x 3.0	536	1174	395	264	732	1606	540	361
	6.6 x 11.5	2.0 x 3.5	864	1606	637	361	1182	2197	872	494
	6.6 x 13.1	2.0 x 4.0	1025	1904	756	428	1402	2607	1034	586
	6.6 x 14.8	2.0 x 4.5	1185	2206	874	496	1622	3016	1196	678
	7.2 x 11.5	2.2 x 3.5	1027	1738	758	391	1405	2378	1037	535
	7.2 x 13.1	2.2 x 4.0	1222	2068	901	465	1672	2829	1233	636
	7.2 x 14.8	2.2 x 4.5	1416	2397	1045	539	1938	3280	1429	737
	7.2 x 16.4	2.2 x 5.0	1611	2726	1188	613	2204	3730	1626	839
	7.2 x 19.7	2.2 x 6.0	2000	3385	1475	761	2737	4631	2019	1041
	10 x 16	3.0 x 4.9	2782	3398	2052	764	3807	4648	2808	1045
	10 x 20	3.0 x 6.1	3697	4515	2727	1015	5059	6174	3731	1388
	10.8 x 14.8	3.3 x 4.5	2847	3207	2100	721	3895	4390	2873	987
	10.8 x 21.3	3.3 x 6.5	4600	5187	3393	1166	Not Available			
	Imperial	2 x 4	0.6 x 1.2	28	169	21	38	39	231	29
2 x 6		0.6 x 1.8	46	280	34	63	64	387	47	87
2 x 8		0.6 x 2.4	65	396	48	89	88	538	65	121
2 x 10		0.6 x 3.0	82	507	61	114	113	694	83	156
3 x 5		0.9 x 1.5	80	321	59	72	109	439	81	99
3 x 6		0.9 x 1.8	100	405	74	91	137	556	101	125
3 x 8		0.9 x 2.4	142	574	105	129	194	787	143	177
3 x 10		0.9 x 3.0	183	743	135	167	251	1019	185	229
3 x 12		0.9 x 3.7	224	913	165	205	307	1249	226	281
3 x 14		0.9 x 4.3	265	1082	196	243	363	1480	268	333
4 x 6		1.2 x 1.8	156	476	115	107	213	654	157	147
4 x 8		1.2 x 2.4	228	703	168	158	313	961	231	216
4 x 10		1.2 x 3.0	302	925	223	208	415	1268	306	285
4 x 12		1.2 x 3.7	376	1148	277	258	515	1575	380	354
4 x 16		1.2 x 4.9	523	1597	386	359	716	2186	528	491
4 x 20		1.2 x 6.1	670	2045	494	460	917	2799	676	629
5 x 8		1.5 x 2.4	350	854	258	192	479	1170	353	263
5 x 10		1.5 x 3.0	464	1130	342	254	635	1548	468	348
5 x 12		1.5 x 3.7	578	1410	426	317	790	1931	583	434
5 x 14		1.5 x 4.3	691	1690	510	380	946	2313	698	520
5 x 16		1.5 x 4.9	806	1969	594	443	1103	2695	813	606
5 x 18		1.5 x 5.5	920	2248	678	505	1258	3076	928	692
6 x 12		1.8 x 3.7	773	1575	570	354	1058	2153	780	484
6 x 16		1.8 x 4.9	1100	2242	811	504	1505	3065	1110	689
6 x 18		1.8 x 5.5	1264	2574	932	579	1729	3522	1275	792
6 x 20		1.8 x 6.1	1428	2909	1053	654	1952	3977	1440	894
7 x 14		2.1 x 4.3	1254	2189	925	492	1716	2994	1266	673
7 x 16		2.1 x 4.9	1478	2580	1090	580	2022	3527	1491	793
7 x 18		2.1 x 5.5	1700	2967	1254	667	2327	4059	1716	913
7 x 20		2.1 x 6.1	1923	3354	1418	754	2632	4591	1941	1032
8 x 14		2.4 x 4.3	1594	2433	1176	547	2182	3332	1609	749
8 x 16		2.4 x 4.9	1889	2882	1393	648	2584	3946	1906	887
8 x 18		2.4 x 5.5	2182	3330	1609	749	2986	4557	2202	1024
8 x 20		2.4 x 6.1	2476	3777	1826	849	3388	5169	2499	1162
8 x 22		2.4 x 6.7	2769	4226	2043	950	3790	5783	2795	1300
9 x 16		2.7 x 4.9	2290	3110	1689	699	3134	4256	2311	957
9 x 18		2.7 x 5.5	2657	3608	1960	811	3638	4938	2683	1110
9 x 20		2.7 x 6.1	3027	4107	2233	923	4142	5621	3055	1264
9 x 22		2.7 x 6.7	3395	4608	2504	1036	4646	6303	3427	1417
10 x 16		3.0 x 4.9	2782	3398	2052	764	3807	4648	2808	1045
10 x 18	3.0 x 5.5	3239	3954	2389	889	4432	5413	3269	1217	
10 x 20	3.0 x 6.1	3697	4515	2727	1015	5059	6174	3731	1388	
10 x 22	3.0 x 6.7	4154	5071	3064	1140	Not Available				
10 x 24	3.0 x 7.3	4612	5629	3401	1265	Not Available				
11 x 18	3.4 x 5.5	3817	4235	2815	952	5223	5792	3852	1302	
11 x 20	3.4 x 6.1	4368	4846	3222	1090	Not Available				
11 x 22	3.4 x 6.7	4920	5458	3629	1227	Not Available				
12 x 24	3.7 x 7.3	Not Available				Not Available				
13 x 26	4.0 x 7.9	Not Available				Not Available				

Foam Fenders – SeaCushion®



Note: Standard manufacturing and performance tolerance:
 Energy: 100%, Reaction: 100%, Tolerance: ± 15%



