TEKMARINE

Marine Fenders

About TekMarine

From its base in the United States, TekMarine Systems LLC designs and supplies advanced marine fendering and mooring systems to ports, harbors and waterways across the world.

We bring a wealth of engineering and market experience to each project. Our fender solutions range from simple modules to the most sophisticated engineered systems. We supply every type of berth, including passenger terminals, bulk and RoRo ports, Oil and Gas installations and naval facilities.

We offer full support at each step from early concept discussions through to design and detailing, material selection, construction, testing, shipping, and installation. A full after-care service helps keep your investment working safely and reliably for many years after commission.

Disclaimer

TekMarine Systems LLC ("TekMarine") has made every effort to ensure that the product descriptions and technical specifications in this catalog are correct. TekMarine can not accept liability or responsibility for errors and omissions for any reason. Customers and catalog users are kindly requested to ask TekMarine for a detailed specification and approved drawings before manufacturing and construction. TekMarine reserves the right to make changes to specifications and drawings without prior notice. All dimensions, performance values, material properties and other product specifications are subject to standard tolerances. This catalog and the information herein replaces all earlier editions. If in any doubt, please contact TekMarine.

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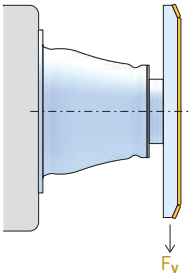
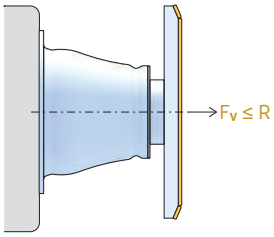
Design Considerations

Chains can assist in controlling the compression geometry of fenders in some applications. Please ask TekMarine for more details.



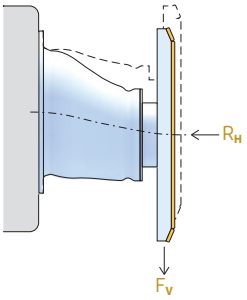
Weight support

Fenders can support large static weights. We recommend weight support chains for panels heavier than the rubber fender.



Tension

When the tension will exceed the fender's rated reaction force, then tension chains are strongly recommended.

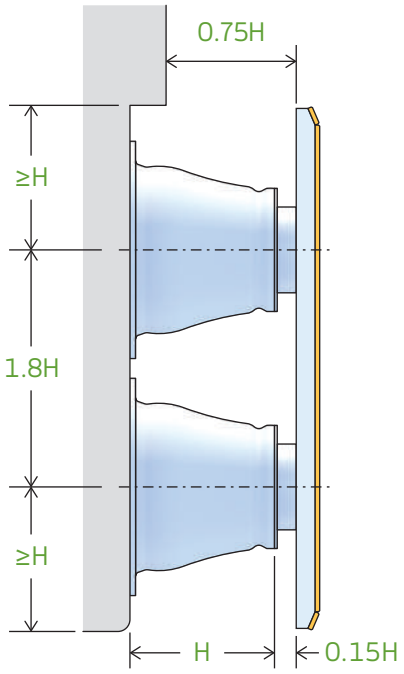


Shear

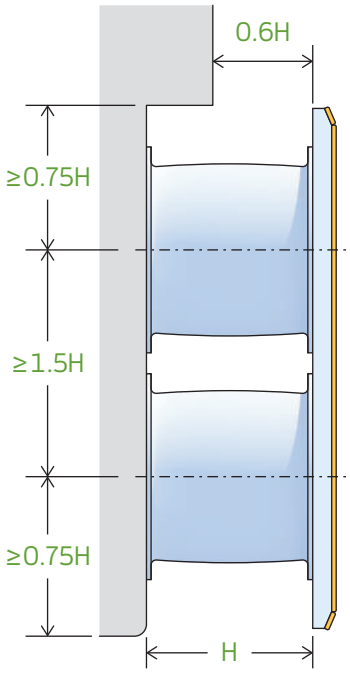
Fenders remain stable with vertical or horizontal shear forces. Shear chains may be needed for some applications and fender layouts.

Clearances

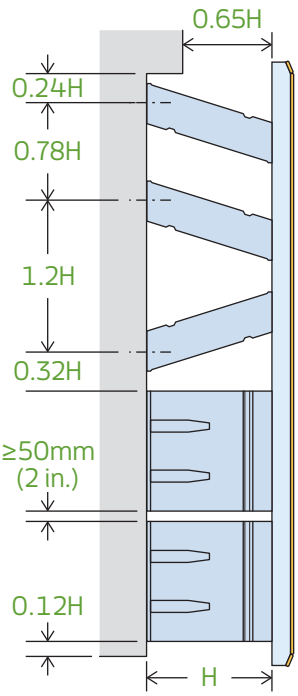
TJCO Cone



TJSC Cell



TJUE Element



Fenders should not contact each other when compressed. Neither fenders nor panel should touch the quay face during compression. Adequate space should be allowed for chains and other fender features. Overhanging hull features such as bow flares and beltings (strakes) should also be considered.

