

Fender Systems

PRODUCT BROCHURE

The Smarter Approach



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The demanding nature of commercial ports and terminals means you need partnership 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. At Trelleborg, we call this the Smarter Approach.

Our Smarter Approach combines global reach with feet-on-the-ground local presence, delivering solutions that continually enhance your operations.

Smart technologies are at the forefront of improving operational efficiencies. Trelleborg's innovative SmartPort offering deploys the latest in marine technology applications to help ports and terminals optimize their operations.

Connect with a partner that combines smart solutions, proven product capability and industry expertise to maintain and enhance port and vessel performance.

Take a Smarter Approach, with Trelleborg Marine Systems.

Fender Systems

Trelleborg Marine Systems is a world leader in the design and manufacture of advanced marine fender systems.

We provide bespoke solutions for large and complex projects all over the world. Best practice design and quality materials ensure a long, low maintenance service life, no matter how demanding the working and environmental conditions.

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

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

Take a Smarter Approach to fender performance with Trelleborg.

Contents

FENDER SYSTEMS

A Smarter Approach at every stage	3
Super Cone Fenders	5
SCK Cell Fenders	15
LEG Fenders	25
MV Elements	
MV V-Fenders	
MV-2000 Elements	
Unit Elements	
UE V-Fenders	
Super Arch and Arch Fenders	47
Parallel Motion Fenders	63
Pivot Fenders	67
Flexible Wall	69
Slide-In, Slide-Out Fender Systems	71
Accessories	73

A Smarter Approach at every stage

A smarter approach to...

CONSULTATION

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



CONCEPTS

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



DESIGN

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



MANUFACTURE

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



TESTING

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



INSTALLATION

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



SUPPORT

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



THE FUTURE

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



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

Super Cone Fenders



Super cone fenders (SCN) are the latest generation of fenders, with optimal performance and efficiency.

The conical body shape makes the SCN very stable even at large compression angles, and provides excellent shear strength. With overload stops the SCN is even more resistant to overcompression.

FEATURES

Highly efficient geometry

Minimal performance loss even at large berthing angles

Stable shape resists shear

Wide choice of rubber grades

APPLICATIONS

General cargo berths

Bulk terminals

Oil and LNG facilities

Container berths

RoRo and cruise terminals

Parallel motion systems

Monopiles and dolphins

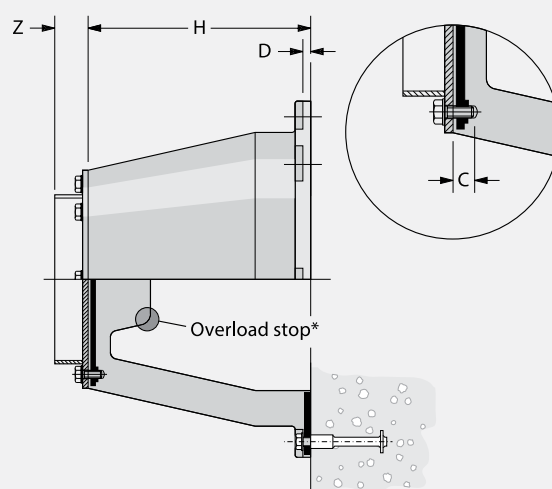
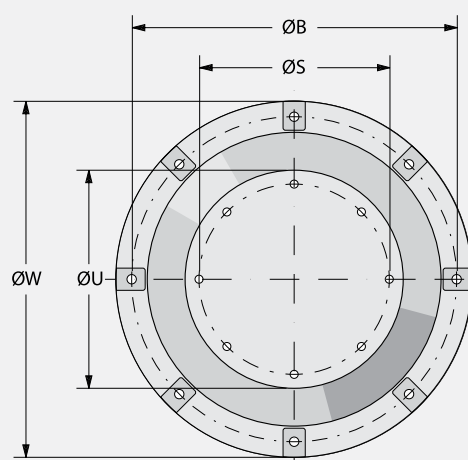
Super Cone Fenders

DIMENSIONS

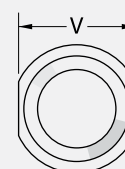
	H	ØW	ØU	C	D	ØB	ØS	F0.9- 1.8 ANCHORS / HEAD BOLTS ^	F1.9- 3.1 ANCHORS / HEAD BOLTS ^	Z _{min}	WEIGHT
SCN 300	300	500	295	27 – 37	20 – 25	440	255	4 x M16	4 x M16	77	40
SCN 350	350	570	330	27 – 37	20 – 25	510	275	4 x M16	4 x M16	77	50
SCN 400	400	650	390	30 – 40	20 – 28	585	340	4 x M16	4 x M20	82	76
SCN 500	500	800	490	32 – 42	30 – 38	730	425	4 x M20	4 x M24	95	160
SCN 550	550	880	540	32 – 42	30 – 38	790	470	4 x M20	4 x M24	95	210
SCN 600	600	960	590	40 – 52	35 – 42	875	515	4 x M20	4 x M30	115	270
SCN 700	700	1120	685	40 – 52	35 – 42	1020	600	4 x M24	4 x M30	120	411
SCN 800	800	1280	785	40 – 52	35 – 42	1165	685	6 x M24	6 x M30	120	606
SCN 860	860	1376	845	40 – 52	35 – 42	1250	735	6 x M24	6 x M30	130	750
SCN 900	900	1440	885	40 – 52	35 – 42	1313	770	6 x M30	6 x M30	135	841
SCN 950	950	1520	930	40 – 52	40 – 50	1390	815	6 x M30	6 x M30	142	980
SCN 1000	1000	1600	980	50 – 65	40 – 50	1460	855	6 x M30	6 x M36	150	1125
SCN 1050	1050	1680	1030	50 – 65	45 – 55	1530	900	6 x M30	6 x M36	157	1360
SCN 1100	1100	1760	1080	50 – 65	50 – 58	1605	940	8 x M30	8 x M36	165	1567
SCN 1150	1150	1840	1125	55 – 70	50 – 58	1680	980	8 x M30	8 x M36	175	1779
SCN 1200	1200	1920	1175	57 – 80	50 – 58	1750	1025	8 x M30	8 x M42	180	2028
SCN 1300	1300	2080	1275	65 – 90	50 – 58	1900	1100	8 x M36	8 x M42	195	2455
SCN 1400	1400	2240	1370	65 – 90	60 – 70	2040	1195	8 x M36	8 x M42	210	3105
SCN 1600	1600	2560	1570	65 – 90	70 – 80	2335	1365	8 x M42	8 x M48	240	4645
SCN 1800	1800	2880	1765	75 – 100	70 – 80	2625	1540	10 x M42	10 x M56	270	6618
SCN 2000	2000	3200	1955	80 – 105	90 – 105	2920	1710	10 x M42	10 x M56	300	9560
SCN 2250	2250	3600	2205	100 – 120	100 – 110	3285	1930	12 x M48	12 x M56	335	13,500
SCN 2500	2500	4000	2450	120 – 150	100 – 120	3650	2150	12 x M48	12 x M64	375	18,500

^ Fender anchors / head bolts indicated are based on a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

[Units: mm, kg]



Some SCN sizes have a modified flange for reduced shipping dimensions.



SIZE	V
SCN 950	1440
SCN 1400	2180
SCN 1600	2390
SCN 1800	2700

* Contact Trelleborg Marine Systems' local offices

[Units: mm]

Super Cone Fenders

PERFORMANCE DATA*

			F 0.9 ^	F 1.0	F 1.1	F 1.2	F 1.3	F 1.4	F 1.5	F 1.6	F 1.7	F 1.8	F 1.9	F 2.0
300	CV	E	7.7	9.0	9.2	9.4	9.6	9.8	10.0	10.4	10.8	11.2	11.6	12.0
		R	49.0	54.0	55.8	57.6	59.4	61.2	63.0	65.6	68.2	70.8	73.4	76.0
	RPD	E _R	8.9	10.4	10.7	10.9	11.1	11.4	11.6	12.1	12.5	13.0	13.5	13.9
		R _R	56.8	62.6	64.7	66.8	68.9	71.0	73.1	76.1	79.1	82.1	85.1	88.2
350	CV	E	12.5	14.0	14.4	14.8	15.2	15.6	16.0	16.6	17.2	17.8	18.4	19.0
		R	67.0	74.0	76.4	78.8	81.2	83.6	86.0	89.4	92.8	96.2	99.6	103.0
	RPD	E _R	14.4	16.1	16.6	17.0	17.5	17.9	18.4	19.1	19.8	20.5	21.2	21.9
		R _R	77.1	85.1	87.9	90.6	93.4	96.1	98.9	102.8	106.7	110.6	114.5	118.5
400	CV	E	18.6	21.0	21.6	22.2	22.8	23.4	24.0	24.8	25.6	26.4	27.2	28.0
		R	87.0	97.0	100.2	103.4	106.6	109.8	113.0	117.4	121.8	126.2	130.6	135.0
	RPD	E _R	21.4	24.2	24.8	25.5	26.2	26.9	27.6	28.5	29.4	30.4	31.3	32.2
		R _R	100.1	111.6	115.2	118.9	122.6	126.3	130.0	135.0	140.1	145.1	150.2	155.3
500	CV	E	36.5	41.0	42.2	43.4	44.6	45.8	47.0	48.4	49.8	51.2	52.6	54.0
		R	137.0	152.0	157.0	162.0	167.0	172.0	177.0	184.0	191.0	198.0	205.0	212.0
	RPD	E _R	41.4	46.5	47.9	49.3	50.6	52.0	53.3	54.9	56.5	58.1	59.7	61.3
		R _R	155.5	172.5	178.2	183.9	189.5	195.2	200.9	208.8	216.8	224.7	232.7	240.6
550	CV	E	49.0	54.0	55.8	57.6	59.4	61.2	63.0	64.8	66.6	68.4	70.2	72.0
		R	165.0	183.0	189.2	195.4	201.6	207.8	214.0	222.4	230.8	239.2	247.6	256.0
	RPD	E _R	55.6	61.3	63.3	65.4	67.4	69.5	71.5	73.5	75.6	77.6	79.7	81.7
		R _R	187.3	207.7	214.7	221.8	228.8	235.9	242.9	252.4	262.0	271.5	281.0	290.6
600	CV	E	63.0	70.0	72.0	74.0	76.0	78.0	80.0	82.0	84.0	86.0	88.0	90.0
		R	189.0	210.0	216.0	222.0	228.0	234.0	240.0	248.4	256.8	265.2	273.6	282.0
	RPD	E _R	71.2	79.1	81.4	83.6	85.9	88.1	90.4	92.7	94.9	97.2	99.4	101.7
		R _R	213.6	237.3	244.1	250.9	257.6	264.4	271.2	280.7	290.2	299.7	309.2	318.7
700	CV	E	117.0	130.0	133.6	137.2	140.8	144.4	148.0	151.4	154.8	158.2	161.6	165.0
		R	280.0	311.0	319.2	327.4	335.6	343.8	352.0	364.0	376.0	388.0	400.0	412.0
	RPD	E _R	131.0	145.6	149.6	153.7	157.7	161.7	165.8	169.6	173.4	177.2	181.0	184.8
		R _R	313.6	348.3	357.5	366.7	375.9	385.1	394.2	407.7	421.1	434.6	448.0	461.4
800	CV	E	171.0	190.0	195.6	201.2	206.8	212.4	218.0	223.4	228.8	234.2	239.6	245.0
		R	359.0	399.0	410.6	422.2	433.8	445.4	457.0	473.2	489.4	505.6	521.8	538.0
	RPD	E _R	189.8	210.9	217.1	223.3	229.5	235.8	242.0	248.0	254.0	260.0	266.0	272.0
		R _R	398.5	442.9	455.8	468.6	481.5	494.4	507.3	525.3	543.2	561.2	579.2	597.2
860	CV	E	215.0	239.0	245	251	258	264	270.0	276	283	289	296	302.0
		R	418.0	465.0	477	489	501	513	525.0	543	561	578	596	614.0
	RPD	E _R	237.6	264.1	270.9	277.8	284.6	291.5	298.4	305.4	312.5	319.6	326.6	333.7
		R _R	461.9	513.8	527.1	540.3	553.6	566.9	580.1	599.8	619.5	639.1	658.8	678.5
900	CV	E	248.0	275.0	282	289	296	303	310.0	317	324	331	338	345.0
		R	462.0	513.0	526	539	552	565	578.0	597	616	635	654	673.0
	RPD	E _R	272.8	302.5	310.2	317.9	325.6	333.3	341.0	348.7	356.4	364.1	371.8	379.5
		R _R	508.2	564.3	578.6	592.9	607.2	621.5	635.8	656.7	677.6	698.5	719.4	740.3
950	CV	E	291.0	322.0	330	339	347	356	364.0	373	381	390	398	407.0
		R	511.0	568.0	583	598	614	629	644.0	666	688	709	731	753.0
	RPD	E _R	320.1	354.2	363.4	372.7	381.9	391.2	400.4	409.9	419.3	428.8	438.2	447.7
		R _R	562.1	624.8	641.5	658.2	675.0	691.7	708.4	732.4	756.4	780.3	804.3	828.3
1000	CV	E	338.0	375.0	385	395	405	415	425.0	435	445	455	465	475.0
		R	567.0	630.0	647	663	680	696	713.0	737	761	786	810	834.0
	RPD	E _R	370.1	410.6	421.6	432.5	443.5	454.4	465.4	476.3	487.3	498.2	509.2	520.1
		R _R	620.9	689.9	708.0	726.2	744.4	762.6	780.7	807.2	833.7	860.2	886.7	913.2

* For explanation of CV and RPD, please refer to note on page 9-10. ^ Fender grades below F0.9 are available upon request. [Units: kNm, kN]

Super Cone Fenders

PERFORMANCE DATA*

			F 2.1	F 2.2	F 2.3	F 2.4	F 2.5	F 2.6	F 2.7	F 2.8	F 2.9	F 3.0	F 3.1
300	CV	E	12.2	12.4	12.6	12.8	13.0	13.2	13.4	13.6	13.8	14.0	16.0
		R	78.2	80.4	82.6	84.8	87.0	89.8	92.6	95.4	98.2	101.0	111.0
	RPD	E _R	14.2	14.4	14.6	14.8	15.1	15.3	15.5	15.8	16.0	16.2	18.6
		R _R	90.7	93.3	95.8	98.4	100.9	104.2	107.4	110.7	113.9	117.2	128.8
350	CV	E	19.4	19.8	20.2	20.6	21.0	21.4	21.8	22.2	22.6	23.0	25.0
		R	106.0	109.0	112.0	115.0	118.0	122.0	126.0	130.0	134.0	138.0	151.0
	RPD	E _R	22.3	22.8	23.2	23.7	24.2	24.6	25.1	25.5	26.0	26.5	28.8
		R _R	121.9	125.4	128.8	132.3	135.7	140.3	144.9	149.5	154.1	158.7	173.7
400	CV	E	28.6	29.2	29.8	30.4	31.0	31.8	32.6	33.4	34.2	35.0	38.0
		R	139.0	143.0	147.0	151.0	155.0	160.2	165.4	170.6	175.8	181.0	199.0
	RPD	E _R	32.9	33.6	34.3	35.0	35.7	36.6	37.5	38.4	39.3	40.3	43.7
		R _R	159.9	164.5	169.1	173.7	178.3	184.2	190.2	196.2	202.2	208.2	228.9
500	CV	E	55.4	56.8	58.2	59.6	61.0	62.4	63.8	65.2	66.6	68.0	74.0
		R	218.2	224.4	230.6	236.8	243.0	251.0	259.0	267.0	275.0	283.0	311.0
	RPD	E _R	62.9	64.5	66.1	67.6	69.2	70.8	72.4	74.0	75.6	77.2	84.0
		R _R	247.7	254.7	261.7	268.8	275.8	284.9	294.0	303.0	312.1	321.2	353.0
550	CV	E	73.8	75.6	77.4	79.2	81.0	82.8	84.6	86.4	88.2	90.0	99.0
		R	263.4	270.8	278.2	285.6	293.0	302.6	312.2	321.8	331.4	341.0	375.0
	RPD	E _R	83.8	85.8	87.8	89.9	91.9	94.0	96.0	98.1	100.1	102.2	112.4
		R _R	299.0	307.4	315.8	324.2	332.6	343.5	354.3	365.2	376.1	387.0	425.6
600	CV	E	93.0	96.0	99.0	102.0	105.0	108.0	111.0	114.0	117.0	120.0	132.0
		R	292.6	303.2	313.8	324.4	335.0	348.4	361.8	375.2	388.6	402.0	442.0
	RPD	E _R	105.1	108.5	111.9	115.3	118.7	122.0	125.4	128.8	132.2	135.6	149.2
		R _R	330.6	342.6	354.6	366.6	378.6	393.7	408.8	424.0	439.1	454.3	499.5
700	CV	E	169.0	173.0	177.0	181.0	185.0	189.0	193.0	197.0	201.0	205.0	226.0
		R	423.8	435.6	447.4	459.2	471.0	486.2	501.4	516.6	531.8	547.0	601.0
	RPD	E _R	189.3	193.8	198.2	202.7	207.2	211.7	216.2	220.6	225.1	229.6	253.1
		R _R	474.7	487.9	501.1	514.3	527.5	544.5	561.6	578.6	595.6	612.6	673.1
800	CV	E	251.6	258.2	264.8	271.4	278.0	284.4	290.8	297.2	303.6	310.0	341.0
		R	554.6	571.2	587.8	604.4	621.0	642.2	663.4	684.6	705.8	727.0	800.0
	RPD	E _R	279.3	286.6	293.9	301.3	308.6	315.7	322.8	329.9	337.0	344.1	378.5
		R _R	615.6	634.0	652.5	670.9	689.3	712.8	736.4	759.9	783.4	807.0	888.0
860	CV	E	310	318	327	335	343.0	351	360	368	377	385.0	423.0
		R	633	652	672	691	710.0	735	760	786	811	836.0	919.0
	RPD	E _R	342.8	351.8	360.9	370.0	379.0	388.3	397.6	406.9	416.1	425.4	467.4
		R _R	699.7	720.9	742.1	763.3	784.6	812.4	840.2	868.1	895.9	923.8	1015.5
900	CV	E	355	364	374	383	393.0	402	412	421	431	440.0	484.0
		R	694	716	737	759	780.0	807	835	862	890	917.0	1008.0
	RPD	E _R	390.1	400.6	411.2	421.7	432.3	442.6	453.0	463.3	473.7	484.0	532.4
		R _R	763.8	787.4	810.9	834.5	858.0	888.1	918.3	948.4	978.6	1008.7	1108.8
950	CV	E	418	429	441	452	463.0	474	485	497	508	519.0	571.0
		R	777	800	824	847	871.0	902	932	963	993	1024.0	1126.0
	RPD	E _R	460.0	472.3	484.7	497.0	509.3	521.6	533.9	546.3	558.6	570.9	628.1
		R _R	854.3	880.2	906.2	932.1	958.1	991.8	1025.4	1059.1	1092.7	1126.4	1238.6
1000	CV	E	488	501	514	527	540.0	553	566	579	592	605.0	666.0
		R	860	886	913	939	965.0	999	1033	1066	1100	1134.0	1247.0
	RPD	E _R	534.4	548.6	562.8	577.1	591.3	605.5	619.8	634.0	648.2	662.5	729.3
		R _R	941.9	970.6	999.3	1028.0	1056.7	1093.7	1130.7	1167.7	1204.7	1241.7	1365.5

* For explanation of CV and RPD, please refer to note on page 9-10.