Germany



USA



Netherlands

Foam Fenders – SeaCushion®

Performance at 60% deflection, STD Grade

	Diameter x Length		Overall Diameter		Standard Capacity			
	(ft)	(m)	(ft)	(m)	Energy (kNm)	Reaction (kNm)	Energy (ft-kip)	Reaction (kip)
Metric	3.3 x 6.6	1.0 x 2.0	4.9	1.5	64	294	47	66
	3.9 x 6.6	1.0 x 2.0	5.6	1.7	88	338	65	76
	4.4 x 8.2	1.4 x 2.5	6.1	1.9	142	485	105	109
	4.9 x 9.8	1.5x 3.0	6.6	2.0	213	654	157	147
	5.6 x 9.8	1.7x 3.0	7.2	2.2	264	721	195	162
	6.6 x 11.5	2.0 x 3.5	8.2	2.5	424	979	313	220
	6.6 x 13.1	2.0 x 4.0	8.2	2.5	498	1152	367	259
	7.2 x 14.8	2.2 x 4.5	8.9	2.7	679	1423	501	320
	8.2 x 13.1	2.5 x 4.0	9.9	3.0	735	1357	542	305
	8.2 x 18.0	2.5 x 5.5	9.9	3.0	1079	1993	796	448
	9.8 x 19.7	3.0 x 6.0	11.5	3.5	1655	2544	1221	572
	10.8 x 14.8	3.3 x 4.5	12.5	3.8	1367	1908	1008	429
10.8 x 21.3	3.3 x 6.5	12.5	3.8	2154	3011	1589	677	
Imperial	3 x 6	0.9 x 1.8	4.7	1.4	49	249	36	56
	4 x 8	1.2 x 2.4	5.7	1.7	115	436	85	98
	5 x 10	1.5 x 3.0	6.7	2.0	222	676	164	152
	6 x 12	1.8 x 3.7	7.7	2.3	382	965	282	217
	7 x 14	2.1 x 4.3	8.7	2.6	603	1308	445	294
	8 x 12	2.4 x 3.7	9.7	2.9	630	1192	465	268
	8 x 16	2.4 x 4.9	9.7	3.3	896	1695	661	381
	9 x 18	2.7 x 5.5	10.7	3.3	1270	2135	937	480
	10 x 16	3.0 x 4.9	11.7	3.6	1323	2002	976	450
	10 x 20	3.0 x 6.1	11.7	3.6	1735	2624	1280	590
	11 x 22	3.4 x 6.7	12.7	3.9	2301	3167	1697	712

	Diameter x Length		Overall Diameter		High Capacity			
	(ft)	(m)	(ft)	(m)	Energy (kNm)	Reaction (kNm)	Energy (ft-kip)	Reaction (kip)
Metric	3.3 x 6.6	1.0 x 2.0	4.9	1.5	93	416	68	94
	3.9 x 6.6	1.0 x 2.0	5.6	1.7	127	478	94	107
	4.4 x 8.2	1.4 x 2.5	6.1	1.9	205	684	152	154
	4.9 x 9.8	1.5x 3.0	6.6	2.0	308	922	227	207
	5.6 x 9.8	1.7x 3.0	7.2	2.2	384	1013	283	228
	6.6 x 11.5	2.0 x 3.5	8.2	2.5	614	1379	453	310
	6.6 x 13.1	2.0 x 4.0	8.2	2.5	721	1619	532	364
	7.2 x 14.8	2.2 x 4.5	8.9	2.7	981	2003	724	450
	8.2 x 13.1	2.5 x 4.0	9.9	3.0	1065	1911	786	430
	8.2 x 18.0	2.5 x 5.5	9.9	3.0	1559	2797	1150	629
	9.8 x 19.7	3.0 x 6.0	11.5	3.5	2397	3581	1768	805
	10.8 x 14.8	3.3 x 4.5	12.5	3.8	1978	2686	1459	604
10.8 x 21.3	3.3 x 6.5	12.5	3.8	3122	4239	2303	953	
Imperial	3 x 6	0.9 x 1.8	4.7	1.4	71	350	52	79
	4 x 8	1.2 x 2.4	5.7	1.7	167	614	123	138
	5 x 10	1.5 x 3.0	6.7	2.0	323	951	238	214
	6 x 12	1.8 x 3.7	7.7	2.3	554	1359	408	306
	7 x 14	2.1 x 4.3	8.7	2.6	874	1838	645	413
	8 x 12	2.4 x 3.7	9.7	2.9	913	1679	673	378
	8 x 16	2.4 x 4.9	9.7	3.3	1298	2388	958	537
	9 x 18	2.7 x 5.5	10.7	3.3	1840	3007	1357	676
	10 x 16	3.0 x 4.9	11.7	3.6	1917	2818	1414	634
	10 x 20	3.0 x 6.1	11.7	3.6	2514	3696	1854	831
	11 x 22	3.4 x 6.7	12.7	3.9	3333	4454	2459	1001

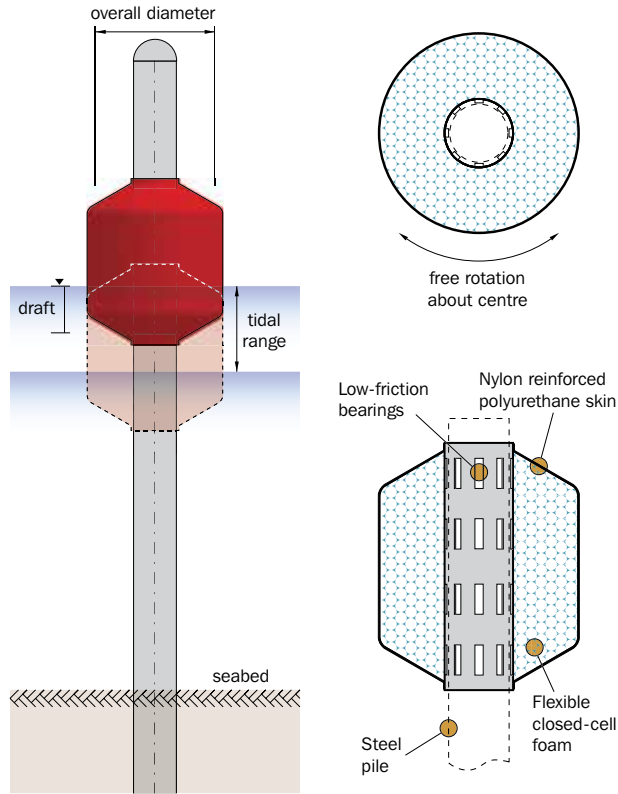
Small standard duty fenders

Performance at 60% deflection

	Diameter x Length		Standard capacity			
	(in)	(mm)	Energy (kNm)	Reaction (kNm)	Energy (ft-kip)	Reaction (kip)
Metric / Imperial	16 x 36	400 x 900	4.2	48.0	3.1	10.8
	24 x 36	600 x 900	8.4	63.6	6.2	14.3
	24 x 48	600 x 1200	12.7	97.0	9.4	21.8
	32 x 50	800 x 1250	22.1	125.9	16.3	28.3
	32 x 60	800 x 1500	28.5	162.4	21.0	36.5
	36 x 60	900 x 1500	34.8	176.6	25.7	39.7
	36 x 72	900 x 1830	44.6	226.0	32.9	50.8
	40 x 60	1000 x 1500	41.6	189.9	30.7	42.7

