

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

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TJSC Cell Fender

The TJSC Cell Fender is a proven design that protects thousands of harbors around the world. Its cylindrical body resists overloading without sacrificing shear resistance.

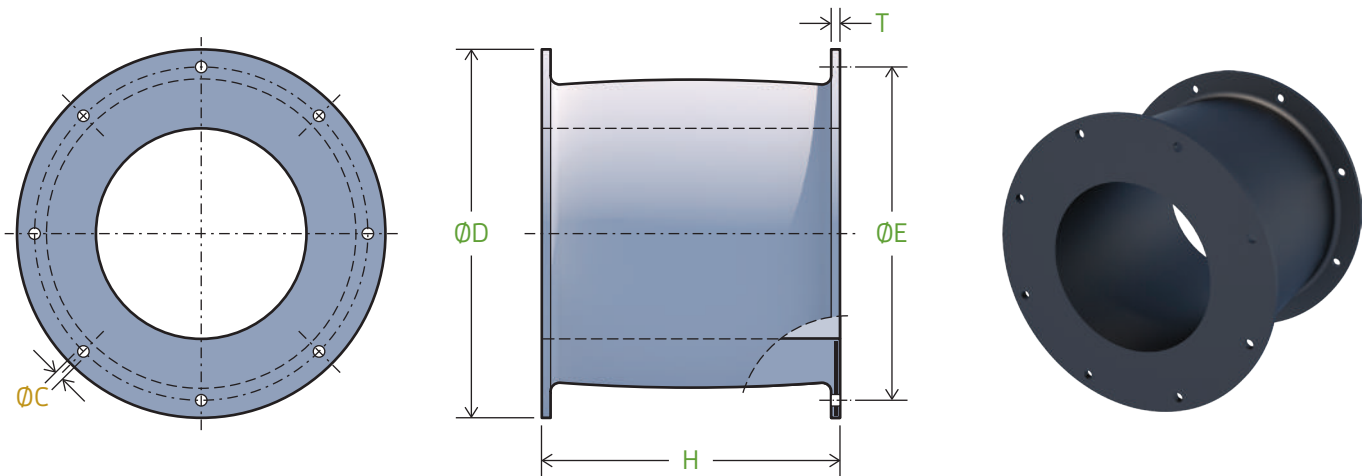
The Cell Fender's large footprint makes installation simple. Its efficient force distribution also enables large, low hull-pressure panel designs. No other fender offers as many sizes in a full range of compounds.

TJSC Cell Fenders are compatible with nearly all legacy cell fenders, making them ideal for replacements and upgrades, as well as new builds. Please ask us about designing for systems at or below the water level.