[Units: kNm, kN]

Super Cone Fenders

PERFORMANCE DATA*

			F 0.9^	F 1.0	F 1.1	F 1.2	F 1.3	F 1.4	F 1.5	F 1.6	F 1.7	F 1.8	F 1.9	F 2.0
1050	CV	E	392.0	435.0	446.6	458.2	469.8	481.4	493.0	504.4	515.8	527.2	538.6	550.0
		R	626.0	695.0	713.4	731.8	750.2	768.6	787.0	813.4	839.8	866.2	892.6	919.0
	RPD	E _R	427.3	474.2	486.8	499.4	512.1	524.7	537.4	549.8	562.2	574.6	587.1	599.5
		R _R	682.3	757.6	777.6	797.7	817.7	837.8	857.8	886.6	915.4	944.2	972.9	1001.7
1100	CV	E	450.0	500.0	513.6	527.2	540.8	554.4	568.0	581.4	594.8	608.2	621.6	635.0
		R	685.0	761.0	781.6	802.2	822.8	843.4	864.0	893.4	922.8	952.2	981.6	1011.0
	RPD	E _R	490.5	545.0	559.8	574.6	589.5	604.3	619.1	633.7	648.3	662.9	677.5	692.2
		R _R	746.7	829.5	851.9	874.4	896.9	919.3	941.8	973.8	1005.9	1037.9	1069.9	1102.0
1150	CV	E	514.1	570.3	585.5	600.7	616	631.2	646.4	661.6	676.8	692	707.2	722.4
		R	750	833.2	855.1	877.1	899	921	942.9	974.9	1007	1039	1071	1103
	RPD	E _R	560.3	621.7	638.2	654.8	671.4	688	704.5	721.1	737.7	754.3	770.9	787.4
		R _R	817.5	908.2	932.1	956	979.9	1003.9	1027.8	1062.7	1097.6	1132.5	1167.3	1202.2
1200	CV	E	585.0	650.0	667.6	685.2	702.8	720.4	738.0	755.4	772.8	790.2	807.6	825.0
		R	818.1	909.0	933.4	957.8	982.2	1006.6	1031.0	1066.0	1101.0	1136.0	1171.0	1206.0
	RPD	E _R	637.7	708.5	727.7	746.9	766.1	785.2	804.4	823.4	842.4	861.3	880.3	899.3
		R _R	891.7	990.8	1017.4	1044.0	1070.6	1097.2	1123.8	1161.9	1200.1	1238.2	1276.4	1314.5
1300	CV	E	742.5	825.0	847.0	869.0	891.0	913.0	935.0	957.0	979.0	1001.0	1023.0	1045.0
		R	957.6	1064.0	1092.4	1120.8	1149.2	1177.6	1206.0	1246.6	1287.2	1327.8	1368.4	1409.0
	RPD	E _R	805.6	895.1	919.0	942.9	966.7	990.6	1014.5	1038.3	1062.2	1086.1	1110.0	1133.8
		R _R	1039.0	1154.4	1185.3	1216.1	1246.9	1277.7	1308.5	1352.6	1396.6	1440.7	1484.7	1528.8
1400	CV	E	927.0	1030.0	1057.6	1085.2	1112.8	1140.4	1168.0	1195.4	1222.8	1250.2	1277.6	1305.0
		R	1111.5	1235.0	1268.0	1301.0	1334.0	1367.0	1400.0	1447.2	1494.4	1541.6	1588.8	1636.0
	RPD	E _R	1001.2	1112.4	1142.2	1172.0	1201.8	1231.6	1261.4	1291.0	1320.6	1350.2	1379.8	1409.4
		R _R	1200.4	1333.8	1369.4	1405.1	1440.7	1476.4	1512.0	1563.0	1614.0	1664.9	1715.9	1766.9
1600	CV	E	1381.5	1535.0	1576.6	1618.2	1659.8	1701.4	1743.0	1784.4	1825.8	1867.2	1908.6	1950.0
		R	1447.2	1608.0	1651.6	1695.2	1738.8	1782.4	1826.0	1888.0	1950.0	2012.0	2074.0	2136.0
	RPD	E _R	1478.2	1642.5	1687.0	1731.5	1776.0	1820.5	1865.0	1909.3	1953.6	1997.9	2042.2	2086.5
		R _R	1548.5	1720.6	1767.2	1813.9	1860.5	1907.2	1953.8	2020.2	2086.5	2152.8	2219.2	2285.5
1800	CV	E	1966.5	2185.0	2244.0	2303.0	2362.0	2421.0	2480.0	2539.0	2598.0	2657.0	2716.0	2775.0
		R	1835.1	2039.0	2094.0	2149.0	2204.0	2259.0	2314.0	2392.6	2471.2	2549.8	2628.4	2707.0
	RPD	E _R	2094.3	2327.0	2389.9	2452.7	2515.5	2578.4	2641.2	2704.0	2766.9	2829.7	2892.5	2955.4
		R _R	1954.4	2171.5	2230.1	2288.7	2347.3	2405.8	2464.4	2548.1	2631.8	2715.5	2799.2	2883.0
2000	CV	E	2700.0	3000.0	3080.0	3160.0	3240.0	3320.0	3400.0	3480.0	3560.0	3640.0	3720.0	3800.0
		R	2259.9	2511.0	2578.0	2645.0	2712.0	2779.0	2846.0	2941.8	3037.6	3133.4	3229.2	3325.0
	RPD	E _R	2862.0	3180.0	3264.8	3349.6	3434.4	3519.2	3604.0	3688.8	3773.6	3858.4	3943.2	4028.0
		R _R	2395.5	2661.7	2732.7	2803.7	2874.7	2945.7	3016.8	3118.3	3219.9	3321.4	3423.0	3524.5
2250	CV	E	3843.9	4271.0	4385.0	4499.0	4613.0	4727.0	4841.0	4955.0	5069.0	5183.0	5297.0	5411.0
		R	2871.9	3191.0	3276.0	3361.0	3446.0	3531.0	3616.0	3738.0	3860.0	3982.0	4104.0	4226.0
	RPD	E _R	4036.1	4484.6	4604.3	4724.0	4843.7	4963.4	5083.1	5202.8	5322.5	5442.2	5561.9	5681.6
		R _R	3015.5	3350.6	3439.8	3529.1	3618.3	3707.6	3796.8	3924.9	4053.0	4181.1	4309.2	4437.3
2500	CV	E	5273.5	5859.4	6015.6	6171.9	6328.1	6484.4	6640.6	6796.9	6953.2	7109.4	7265.7	7422.0
		R	3531.1	3923.4	4028.1	4132.8	4237.5	4342.2	4446.9	4596.6	4746.3	4895.9	5045.6	5195.3
	RPD	E _R	5537.1	6152.4	6316.4	6480.5	6644.5	6808.6	6972.6	7136.7	7300.8	7464.9	7629.0	7793.1
		R _R	3707.6	4119.6	4229.5	4339.4	4449.4	4559.3	4669.2	4826.4	4983.6	5140.7	5297.9	5455.1

^ Fender grades below F0.9 are available upon request.

[Units: kNm, kN]

*Note:

1. CV: slow speed constant velocity (2-8mm/s) compression.
2. RPD: Rated performance data, in accordance with PIANC with initial berthing velocity 150mm/s. RPD is corrected for decreasing velocity (DV) of compression of fenders by deceleration factors (0.74) (Please refer to fender design manual page 32).
3. RPD = CV (performance) * VF (velocity factor).
4. VF has been determined through experiments. Its value depends on strain rate (compression time) and nature of the rubber compounds (100% natural rubber, 100% synthetic rubber or blend).

Super Cone Fenders

PERFORMANCE DATA*

			F 2.1	F 2.2	F 2.3	F 2.4	F 2.5	F 2.6	F 2.7	F 2.8	F 2.9	F 3.0	F 3.1
1050	CV	E	565.0	580.0	595.0	610.0	625.0	640.0	655.0	670.0	685.0	700.0	770.0
		R	948.0	977.0	1006.0	1035.0	1064.0	1101.0	1138.0	1175.0	1212.0	1249.0	1374.0
	RPD	E _R	615.9	632.2	648.6	664.9	681.3	697.6	714.0	730.3	746.7	763.0	839.3
		R _R	1033.3	1064.9	1096.5	1128.2	1159.8	1200.1	1240.4	1280.8	1321.1	1361.4	1497.7
1100	CV	E	652.0	669.0	686.0	703.0	720.0	737.0	754.0	771.0	788.0	805.0	886.0
		R	1042.4	1073.8	1105.2	1136.6	1168.0	1208.2	1248.4	1288.6	1328.8	1369.0	1506.0
	RPD	E _R	710.7	729.2	747.7	766.3	784.8	803.3	821.9	840.4	858.9	877.5	965.7
		R _R	1136.2	1170.4	1204.7	1238.9	1273.1	1316.9	1360.8	1404.6	1448.4	1492.2	1641.5
1150	CV	E	742.2	762	781.7	801.5	821.3	841	860.8	880.6	900.4	920.1	1012.9
		R	1137.6	1172.3	1206.9	1241.6	1276.2	1320.9	1365.6	1410.3	1455	1499.7	1649.2
	RPD	E _R	809	830.5	852.1	873.6	895.2	916.7	938.3	959.8	981.4	1002.9	1104.1
		R _R	1240	1277.8	1315.5	1353.3	1391.1	1439.8	1488.5	1537.2	1586	1634.7	1797.6
1200	CV	E	847.0	869.0	891.0	913.0	935.0	957.0	979.0	1001.0	1023.0	1045.0	1150.0
		R	1243.2	1280.4	1317.6	1354.8	1392.0	1439.8	1487.6	1535.4	1583.2	1631.0	1794.0
	RPD	E _R	923.2	947.2	971.2	995.2	1019.2	1043.1	1067.1	1091.1	1115.1	1139.1	1253.5
		R _R	1355.1	1395.6	1436.2	1476.7	1517.3	1569.4	1621.5	1673.6	1725.7	1777.8	1955.5
1300	CV	E	1073.6	1102.2	1130.8	1159.4	1188.0	1216.4	1244.8	1273.2	1301.6	1330.0	1463.0
		R	1453.4	1497.8	1542.2	1586.6	1631.0	1688.0	1745.0	1802.0	1859.0	1916.0	2107.0
	RPD	E _R	1164.9	1195.9	1226.9	1257.9	1289.0	1319.8	1350.6	1381.4	1412.2	1443.1	1587.4
		R _R	1576.9	1625.1	1673.3	1721.5	1769.6	1831.5	1893.3	1955.2	2017.0	2078.9	2286.1
1400	CV	E	1340.6	1376.2	1411.8	1447.4	1483.0	1518.4	1553.8	1589.2	1624.6	1660.0	1826.0
		R	1687.4	1738.8	1790.2	1841.6	1893.0	1959.0	2025.0	2091.0	2157.0	2223.0	2445.0
	RPD	E _R	1447.8	1486.3	1524.7	1563.2	1601.6	1639.9	1678.1	1716.3	1754.6	1792.8	1972.1
		R _R	1822.4	1877.9	1933.4	1988.9	2044.4	2115.7	2187.0	2258.3	2329.6	2400.8	2640.6
1600	CV	E	2003.0	2056.0	2109.0	2162.0	2215.0	2268.0	2321.0	2374.0	2427.0	2480.0	2728.0
		R	2203.0	2270.0	2337.0	2404.0	2471.0	2557.0	2643.0	2729.0	2815.0	2901.0	3191.0
	RPD	E _R	2143.2	2199.9	2256.6	2313.3	2370.1	2426.8	2483.5	2540.2	2596.9	2653.6	2919.0
		R _R	2357.2	2428.9	2500.6	2572.3	2644.0	2736.0	2828.0	2920.0	3012.1	3104.1	3414.4
1800	CV	E	2850.6	2926.2	3001.8	3077.4	3153.0	3228.4	3303.8	3379.2	3454.6	3530.0	3883.0
		R	2792.0	2877.0	2962.0	3047.0	3132.0	3241.0	3350.0	3459.0	3568.0	3677.0	4045.0
	RPD	E _R	3035.9	3116.4	3196.9	3277.4	3357.9	3438.2	3518.5	3598.8	3679.1	3759.5	4135.4
		R _R	2973.5	3064.0	3154.5	3245.1	3335.6	3451.7	3567.8	3683.8	3799.9	3916.0	4307.9
2000	CV	E	3904.0	4008.0	4112.0	4216.0	4320.0	4424.0	4528.0	4632.0	4736.0	4840.0	5324.0
		R	3430.0	3535.0	3640.0	3745.0	3850.0	3984.6	4119.2	4253.8	4388.4	4523.0	4975.0
	RPD	E _R	4138.2	4248.5	4358.7	4469.0	4579.2	4689.4	4799.7	4909.9	5020.2	5130.4	5643.4
		R _R	3635.8	3747.1	3858.4	3969.7	4081.0	4223.7	4366.4	4509.0	4651.7	4794.4	5273.5
2250	CV	E	5559.0	5707.0	5855.0	6003.0	6151.0	6299.0	6447.0	6595.0	6743.0	6891.0	7580.0
		R	4359.4	4492.8	4626.2	4759.6	4893.0	5064.0	5235.0	5406.0	5577.0	5748.0	6323.0
	RPD	E _R	5837.0	5992.4	6147.8	6303.2	6458.6	6614.0	6769.4	6924.8	7080.2	7235.6	7959.0
		R _R	4577.4	4717.4	4857.5	4997.6	5137.7	5317.2	5496.8	5676.3	5855.9	6035.4	6639.2
2500	CV	E	7625.1	7828.2	8031.3	8234.4	8437.5	8640.6	8843.7	9046.8	9249.9	9453.0	10398.0
		R	5359.4	5523.4	5687.5	5851.5	6015.6	6225.9	6436.2	6646.4	6856.7	7067.0	7773.4
	RPD	E _R	8006.4	8219.6	8432.9	8646.1	8859.4	9072.6	9285.9	9499.1	9712.4	9925.7	10917.9
		R _R	5627.3	5799.6	5971.9	6144.1	6316.4	6537.2	6758.0	6978.8	7199.6	7420.4	8162.1

[Units: kNm, kN]