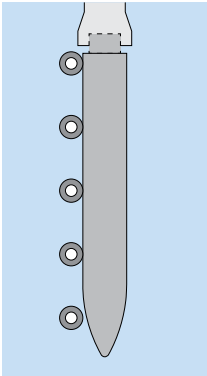
Other sizes, material grades and performance available upon request. Please contact Trelleborg Marine Systems' local offices.

Foam Fenders – Donut Fenders

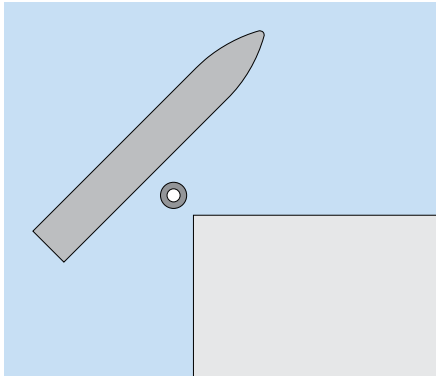


Applications

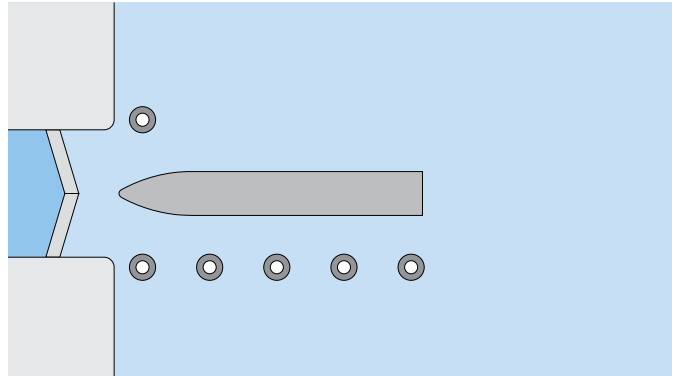
Breasting dolphins



Corner protection



Guiding structures



Germany



United Kingdom



USA

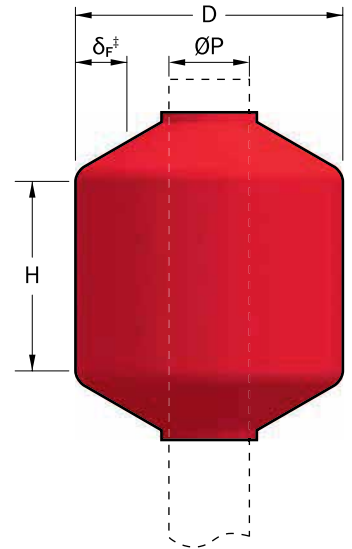
Standard manufacturing and performance tolerances apply. Refer to Design and Testing Manual.

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Foam Fenders – Donut Fenders

Performance at 60% deflection, STD Grade

Donut size D		Maximum pile ØP		Energy*	Reaction*	Energy	Reaction*
mm	ft	mm	ft	kNm	kN	ft-kip	kip
1270	4.2	610	2.0	7.2	116	1.6	7.9
1450	4.8	710	2.3	9.2	131	2.1	9.0
1520	5.0	762	2.5	10.5	140	2.4	9.6
1780	5.8	914	3.0	14.1	162	3.2	11.1
1910	6.3	995	3.3	16.4	175	3.7	12.0
2030	6.7	1067	3.5	18.6	186	4.2	12.8
2210	7.3	1185	3.9	22.3	204	5.0	14.0
2290	7.5	1219	4.0	23.6	210	5.3	14.4
2490	8.2	1345	4.4	28.0	229	6.3	15.7
2540	8.3	1372	4.5	29.3	234	6.6	16.0
2790	9.2	1524	5.0	35.3	256	7.9	17.6
2970	9.7	1636	5.4	40.1	273	9.0	18.7
3050	10.0	1676	5.5	42.1	280	9.5	19.2
3300	10.8	1829	6.0	49.5	304	11.1	20.8
3450	11.3	1933	6.3	54.6	319	12.3	21.9t
3530	11.6	1981	6.5	57.2	327	12.9	22.4
3810	12.5	2134	7.0	65.9	350	14.8	24.0
3960	13.0	2241	7.4	72.1	366	16.2	25.1
4060	13.3	2286	7.5	75.1	374	16.9	25.6
4220	13.8	2388	7.8	81.3	389	18.3	26.7



Increasing Donut height (H) will increase reaction and energy proportionately.