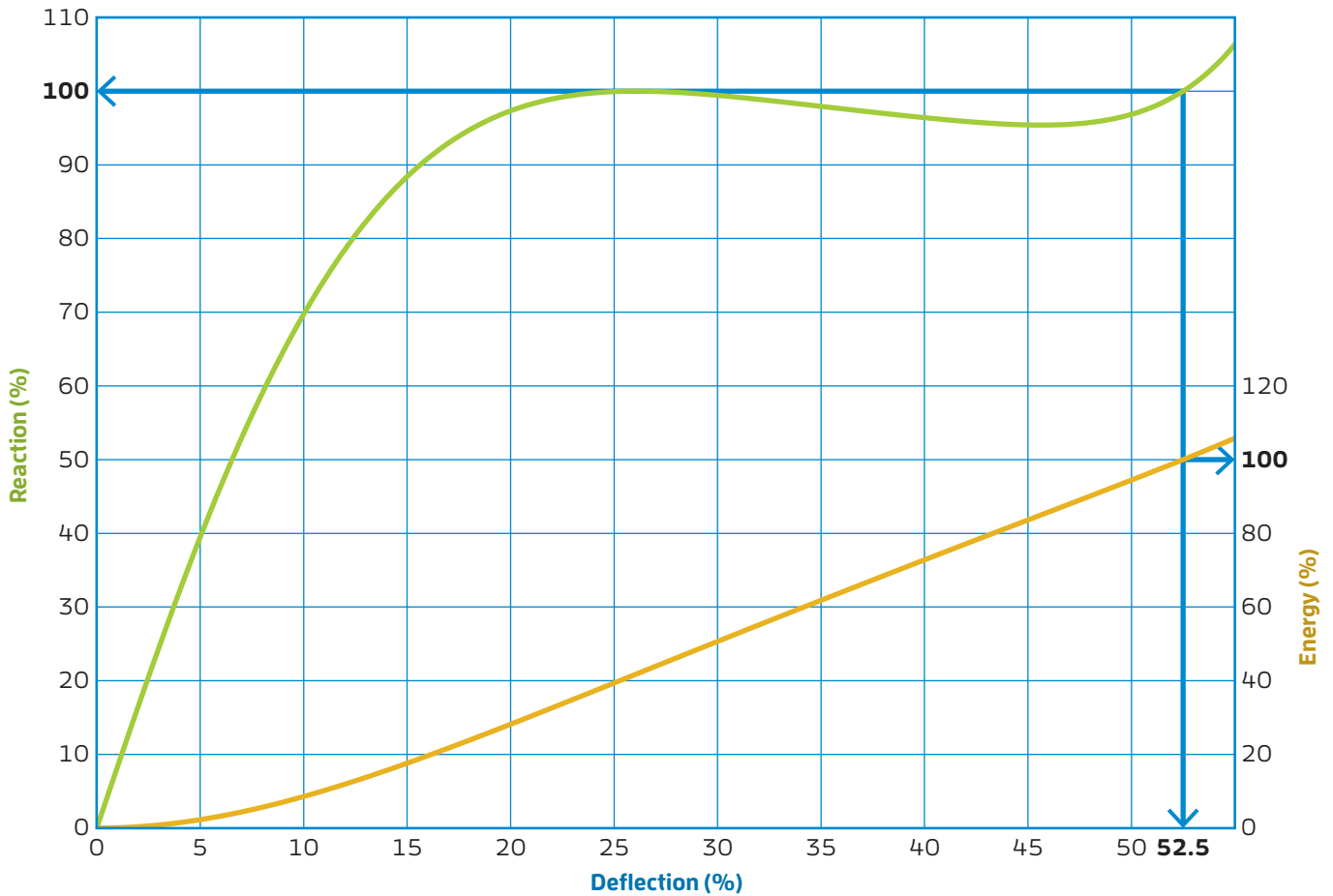


Dimensions

Model	Height		ØD		ØE		T		n × ØC		Bolt	Weight	
	mm	in	mm	in	mm	in	mm	in	mm	in		mm	kg
TJSC 400	400	15.7	650	25.6	550	21.7	25	1.00	4 × 30	4 × 1.20	M22	83	183
TJSC 500	500	19.7	650	25.6	550	21.7	25	0.98	4 × 32	4 × 1.26	M24	110	243
TJSC 630	630	24.8	840	33.1	700	27.6	30	1.18	4 × 39	4 × 1.54	M30	235	518
TJSC 800	800	31.5	1050	41.3	900	35.4	30	1.18	6 × 40	6 × 1.57	M30	410	904
TJSC 1000	1000	39.4	1300	51.2	1100	43.3	35	1.38	6 × 47	6 × 1.85	M36	805	1775
TJSC 1150	1150	45.3	1500	59.1	1300	51.2	40	1.57	6 × 50	6 × 1.97	M42	1223	2697
TJSC 1250	1250	49.2	1650	65.0	1450	57.1	45	1.77	6 × 53	6 × 2.09	M42	1490	3285
TJSC 1450	1450	57.1	1850	72.8	1650	65.0	47	1.85	6 × 61	6 × 2.40	M48	2330	5138
TJSC 1600	1600	63.0	2000	78.7	1800	70.9	50	1.97	8 × 61	8 × 2.40	M48	3020	6659
TJSC 1700	1700	66.9	2100	82.7	1900	74.8	55	2.17	8 × 66	8 × 2.60	M56	3730	8225
TJSC 2000	2000	78.7	2200	86.6	2000	78.7	55	2.17	8 × 74	8 × 2.91	M64	5023	11076
TJSC 2250	2250	88.6	2550	100	2300	90.6	60	2.36	10 × 74	10 × 2.91	M64	7450	16427
TJSC 2500	2500	98.4	2950	116	2700	106	70	2.76	10 × 74	10 × 2.91	M64	10750	23704
TJSC 3000	3000	118	3350	131	3150	124	75	2.95	12 × 92	12 × 3.62	M76	16320	35904



TJSC Performance



Intermediate values

Deflection	Reaction	Energy
%	%	%
5	39	2
10	70	9
15	88	18
20	97	28
25	100	39
30	98	51
35	96	62
40	95	73
45	95	84
50	97	94
52.5	100	100
55	106	106

Angle factor

Angle (°)	γ_A	
	Energy	Reaction
0	1.00	1.00
3	0.97	0.98
5	0.95	0.95
8	0.91	0.94
10	0.89	0.92
15	0.80	0.88
20	0.65	0.80

Velocity factors

Time (s)	γ_V
1	1.22
2	1.09
3	1.05
4	1.03
5	1.02
6	1.01
7	1.01
8	1.00
9	1.00
≥10	1.00

Temperature factor

Temperature		γ_T
(°C)	(°F)	
50	122	0.90
40	104	0.94
30	86	0.98
23	73	1.00
10	50	1.06
0	32	1.10
-10	14	1.14
-20	-4	1.19
-30	-22	1.24

Values are for single units. Standard tolerance $\pm 10\%$. Please ask TekMarine if $t < 4$ seconds or for any other performance data.