The values given in the diagrams indicate minimum clearances between fenders, with respect to fender height. Values are for guidance only and should be calculated and checked in each case.

Rubber Properties

Every TekMarine rubber fender unit uses the highest quality Natural Rubber (NR) and/or Styrene-butadiene (SBR) based compounds. These meet or exceed the performance requirements of the main international fender specifications such as PIANC and EAU-E 62 "Acceptance Requirements for Fender Elastomers". The table below shows typical specifications for laboratory prepared and tested specimens.

Please consult TekMarine about other fender compounds such as EPDM, Butyl, Neoprene and Polyurethane.

Material samples for laboratory test purposes are prepared differently to rubber fender units. Please ask TekMarine for details.

Property	Test method	Conditions	Requirements	Unit
Tensile Strength	ASTM D412 Die C; AS 1180.2; BS 903.A2; ISO 37; JIS K6251 Item 3, Dumbell 3	Original	≥ 16.0	MPa
		Aged for 96 hours at 70°C	≥ 12.8	
Elongation at Break	ASTM D 412 Die C; AS 1180.2; BS 903.A2; ISO 37; JIS K 6251 Item 3, Dumbell 3	Original	≥ 400	%
		Aged for 96 hours at 70°C	≥ 320	
Hardness	ASTM D 2240; AS1683.15.2; BS 903.A6; ISO 815; JIS K 6301 Item 5A Tester	Original	≤ 78°	Shore A
		Aged for 96 hours at 70°C	original value +6°	
Compression Set	ASTM D 395; AS1683.13B; BS903. A6; ISO 815; JIS K6262 Item 10	Aged for 22 hours at 70°C	≤ 30	%
	DIN 53517	Aged for 24 hours at 70°C	≤ 40	
Tear Resistance	ASTM D624; AS1683.12; BS903. A3: ISO 34.1; JIS K6301 Item 9; Test Piece A	Die B	≥ 70	kN/m
Ozone Resistance	ASTM D1149; AS1683.24; BS903.43; DIN 53509; ISO 143/1	1ppm at 20% strain at 40°C for 100 hours	no visible cracking	n/a
Seawater Resistance (Hardness)	ASTM D 471; BS ISO 1817	28 days in artificial seawater at 95°C ±2°C	≤ ±10°	Shore A
Seawater Resistance (Volume)			≤ +10/-5	%
Abrasion Resistance	BS 903.A9	Method B	≤ 0.5	cc
Bond Strength (Steel to Rubber)	BS 903.A21	Method B	≥ 7	N/mm

Tolerances

Standard manufacturing and performance tolerances apply to all TekMarine fenders. TekMarine may agree to smaller tolerances in special cases. Please ask TekMarine for tolerances of types not listed below.

Fender Type	Property		Tolerance
TJCO, TJSC, TJUE, TJDA-A and TJDA-B	All dimensions		±3% or ±2mm (whichever greater)
	Bolt hole spacing		±2mm
TJCY	Outside diameter		±4%
	Inside diameter		±4%
	Length		±40mm
TJDD, TJSD, TJDO and TJSO	Cross-section		±4%
	Length		±2% or ±10mm(whichever greater)
	Drilled hole centers		±4mm (non-cumulative)
	Counterbore depth		±4mm (under-head depth)
TJCA, TJCB	Cross-section		±3% or ±2mm (whichever greater)
	Length		±2% or ±25mm (whichever greater)
	Drilled hole centers		±4mm (non-cumulative)
	Counterbore depth		±4mm (under-head depth)
HD-PE fenders	Cross-section		±4%
	Length		±2% or ±20mm (whichever greater)
	Drilled hole centers		±4mm (non-cumulative)
	Counterbore depth		±4mm (under-head depth)
UHMW-PE panels	Length and width	(cut panels)	±5mm (cut pads)
		(uncut sheets)	±20mm (uncut sheets)
	Planed thickness	≤ 30mm	±0.2mm
		31–100mm	±0.3mm
		≥ 100mm	±0.5mm
	Unplaned thickness	≤ 30mm	±2.5mm
		31–100mm	±4.0mm
		≥ 100mm	±6.0mm
	Drilled hole centers		±2mm (non-cumulative)
	Counterbore depth		±2mm (under-head depth)
M, W and Block fenders	Cross-section		±3% or ±2mm (whichever greater)
	Length		±3% or ±20mm (whichever greater)
	Fixing hole centers		±3mm
	Fixing hole diameter		±3mm

Performance

Fender Type	Property	Tolerance
TJCO, TJSC, TJUE, TJDA-A and TJDA-B	Reaction, energy and deflection	±10%
Cylindricals (wrapped)	Reaction, energy and deflection	±10%
Cylindricals (extruded)	Reaction, energy and deflection	±10%
Profile fenders	Reaction, energy and deflection	±10%
Pneumatic fenders	Reaction and energy	±10%
Foam fenders	Reaction and energy	±15%

Unless otherwise listed or agreed with TekMarine, tolerances are ±20%.