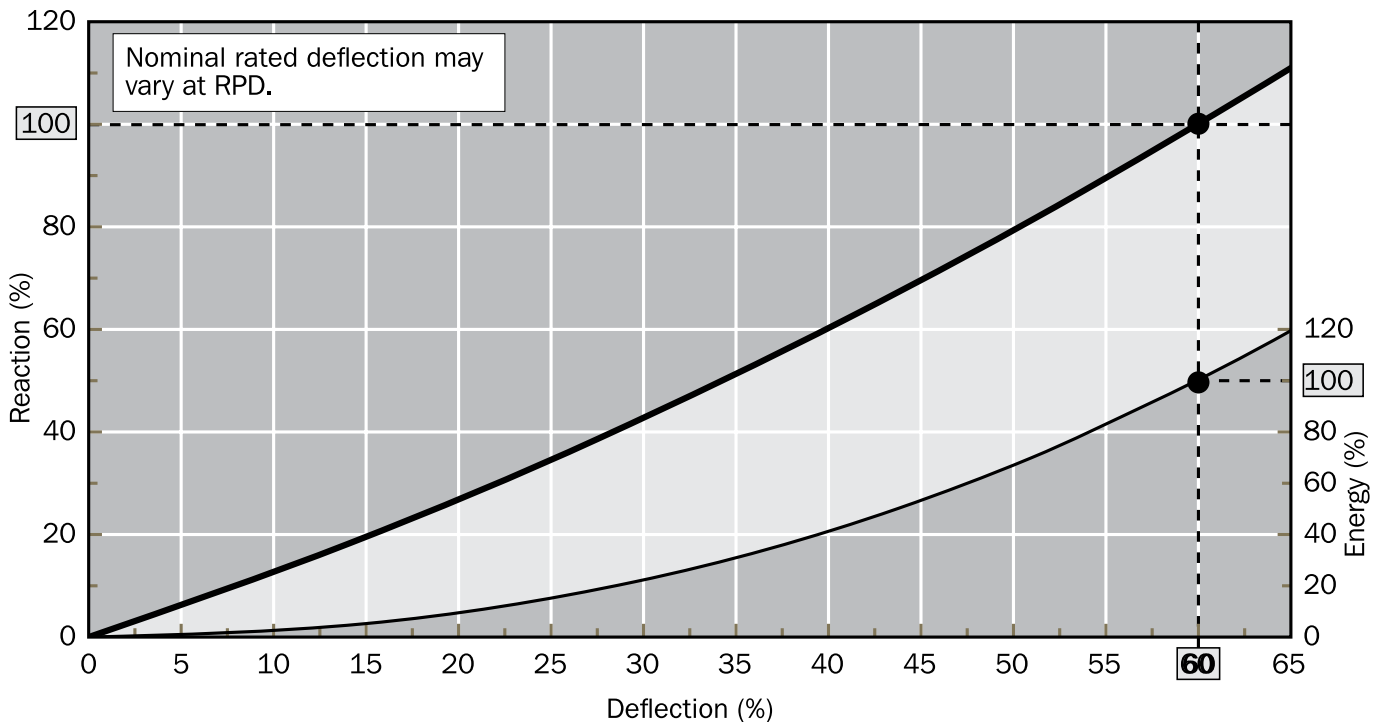
Other sizes, material grades and performance available upon request.

Please contact Trelleborg Marine Systems' local offices.

* values for H = 1000mm.

† values for H = 1 foot.

‡ all performances at $\delta F = 60\%$ of Donut resilient foam wall thickness.



Note: Standard manufacturing and performance tolerance:

Energy: 100%, Reaction: 100%, Tolerance: $\pm 15\%$

SeaBarrier®

Floating Barrier Systems are designed to provide a reliable, highly visible floating physical barrier that is easy to install and maintain.

The SeaBarrier®'s design is founded on the proven technology, materials and tested performance of SeaGuard® foam filled marine fenders that have set the international industry standard for over 30 years. Their design provides the energy absorption, unsinkable buoyancy, and the ease of deployment necessary to effectively and quickly create a barrier to any intruder.

The smaller SeaBarrier® sizes are intended primarily as a demarcation or delineation barrier to mark an exclusionary zone. Larger design sizes add to that a significant physical barrier to insure all your security requirements are met.

Available in various sizes, profiles and colors, the SeaBarrier® can be custom designed to meet your specific requirements. Standard units are delivered with a bright, highly visible international orange color and include connection hardware. Optional accessories include buoys and modified Donut fender style moorings, anchorage devices, capture net systems and a wide range of interconnecting fittings designed to work with the SeaBarrier® units.

Features

Utilizes proven SeaGuard® technology

Low maintenance

High visibility, high freeboard

Durable, long life materials

Easy to transport, deploy and relocate

Foam filled construction won't lose buoyancy if punctured

High pull-through strength

Applications

Military facilities and vessels

Ports and harbors

Cruise ship and marine casino facilities

Refineries and petrochemical plants

Power plants

Airports

Temporary blockades of vital waterways

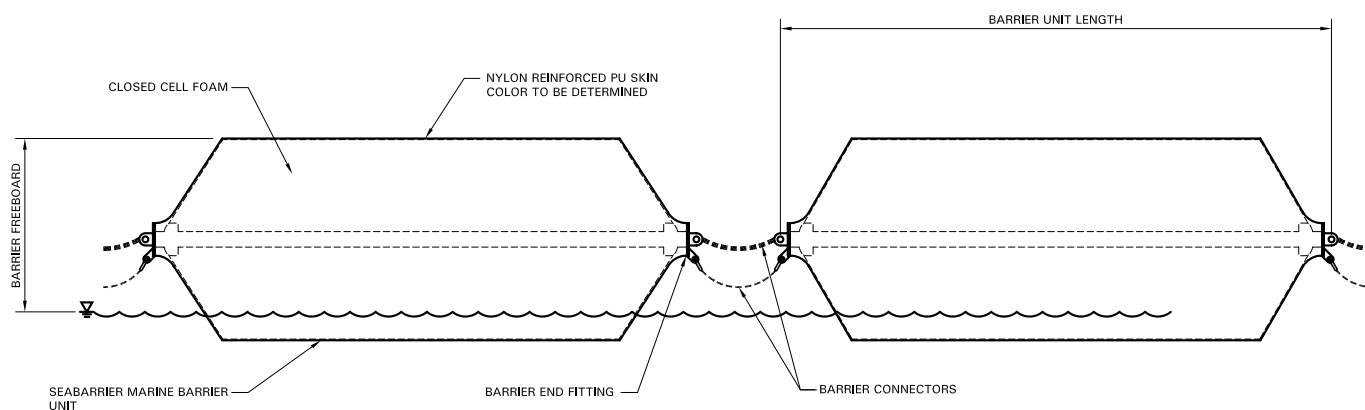
Other marine security applications

Foam Fenders – SeaBarrier®

Specification

Dimensions are for one SeaBarrier® module. Overall length includes hardware supplied with the unit. Weight is per module, including hardware.