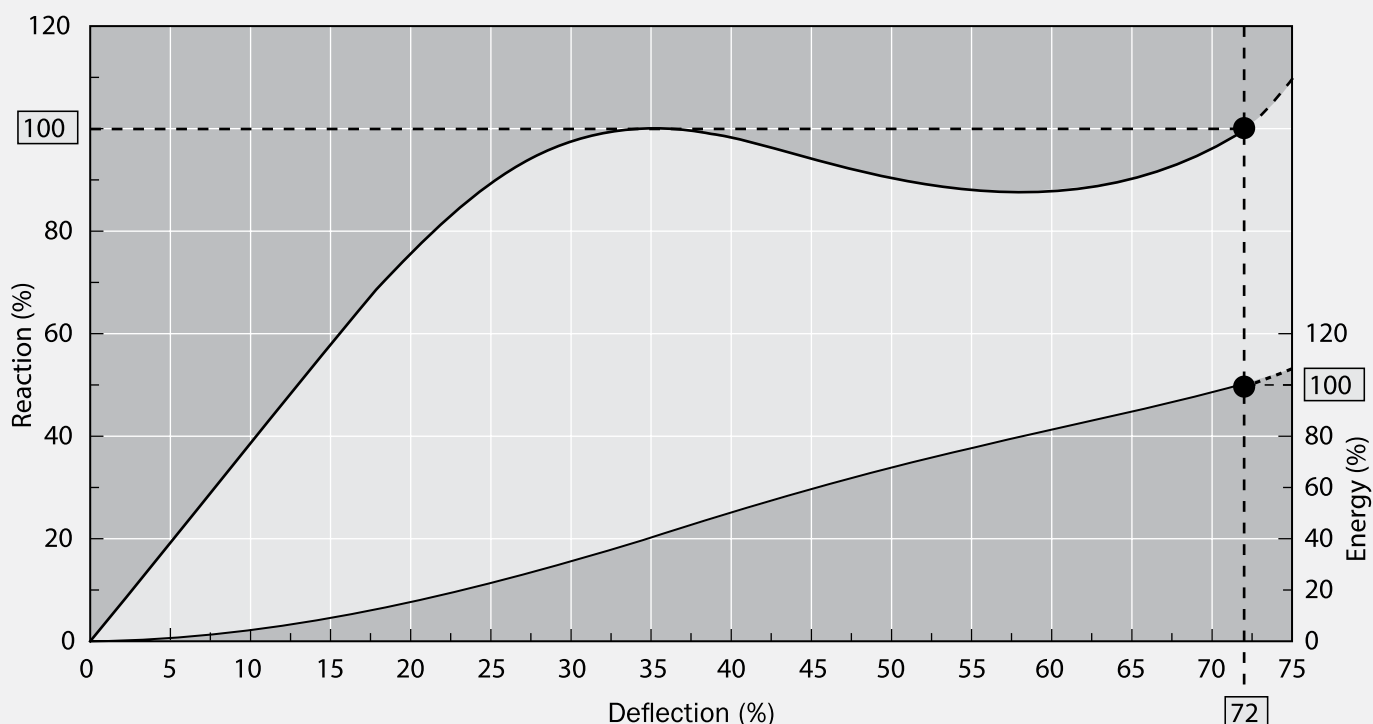
- For other initial berthing velocities, VF should be calculated separately (Refer to fender design manual).
- Performance for RPD is based on a rubber compound with a blend of NR and SBR. 100% Natural rubber compound and 100% Synthetic rubber compound are available on request. Please contact TMS office.
- In case of fenders are tested in decreasing velocity (DV) mode, RPD = DV (performance).
- Fender performance is subject to $\pm 10\%$ manufacturing tolerance (+10% for reaction force and -10% for energy).
- RPD is reported at 23°C $\pm$ 5°C temperature and 0° compression angle.

Super Cone Fenders

INTERMEDIATE DEFLECTIONS

D _i (%)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	72	75
E _i (%)	0	1	4	8	15	22	31	40	50	59	67	75	82	89	96	100	106
R _i (%)	0	20	39	58	76	90	98	100	98	94	90	88	88	90	96	100	110

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.

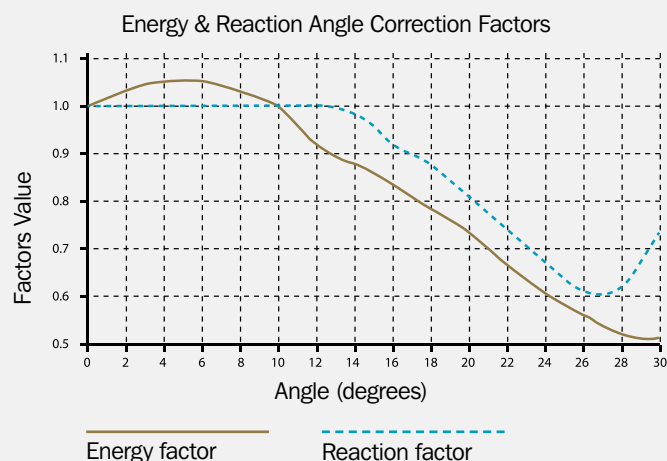


Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

ANGLE FACTOR (AF) TABLE

ANGLE (°)	ENERGY FACTOR	REACTION FACTOR
0	1.000	1.000
3	1.039	1.000
5	1.055	1.000
8	1.029	1.000
10	1.000	1.000
15	0.856	0.950
20	0.739	0.800

The graph shows fender performance with no chain restraints up to 12 degrees and chain restraints for angles above 12 degrees. Fender is fitted with a standard frontal frame.



Super Cone Fenders

VELOCITY FACTOR (VF) TABLE

COMPRESSION TIME (SECONDS)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	VF	VF	VF
1	1.20	1.14	1.31
2	1.16	1.10	1.25
3	1.14	1.09	1.22
4	1.13	1.07	1.20
5	1.11	1.06	1.19
6	1.10	1.06	1.17
7	1.09	1.05	1.16
8	1.09	1.04	1.15
9	1.08	1.04	1.14
10	1.07	1.03	1.14
11	1.07	1.03	1.13
12	1.06	1.02	1.12
13	1.06	1.02	1.12
14	1.05	1.02	1.11
15	1.05	1.01	1.11
16	1.05	1.01	1.10
17	1.04	1.01	1.10
18	1.04	1.01	1.09
19	1.04	1.00	1.09
20	1.03	1.00	1.08

Compression time needs to be calculated using the following formula: $t = d/(f \cdot Vd)$

Where:

t = compression time (seconds)*

d = rated deflection (mm)

Vd = initial berthing velocity (mm/s)

f = 0.74 deceleration factor (Peak reaction force occurs at between 30% - 40% deflection, where there has been a deceleration due to energy absorption. f represents the factor associated with deceleration.)

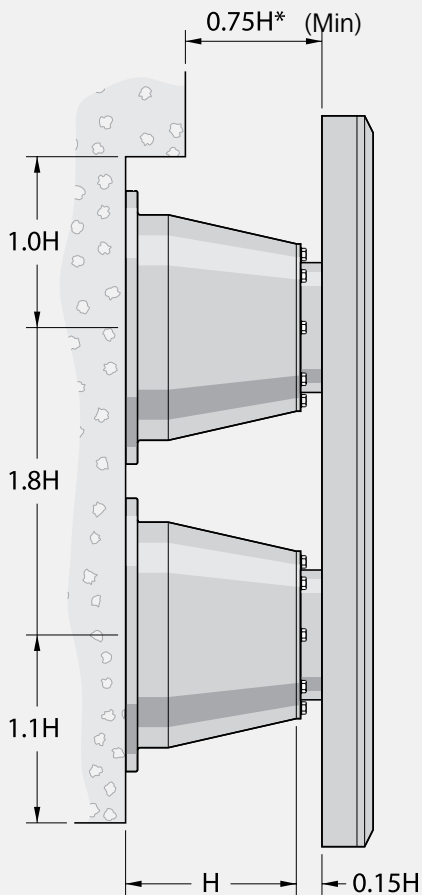
* Applicable for both partial deflection and rated deflection.

TEMPERATURE FACTOR (TF) TABLE

TEMPERATURE (°C)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	TF	TF	TF
+50	0.916	0.914	0.918
+40	0.947	0.946	0.948
+30	0.978	0.978	0.979
+23	1.000	1.000	1.000
+10	1.030	1.025	1.038
+0	1.075	1.053	1.108
-10	1.130	1.080	1.206
-20	1.249	1.142	1.410
-30	1.540	1.315	1.877

Super Cone Fenders

CLEARANCES



There must be enough space around and between super cone fenders and the steel panel to allow them to deflect without interference.

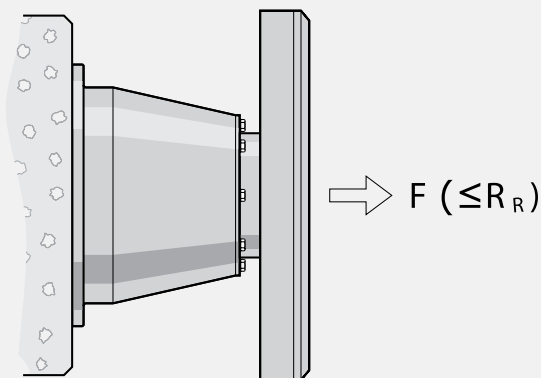
Distances given in the above diagram are for guidance. Please enquire if in doubt.

*Does not allow for bow flares

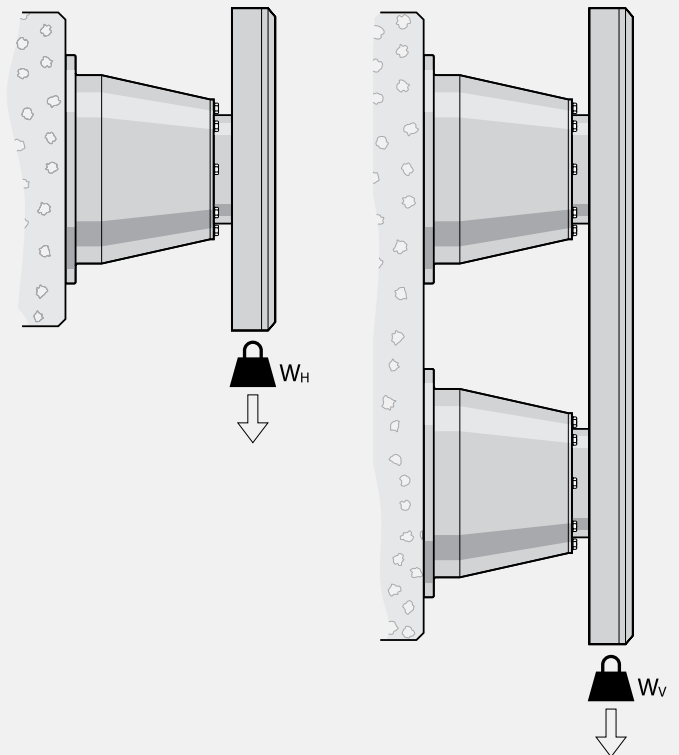
TENSION

If the tensile load exceeds the rated reaction then tension chains may be required.

Please ask for advice on the design of tension chains.



WEIGHT SUPPORT



Super cone fenders can support a lot of static weight. The table is a guide to the permitted weight of front panel before additional support chains may be required.

SCN	PANEL WEIGHT (kg)	
	SINGLE OR MULTIPLE HORIZONTAL ($n \geq 1$)	MULTIPLE VERTICAL ($n \geq 2$)
F1	$W_H \leq n \times 1.0 \times W$	$W_V \leq n \times 1.25 \times W$
F2	$W_H \leq n \times 1.3 \times W$	$W_V \leq n \times 1.625 \times W$
F3	$W_H \leq n \times 1.5 \times W$	$W_V \leq n \times 1.875 \times W$

n = Number of super cones.
 W = Super cone weight
 W_H = Panel weight (single or multi-horizontal)
 W_V = Panel weight (single or multi-vertical)

Interpolate for other grades.

Refer to your local office when Super Cone direction is reversed.

1. PHILIPPINES

2. ITALY

3. SINGAPORE

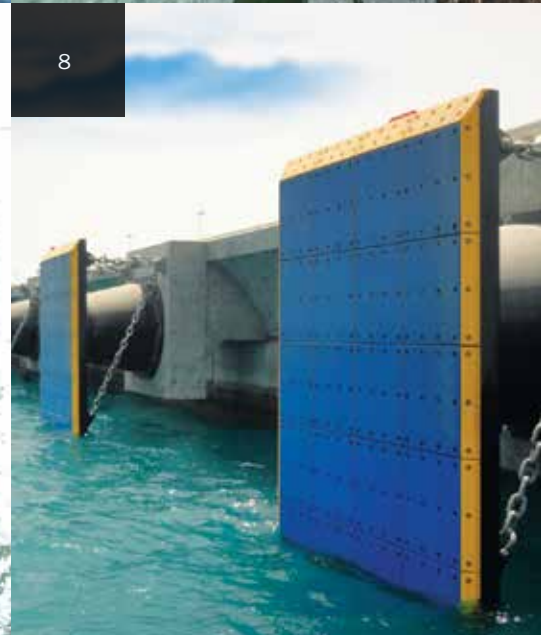
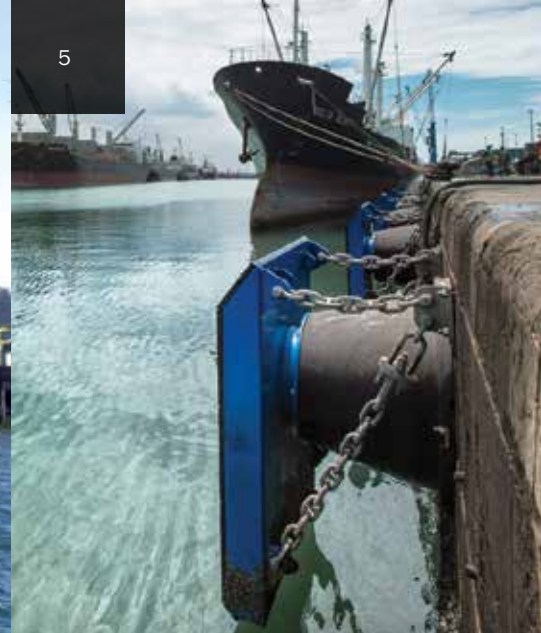
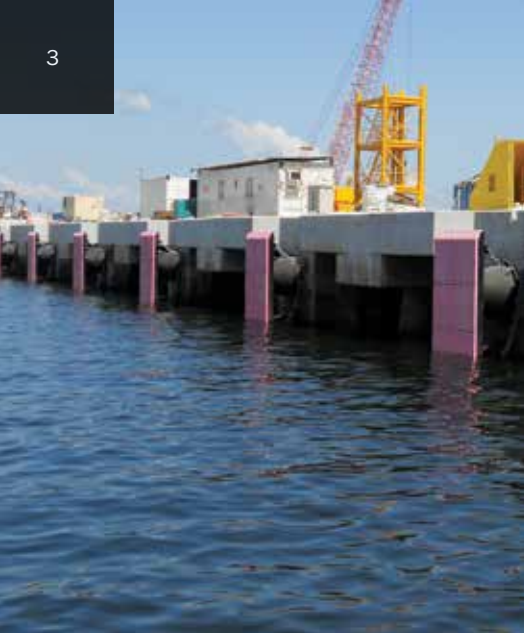
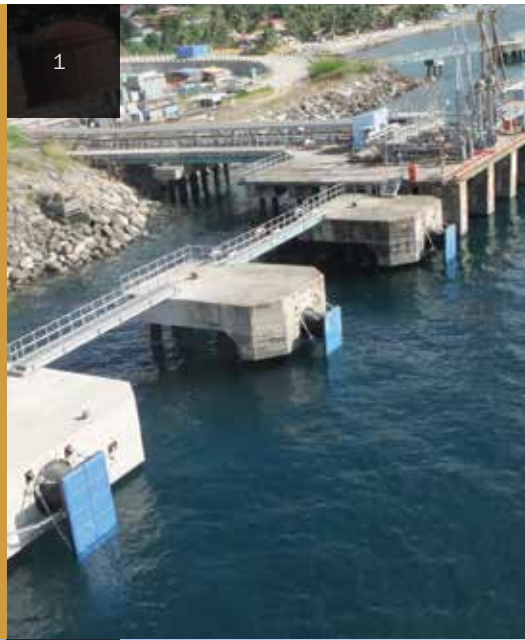
4. USA

5. GHANA

6. SWEDEN

7. UNITED KINGDOM

8. QATAR



SCK Cell Fenders



SCK cell fenders have a very long track record and remain popular because of their simplicity, high performance and strength.

They come in a wide range of standard sizes and are interchangeable with many older cell fender types.