TJSC Performance (metric units)

Model		E = kNm, R=kN											
		T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
TJSC 400	E	8.8	9.3	9.8	10.3	10.8	11.3	11.8	12.3	13.0	13.7	14.5	15.2
	R	50.3	53.1	55.9	58.7	61.5	64.2	67.0	69.8	74.0	78.2	82.4	86.6
TJSC 500	E	17.3	18.2	19.2	20.1	21.1	22.0	23.0	23.9	25.4	26.8	28.3	29.7
	R	78.6	82.9	87.3	91.6	96.0	100	105	109	116	122	129	135
TJSC 630	E	34.4	36.3	38.2	40.2	42.2	44.1	46.1	48.1	51.0	53.9	56.7	59.6
	R	124	131	138	145	152	160	167	174	184	195	205	216
TJSC 800	E	70.8	74.8	78.7	82.6	86.5	90.5	94.4	98.3	104	110	116	121
	R	202	213	224	235	246	258	269	280	297	313	330	346
TJSC 1000	E	138	145	153	161	169	176	184	192	203	215	226	238
	R	314	332	349	367	384	402	419	437	463	489	516	542
TJSC 1150	E	210	221	233	245	257	268	280	292	309	327	344	362
	R	416	439	462	485	508	532	555	578	652	727	801	876
TJSC 1250	E	269	284	299	314	329	344	359	374	397	419	442	464
	R	491	518	545	572	600	627	655	682	723	764	805	846
TJSC 1450	E	420	444	467	490	514	537	561	584	620	656	692	728
	R	661	697	734	771	808	844	881	918	974	1031	1087	1144
TJSC 1600	E	565	597	628	660	692	723	755	787	834	880	927	973
	R	805	849	894	939	984	1030	1075	1120	1186	1252	1318	1384
TJSC 1700	E	679	716	754	793	832	870	909	948	1002	1057	1111	1166
	R	909	960	1010	1062	1114	1166	1218	1270	1344	1418	1492	1566
TJSC 2000	E	1098	1159	1220	1284	1348	1412	1476	1540	1630	1720	1810	1900
	R	1251	1321	1390	1462	1534	1606	1678	1750	1854	1958	2062	2166
TJSC 2250	E	1854	1957	2060	2132	2204	2276	2348	2420	2566	2712	2858	3004
	R	1881	1986	2090	2162	2234	2306	2378	2450	2598	2746	2894	3042
TJSC 2500	E	2538	2679	2820	2922	3024	3126	3228	3330	3526	3722	3918	4114
	R	2313	2442	2570	2662	2754	2846	2938	3030	3210	3390	3570	3750
TJSC 3000	E	4401	4646	4890	5062	5234	5406	5578	5750	6094	6438	6782	7126
	R	3339	3525	3710	3842	3974	4106	4238	4370	4630	4890	5150	5410

Other sizes and intermediate performances are available on request. Please ask TekMarine for details.

TJSC Performance (metric units)

Model		E = kNm, R=kN												
		T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32
TJSC 400	E	15.9	16.4	16.9	17.4	17.9	18.4	18.9	19.3	19.8	20.2	20.7	21.7	22.8
	R	90.8	93.6	96.5	99.3	102	105	108	110	113	115	118	124	130
TJSC 500	E	31.2	32.2	33.1	34.1	35.0	36.0	36.9	37.8	38.6	39.5	40.4	42.4	44.4
	R	142	146	151	155	160	164	168	172	176	180	184	193	202
TJSC 630	E	62.5	64.4	66.3	68.1	70.0	71.9	73.7	75.5	77.2	79.0	80.8	84.8	88.9
	R	226	233	240	246	253	260	266	273	279	286	292	307	321
TJSC 800	E	127	131	135	139	143	147	151	155	158	162	166	174	183
	R	363	374	385	397	408	419	430	440	451	461	472	496	519
TJSC 1000	E	249	257	265	272	280	288	295	302	310	317	324	340	356
	R	568	585	603	620	638	655	672	688	705	721	738	775	812
TJSC 1150	E	379	391	402	414	425	437	448	459	471	482	493	518	542
	R	950	933	916	900	883	866	888	910	932	954	976	1025	1074
TJSC 1250	E	487	502	516	531	545	560	575	591	606	622	637	669	701
	R	887	914	940	967	993	1020	1048	1076	1104	1132	1160	1218	1276
TJSC 1450	E	764	786	807	829	850	872	895	918	941	964	987	1036	1086
	R	1200	1234	1268	1302	1336	1370	1406	1442	1478	1514	1550	1628	1705
TJSC 1600	E	1020	1052	1084	1116	1148	1180	1210	1240	1270	1300	1330	1397	1463
	R	1450	1496	1542	1588	1634	1680	1722	1764	1806	1848	1890	1985	2079
TJSC 1700	E	1220	1258	1296	1334	1372	1410	1446	1482	1518	1554	1590	1670	1749
	R	1640	1690	1740	1790	1840	1890	1938	1986	2034	2082	2130	2237	2343
TJSC 2000	E	1990	2052	2114	2176	2238	2300	2358	2416	2474	2532	2590	2720	2849
	R	2270	2340	2410	2480	2550	2620	2686	2752	2818	2884	2950	3098	3245
TJSC 2250	E	3150	3246	3342	3438	3534	3630	3724	3818	3912	4006	4100		
	R	3190	3288	3386	3484	3582	3680	3774	3868	3962	4056	4150		
TJSC 2500	E	4310	4444	4578	4712	4846	4980	5108	5236	5364	5492	5620		
	R	3930	4052	4174	4296	4418	4540	4656	4772	4888	5004	5120		
TJSC 3000	E	7470	Please speak to TekMarine about harder grades in these sizes.											
	R	5670												

Other sizes and intermediate performances are available on request. Please ask TekMarine for details.