English Sizes	Model Number	Diameter (feet)	Overall Length (feet)	Pull-Through SWL (pounds)
	SB220	2.0	20	30,000
	SB420	4.0	20	50,000
	SB620	6.0	20	50,000
	SB820	8.0	20	70,000
Metric Sizes	Model Number	Diameter (meters)	Overall Length (meters)	Pull-Through SWL (tons)
	SB500	0.5	6.6	13.6
	SB1000	1.0	6.7	22.7
	SB2000	2.0	6.7	22.7
	SB3000	3.0	7.0	31.8



USA



USA

Foam Fenders – Product Material Tables

Construction

*Standard Foam Material Properties

Test item	Test method	Required value
Density	ASTM D-3575 Suffix W	62 kg/ cu m (+/-10%)
Tensile strength	ASTM D-3575 Suffix T	413 kPa
Elongation	ASTM D-3575 Suffix T	100 % Min.
Tear Resistance	ASTM D-3575 Suffix G	2.3 kN/m Min.
Compressive Strength	ASTM D-3575 Suffix D	
10% Deflection		27 kPa Min.
25% Deflection		48 kPa Min.
40% Deflection		77 kPa Min.
50% Deflection		110 kPa Min.
Compression Set	ASTM D-3575 Suffix B	
Thermal Stability	ASTM D-3575 Suffix S	<0.5 % change (24 hrs at 70 deg C)
Water Absorption	ASTM D-3575 Suffix L	<0.34 kg/ sq m (skived)
Flammability	FMVSS302 PPP-C-1752B	Pass -54 deg C to 99 deg C

Polyurethane Elastomer Skin Material Property Requirements

Test item	Test method	Required value
Shore A Durometer Hardness	ASTM D-2240	75-95
Tensile strength	ASTM D-412	13.8 MPa Min.
Elongation	ASTM D-412	300% Min.
Tear Strength	ASTM D-624	32.4 kN/m Min.
Flex Life (Ross)	ASTM D-1052	100,000 Cycles Min. Break
Abrasion Resistance (NBS)	ASTM D-1630	100

Nylon Filament Reinforcement Material Property Requirements

Test item	Test method	Required value
Nylon Cord Weight	ASTM D-885	0.280 g/m avg.
Breaking Strength	ASTM D-885	231 N avg.
Elongation (Ultimate)	ASTM D-885	16% avg.

Nylon Filament Reinforced Elastomer Skin Material Property Requirements

Test item	Test method	Required value
Tensile Strength	ASTM D-412	31.0 Mpa Min.
Elongation	ASTM D-412	16% Min.
Tear Strength	ASTM D-624	78.8 kN/m Min.

*Foam Material Properties vary based on the Material grades used. Contact your local office for Foam Fender specification.

Fender Deployment Systems

Trelleborg Marine Systems not only supply easy-to-deploy floating fenders, we also offer fender deployment systems to deploy, retrieve and store fenders.

In recent years Trelleborg Marine Systems focused on the development of fender deployment systems for the growing FSRU and FLNG applications. This market niche offers unique challenges due to the space restrictions on board FLNG and FSRU, which are driving the re-think of the common fender deployment system: current

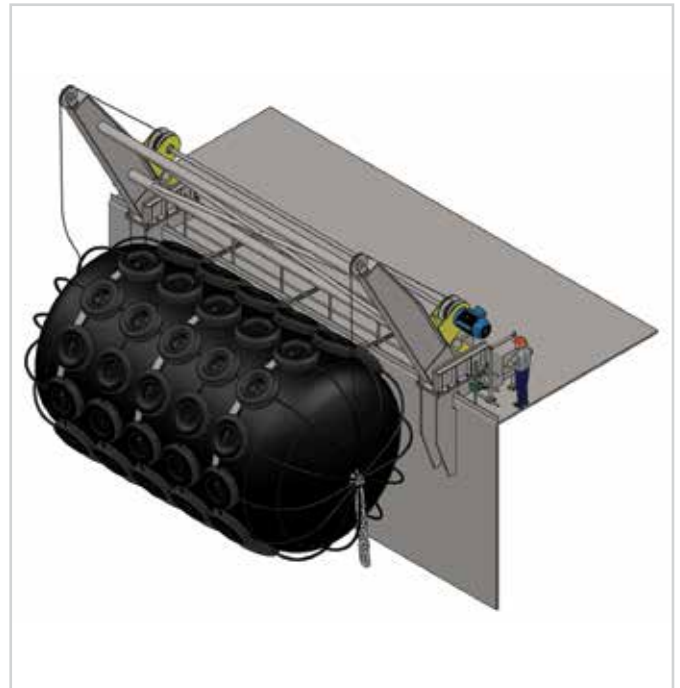
solutions explore telescopic arms or A-frame type davits to safely store the fenders on deck or over the hull during bad weather or routine maintenance inspections. Other features are: pneumatic fender pressure monitoring, hazardous rating and auto-tension system for lifting wire.

Trelleborg Marine Systems' expertise in fender manufacture, in rubber technology and marine engineering mean an integrated solution from one supplier.

Fender Deployment Systems



Fender Davits



Davit suitable for Pneumatic and Foam Fenders. Standard sizes to suit 3.3 x 6.5 and 4.5 x 9.0 fenders.

Floating Fender Rental Service

Need top performing floating fenders fast? Ensure you get the capability and end-to-end support you need with Trelleborg Marine Systems.

Trelleborg will deliver and install floating foam or pneumatic fenders within days to any location on the planet. Rental is highly cost effective for temporary applications and with Trelleborg you get a fender rental service second to none.

Trelleborg pneumatic fenders have been used in a variety of applications such as RoRo terminals in Northern Europe to cater for various types of vessels as well as floatation and protection of wind farm installation offshore.

Rental service

Expert advice with local knowledge

Huge range of products

Fast lead times

Installation assistance



Lithuania

Floating Fender Rental Service

Case Studies

An Ideal Solution for Shetland Floating Hotel

To overcome a shortage in accommodation for a substantial labour force, several floating hotels – or floatels – based on barges, were towed to Lerwick and Scalloway in Shetland, to provide beds for up to 1,070 workers.

As part of its innovative fender rental service, Trelleborg supplied six of its high quality 1.5 x 3 metre pneumatic fenders to Shetland Maritime Ltd, on a long term lease.



Pneumatic Fenders for Italian Ship-to-Ship Operation

Trelleborg supplied eight of its high quality pneumatic rubber fenders for a new ship-to-ship (STS) operation in Sicily, Italy as part of a long-term rental agreement.