FEATURES

- High performance
- Can support large panels
- Strong, well-proven design
- Ideal for low hull pressure systems

APPLICATIONS

- Oil and LNG facilities
- Bulk terminals
- Offshore platforms
- Container berths
- RoRo and cruise terminals
- Multi-user berths

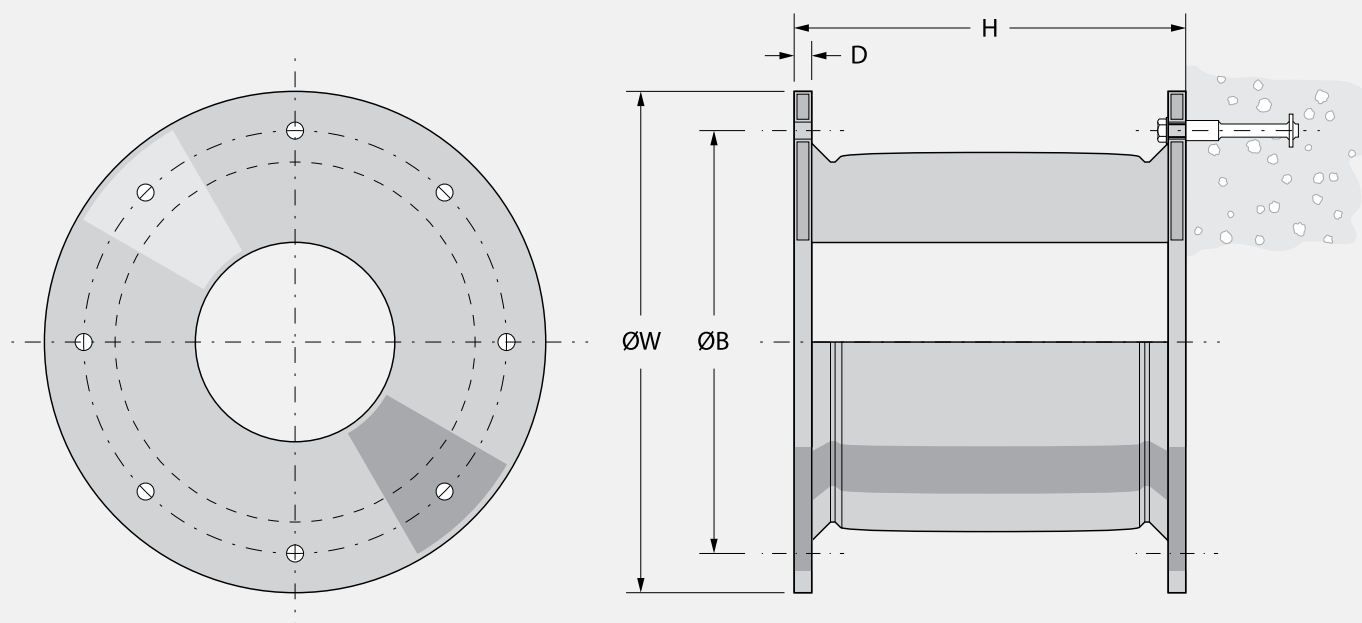
SCK Cell Fenders

DIMENSIONS

	H	ØW	ØB	D	ANCHORS / HEAD BOLTS ^	WEIGHT
SCK 400	400	650	550	24 – 32	4 × M20	75
SCK 500	500	650	550	24 – 32	4 × M24	95
SCK 630	630	840	700	24 – 32	4 × M27	220
SCK 800	800	1050	900	30 – 40	6 × M30	400
SCK 1000	1000	1300	1100	33 – 43	6 × M36	790
SCK 1150	1150	1500	1300	38 – 48	6 × M42	1200
SCK 1250	1250	1650	1450	38 – 48	6 × M42	1500
SCK 1450	1450	1850	1650	43 – 53	6 × M48	2300
SCK 1600	1600	2000	1800	45 – 55	8 × M48	3000
SCK 1700	1700	2100	1900	52 – 62	8 × M56	3700
SCK 2000	2000	2200	2000	50 – 65	8 × M64	5000
SCK 2250	2250	2550	2300	55 – 70	10 × M64	7400
SCK 2500	2500	2950	2700	65 – 80	10 × M64	10700
SCK 3000	3000	3350	3150	70 – 90	12 × M76	18500

^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

[Units: mm, kg]



SCK Cell Fenders

PERFORMANCE DATA*

			E 0.9	E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9	E 2.0
400	CV	E	9.0	10.0	10.6	11.2	11.8	12.4	13.0	13.6	14.2	14.8	15.4	16.0
		R	50.0	56.0	59.6	63.2	66.8	70.4	74.0	77.4	80.8	84.2	87.6	91.0
	RPD	E _R	10.5	11.7	12.4	13.1	13.8	14.5	15.2	15.9	16.6	17.3	18.0	18.7
		R _R	58.5	65.5	69.7	73.9	78.2	82.4	86.6	90.6	94.5	98.5	102.5	106.5
500	CV	E	17.0	19.0	20.2	21.4	22.6	23.8	25.0	26.0	27.0	28.0	29.0	30.0
		R	79.0	87.0	92.6	98.2	103.8	109.4	115.0	120.4	125.8	131.2	136.6	142.0
	RPD	E _R	19.6	21.9	23.2	24.6	26.0	27.4	28.8	29.9	31.1	32.2	33.4	34.5
		R _R	90.9	100.1	106.5	112.9	119.4	125.8	132.3	138.5	144.7	150.9	157.1	163.3
630	CV	E	34.0	38.0	40.4	42.8	45.2	47.6	50.0	52.4	54.8	57.2	59.6	62.0
		R	124.0	137.0	145.6	154.2	162.8	171.4	180.0	188.8	197.6	206.4	215.2	224.0
	RPD	E _R	38.8	43.3	46.1	48.8	51.5	54.3	57.0	59.7	62.5	65.2	67.9	70.7
		R _R	141.4	156.2	166.0	175.8	185.6	195.4	205.2	215.2	225.3	235.3	245.3	255.4
800	CV	E	67.0	75.0	80.0	85.0	90.0	95.0	100.0	104.8	109.6	114.4	119.2	124.0
		R	190.0	211.0	225.4	239.8	254.2	268.6	283.0	297.4	311.8	326.2	340.6	355.0
	RPD	E _R	76.0	85.1	90.8	96.5	102.2	107.8	113.5	118.9	124.4	129.8	135.3	140.7
		R _R	215.7	239.5	255.8	272.2	288.5	304.9	321.2	337.5	353.9	370.2	386.6	402.9
1000	CV	E	138.0	153.0	162.6	172.2	181.8	191.4	201.0	210.6	220.2	229.8	239.4	249.0
		R	314.0	349.0	370.8	392.6	414.4	436.2	458.0	480.0	502.0	524.0	546.0	568.0
	RPD	E _R	154.6	171.4	182.1	192.9	203.6	214.4	225.1	235.9	246.6	257.4	268.1	278.9
		R _R	351.7	390.9	415.3	439.7	464.1	488.5	513.0	537.6	562.2	586.9	611.5	636.2
1150	CV	E	210.0	233.0	247.6	262.2	276.8	291.4	306.0	320.6	335.2	349.8	364.4	379.0
		R	416.0	462.0	490.8	519.6	548.4	577.2	606.0	634.8	663.6	692.4	721.2	750.0
	RPD	E _R	232.1	257.5	273.6	289.7	305.9	322.0	338.1	354.3	370.4	386.5	402.7	418.8
		R _R	459.7	510.5	542.3	574.2	606.0	637.8	669.6	701.5	733.3	765.1	796.9	828.8
1250	CV	E	269.0	299.0	317.8	336.6	355.4	374.2	393.0	411.6	430.2	448.8	467.4	486.0
		R	491.0	545.0	579.2	613.4	647.6	681.8	716.0	750.2	784.4	818.6	852.8	887.0
	RPD	E _R	295.9	328.9	349.6	370.3	390.9	411.6	432.3	452.8	473.2	493.7	514.1	534.6
		R _R	540.1	599.5	637.1	674.7	712.4	750.0	787.6	825.2	862.8	900.5	938.1	975.7
1450	CV	E	421.0	468.0	497.2	526.4	555.6	584.8	614.0	643.2	672.4	701.6	730.8	760.0
		R	661.0	734.0	781.0	828.0	875.0	922.0	969.0	1013.8	1058.6	1103.4	1148.2	1193.0
	RPD	E _R	458.9	510.1	541.9	573.8	605.6	637.4	669.3	701.1	732.9	764.7	796.6	828.4
		R _R	720.5	800.1	851.3	902.5	953.8	1005.0	1056.2	1105.0	1153.9	1202.7	1251.5	1300.4
1600	CV	E	566.0	629.0	668.2	707.4	746.6	785.8	825.0	864.2	903.4	942.6	981.8	1021.0
		R	805.0	894.0	950.0	1006.0	1062.0	1118.0	1174.0	1229.8	1285.6	1341.4	1397.2	1453.0
	RPD	E _R	616.9	685.6	728.3	771.1	813.8	856.5	899.3	942.0	984.7	1027.4	1070.2	1112.9
		R _R	877.5	974.5	1035.5	1096.5	1157.6	1218.6	1279.7	1340.5	1401.3	1462.1	1522.9	1583.8

* For explanation of CV and RPD, please refer to note on page 19-20.

[Units: kNm, kN]

SCK Cell Fenders

PERFORMANCE DATA*

			E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0	E 3.1
400	CV	E	16.4	16.8	17.2	17.6	18.0	18.6	19.2	19.8	20.4	21.0	23.0
		R	93.6	96.2	98.8	101.4	104.0	106.8	109.6	112.4	115.2	118.0	129.0
	RPD	E _R	19.2	19.7	20.1	20.6	21.1	21.8	22.5	23.2	23.9	24.6	26.9
		R _R	109.5	112.6	115.6	118.6	121.7	125.0	128.2	131.5	134.8	138.1	150.9
500	CV	E	31.0	32.0	33.0	34.0	35.0	35.8	36.6	37.4	38.2	39.0	43.0
		R	146.2	150.4	154.6	158.8	163.0	167.2	171.4	175.6	179.8	184.0	203.0
	RPD	E _R	35.7	36.8	38.0	39.1	40.3	41.2	42.1	43.0	43.9	44.9	49.5
		R _R	168.1	173.0	177.8	182.6	187.5	192.3	197.1	201.9	206.8	211.6	233.5
630	CV	E	63.8	65.6	67.4	69.2	71.0	72.8	74.6	76.4	78.2	80.0	88.0
		R	230.6	237.2	243.8	250.4	257.0	263.6	270.2	276.8	283.4	290.0	319.0
	RPD	E _R	72.7	74.8	76.8	78.9	80.9	83.0	85.0	87.1	89.1	91.2	100.3
		R _R	262.9	270.4	277.9	285.5	293.0	300.5	308.0	315.6	323.1	330.6	363.7
800	CV	E	128.0	132.0	136.0	140.0	144.0	147.8	151.6	155.4	159.2	163.0	179.0
		R	365.8	376.6	387.4	398.2	409.0	420.0	431.0	442.0	453.0	464.0	510.0
	RPD	E _R	145.3	149.8	154.4	158.9	163.4	167.8	172.1	176.4	180.7	185.0	203.2
		R _R	415.2	427.4	439.7	452.0	464.2	476.7	489.2	501.7	514.2	526.6	578.9
1000	CV	E	256.4	263.8	271.2	278.6	286.0	293.6	301.2	308.8	316.4	324.0	356.0
		R	585.0	602.0	619.0	636.0	653.0	669.8	686.6	703.4	720.2	737.0	811.0
	RPD	E _R	287.2	295.5	303.7	312.0	320.3	328.8	337.3	345.9	354.4	362.9	398.7
		R _R	655.2	674.2	693.3	712.3	731.4	750.2	769.0	787.8	806.6	825.4	908.3
1150	CV	E	390.4	401.8	413.2	424.6	436.0	447.2	458.4	469.6	480.8	492.0	541.0
		R	772.6	795.2	817.8	840.4	863.0	885.6	908.2	930.8	953.4	976.0	1073.0
	RPD	E _R	431.4	444.0	456.6	469.2	481.8	494.2	506.5	518.9	531.3	543.7	597.8
		R _R	853.7	878.7	903.7	928.6	953.6	978.6	1003.6	1028.5	1053.5	1078.5	1185.7
1250	CV	E	500.6	515.2	529.8	544.4	559.0	573.8	588.6	603.4	618.2	633.0	696.0
		R	913.6	940.2	966.8	993.4	1020.0	1046.6	1073.2	1099.8	1126.4	1153.0	1269.0
	RPD	E _R	550.7	566.7	582.8	598.8	614.9	631.2	647.5	663.7	680.0	696.3	765.6
		R _R	1005.0	1034.2	1063.5	1092.7	1122.0	1151.3	1180.5	1209.8	1239.0	1268.3	1395.9
1450	CV	E	782.8	805.6	828.4	851.2	874.0	896.8	919.6	942.4	965.2	988.0	1086.0
		R	1228.8	1264.6	1300.4	1336.2	1372.0	1407.8	1443.6	1479.4	1515.2	1551.0	1707.0
	RPD	E _R	853.3	878.1	903.0	927.8	952.7	977.5	1002.4	1027.2	1052.1	1076.9	1183.7
		R _R	1339.4	1378.4	1417.4	1456.5	1495.5	1534.5	1573.5	1612.5	1651.6	1690.6	1860.6
1600	CV	E	1051.6	1082.2	1112.8	1143.4	1174.0	1204.6	1235.2	1265.8	1296.4	1327.0	1460.0
		R	1496.6	1540.2	1583.8	1627.4	1671.0	1714.6	1758.2	1801.8	1845.4	1889.0	2078.0
	RPD	E _R	1146.2	1179.6	1213.0	1246.3	1279.7	1313.0	1346.4	1379.7	1413.1	1446.4	1591.4
		R _R	1631.3	1678.8	1726.3	1773.9	1821.4	1868.9	1916.4	1964.0	2011.5	2059.0	2265.0

* For explanation of CV and RPD, please refer to note on page 19-20.

[Units: kNm, kN]

SCK Cell Fenders

PERFORMANCE DATA*

			E 0.9	E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9	E 2.0
1700	CV	E	678.0	753.0	800.2	847.4	894.6	941.8	989.0	1036.2	1083.4	1130.6	1177.8	1225.0
		R	908.0	1009.0	1072.2	1135.4	1198.6	1261.8	1325.0	1388.2	1451.4	1514.6	1577.8	1641.0
	RPD	E _R	739.0	820.8	872.2	923.7	975.1	1026.6	1078.0	1129.5	1180.9	1232.4	1283.8	1335.3
		R _R	989.7	1099.8	1168.7	1237.6	1306.5	1375.4	1444.3	1513.1	1582.0	1650.9	1719.8	1788.7
2000	CV	E	1104.0	1227.0	1303.6	1380.2	1456.8	1533.4	1610.0	1686.8	1763.6	1840.4	1917.2	1994.0
		R	1258.0	1397.0	1484.2	1571.4	1658.6	1745.8	1833.0	1920.0	2007.0	2094.0	2181.0	2268.0
	RPD	E _R	1186.8	1319.0	1401.4	1483.7	1566.1	1648.4	1730.8	1813.3	1895.9	1978.4	2061.0	2143.6
		R _R	1352.4	1501.8	1595.5	1689.3	1783.0	1876.7	1970.5	2064.0	2157.5	2251.1	2344.6	2438.1
2250	CV	E	1854.0	2060.0	2169.2	2278.4	2387.6	2496.8	2606.0	2715.0	2824.0	2933.0	3042.0	3151.0
		R	1876.0	2085.0	2195.4	2305.8	2416.2	2526.6	2637.0	2747.4	2857.8	2968.2	3078.6	3189.0
	RPD	E _R	1983.8	2204.2	2321.0	2437.9	2554.7	2671.6	2788.4	2905.1	3021.7	3138.3	3254.9	3371.6
		R _R	2007.3	2231.0	2349.1	2467.2	2585.3	2703.5	2821.6	2939.7	3057.8	3176.0	3294.1	3412.2
2500	CV	E	2544.0	2826.0	2975.8	3125.6	3275.4	3425.2	3575.0	3724.6	3874.2	4023.8	4173.4	4323.0
		R	2317.0	2574.0	2710.4	2846.8	2983.2	3119.6	3256.0	3392.2	3528.4	3664.6	3800.8	3937.0
	RPD	E _R	2696.6	2995.6	3154.3	3313.1	3471.9	3630.7	3789.5	3948.1	4106.7	4265.2	4423.8	4582.4
		R _R	2456.0	2728.4	2873.0	3017.6	3162.2	3306.8	3451.4	3595.7	3740.1	3884.5	4028.8	4173.2
3000	CV	E	3795.0	4217.0	4452.4	4687.8	4923.2	5158.6	5394.0	5629.4	5864.8	6100.2	6335.6	6571.0
		R	3310.0	3678.0	3879.0	4080.0	4281.0	4482.0	4683.0	4884.0	5085.0	5286.0	5487.0	5688.0
	RPD	E _R	3984.8	4427.9	4675.0	4922.2	5169.4	5416.5	5663.7	5910.9	6158.0	6405.2	6652.4	6899.6
		R _R	3475.5	3861.9	4073.0	4284.0	4495.1	4706.1	4917.2	5128.2	5339.3	5550.3	5761.4	5972.4

[Units: kNm, kN]

*Note:

1. CV: performance data at slow speed constant velocity (2-8 cm/min) compression at 23 ±5°C temperature and 0° compression angle.
2. RPD: Rated performance data, in accordance with PIANC with initial high speed berthing velocity 0.15 m/s.
 RPD = CV (performance) x VF (velocity factor for Natural and Synthetic rubber blend) x TF (temperature factor) x AF (angle factor).
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore TF = 1, AF = 1.