TJSC Performance (US units)

Model		E = ft.kip, R=kips											
		T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19
TJSC 400	E	6.5	6.9	7.2	7.6	8.0	8.3	8.7	9.1	9.6	10.1	10.7	11.2
	R	11.3	11.9	12.6	13.2	13.8	14.4	15.1	15.7	16.6	17.6	18.5	19.5
TJSC 500	E	12.7	13.5	14.2	14.9	15.5	16.2	16.9	17.6	18.7	19.8	20.9	21.9
	R	17.7	18.6	19.6	20.6	21.6	22.6	23.5	24.5	26.0	27.5	29.0	30.4
TJSC 630	E	25.4	26.8	28.2	29.6	31.1	32.6	34.0	35.5	37.6	39.7	41.8	44.0
	R	27.9	29.5	31.0	32.6	34.3	35.9	37.5	39.1	41.5	43.8	46.1	48.5
TJSC 800	E	52.2	55.1	58.0	60.9	63.8	66.7	69.6	72.5	76.7	81.0	85.2	89.4
	R	45.3	47.8	50.4	52.9	55.4	57.9	60.4	62.9	66.7	70.4	74.1	77.9
TJSC 1000	E	102	107	113	119	124	130	136	142	150	158	167	175
	R	70.6	74.5	78.5	82.4	86.4	90.3	94.3	98.2	104	110	116	122
TJSC 1150	E	155	163	172	181	189	198	207	215	228	241	254	267
	R	93.5	98.7	104	109	114	120	125	130	147	163	180	197
TJSC 1250	E	198	210	221	232	243	254	265	276	293	309	326	343
	R	110	116	123	129	135	141	147	153	163	172	181	190
TJSC 1450	E	310	327	344	362	379	396	413	431	457	484	510	537
	R	149	157	165	173	182	190	198	206	219	232	244	257
TJSC 1600	E	417	440	463	487	510	534	557	580	615	649	684	718
	R	181	191	201	211	221	231	242	252	267	281	296	311
TJSC 1700	E	501	528	556	585	613	642	671	699	739	779	820	860
	R	204	216	227	239	250	262	274	286	302	319	335	352
TJSC 2000	E	810	855	900	947	994	1041	1089	1136	1202	1269	1335	1401
	R	281	297	312	329	345	361	377	393	417	440	464	487
TJSC 2250	E	1367	1443	1519	1572	1626	1679	1732	1785	1893	2000	2108	2216
	R	423	446	470	486	502	518	535	551	584	617	651	684
TJSC 2500	E	1872	1976	2080	2155	2230	2306	2381	2456	2601	2745	2890	3034
	R	520	549	578	598	619	640	660	681	722	762	803	843
TJSC 3000	E	3246	3426	3607	3734	3860	3987	4114	4241	4495	4748	5002	5256
	R	751	792	834	864	893	923	953	982	1041	1099	1158	1216

Other sizes and intermediate performances are available on request. Please ask TekMarine for details.

TJSC Performance (US units)

Model		E = ft.kip, R=kips												
		T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32
TJSC 400	E	11.7	12.1	12.5	12.8	13.2	13.6	13.9	14.2	14.6	14.9	15.3	16.0	16.8
	R	20.4	21.1	21.7	22.3	23.0	23.6	24.2	24.8	25.4	25.9	26.5	27.9	29.2
TJSC 500	E	23.0	23.7	24.4	25.1	25.8	26.6	27.2	27.9	28.5	29.1	29.8	31.3	32.8
	R	31.9	32.9	33.9	34.9	35.9	36.9	37.8	38.7	39.6	40.5	41.4	43.4	45.5
TJSC 630	E	46.1	47.5	48.9	50.3	51.6	53.0	54.3	55.7	57.0	58.3	59.6	62.6	65.6
	R	50.8	52.3	53.9	55.4	56.9	58.5	59.9	61.3	62.8	64.2	65.6	68.9	72.2
TJSC 800	E	93.7	96.6	100	103	105	108	111	114	117	120	122	129	135
	R	81.6	84.1	86.6	89.2	91.7	94.2	96.6	99.0	101	104	106	111	117
TJSC 1000	E	184	189	195	201	207	212	218	223	228	234	239	251	263
	R	128	132	136	139	143	147	151	155	158	162	166	174	182
TJSC 1150	E	280	288	297	305	314	322	331	339	347	355	364	382	400
	R	214	210	206	202	198	195	200	205	210	214	219	230	241
TJSC 1250	E	359	370	381	391	402	413	424	436	447	458	470	493	517
	R	199	205	211	217	223	229	236	242	248	254	261	274	287
TJSC 1450	E	563	579	595	611	627	643	660	677	694	711	728	764	801
	R	270	277	285	293	300	308	316	324	332	340	348	366	383
TJSC 1600	E	752	776	800	823	847	870	892	915	937	959	981	1030	1079
	R	326	336	347	357	367	378	387	397	406	415	425	446	467
TJSC 1700	E	900	928	956	984	1012	1040	1067	1093	1120	1146	1173	1231	1290
	R	369	380	391	402	414	425	436	446	457	468	479	503	527
TJSC 2000	E	1468	1513	1559	1605	1651	1696	1739	1782	1825	1868	1910	2006	2101
	R	510	526	542	558	573	589	604	619	634	648	663	696	730
TJSC 2250	E	2323	2394	2465	2536	2607	2677	2747	2816	2885	2955	3024		
	R	717	739	761	783	805	827	848	870	891	912	933		
TJSC 2500	E	3179	3278	3377	3475	3574	3673	3767	3862	3956	4051	4145		
	R	883	911	938	966	993	1021	1047	1073	1099	1125	1151		
TJSC 3000	E	5510	Please speak to TekMarine about harder grades in these sizes.											
	R	1275												