Fast and easy to deploy, four of the high quality fenders were road freighted from Trelleborg's warehouse, direct to the port, while the remaining four fenders were delivered direct from Trelleborg factory where the fenders are manufactured.

Fender Rental for North Sea Decommissioning Project

Trelleborg has rented two of its high quality pneumatic rubber fenders for use with a heavy lift vessel, for a challenging decommissioning project in the North Sea.

Capable of ensuring sufficient clearance between the vessel and the offshore structure, minimising risk of damage to the vessel and protecting both people and cargo, Trelleborg's pneumatic rubber fenders provided the ideal solution.

For enquires on floating fender rental, please email us at:

performancepeople@trelleborg.com

Accessories

Chains

Some fender systems need chains to help support heavy components or to control how the fender deflects and

shears during impact. Open link or stud link chains are commonly used and these can be supplied in several different strength grades.

Features

Applications

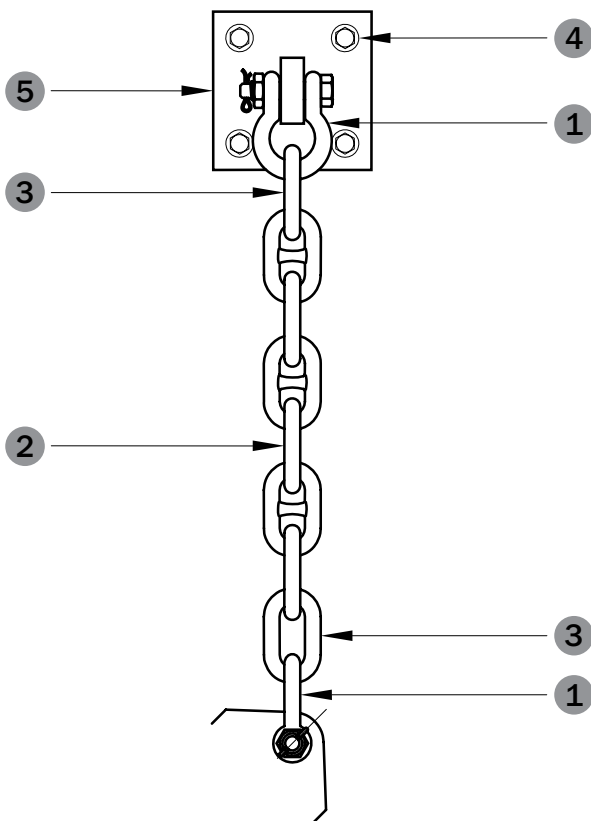
Large fender panels

Cylindrical fenders

Floating fender moorings

Safety applications

Lifting and installing



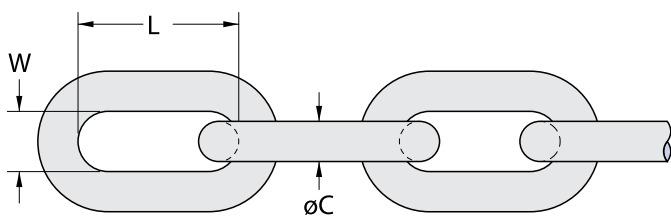
- ① Bolt-type anchor shackle
- ② Stud link or open link chain
- ③ End links are chain with stud removed
- ④ Anchor bolt
- ⑤ Chain bracket

Accessories

Open link chains

∅C	3.0D links			3.5D links			4.0D links			5.0D links			MBL	
	L	W	Weight	L	W	Weight	L	W	Weight	L	W	Weight	SL2	SL3
14	42	18	0.2	49	20	0.2	56	20	0.2	70	21	0.3	124	154
16	48	21	0.3	56	22	0.3	64	22	0.3	80	24	0.4	160	202
18	54	23	0.4	63	25	0.4	72	25	0.5	90	27	0.5	209	262
20	60	26	0.5	70	28	0.6	80	28	0.6	100	30	0.8	264	330
22	66	29	0.7	77	31	0.8	88	31	0.8	110	33	1.0	304	380
25	75	33	1.1	88	35	1.1	100	35	1.2	125	38	1.5	393	491
28	84	36	1.4	98	39	1.6	112	39	1.7	140	42	2.0	492	616
30	90	39	1.8	105	42	2.0	120	42	2.1	150	45	2.5	566	706
32	96	42	2.2	112	45	2.4	128	45	2.5	160	48	3.0	644	804
35	105	46	2.8	123	49	3.1	140	49	3.3	175	53	4.0	770	964
38	114	49	3.6	133	53	3.9	152	53	4.3	190	57	5.1	900	1130
40	120	52	4.2	140	56	4.6	160	56	5.0	200	60	6.0	1010	1260
45	135	59	6.0	158	63	6.5	180	63	7.1	225	68	8.5	1275	1590
50	150	65	8.2	175	70	8.9	200	70	9.7	250	75	12	1570	1960
55	165	72	11	193	77	12	220	77	13	275	83	15.5	1900	2380
60	180	78	14	210	84	15.4	240	84	17	300	90	20	2260	2770

[Units: mm, kg/link, kN]

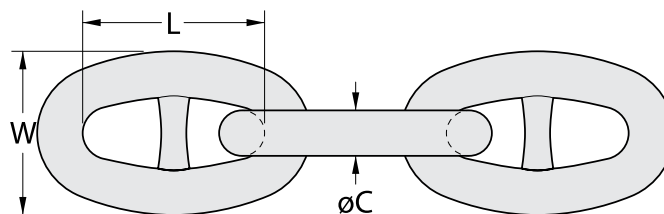


MBL = Minimum Breaking Load (kN)
 NBL = Nominal Breaking Load (kN)
 Tolerance: all dimensions ±2%

Stud Link Chains

∅C	Common link			MBL	
	L	W	Weight	SL2 (U2)	SL3 (U3)
19	76	68	0.6	210	300
22	88	79	0.9	280	401
26	104	94	1.5	389	556
28	112	101	1.9	449	642
32	128	115	2.8	583	833
34	136	122	3.4	655	937
38	152	137	4.7	812	1160
42	168	151	6.3	981	1400
44	176	158	7.3	1080	1540
48	192	173	9.4	1270	1810
52	208	187	12	1480	2110
58	232	209	17	1810	2600
64	256	230	22	2190	3130
70	280	252	30	2580	3690
76	304	274	38	3010	4300
90	360	324	63	4090	5840