SCK Cell Fenders

PERFORMANCE DATA*

			E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0	E 3.1
1700	CV	E	1261.6	1298.2	1334.8	1371.4	1408.0	1444.8	1481.6	1518.4	1555.2	1592.0	1751.0
		R	1690.0	1739.0	1788.0	1837.0	1886.0	1935.2	1984.4	2033.6	2082.8	2132.0	2345.0
	RPD	E _R	1375.1	1415.0	1454.9	1494.8	1534.7	1574.8	1614.9	1655.1	1695.2	1735.3	1908.6
		R _R	1842.1	1895.5	1948.9	2002.3	2055.7	2109.4	2163.0	2216.6	2270.3	2323.9	2556.1
2000	CV	E	2053.8	2113.6	2173.4	2233.2	2293.0	2352.8	2412.6	2472.4	2532.2	2592.0	2851.0
		R	2335.4	2402.8	2470.2	2537.6	2605.0	2672.4	2739.8	2807.2	2874.6	2942.0	3236.0
	RPD	E _R	2207.8	2272.1	2336.4	2400.7	2465.0	2529.3	2593.5	2657.8	2722.1	2786.4	3064.8
		R _R	2510.6	2583.0	2655.5	2727.9	2800.4	2872.8	2945.3	3017.7	3090.2	3162.7	3478.7
2250	CV	E	3245.6	3340.2	3434.8	3529.4	3624.0	3718.4	3812.8	3907.2	4001.6	4096.0	4506.0
		R	3284.8	3380.6	3476.4	3572.2	3668.0	3763.6	3859.2	3954.8	4050.4	4146.0	4561.0
	RPD	E _R	3472.8	3574.0	3675.2	3776.5	3877.7	3978.7	4079.7	4180.7	4281.7	4382.7	4821.4
		R _R	3514.7	3617.2	3719.7	3822.3	3924.8	4027.1	4129.3	4231.6	4333.9	4436.2	4880.3
2500	CV	E	4452.6	4582.2	4711.8	4841.4	4971.0	5100.6	5230.2	5359.8	5489.4	5619.0	6181.0
		R	4055.2	4173.4	4291.6	4409.8	4528.0	4646.2	4764.4	4882.6	5000.8	5119.0	5631.0
	RPD	E _R	4719.8	4857.1	4994.5	5131.9	5269.3	5406.6	5544.0	5681.4	5818.8	5956.1	6551.9
		R _R	4298.5	4423.8	4549.1	4674.4	4799.7	4925.0	5050.3	5175.6	5300.8	5426.1	5968.9
3000	CV	E	6761.8	6952.6	7143.4	7334.2	7525.0	7715.8	7906.6	8097.4	8288.2	8479.0	9327.0
		R	5855.6	6023.2	6190.8	6358.4	6526.0	6693.4	6860.8	7028.2	7195.6	7363.0	8099.0
	RPD	E _R	7099.9	7300.2	7500.6	7700.9	7901.3	8101.6	8301.9	8502.3	8702.6	8903.0	9793.4
		R _R	6148.4	6324.4	6500.3	6676.3	6852.3	7028.1	7203.8	7379.6	7555.4	7731.2	8504.0

[Units: kNm, kN]

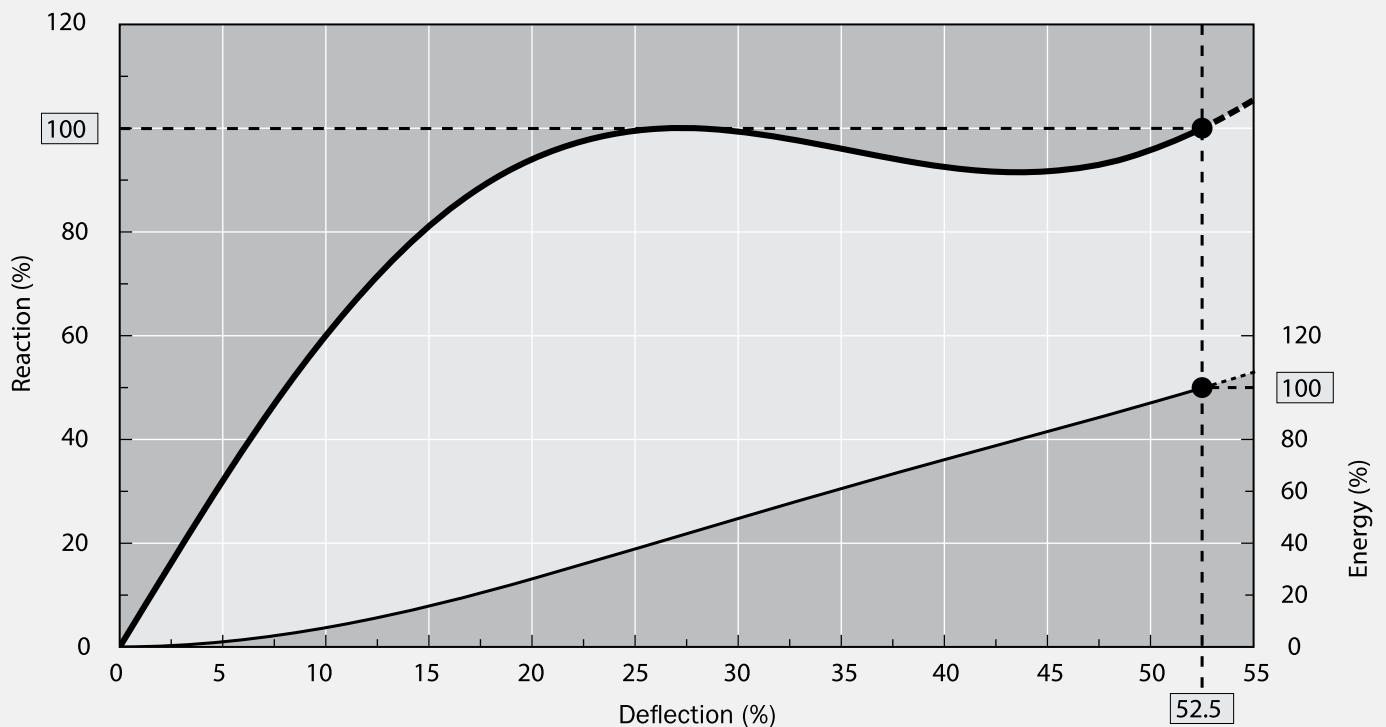
- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing temperature, RPD = DV (performance).
- Fender performance is subject to ±10% manufacturing tolerance (+10% for reaction force and -10% for energy).

SCK Cell Fenders

INTERMEDIATE DEFLECTIONS

D _i (%)	0	5	10	15	20	25	30	35	40	45	50	52.5	55
E _i (%)	0	2	7	16	26	38	50	61	72	83	94	100	106
R _i (%)	0	32	60	81	94	99	99	96	92	92	96	100	106

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.



Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

ANGLE FACTOR (AF) TABLE

ANGLE (°)	ENERGY FACTOR	REACTION FACTOR
0	1.000	1.000
3	0.977	1.000
5	0.951	1.000
8	0.909	1.000
10	0.883	1.000
15	0.810	1.000
20	0.652	1.000

SCK Cell Fenders

VELOCITY FACTOR (VF) TABLE

COMPRESSION TIME (SECONDS)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	VF	VF	VF
1	1.20	1.14	1.31
2	1.16	1.10	1.25
3	1.14	1.09	1.22
4	1.13	1.07	1.20
5	1.11	1.06	1.19
6	1.10	1.06	1.17
7	1.09	1.05	1.16
8	1.09	1.04	1.15
9	1.08	1.04	1.14
10	1.07	1.03	1.14
11	1.07	1.03	1.13
12	1.06	1.02	1.12
13	1.06	1.02	1.12
14	1.05	1.02	1.11
15	1.05	1.01	1.11
16	1.05	1.01	1.10
17	1.04	1.01	1.10
18	1.04	1.01	1.09
19	1.04	1.00	1.09
20	1.03	1.00	1.08

Compression time needs to be calculated using the following formula: $t = d/(f \cdot V_d)$

Where:

t = compression time (seconds)*

d = rated deflection (mm)

V_d = initial berthing velocity (mm/s)

f = 0.74 deceleration factor (Peak reaction force occurs at between 30% - 40% deflection, where there has been a deceleration due to energy absorption. f represents the factor associated with deceleration.)

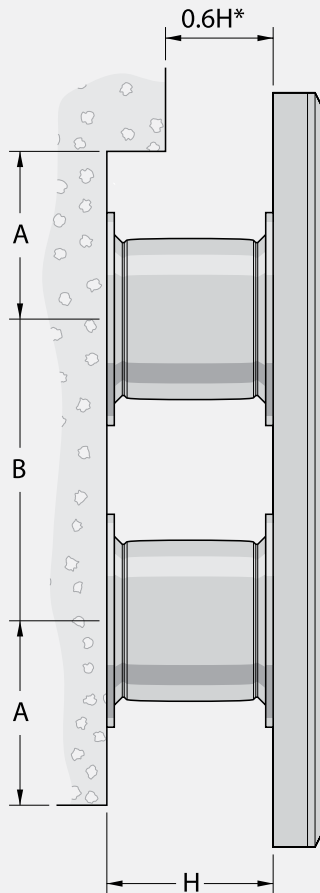
* Applicable for both partial deflection and rated deflection.

TEMPERATURE FACTOR (TF) TABLE

TEMPERATURE (°C)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	TF	TF	TF
+50	0.916	0.914	0.918
+40	0.947	0.946	0.948
+30	0.978	0.978	0.979
+23	1.000	1.000	1.000
+10	1.030	1.025	1.038
+0	1.075	1.053	1.108
-10	1.130	1.080	1.206
-20	1.249	1.142	1.410
-30	1.540	1.315	1.877

SCK Cell Fenders

CLEARANCES



*Does not allow for bow flares

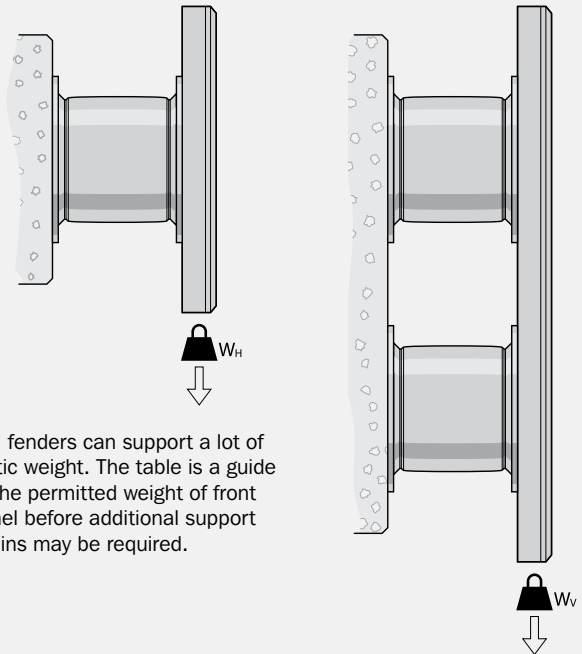
There must be enough space around and between the Cell fenders and the steel panel to allow them to deflect without interference.

Distances given in the above diagram are for guidance. If in doubt, please ask.

SCK (H)	EDGE (A)	CENTRES (B)
400	480	700
500	510	700
630	600	880
800	700	1120
1000	850	1500
1150	990	1730
1250	1060	1870
1450	1200	2180
1600	1270	2400
1700	1470	2550
2000	1560	2880
2250	1710	3360
2500	1910	3730
3000	2240	4500

[Units: mm]

WEIGHT SUPPORT



Cell fenders can support a lot of static weight. The table is a guide to the permitted weight of front panel before additional support chains may be required.

SCK	SINGLE OR MULTIPLE HORIZONTAL ($n \geq 1$)	MULTIPLE VERTICAL ($n \geq 2$)	H
E1	$W_H \leq n \times 1.0 \times W$	$W_V \leq n \times 1.25 \times W$	≤ 800
E2	$W_H \leq n \times 1.3 \times W$	$W_V \leq n \times 1.75 \times W$	
E3	$W_H \leq n \times 1.5 \times W$	$W_V \leq n \times 2.25 \times W$	
E1	$W_H \leq n \times 11 \times W^{0.6}$	$W_V \leq n \times 13.75 \times W^{0.6}$	≥ 1000
E2	$W_H \leq n \times 19 \times W^{0.6}$	$W_V \leq n \times 23.75 \times W^{0.6}$	
E2	$W_H \leq n \times 25 \times W^{0.6}$	$W_V \leq n \times 31.25 \times W^{0.6}$	

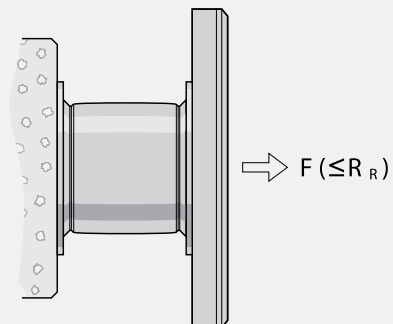
n = number of Cell fenders.

W = SCK weight

W_H = panel weight (single or multi-horizontal)

W_V = panel weight (single or multi-vertical)

Interpolate for other grades



If the tensile load exceeds the rated reaction then tension chains may be required. Please ask for advice on the design of tension chains.

1. SINGAPORE
2. DJIBOUTI
3. ITALY
4. SINGAPORE
5. VIETNAM
6. USA
7. NETHERLANDS MAASVLAKTE
8. VENEZUELA

1



2



3



4



5



6



7



8



Leg Fenders

Leg fenders provide an extremely compact solution, ideal for when fenders need to be mounted in a limited area. These versatile fenders have a modular design and are available as MV elements, MV V-elements, MI elements, Unit elements and UE V-fenders solutions.

FENDERS	FEATURES	APPLICATIONS
MV Elements	Modular design system Many standard sizes High performance geometry Recessed fixings Long life, low maintenance	All vessel types which use the following systems: Fender piles V-fenders Multiple fenders Pivot pillars Parallel Motion (Torsion Arm)
MV V-Fenders	Simple, modular design Low-friction shield Non-marking face Reduced hull pressure Easy maintenance	General cargo quays Berthing dolphins Pontoon fendering Passenger ferry berths Offshore platforms Long fender walls
MI-2000 Elements	Modular design system Choice of lengths and rubber grades High performance and efficiency Long life, low maintenance	Ideal for larger vessels including: Tankers and LNG ships Bulk carriers Post-Panamax containers Mega cruise ships
Unit Elements	Versatile modular system Highly efficient shape Symmetrical or asymmetrical fixings Strong in lengthwise shear Easy to install Low maintenance	Container terminals Tanker Berths RoRo and cruise ships Dolphins and monopiles Bulk and general cargo berths Fender walls Small craft berths
UE V-Fenders	Simple, modular design Low-friction shield Non-marking face Reduced hull pressure Easy maintenance	Multi-user berths Small RoRo terminals Workboat berths Pontoon fenders

MV Elements

DIMENSIONS

	L	B	C	F	G	J	T	ANCHORS / HEAD BOLTS ^	HOLES	WEIGHT
*MV300	600	150	300	94	93	47	17-26	M20	2 + 2	27
	900								3 + 3	41
	1200								4 + 4	54
	1500								5 + 5	68
MV400	750	125	500	125	124	63	17-26	M24	2 + 2	50
	1000	250							2 + 2	66
	1500								3 + 3	99
	2000								4 + 4	132
	2500								5 + 5	165
	3000								6 + 6	198
MV500	750	125	500	158	142	87	17-26	M30	2 + 2	84
	1000	250							2 + 2	111
	1500								3 + 3	167
	2000								4 + 4	222
	2500								5 + 5	278
	3000								6 + 6	334
MV550	750	125	500	172	170	87	18-27	M30	2 + 2	100
	1000	250							2 + 2	132
	1500	3 + 3							200	
MV600	750	125	500	188	199	87	18-28	M30	2 + 2	115
	1000	250							2 + 2	153
	1500	3 + 3							230	
MV750	750	125	500	235	230	118	22-32	M36	2 + 2	180
	1000	250							2 + 2	239
	1500	3 + 3							359	
MV800	800	150	500	250	240	129	22-32	M36	2 + 2	214
	1000	250							2 + 2	268
	1500								3 + 3	402
	2000								4 + 4	536
MV1000	800	150	500	322	310	162	28-40	M42	2 + 2	346
	850	175							2 + 2	368
	900	200							2 + 2	389
	950	225							2 + 2	411
	1000	250							2 + 2	432
	1050	275							2 + 2	454
	1100	300							2 + 2	476
	1150	325							2 + 2	497
	1200	350							2 + 2	519
	1500	250							3 + 3	648
	2000								4 + 4	864

*MV300 elements up to 3000mm length available on request.