Other sizes and intermediate performances are available on request. Please ask TekMarine for details.



UHMW-PE Facings

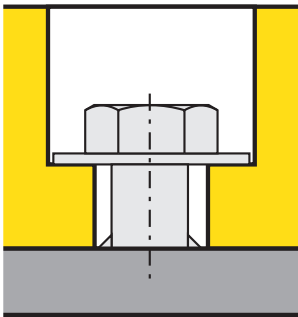
TekMarine protects every fender panel with top quality UHMW-PE (Ultra High Molecular Weight Polyethylene) facings. Impact resistant and very low in friction, UHMW-PE allows vessels to move smoothly past a fender system without snagging or abrasion. It is also popular for heavy duty impact protection where fenders are not required.

Easy to machine and install, UHMW-PE comes in many colors and several quality grades.

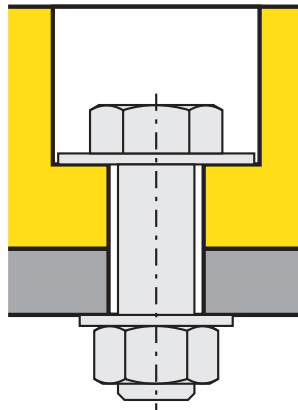
UHMW-PE does not rot, split or decay and does not suffer from UV or ozone damage. It is fully recyclable.



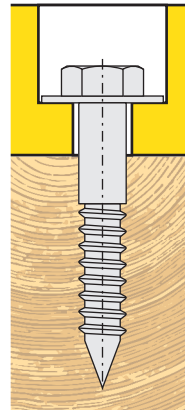
Steel panel with welded stud



Open steel structure



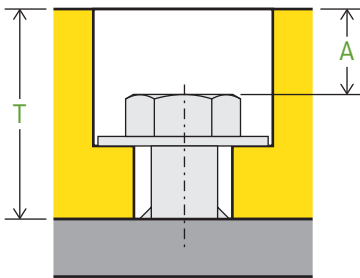
Timber structure



The fixing type depends on the underlying structure. Welded studs or stronger 'blind boss' fixings are used for steel panels. Oversize washers are recommended when bolting through open steel structures.

Fixings are available in various steel grades and finishes: please ask TekMarine for more details.

Wear Allowances



T	A
30	5
40	10
50	15
70	25
100	40

A small increase in the thickness of UHMW-PE can dramatically improve the working life of the facing, protecting the fender and structure for longer.

Physical Properties

Property	Test method	Metric			US Units		
		Unit	Virgin	Recycled	Unit	Virgin	Recycled
Density	ASTM D-792	kg/m ³	930	945	lb/ft ³	58.01	58.9
Molecular Weight	Viscosimetric	g/mol	4.2 × 10 ⁶	4.2 × 10 ⁶	g/mol	4.2 × 10 ⁶	4.2 × 10 ⁶
Yield Strength	ASTM D-638	MPa	21	20	psi	3050	2900
Ultimate Strength	ASTM D-638	MPa	40	34.3	psi	5800	4974
Elongation at Break	ASTM D-638	%	250	218	%	250	218
Impact Strength	ASTM D-4020	kJ/m ²	70	50	ft-lb/in ²	34	24
Tensile Impact	DIN 53448	kJ/m ²	2200	1600	ft-lb/in ²	1050	762
Abrasion Index (Sand Slurry)	ASTM 965	AR-01 Steel=100	90	116	AR-01 Steel=100	90	116
Hardness	ASTM D-2240	Type D	68	70	Type D	68	70
Static Friction	ASTM D-1894	-	0.15	0.15-0.20	-	0.15	0.15-0.20
Dynamic Friction	ASTM D-1894	-	0.12	0.14-0.16	-	0.12	0.14-0.16
Operating Temperature		°C	-80 to +80	-80 to +80	°F	-112 to 176	-112 to 176
Thermal Expansion	ASTM D-696	K ⁻¹	2.0 × 10 ⁻⁴	1.8 × 10 ⁻⁴	°F ⁻¹	1.1 × 10 ⁻⁴	1.1 × 10 ⁻⁴
Melting Point	ASTM D-3417	°C	137-143	137-143	°F	278-289	278
Water Absorption	ASTM D-570	%	0	0	%	0	0

Friction comparisons

Material	Coefficient of friction against steel (μ)
UHMW-PE	0.15-0.2
HD-PE	0.3
Nylon	0.2
Rubber	0.6-0.7
Timber	0.4
Steel	0.5

The coefficient of friction of UHMW-PE varies according to the material grade and the pressure applied to the panel's surface.