[Units: mm, kg/link, kN]



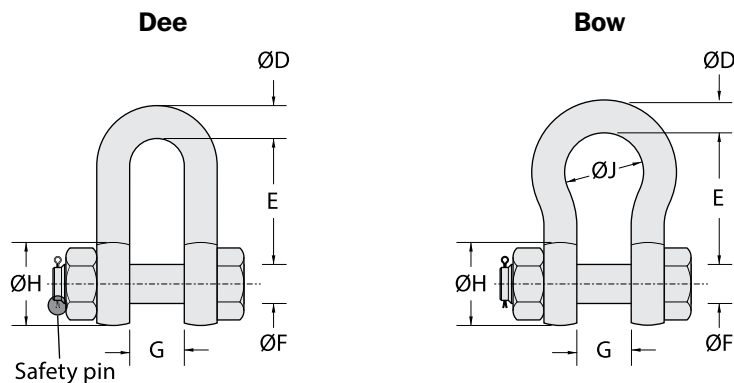
Accessories

High Strength Shackles

ØD	ØF	ØH	G	Dee shackle		Bow shackle			NBL
				E	Weight	E	ØJ	Weight	
13	16	26	22	43	0.4	51	32	0.4	120
16	19	32	27	51	0.7	64	43	0.8	195
19	22	38	31	59	1.1	76	51	1.3	285
22	25	44	36	73	1.5	83	58	1.9	390
25	28	50	43	85	2.6	95	68	2.8	510
28	32	56	47	90	3.3	108	75	3.8	570
32	35	64	51	94	4.7	115	83	5.3	720
35	38	70	57	115	6.2	133	95	7.0	810
38	42	76	60	127	7.6	146	99	8.8	1020
45	50	90	74	149	13	178	126	15	1500
50	57	100	83	171	18	197	138	21	2100
57	65	114	95	190	28	222	160	29	2550
65	70	130	105	203	35	254	180	41	3330
75	80	150	127	230	60	330	190	65	5100
89	95	178	146	267	93	381	238	110	7200
102	108	204	165	400	145	400	275	160	9000

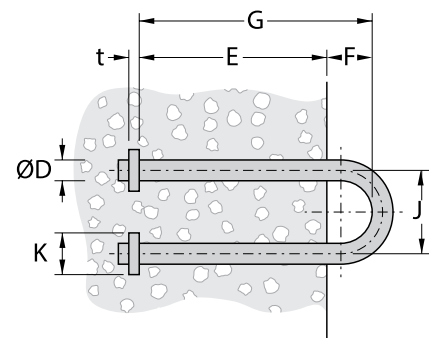
Please refer to your local office for detailed information

[Units: mm, kg, kN]



U-Anchors

ØD	E	F	G	J	K	t	Weight	NBL
26	260	60	320	104	50	12	3.4	209
30	300	70	370	120	50	15	5.1	264
34	340	70	410	136	60	15	7.3	304
36	360	70	430	144	60	20	8.6	393
42	420	90	510	168	70	20	14	492
44	440	100	540	176	80	20	16	566
48	480	100	580	192	80	25	21	644
50	500	110	610	200	90	25	24	770
56	560	120	680	224	100	30	33	900
60	600	130	730	240	110	30	41	1010
66	660	140	800	264	120	35	55	1275
74	740	160	900	296	130	40	77	1570



[Units: mm, kg, kN]

Standard manufacturing and performance tolerances apply. Refer to Design and Testing Manual.

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Accessories

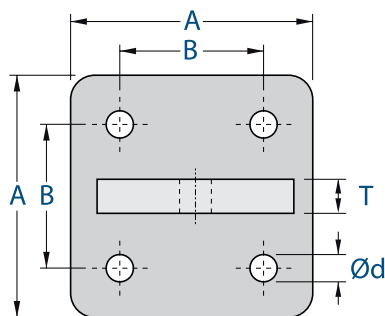
Brackets

A	B	C		E	F	Ød	R	t	T	Single Lug			Twin Lug		Anchor	
		CB2	CB2							Shackle		ØD	Shackle			ØD
										Body	Pin		Bolt Pin			
190	130	40	65	160	24	40	15	30	19	22	28	M24x100	28	2/4xM20		
220	150	45	75	190	24	50	15	30	22	25	28	M24x100	28	2/4xM20		
250	170	50	85	210	28	55	20	40	25	28	36	M30x120	36	2/4xM24		
280	190	60	95	240	28	65	20	40	28	32	36	M30x120	36	2/4xM24		
320	220	65	110	270	36	75	25	45	32	35	42	M36x150	42	2/4xM30		
350	240	70	120	300	36	80	25	50	35	38	42	M36x150	42	2/4xM30		
380	260	80	130	320	42	85	30	50	38	42	50	M42x170	50	2/4xM36		
420	290	85	145	360	42	95	30	60	42	48	50	M42x170	50	2/4xM36		
440	300	90	150	380	50	100	30	60	45	50	60	M48x190	60	2/4xM42		

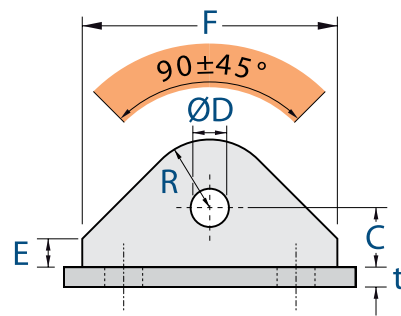
Standard steel grade: S235/S275. Finish: Galvanised (85µm).

[Units: mm, kN]

S-Series



CB2



- All chain and accessory information is for guidance only.
- Every chain design should be checked to confirm suitability for the intended application.
- Select chain system components so $MBL \approx NBL$.
- Every chain system is different. Check all dimensions for fit, clearance and tolerance.
- Chain brackets can be specified with 2 or 4 anchors to suit application and loads.
- If extra long life is required, add a corrosion allowance.
- Some slack in the chain is unavoidable and will not affect operation.
- For special sizes and applications, please refer to Trelleborg Marine Systems office.