[Units: mm, kg]

^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

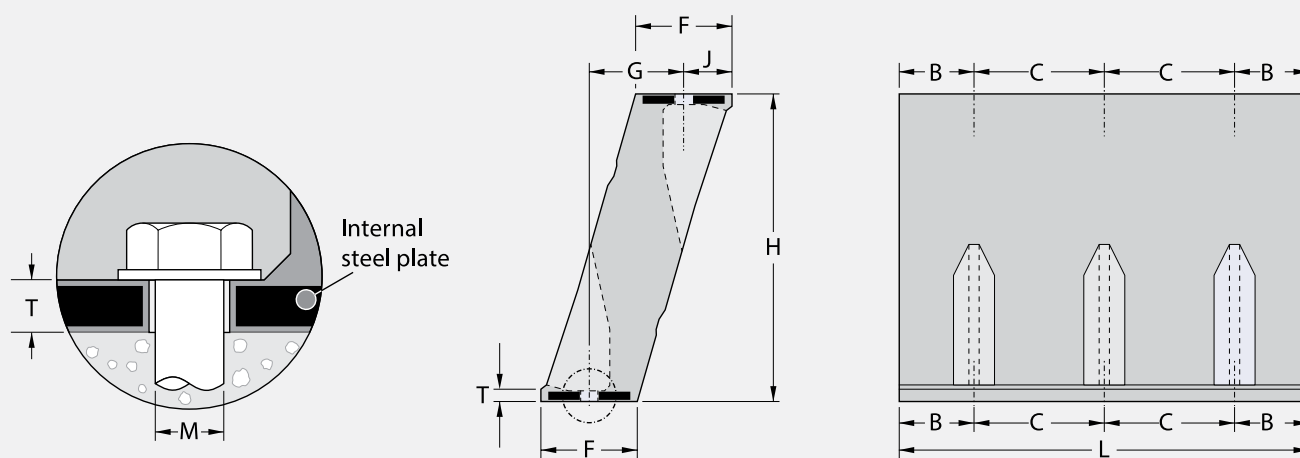
MV Elements

DIMENSIONS

	L	B	C	F	G	J	T	ANCHORS / HEAD BOLTS ^	HOLES	WEIGHT
MV1250	800	150	500	401	388	202	35-47	M48	2 + 2	511
	850	175							2 + 2	543
	900	200							2 + 2	575
	950	225							2 + 2	607
	1000	250							2 + 2	639
	1050	275							2 + 2	671
	1100	300							2 + 2	703
	1150	325							2 + 2	735
	1200	350							2 + 2	767
	1250	375							2 + 2	799
	1500	250							3 + 3	959
	2000								4 + 4	1278
MV1450	900	200	500	454	445	228	35-50	M48	2 + 2	786
	1000	250							2 + 2	873
	1100	300							2 + 2	960
	1200	350							2 + 2	1048
	1500	250							3 + 3	1310
	2000								4 + 4	1746
MV1600	1000	250	500	507	480	261	45-50	M56	2 + 2	1114
	1100	300							2 + 2	1226
	1200	350							2 + 2	1337
	1500	250							3 + 3	1671
	2000								4 + 4	2228

^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

[Units: mm, kg]



MV Elements

RATED PERFORMANCE DATA (RPD)

	L	COMPOUND A		COMPOUND B	
		E	R	E	R
300	600	13	91.4	8.8	64
	900	19	137	13	96
	1200	25	183	18	128
	1500	32	229	22	160
400	750	27	146	19	102
	1000	37	203	26	142
	1500	56	305	39	213
	2000	75	406	52	284
	2500	94	508	65	356
	3000	112	609	79	427
500	750	41	179	29	125
	1000	58	254	41	178
	1500	88	381	61	267
	2000	117	508	82	356
550	750	50	197	35	138
	1000	71	279	50	196
	1500	106	419	74	293
600	750	59	215	42	151
	1000	84	305	59	213
	1500	126	457	88	320
750	750	90	262	63	183
	1000	131	381	92	267
	1500	197	571	138	400
800	800	111	302	78	212
	1000	150	406	105	284
	1500	224	609	157	427
	2000	299	813	209	569
1000	800	175	380	122	266
	850	189	412	133	288
	900	204	444	143	311
	950	219	476	153	333
	1000	234	508	164	356
	1050	248	540	174	378
	1100	263	572	184	400
	1150	278	604	195	423
	1200	293	636	205	445
	1500	350	762	245	533
1250	2000	467	1016	327	711
	800	269	468	188	327
	850	293	510	205	357
	900	317	551	222	386
	950	341	593	239	415
	1000	365	635	256	444
	1050	389	677	272	474
	1100	413	718	289	503
	1150	437	760	306	532
	1200	461	802	323	561
	1250	485	844	340	591
	1500	548	952	383	667
	2000	730	1270	511	889
1450	900	426	638	298	447
	1000	491	736	344	516
	1100	557	835	390	584
	1200	622	933	436	653
	1500	737	1105	516	773
	2000	982	1473	688	1031
1600	1000	598	813	419	569
	1100	690	937	483	656
	1200	781	1061	547	743
	1500	897	1219	628	853
	2000	1196	1625	837	1138

[Units: kNm, kN]

MV-elements are the foundation of many fender systems. These modular units are compression molded from a high performance polymer which resists attack from ultraviolet light, ozone and immersion in seawater for long service life and low maintenance.

Available in a full range of sizes, the geometry of the MV-element has been optimized for maximum energy absorption per unit volume of rubber combined with a low reaction force. Fully encapsulated steel mounting plates are vulcanized inside the MV-element to allow easy fixing. Bolts are located centrally on the base flanges to reduce stresses, but being recessed into pockets the fixings are well protected from damage.

RPD is reported at:

- 0.15 m/s (initial berthing speed)
- 23°C ± 5°C temperature
- 0° compression angle

All MV/MI/MV-V fender performances are based on decreasing velocity (DV) method compression testing of full size elements.

All performance values are for a single element. Per leg per meter.

* Reference testing conditions to Fender Application Design Manual. Tolerance ± 10%.

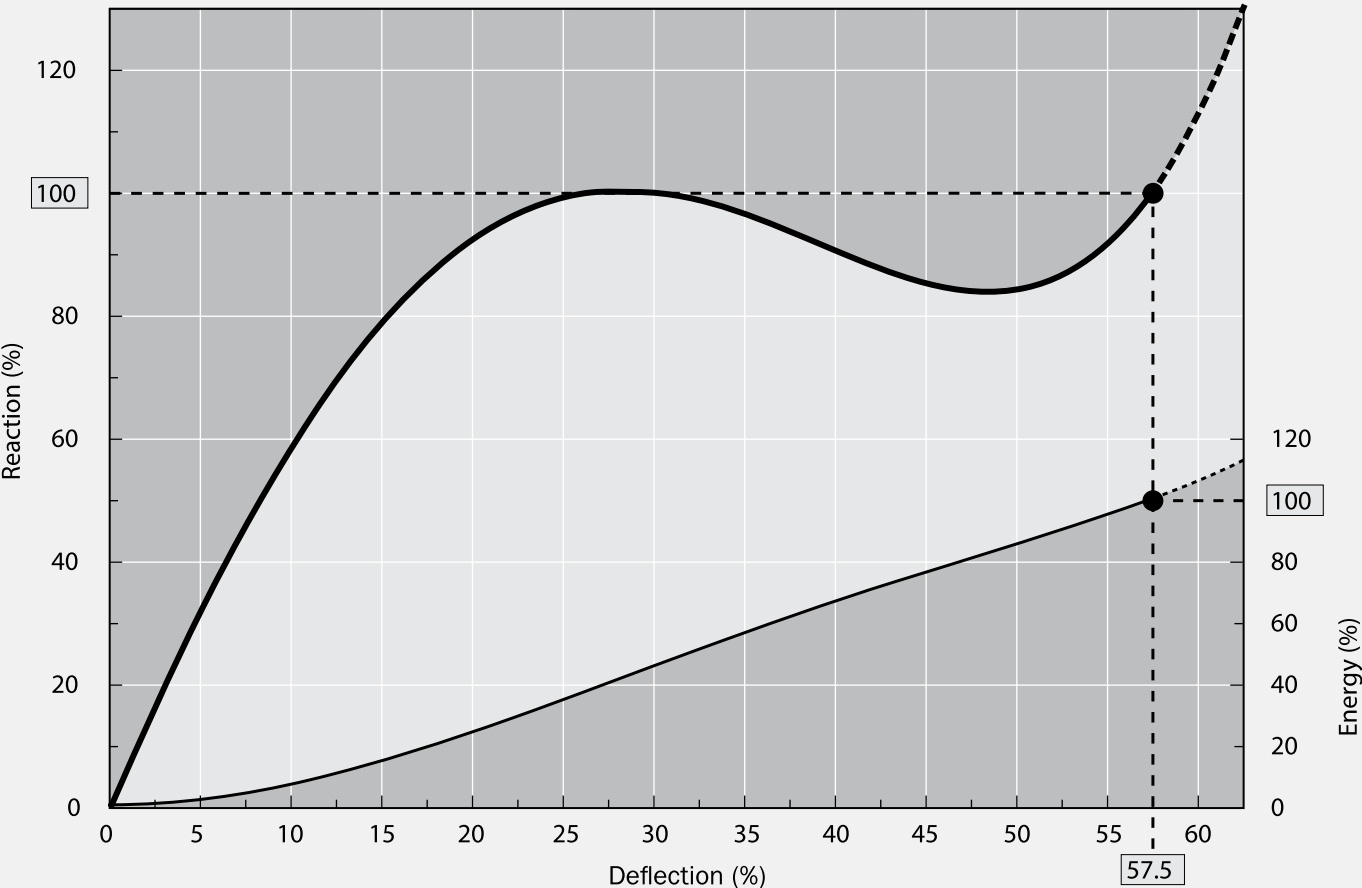
* Values are for a single element, 1000mm long.

MV Elements

INTERMEDIATE DEFLECTIONS

D _i (%)	0	5	10	15	20	28	35	40	45	50	57.5	62.5
E _i (%)	0	2	7	14	24	41	56	66	76	85	100	113
R _i (%)	0	31	58	78	92	100	96	90	85	84	100	130

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.



Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

MV Elements

ANGLE FACTORS (AF) TRANVERSE LOAD

Reduction factor R_s for energy absorption E is dependent on the relation between the spacing A and the dimension H of the fender element.

Example

2 fender elements MV 1000 x 2000 A

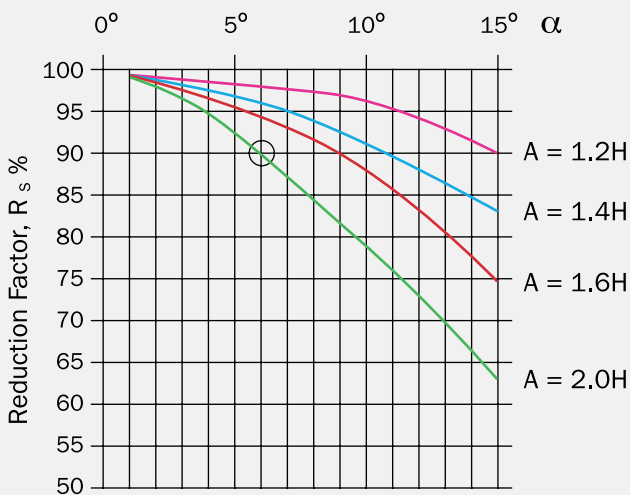
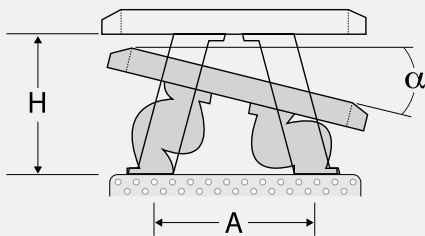
Rated energy absorption $E = 2 \times 467 = 934 \text{ kNm}$

Angular berthing 6°

$A = 2.0 H$

Reduction factor $R_s = 0.9$

Energy absorption $E_{6^\circ} = 0.9 \times 934 = 840.6 \text{ kNm}$



- The above curves are valid for all MV-element sizes.
- The characteristics consider an average rated reaction force and therefore the reaction force should always be the same as 0° compression.
- For ratios and angles not given, one may interpolate.
- In the case of both transverse and longitudinal angular berthing, the factors R_s and R_l are to be multiplied to give the combined reduction factor for the compound angle.

LONGITUDINAL LOAD

Reduction factor R_l for energy absorption E is dependent on the relation between the length L and the dimension H of the fender element.

Example

2 fender elements MV 750 x 1500 B

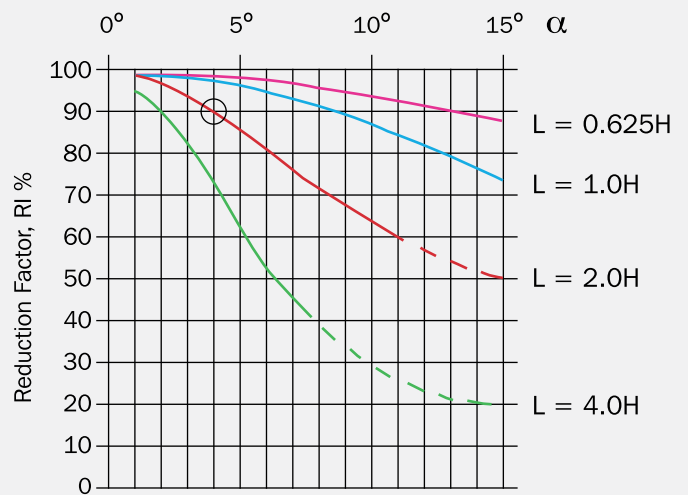
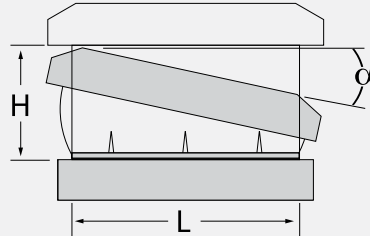
Rated energy absorption $E = 2 \times 138 = 276 \text{ kNm}$

Angular berthing 4°

$L = 2.0 H$

Reduction factor $R_l = 0.9$

Energy absorption $E_{4^\circ} = 0.9 \times 276 = 248.4 \text{ kNm}$



Example

Bow radius gives transverse $\alpha = 6^\circ$; $R_s = 0.9$

Flare gives longitudinal $\alpha = 4^\circ$; $R_l = 0.9$

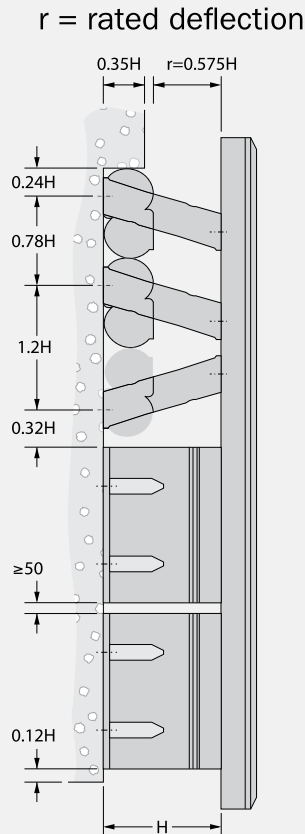
$R_{\text{total}} = 0.9 \times 0.9 = 0.81$

MV Elements

ELEMENT SPACING

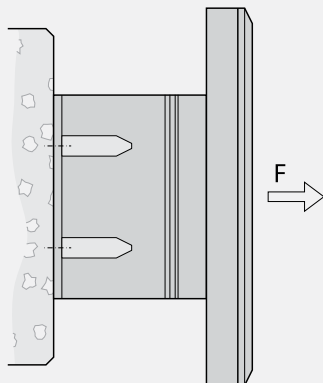
MV-elements can be mounted horizontally or vertically. There must be enough space around and between MV-element fenders and the steel panel to allow them to deflect without interference.

Distances given in the diagram are for guidance. If in doubt, contact your local office.



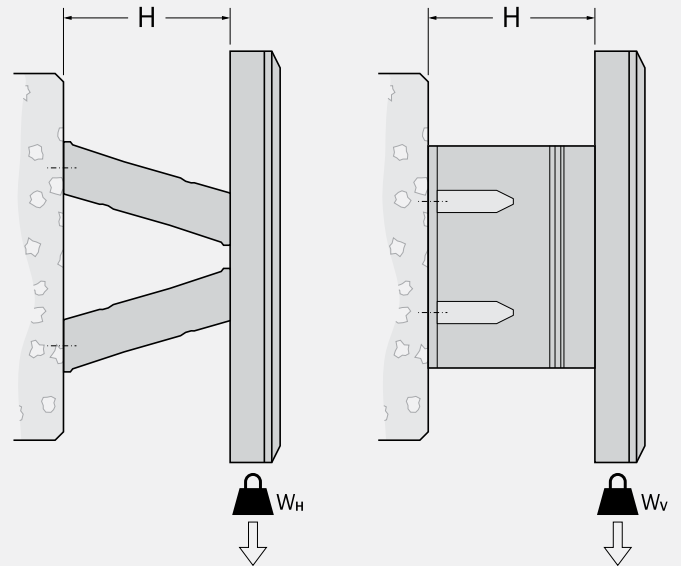
TENSION

If the likely tensile load exceeds the rated reaction then tension chains may be required. Please refer to your local office.