These coefficients of friction only apply to smooth contact surfaces.

Source: BS 6349-4:2014

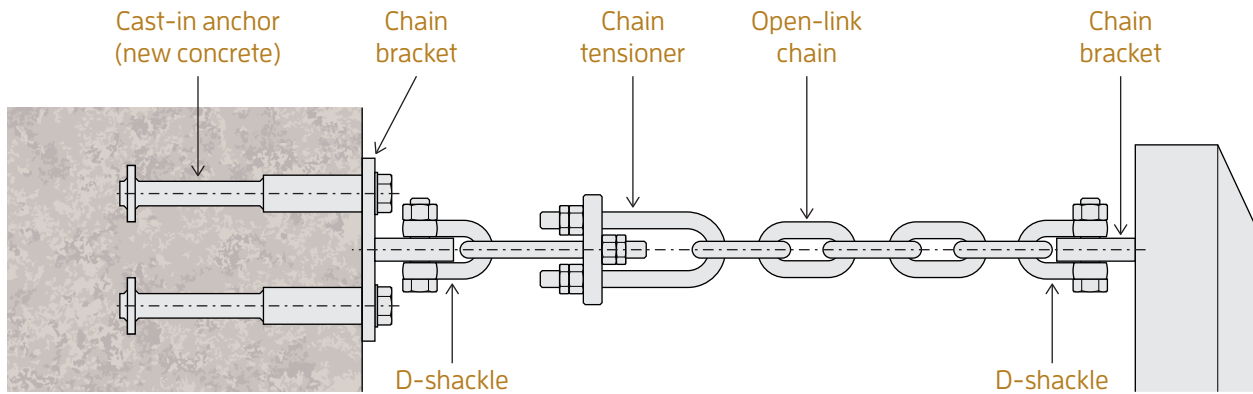
For more information please consult TekMarine.



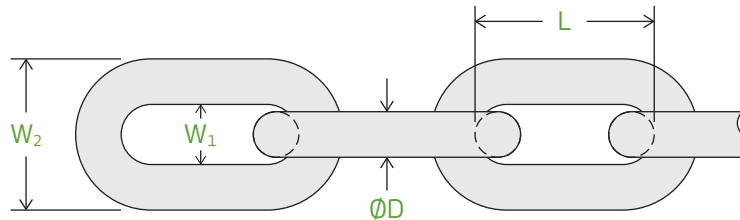
Anchors and Fixings

A fender system relies on the best quality fixings and accessories to perform properly. Large or heavy-duty fenders need chain systems to manage shear, tension and weight. These comprise open or stud-link chain, tensioners and shackles. Cast-in or resin anchors connect the chain systems and brackets to the quay structure. Various material grades and finishes are available: please ask TekMarine for details.

Typical chain system

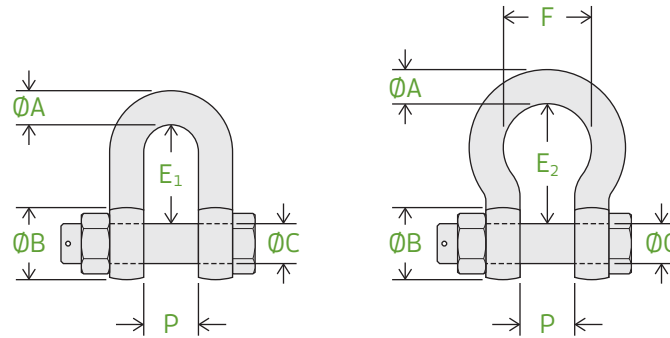


Chains



ØD	W ₁	W ₂	L = 4D	Weight	W ₁	W ₂	L = 5D	Weight	MBL	
									SL2	SL3
mm	mm	mm	mm	kg/m	mm	mm	mm	kg/m	kN	kN
14	20	48	56	3.8	21	49	70	3.7	124	154
16	22	54	64	5.0	24	56	80	4.8	160	202
18	25	61	72	6.3	27	63	90	6.0	209	262
20	28	68	80	7.8	30	70	100	7.5	264	330
22	31	75	88	9.4	33	77	110	9.0	304	380
25	35	85	100	12.1	38	88	125	11.6	393	491
28	39	95	112	15.2	42	98	140	14.6	492	616
30	42	102	120	17.4	45	105	150	16.7	566	706
32	45	109	128	19.8	48	112	160	19.0	644	804
35	49	119	140	23.8	53	123	175	22.8	770	964
38	53	129	152	28.0	57	133	190	26.9	900	1130
40	56	136	160	31.0	60	140	200	29.8	1010	1260
45	63	153	180	39.3	68	158	225	37.7	1275	1590
50	70	170	200	48.5	75	175	250	46.5	1570	1960
55	77	187	220	58.6	83	193	275	56.4	1900	2380
60	84	204	240	70.0	90	210	300	67.0	2260	2770