Accessories

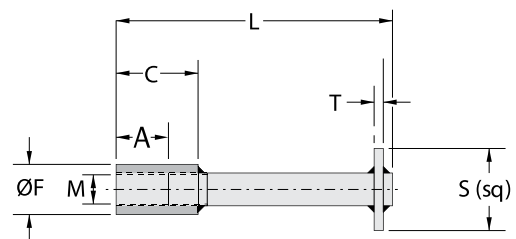
NC3 Anchors

Thread	A	C	ØF	L	S (sq)	T	Weight
M20	40	60	30	200	63	10	1
M22	44	66	32	225	63	10	1
M24	48	73	36	250	75	10	2
M27	54	84	40	265	75	10	2
M30	60	95	45	270	100	10	4
M36	72	112	54	320	100	12	6
M42	84	134	63	360	100	12	8
M48	96	156	72	400	100	15	12
M56	112	182	84	550	120	15	20
M64	128	208	100	600	130	20	30
M76	152	242	114	700	150	20	46

Anchors available in mid steel, HDG, SS 316 or super duplex

[Units: mm, kg]

The NC3 is a traditional cast-in anchor design used for installing fenders to new concrete. The NC3 anchor has a threaded socket, a long tail and a square anchor plate. Non-standard sizes and other cast-in anchor types are available on request.



Always check min/max clamping thickness and socket depths actual threaded length on bolts.

EC2 Anchors

Thread	B	E	G	J	L (typ.)	ØS	Capsule
M12	110	5-8	10	2.5	-	15	1 × C12
M16	140	6-9	13	3	175	20	1 × C16
M20	170	6-9	16	3	240	25	1 × C20
M24	210	8-12	19	4	270	28	1 × C24
M27	240	8-12	22	4	330	30	1 × C24
M30	280	8-12	24	4	360	35	1 × C30
M36	330	10-15	29	5	420	40	1 × C30
M42	420	14-21	34	7	500	50	2 × C30
M48	480	16-24	38	8	580	54	2 × C30 + 1 × C24
M56	560	18-27	45	9	-	64	4 × C30

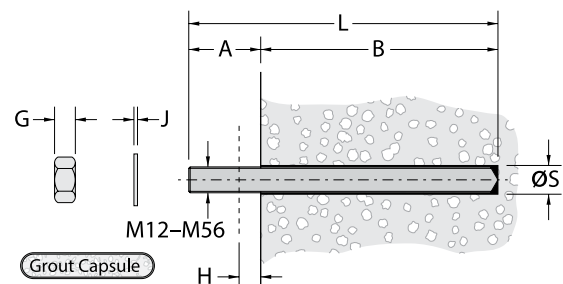
[Units: mm]

A = E + G + H + J, rounded up to nearest 10mm.

E = clear threads after assembly.

H = clamping thickness of fender.

The EC2 anchor is used for installing fenders onto existing concrete or where cast-in anchors are unsuitable. The anchor is usually secured into a drilled hole using special grout capsules. Non-standard sizes and other grout systems are available on request.



Always follow the manufacturer's instructions when installing EC2 anchors.

Accessories

Bolts, Nuts and Washers

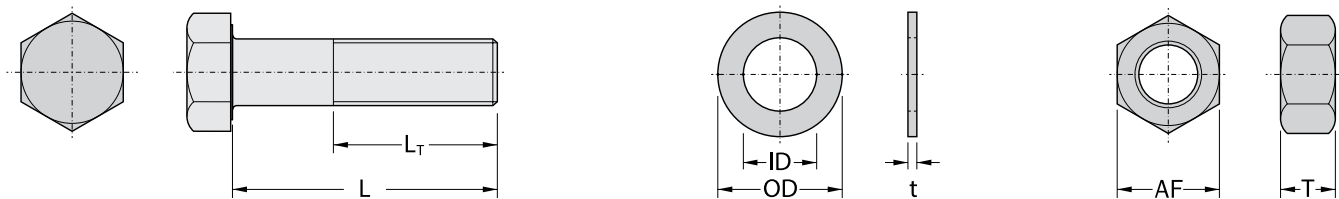
Size	Thread area *	Washers †			Nuts		Typical thread lengths ‡		Thread pitch
	(mm ²)	OD	ID	t	AF	T	L ≤ 125	L > 125	
M16	157	30	18	3	24	13	38	44	2.0
M20	245	37	22	3	30	16	46	52	2.5
M24	353	44	26	4	36	19	54	60	3.0
M27	459	52	29	4	41	22	60	66	3.0
M30	561	56	33	4	46	24	66	72	3.5
M36	817	66	39	5	55	29	78	84	4.0
M42	1120	78	45	7	65	34	90	96	4.5
M48	1470	92	52	8	75	38	102	108	5.0
M56	2030	105	62	9	85	45	118	124	5.5
M64	2680	115	70	9	95	51	134	140	6.0

[Units: mm]

* According to BS 3692: Table 13.

† Standard washers given. Large OD washers available on request.

‡ Thread lengths may vary depending on standard. Other lengths available.



Grades

	ISO 898 Galvanised		ISO 356 Stainless Steel *	
	4.6	8.8	A-50 †	A-70 ‡
Bolt grade	4.6	8.8	A-50 †	A-70 ‡
Nut grade	4	8	A-50 †	A-70 ‡
Tensile strength (MPa)	400	800	500	700
0.2% yield stress (MPa)	240	640	210	450

* Refer to Design and Testing Manual for further details about PREN and galling.

† Size ≤ M39 unless agreed with manufacturer.

‡ Size ≤ M24 unless agreed with manufacturer.

Fenders must be properly fixed to operate correctly. Anchors are supplied to suit new or existing structures, in various strength ratings and with the choice of galvanised or various stainless steels.

Disclaimer

Trelleborg AB has made every effort to ensure that the technical specifications and product descriptions in this catalogue 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 Systems.

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Trelleborg Marine Systems designs, manufactures and installs bespoke fender systems, docking and mooring equipment, oil and gas transfer technology and vessel efficiency technology for marine environments all over the world. Our polymer engineering expertise also extends to our range of general marine products, including navigation aids and buoys.

WWW.TRELLEBORG.COM/MARINE