WEIGHT SUPPORT

MV-elements can support a lot of weight. The table is a guide to the permitted weight of the front panel in tonnes per metre of element pair before additional support chains may be required.



MV	PANEL WEIGHT*	
	SINGLE OR MULTIPLE HORIZONTAL	SINGLE OR MULTIPLE VERTICAL
Compound A	$W_H \leq 1.0 \times H \times L$	$W_V \leq 1.78 \times H \times L$
Compound B	$W_H \leq 0.7 \times H \times L$	$W_V \leq 1.25 \times H \times L$

* Per pair of elements.

[Units: ton, meter]

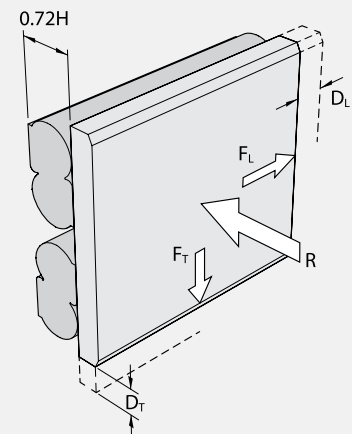
SHEAR STIFFNESS

Some temporary shear may be caused by friction as the MV-elements are compressed. Maximum shear usually occurs at approximately 28% deflection.

$$DL \approx 0.39 \times \mu \times H$$

$$DT \approx 0.82 \times \mu \times H$$

Where,
 H = fender height
 μ = friction coefficient



MV V-Fenders

DIMENSIONS

H	T(min)	So	M _w	S _w	A	B	C	FIXINGS
MV300P	70	370	270	410	360	454	172	M20
MV400P	80	480	360	500	480	606	232	M24
MV500P	90	590	460	660	600	774	316	M30
MV550P	90	640	500	750	660	834	320	M30
MV600P	90	690	530	800	720	894	322	M30
MV750P	100	850	680	1010	900	1136	440	M36
MV800P	100	900	730	1170	960	1218	480	M36
MV1000P	120	1120	900	1330	1200	1524	580	M42
MV1250P	120	1370	1140	1660	1500	1904	724	M48

Please ask for other dimensions

[Units: mm]

Performance is for a pair of elements, 1000mm long. Tolerance $\pm 10\%$.

V-fenders fulfil the need for a simple, and maintenance-free fender system with high performance and a robust design at low costs. All V-fenders use one or several pairs of MV-elements and a front shield. The shield is a structural component of the fender, directly bolted to the MV-element and easily able to withstand constant use in busy harbors.

The UHMW-PE face is also very gentle on ships. It will conform to the contours of the hull, will not mark paint (unlike rubber) and does not spark. UHMW-PE has very low friction which reduces stresses in the V-fenders and fixings.

RATED PERFORMANCE (PER METER)

COMPOUND A		COMPOUND B	
E	R	E	R
42	305	30	213
75	406	52	284
117	508	82	356
141	558	99	392
168	610	118	426
262	762	184	534
300	812	210	568
468	1016	328	712
730	1270	512	888

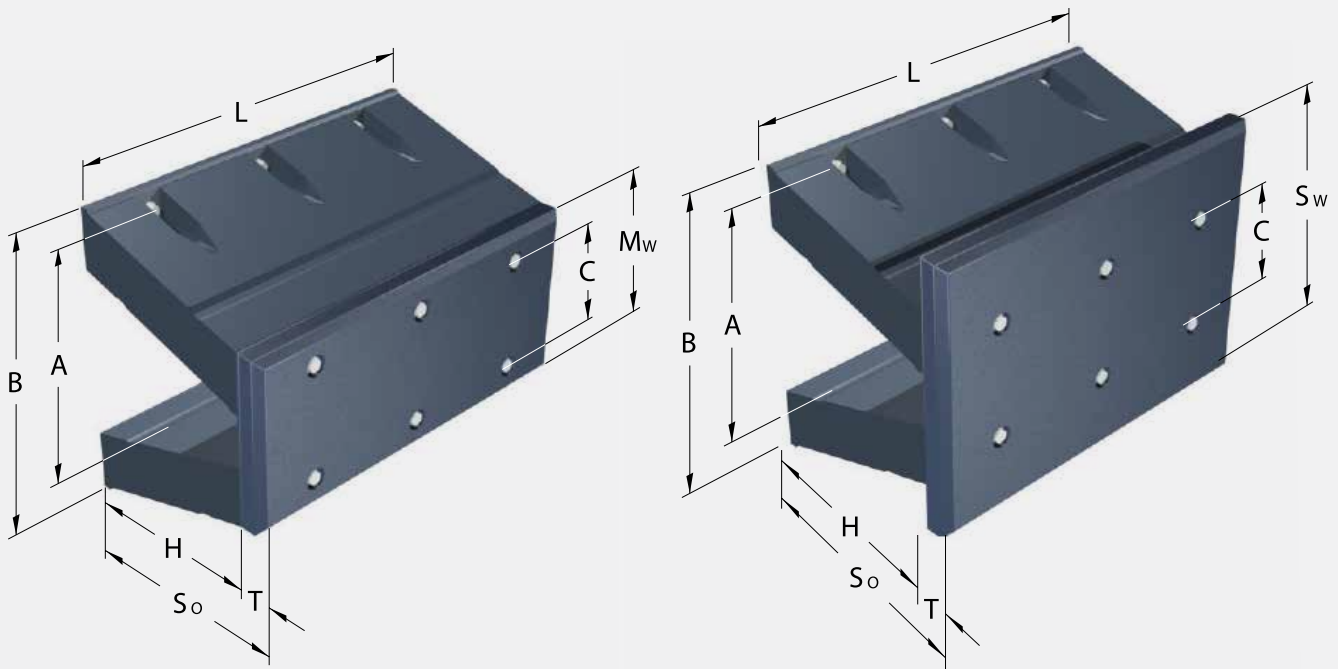
[Units: kNm, kN]

Reported at:

- 0.15 m/s (initial berthing speed)
- 23°C $\pm$ 5°C temperature
- 0° compression angle

All MV/MI/MV-V fender performances are based on decreasing velocity (DV) method compression testing of full size elements.

* Values are for a single element, 1000mm long.



Always specify 'P' type elements for V-fenders (ie. MV500P). These have special internal plates designed to flex with the UHMW-PE shield. The flange marked 'Panel Side' should be connected to the shield.

MI-2000 Elements

DIMENSIONS

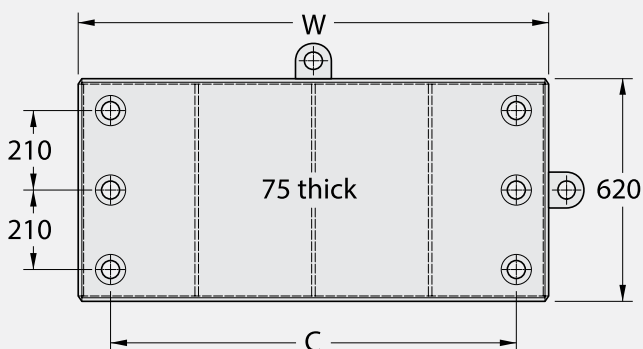
A	B	C	ANCHORS / HEAD BOLTS ^	HOLES	WEIGHT	
					MI-2000	MI-2000S
1000	1270	1130	M42	6+6	1840	2191
1050	1320	1180	M42	6+6	1941	2286
1100	1370	1230	M42	6+6	2042	2383
1150	1420	1280	M42	6+6	2144	2480
1200	1470	1330	M42	6+6	2245	2573
1250	1520	1380	M42	6+6	2346	2670
1300	1570	1430	M42	6+6	2447	2765
1350	1620	1480	M42	6+6	2549	2860
1400	1670	1530	M42	6+6	2650	2957

^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

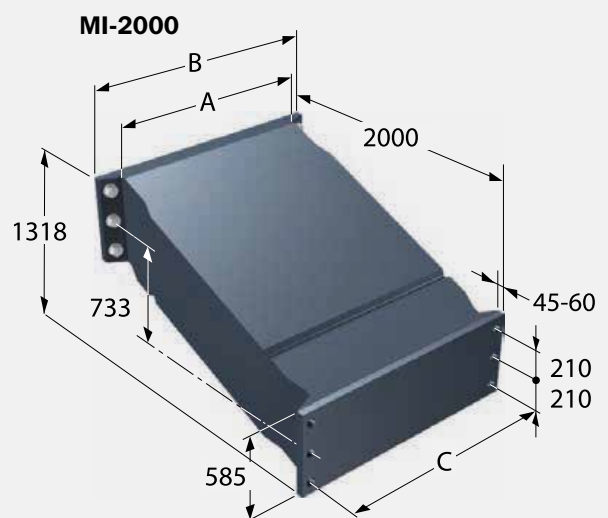
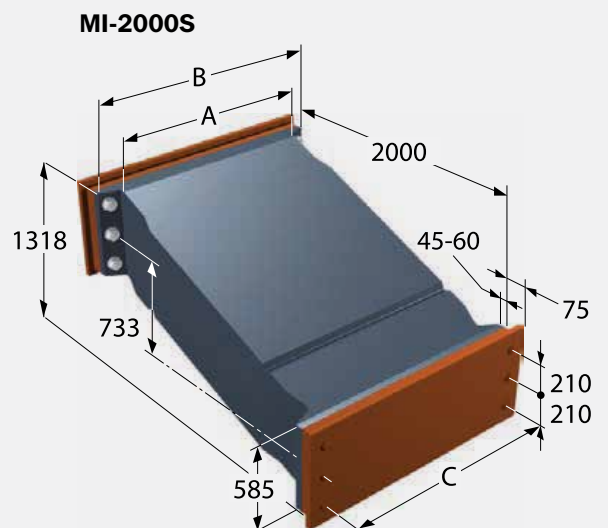
[Units: mm, kg]

MI-2000 fender systems suit very large vessels and high energy applications. They share the modular design concept with MV elements but with a modified fixing arrangement to allow greater deflections and efficiency.

The rubber unit is available in several standard lengths and rubber grades which, combined with the modularity of the MI system, provides designers with greater choice and versatility.



* MI-2000S weight includes fabricated spacers for both flanges (supplied with fender elements on request).



MI-2000 Elements

RATED PERFORMANCE DATA*

A		MI-2000		MI-2000S	
		COMPOUND A	COMPOUND B	COMPOUND A	COMPOUND B
1000	E _R	925	565	989	604
	R _R	925	565	925	565
1050	E _R	971	593	1039	635
	R _R	971	593	971	593
1100	E _R	1017	621	1088	665
	R _R	1017	621	1017	621
1150	E _R	1063	650	1138	695
	R _R	1063	650	1063	650
1200	E _R	1110	678	1187	725
	R _R	1110	678	1110	678
1250	E _R	1156	706	1237	756
	R _R	1156	706	1156	706
1300	E _R	1202	734	1286	786
	R _R	1202	734	1202	734
1350	E _R	1248	763	1336	816
	R _R	1248	763	1248	763
1400	E _R	1295	791	1385	846
	R _R	1295	791	1295	791

*All values are for a single element. Tolerance $\pm 10\%$.

[Units: kNm, kN]

Reported at:

- 0.15 m/s (initial berthing speed)
- 23°C $\pm$ 5°C temperature
- 0° compression angle

All MV/MI/MV-V fender performances are based on decreasing velocity (DV) method compression testing of full size elements.

INTERMEDIATE DEFLECTIONS

MI-2000

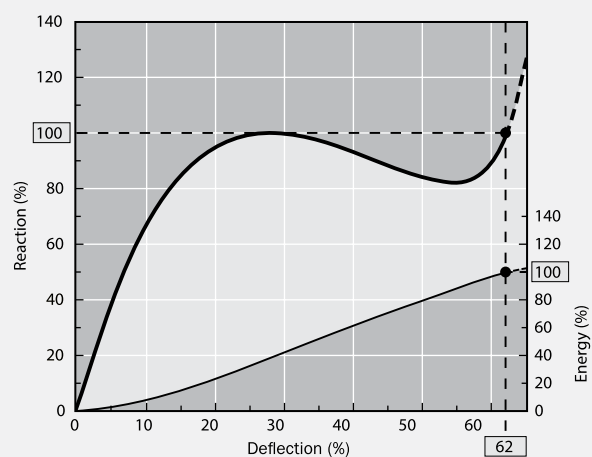
D _i (%)	0	5	10	15	20	25	30	35	40	45	50	55	60	62	65
E _i (%)	0	2	6	14	23	32	42	52	61	71	79	88	96	100	103
R _i (%)	0	34	63	84	95	99	100	98	95	91	86	82	90	100	127

MI-2000S

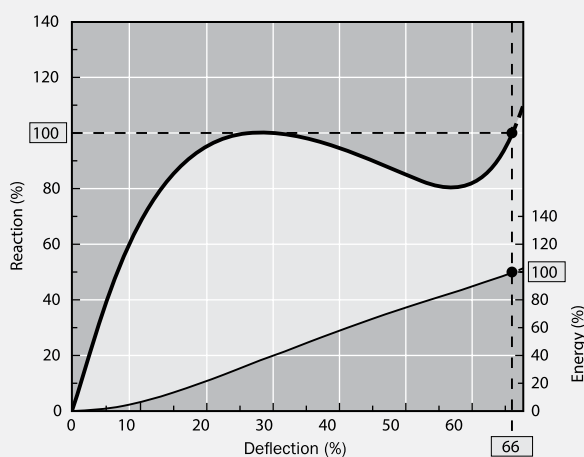
D _i (%)	0	5	10	15	20	25	30	35	40	45	50	55	60	66	67.5
E _i (%)	0	2	6	13	21	30	40	49	58	67	75	82	90	100	103
R _i (%)	0	35	63	83	95	99	100	98	94	90	85	81	81	100	110

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.

MI-2000



MI-2000S



Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

Unit Elements

DIMENSIONS

ELEMENT	H	A	B*	C*	D	F	J	M	W	K	E	ANCHORS / HEAD BOLTS ^	WEIGHT
UE250	250	109	114	71	20 – 27	152	33	25 – 35	218	50	300	M20	38
UE300	300	130	138	84	23 – 32	184	38	30 – 40	260	50	300	M24	54
UE400	400	165	187	102	25 – 35	248	41	30 – 40	330	250	500	M24	89
UE500	500	195	229	119	28 – 37	306	42	40 – 52	390	250	500	M30	135
UE550	550	210	252	126	32 – 38	336	42	40 – 52	420	250	500	M30	153
UE600	600	225	275	133	35 – 45	366	42	40 – 52	450	250	500	M30	179
UE700	700	270	321	163	35 – 45	428	56	50 – 65	540	250	500	M36	247
UE750	750	285	344	170	38 – 45	458	56	50 – 65	570	250	500	M36	298
UE800	800	300	366	178	38 – 45	488	56	50 – 65	600	250	500	M36	338
UE900	900	335	412	198	42 – 50	550	60	57 – 80	670	250	500	M42	410
UE1000	1000	365	458	212	46 – 58	610	60	57 – 80	730	250	500	M42	509
UE1200	1200	435	557	252	46 – 60	748	61	65 – 90	870	250	500	M48	717
UE1400	1400	495	642	281	50 – 65	856	67	65 – 90	990	250	500	M48	948
UE1600	1600	565	733	321	50 – 65	978	76	75 – 100	1130	250	500	M56	1236

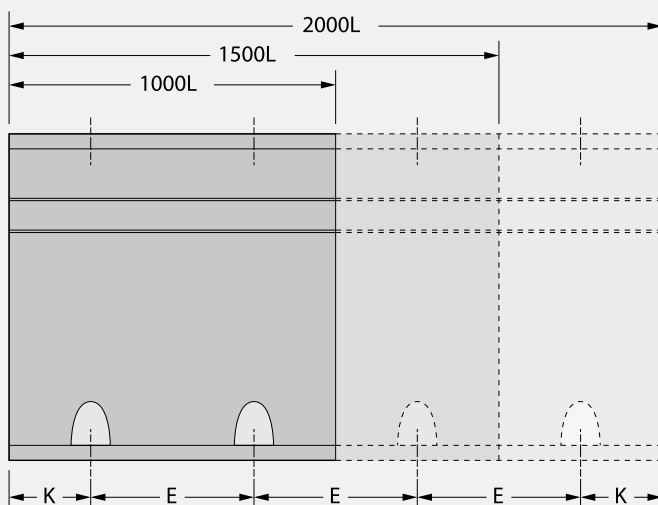
* Asymmetrical bolting version only

[Units: mm, kg/m]

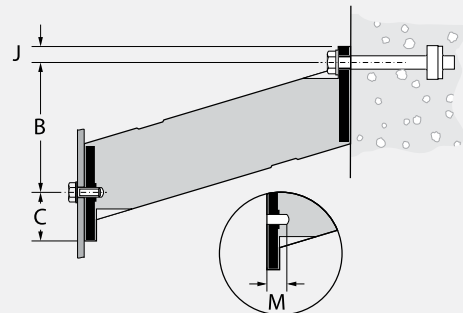
^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

Unit Elements are high-performance modular rubber fenders. Elements are versatile and can be combined in unlimited combinations of length and direction.