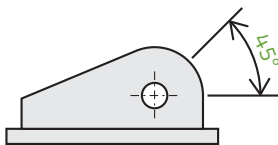
Shackles



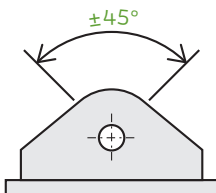
ØA	ØB	ØC	P	D-shackle		Bow shackle			NBL
				E ₁	Weight	E ₂	F	Weight	
mm	mm	mm	mm	mm	kg	mm	mm	kg	kN
13	26	16	22	43	0.4	51	32	0.4	120
16	32	19	27	51	0.7	64	43	0.8	195
19	38	22	31	59	1.1	76	51	1.3	285
22	44	25	36	73	1.5	83	58	1.9	390
25	50	28	43	85	2.6	95	68	2.8	510
28	56	32	47	90	3.3	108	75	3.8	570
32	64	35	51	94	4.7	115	83	5.3	720
35	70	38	57	115	6.2	133	95	7.0	810
38	76	42	60	127	7.6	146	99	8.8	1020
45	90	50	74	149	12.8	178	126	15.0	1500
50	100	57	83	171	18.2	197	138	20.7	2100
57	114	65	95	190	27.8	222	160	29.3	2550
65	130	70	105	203	35.1	254	180	64.5	3330

Brackets

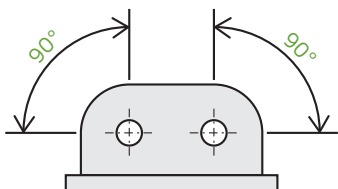
BSO



BSC

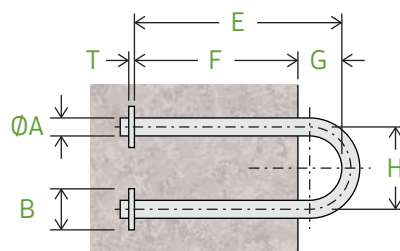


BDB



Brackets are purpose designed for every project. Please ask TekMarine for details.

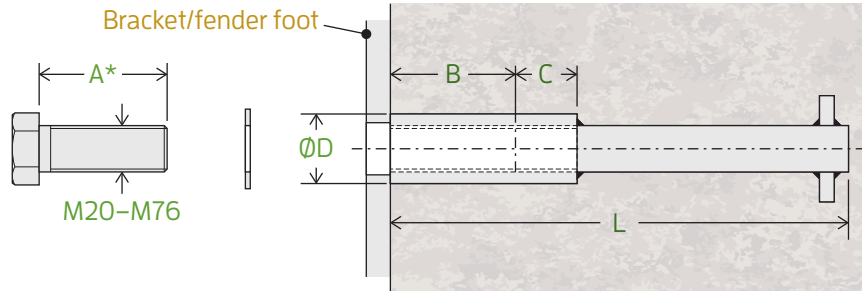
U-anchors



ØA	E	F	G	H	B	T	Weight	NBL
mm	mm	mm	mm	mm	mm	mm	kg	kN
26	320	260	60	104	50	12	3.4	209
30	370	300	70	120	50	15	5.1	264
34	410	340	70	136	60	15	7.3	304
36	430	360	70	144	60	20	8.6	393
42	510	420	90	168	70	20	13.7	492
44	540	440	100	176	80	20	16.1	566
48	580	480	100	192	80	25	20.5	644
50	610	500	110	200	90	25	23.7	770
56	680	560	120	224	100	30	33.4	900
60	730	600	130	240	110	30	41.1	1010
66	800	660	140	264	120	35	54.8	1275
74	900	740	160	296	130	40	76.9	1570

Anchors

Anchors are available in galvanized or stainless steel finishes, in various strength grades and in metric or inch sizes. Ask TekMarine for details if the required specification is not listed.



Cast-in type

Cast-in anchors are preferred for new concrete structures. The threaded anchor links via a long tail to an anchor plate, for even load distribution.

* Dimension A varies according to the thickness of the bracket or fender foot and should always be calculated.

Anchor	B	C	ØD	L	Weight
mm	mm	mm	mm	mm	kg
M20	50	20	30	214	0.9
M24	60	25	35	258	1.5
M30	70	30	45	318	2.7
M36	80	40	55	328	4.2
M42	85	45	65	416	6.9
M48	100	50	75	431	10.2
M56	105	60	85	436	14.0
M64	128	80	100	600	29.8
M76	152	90	114	700	46.1

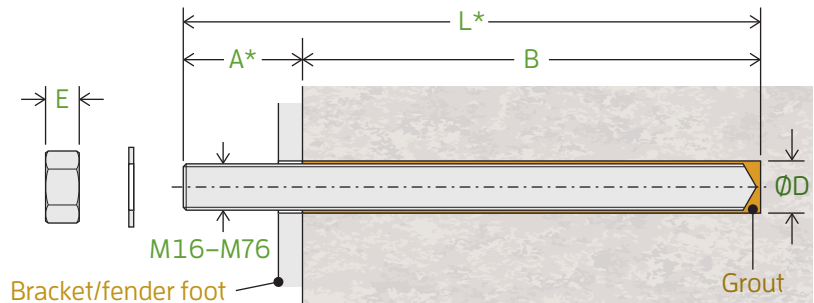
Chemical type

Chemical anchors are used for existing concrete structures.