Testing

Testing of molded[1] and wrapped cylindrical[2] fenders is conducted in-house, with an option for third party witnessing, using full size fenders in accordance with the PIANC 2002[3] guidelines below.

- All fender units have a unique serial number which can be traced back to manufacturing and testing records.
- Fenders are tested under direct (vertical) compression using the Constant Velocity (CV) method.
- The test specimen shall be broken-in by deflected three or more times to at least its rated deflection. After break-in cycles the fender specimen is allowed to recover for at least one hour.
- Axial compression test speed is 2 cm/min ± 8cm/min.
- The test specimen is temperature stabilized to 23°C ± 5°C.[4]
- Reaction force[5] is recorded at intervals to at least a deflection at which the permitted[6] minimum energy absorption is achieved.
- Energy absorption[5] is determined as the integral of reaction and deflection, calculated using Simpson's Rule. The results of a pre-compression cycle[6] and subsequence break-in compression cycle(s) are not recorded.
- The fender performance shall be determined from a single measured compression cycle and pass if the reaction force is less than the maximum permitted[7] reaction force and more than the minimum permitted[7] energy absorption.[8]
- Sampling is 10% of fenders (rounded up to a unit).[9]
- If any sample does not satisfy the specifications, sampling of the remainder is increased to 20% of fenders (rounded up to a unit), excluding non-compliant units.
- If any further sample does not satisfy the specifications, 100% of remaining samples will be tested. Only units which satisfy the specifications shall be passed for shipment. The non-compliant fenders will be rejected.

1 Molded fenders include TJCO, TJSC, TJUE, TJDA-A and TJDA-B fenders. TJCO, TJSC, TJDA-A and TJDA-B fenders are tested singly. TJUE fenders are tested in pairs.

2 Excluding TJTB tug cylindrical fenders.

3 Permanent International Association of Navigation Congress Report of the International Commission for Improving the Design of Fender Systems (Guidelines for the design of Fender systems: 2002, Appendix A).

4 Where the ambient temperature is outside this range, fenders shall be normalized to this temperature range in a conditioning room for a suitable period (according to fender size), or performance values may be adjusted according to the temperature correction factor tables.

5 Reaction forces (and the corresponding, calculated energy absorption) shall be the exact recorded value and not corrected or otherwise adjusted for speed, unless the project specifications require otherwise.

6 Pre-compression testing involves a single 'run in' cycle up to the catalogue rated deflection. The reaction force is not recorded.

7 Maximum permitted reaction force is the catalogue value plus the applicable manufacturing tolerance. Minimum permitted energy absorption is the catalogue value minus the applicable manufacturing tolerance.

8 The deflection at which the minimum permitted energy absorption is achieved may differ from the nominal 'rated' deflection indicated in the catalogue for the corresponding fender type. Actual deflection is not considered as a pass/fail criterion.

9 Testing to PIANC protocols is included within the fender price. Higher testing frequencies, third party witnessing and temperature stabilization costs shall be paid by the purchaser.

Unit Conversions

Length

	m	ft	in
1 m =	1	3.281	39.37
1 ft =	0.3048	1	12
1 in =	0.0245	0.0833	1

Force

	kN	tonne-f	ton-f
1 kN =	1	0.102	0.225
1 tonne-f =	9.81	1	2.2046
1 ton-f =	4.45	0.454	1

Area

	m²	ft²	in²
1 m² =	1	10.764	1550
1 ft² =	0.0929	1	144
1 in² =	645.2×10^{-6}	6.944×10^{-3}	1

Energy

	kNm	tf-m	ft.kip
1 kNm =	1	0.102	0.7376
1 tf-m =	9.81	1	7.233
1 ft.kip =	1.36	0.138	1

Volume

	m³	ft³	in³
1 m³ =	1	35.315	61024
1 ft³ =	0.0283	1	1728
1 in³ =	16.387×10^{-6}	578.7×10^{-6}	1

Pressure

	kPa	t/m²	kip/ft²
1 kPa =	1	0.102	0.0209
1 t/m² =	9.81	1	0.205
1 kip/ft² =	47.9	4.88	1

Velocity

	m/s	ft/s	km/h	mph	knot
1 m/s =	1	3.2808	3.6	2.2369	1.9438
1 ft/s =	0.3048	1	1.0973	0.6818	0.5925
1 km/h =	0.2778	0.9113	1	0.6214	0.54
1 mph =	0.447	1.4667	1.6093	1	0.869
1 knot =	0.5144	1.6878	1.852	1.1508	1

Acceleration

	g	m/s²	ft/s²
1 g =	1	9.807	32.17
1 m/s² =	0.102	1	3.281
1 ft/s² =	0.031	0.3048	1

Important note

US customary units are listed for your convenience in this catalog, however figures in metric prevail throughout.

Useful software

At the time of publication, third-party unit conversion tools include:

Convert for Windows: https://joshmadison.com/convert-for-windows/

NumericalChameleon: http://sourceforge.net/projects/numchameleon/

TekMarine offers no warranty for nor makes any claims as to accuracy or fitness for purpose of these programs.

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Catalogue version 001d