Please ask about glass grout capsules and other grouting systems.

For an accurately drilled hole, allow for grout wastage of 10%–30%, depending on grout type.

* Dimensions A and L depend on the bracket/fender foot thickness and the concrete grade, and should always be calculated.

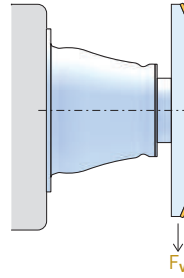


Anchor	B	ØD	E	Grout
mm	mm	mm	mm	ml
M16	140	20	13	16
M20	170	24	16	23
M24	210	28	19	34
M30	280	35	24	71
M36	360	42	29	132
M42	420	50	34	243
M48	460	54	38	221
M56	500	64	45	377
M64	560	72	51	479
M76	670	84	61	674



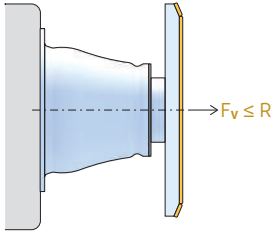
Design Considerations

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



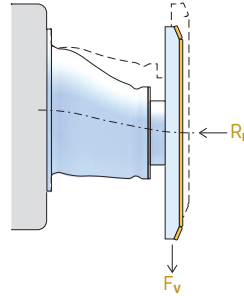
Weight support

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.

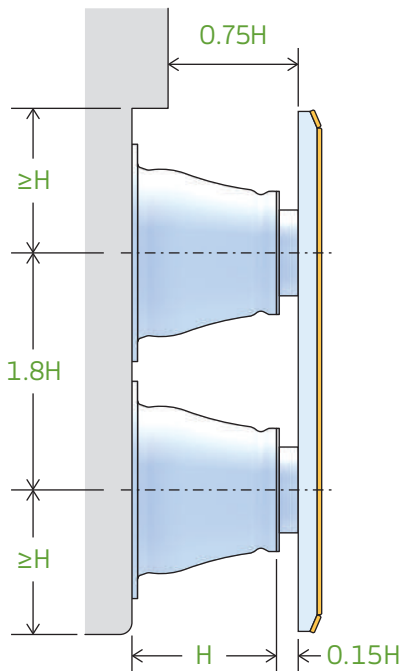


Shear

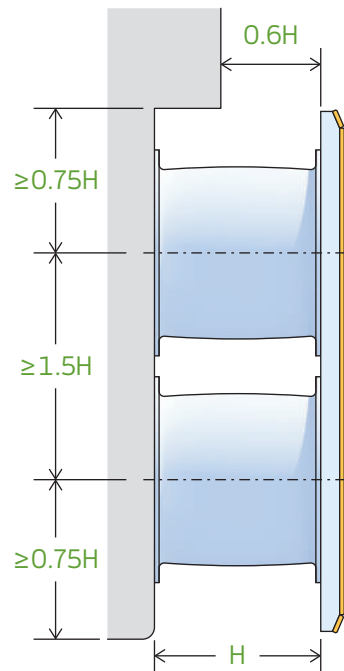
Fenders remain stable with vertical or horizontal shear forces. Shear chains may be needed for some applications and fender layouts.

Clearances

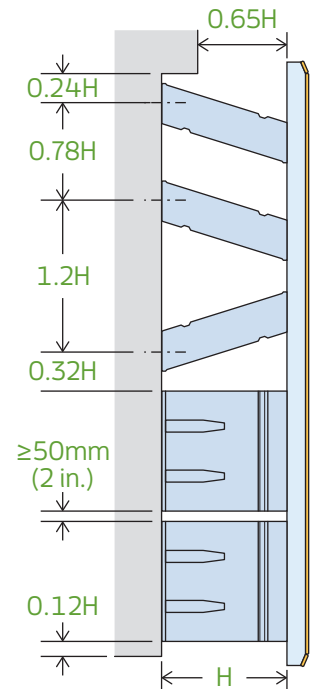
TJCO Cone



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 molded¹ and wrapped cylindrical² fenders is conducted in-house, with an option for third party witnessing, using full size fenders in accordance with the PIANC 2002³ 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 \pm 8cm/min.
- The test specimen is temperature stabilized to 23°C \pm 5°C.⁴
- Reaction force⁵ is recorded at intervals to at least a deflection at which the permitted⁶ minimum energy absorption is achieved.
- Energy absorption⁵ is determined as the integral of reaction and deflection, calculated using Simpson's Rule. The results of a pre-compression cycle⁶ and subsequent 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 permitted⁷ reaction force and more than the minimum permitted⁷ 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.



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Catalogue version 001d