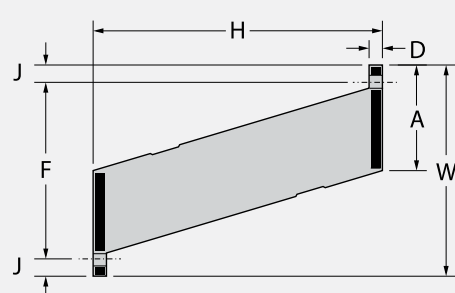
The simplest Unit Element system is the UE-V fender, with pairs of legs and a UHMW-PE non-marking shield. For heavy duty applications Unit Elements are combined with a steel panel (frame) which can cope with belting, bow flares, low hull pressures and high tides.



ASYMMETRICAL BOLTING



SYMMETRICAL BOLTING



ELEMENT LENGTHS

◀ H	L ▶	600	750	900	1000	1200	1400	1500	1800	2000	MAX
UE250		○	●	○	●	○	○	●	○	●	2800
UE300		○	●	○	●	○	○	●	○	●	2000
UE400			●	○	●	○	○	●	○	●	2000
UE 500–UE 550			●	○	●	○	○	●			1500
UE 600–UE 800			●	○	●	○	○	●	○	●	2000
UE 900–UE 1200				○	●	○	○	●			1500
UE1400				○	●	○	○	●	○	●	2000
UE1600					●	○	○	●	○	●	2000

● preferred lengths ○ typical non-standard lengths

[Units: mm]

- 1. SWEDEN
- 2. NORWAY
- 3. OMAN
- 4. DENMARK
- 5. DUBAI, UAE
- 6. SINGAPORE
- 7. DUBAI, UAE
- 8. SWEDEN



Unit Elements

PERFORMANCE DATA*

			E 0.9	E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9	E 2.0
250	CV	E	8.1	9.0	9.3	9.6	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0
		R	79.0	88.0	90.0	93.0	95.0	98.0	100.0	103.0	106.0	108.0	111.0	113.0
	RPD	E _R	9.6	10.6	11.0	11.3	11.7	12.0	12.4	12.7	13.1	13.5	13.8	14.2
		R _R	93.2	103.8	106.2	109.7	112.1	115.6	118.0	121.5	125.1	127.4	131.0	133.3
300	CV	E	11.7	13.0	13.4	13.8	14.2	14.6	15.0	15.4	15.8	16.2	16.6	17.0
		R	95.0	105.0	108.0	111.0	114.0	117.0	121.0	124.0	127.0	130.0	133.0	136.0
	RPD	E _R	13.7	15.2	15.7	16.1	16.6	17.1	17.6	18.0	18.5	19.0	19.4	19.9
		R _R	111.2	122.9	126.4	129.9	133.4	136.9	141.6	145.1	148.6	152.1	155.6	159.1
400	CV	E	21.0	23.0	24.0	24.0	25.0	26.0	27.0	27.0	28.0	29.0	29.0	30.0
		R	113.0	126.0	130.0	134.0	137.0	141.0	145.0	149.0	153.0	156.0	160.0	164.0
	RPD	E _R	24.4	26.7	27.8	27.8	29.0	30.2	31.3	31.3	32.5	33.6	33.6	34.8
		R _R	131.1	146.2	150.8	155.4	158.9	163.6	168.2	172.8	177.5	181.0	185.6	190.2
500	CV	E	32.4	36.0	37.1	38.2	39.3	40.4	41.5	42.6	43.7	44.8	45.9	47.0
		R	142.0	158.0	163.0	167.0	172.0	177.0	182.0	186.0	191.0	196.0	200.0	205.0
	RPD	E _R	37.4	41.6	42.9	44.1	45.4	46.7	47.9	49.2	50.5	51.7	53.0	54.3
		R _R	164.0	182.5	188.3	192.9	198.7	204.4	210.2	214.8	220.6	226.4	231.0	236.8
550	CV	E	40.0	44.0	45.0	47.0	48.0	49.0	51.0	52.0	53.0	54.0	56.0	57.0
		R	157.0	174.0	179.0	184.0	190.0	195.0	200.0	205.0	210.0	216.0	221.0	226.0
	RPD	E _R	46.0	50.6	51.8	54.1	55.2	56.4	58.7	59.8	61.0	62.1	64.4	65.6
		R _R	180.6	200.1	205.9	211.6	218.5	224.3	230.0	235.8	241.5	248.4	254.2	259.9
600	CV	E	47.0	52.0	54.0	55.0	57.0	58.0	60.0	62.0	63.0	65.0	66.0	68.0
		R	171.0	190.0	196.0	201.0	207.0	212.0	218.0	224.0	229.0	235.0	240.0	246.0
	RPD	E _R	53.6	59.3	61.6	62.7	65.0	66.1	68.4	70.7	71.8	74.1	75.2	77.5
		R _R	194.9	216.6	223.4	229.1	236.0	241.7	248.5	255.4	261.1	267.9	273.6	280.4
700	CV	E	63.0	70.0	72.0	74.0	77.0	79.0	81.0	83.0	85.0	88.0	90.0	92.0
		R	199.0	221.0	228.0	234.0	241.0	247.0	254.0	261.0	267.0	274.0	280.0	287.0
	RPD	E _R	71.5	79.5	81.7	84.0	87.4	89.7	91.9	94.2	96.5	99.9	102.2	104.4
		R _R	225.9	250.8	258.8	265.6	273.5	280.3	288.3	296.2	303.0	311.0	317.8	325.7
750	CV	E	73.0	81.0	84.0	86.0	89.0	91.0	94.0	96.0	99.0	101.0	104.0	106.0
		R	214.0	238.0	245.0	252.0	259.0	266.0	274.0	281.0	288.0	295.0	302.0	309.0
	RPD	E _R	82.5	91.5	94.9	97.2	100.6	102.8	106.2	108.5	111.9	114.1	117.5	119.8
		R _R	241.8	268.9	276.9	284.8	292.7	300.6	309.6	317.5	325.4	333.4	341.3	349.2
800	CV	E	84.0	93.0	96.0	99.0	101.0	104.0	107.0	110.0	113.0	115.0	118.0	121.0
		R	228.0	253.0	261.0	268.0	276.0	283.0	291.0	299.0	306.0	314.0	321.0	329.0
	RPD	E _R	94.9	105.1	108.5	111.9	114.1	117.5	120.9	124.3	127.7	130.0	133.3	136.7
		R _R	257.6	285.9	294.9	302.8	311.9	319.8	328.8	337.9	345.8	354.8	362.7	371.8

* For explanation of CV and RPD, please refer to note on page 29-30.

[Units: kNm, kN]

* Values are for a single element, 1000mm long.

Unit Elements

PERFORMANCE DATA*

			E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0	E 3.1
250	CV	E	12.3	12.6	12.9	13.2	13.5	13.8	14.1	14.4	14.7	15.0	16.5
		R	117.0	120.0	124.0	127.0	131.0	134.0	138.0	141.0	145.0	148.0	163.0
	RPD	E _R	14.5	14.9	15.2	15.6	15.9	16.3	16.6	17.0	17.3	17.7	19.5
		R _R	138.1	141.6	146.3	149.9	154.6	158.1	162.8	166.4	171.1	174.6	192.3
300	CV	E	17.5	180.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	24.2
		R	140.0	144.0	149.0	153.0	157.0	161.0	165.0	170.0	174.0	178.0	196.0
	RPD	E _R	20.5	210.6	21.6	22.2	22.8	23.4	24.0	24.6	25.2	25.7	28.3
		R _R	163.8	168.5	174.3	179.0	183.7	188.4	193.1	198.9	203.6	208.3	229.3
400	CV	E	31.0	32.0	33.0	34.0	35.0	35.0	36.0	37.0	38.0	39.0	43.0
		R	169.0	174.0	179.0	184.0	189.0	194.0	199.0	204.0	209.0	214.0	235.0
	RPD	E _R	36.0	37.1	38.3	39.4	40.6	40.6	41.8	42.9	44.1	45.2	49.9
		R _R	196.0	201.8	207.6	213.4	219.2	225.0	230.8	236.6	242.4	248.2	272.6
500	CV	E	48.5	50.0	51.5	53.0	54.5	56.0	57.5	59.0	60.5	62.0	68.2
		R	211.0	217.0	224.0	230.0	236.0	242.0	248.0	255.0	261.0	267.0	294.0
	RPD	E _R	56.0	57.8	59.5	61.2	62.9	64.7	66.4	68.1	69.9	71.6	78.8
		R _R	243.7	250.6	258.7	265.7	272.6	279.5	286.4	294.5	301.5	308.4	339.6
550	CV	E	59.0	61.0	62.0	64.0	66.0	68.0	70.0	71.0	73.0	75.0	83.0
		R	233.0	240.0	246.0	253.0	260.0	267.0	274.0	280.0	287.0	294.0	323.0
	RPD	E _R	67.9	70.2	71.3	73.6	75.9	78.2	80.5	81.7	84.0	86.3	95.5
		R _R	268.0	276.0	282.9	291.0	299.0	307.1	315.1	322.0	330.1	338.1	371.5
600	CV	E	70.0	72.0	74.0	76.0	79.0	81.0	83.0	85.0	87.0	89.0	98.0
		R	253.0	261.0	268.0	276.0	283.0	290.0	298.0	305.0	313.0	320.0	352.0
	RPD	E _R	79.8	82.1	84.4	86.6	90.1	92.3	94.6	96.9	99.2	101.5	111.7
		R _R	288.4	297.5	305.5	314.6	322.6	330.6	339.7	347.7	356.8	364.8	401.3
700	CV	E	95.0	98.0	100.0	103.0	106.0	109.0	112.0	114.0	117.0	120.0	132.0
		R	296.0	305.0	313.0	322.0	331.0	340.0	349.0	357.0	366.0	375.0	413.0
	RPD	E _R	107.8	111.2	113.5	116.9	120.3	123.7	127.1	129.4	132.8	136.2	149.8
		R _R	336.0	346.2	355.3	365.5	375.7	385.9	396.1	405.2	415.4	425.6	468.8
750	CV	E	109.0	112.0	115.0	118.0	122.0	125.0	128.0	131.0	134.0	137.0	151.0
		R	318.0	328.0	337.0	347.0	356.0	365.0	375.0	384.0	394.0	403.0	443.0
	RPD	E _R	123.2	126.6	130.0	133.3	137.9	141.3	144.6	148.0	151.4	154.8	170.6
		R _R	359.3	370.6	380.8	392.1	402.3	412.5	423.8	433.9	445.2	455.4	500.6
800	CV	E	125.0	128.0	132.0	135.0	139.0	143.0	146.0	150.0	153.0	157.0	173.0
		R	339.0	349.0	358.0	368.0	378.0	388.0	398.0	407.0	417.0	427.0	470.0
	RPD	E _R	141.3	144.6	149.2	152.6	157.1	161.6	165.0	169.5	172.9	177.4	195.5
		R _R	383.1	394.4	404.5	415.8	427.1	438.4	449.7	459.9	471.2	482.5	531.1

* For explanation of CV and RPD, please refer to note on page 29-30.

[Units: kNm, kN]

Unit Elements

PERFORMANCE DATA*

			E 0.9	E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9	E 2.0
900	CV	E	106.0	118.0	122.0	125.0	129.0	132.0	136.0	139.0	143.0	146.0	150.0	153.0
		R	256.0	284.0	293.0	301.0	310.0	318.0	327.0	336.0	344.0	353.0	361.0	370.0
	RPD	E _R	118.7	132.2	136.6	140.0	144.5	147.8	152.3	155.7	160.2	163.5	168.0	171.4
		R _R	286.7	318.1	328.2	337.1	347.2	356.2	366.2	376.3	385.3	395.4	404.3	414.4
1000	CV	E	131.0	146.0	150.0	155.0	159.0	163.0	168.0	172.0	176.0	180.0	185.0	189.0
		R	284.0	316.0	326.0	335.0	345.0	354.0	364.0	373.0	383.0	392.0	402.0	411.0
	RPD	E _R	145.4	162.1	166.5	172.1	176.5	180.9	186.5	190.9	195.4	199.8	205.4	209.8
		R _R	315.2	350.8	361.9	371.9	383.0	392.9	404.0	414.0	425.1	435.1	446.2	456.2
1200	CV	E	186.0	207.0	213.0	220.0	226.0	232.0	239.0	245.0	251.0	257.0	264.0	270.0
		R	340.0	378.0	389.0	401.0	412.0	424.0	435.0	446.0	458.0	469.0	481.0	492.0
	RPD	E _R	204.6	227.7	234.3	242.0	248.6	255.2	262.9	269.5	276.1	282.7	290.4	297.0
		R _R	374.0	415.8	427.9	441.1	453.2	466.4	478.5	490.6	503.8	515.9	529.1	541.2
1400	CV	E	257.0	286.0	294.0	303.0	311.0	320.0	328.0	336.0	345.0	353.0	362.0	370.0
		R	398.0	442.0	455.0	469.0	482.0	495.0	509.0	552.0	535.0	548.0	562.0	575.0
	RPD	E _R	280.1	311.7	320.5	330.3	339.0	348.8	357.5	366.2	376.1	384.8	394.6	403.3
		R _R	433.8	481.8	496.0	511.2	525.4	539.6	554.8	601.7	583.2	597.3	612.6	626.8
1600	CV	E	337.0	374.0	385.0	396.0	407.0	418.0	429.0	440.0	451.0	462.0	473.0	484.0
		R	455.0	506.0	521.0	535.0	552.0	567.0	582.0	597.0	612.0	628.0	643.0	658.0
	RPD	E _R	367.3	407.7	419.7	431.6	443.6	455.6	467.6	479.6	491.6	503.6	515.6	527.6
		R _R	496.0	551.5	567.9	583.2	601.7	618.0	634.4	650.7	667.1	684.5	700.9	717.2

[Units: kNm, kN]

*Note:

1. CV: performance data at slow speed constant velocity (2-8 cm/min) compression at 23 ±5°C temperature and 0° compression angle.
2. RPD: Rated performance data, in accordance with PIANC with initial high speed berthing velocity 0.15 m/s.
 RPD = CV (performance) x VF (velocity factor for Natural and Synthetic rubber blend) x TF (temperature factor) x AF (angle factor).
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore TF = 1, AF = 1.

Unit Elements

PERFORMANCE DATA*

			E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0	E 3.1
900	CV	E	158.0	162.0	167.0	171.0	176.0	181.0	185.0	190.0	194.0	199.0	219.0
		R	381.0	392.0	403.0	414.0	426.0	437.0	448.0	459.0	470.0	481.0	529.0
	RPD	E _R	177.0	181.4	187.0	191.5	197.1	202.7	207.2	212.8	217.3	222.9	245.3
		R _R	426.7	439.0	451.4	463.7	477.1	489.4	501.8	514.1	526.4	538.7	592.5
1000	CV	E	195.0	200.0	206.0	212.0	218.0	223.0	229.0	235.0	240.0	246.0	271.0
		R	423.0	436.0	448.0	460.0	473.0	485.0	497.0	509.0	522.0	534.0	587.0
	RPD	E _R	216.5	222.0	228.7	235.3	242.0	247.5	254.2	260.9	266.4	273.1	300.8
		R _R	469.5	484.0	497.3	510.6	525.0	538.4	551.7	565.0	579.4	592.7	651.6
1200	CV	E	278.0	286.0	294.0	302.0	311.0	319.0	327.0	335.0	343.0	351.0	386.0
		R	507.0	522.0	537.0	552.0	567.0	582.0	597.0	612.0	627.0	642.0	706.0
	RPD	E _R	305.8	314.6	323.4	332.2	342.1	350.9	359.7	368.5	377.3	386.1	424.6
		R _R	557.7	574.2	590.7	607.2	623.7	640.2	656.7	673.2	689.7	706.2	776.6
1400	CV	E	381.0	392.0	404.0	415.0	426.0	437.0	448.0	460.0	471.0	482.0	530.0
		R	592.0	610.0	627.0	644.0	662.0	679.0	696.0	713.0	731.0	748.0	823.0
	RPD	E _R	415.3	427.3	440.4	452.4	464.3	476.3	488.3	501.4	513.4	525.4	577.7
		R _R	645.3	664.9	683.4	702.0	721.6	740.1	758.6	777.2	796.8	815.3	897.1
1600	CV	E	499.0	513.0	528.0	542.0	557.0	572.0	586.0	601.0	615.0	630.0	693.0
		R	678.0	697.0	717.0	736.0	756.0	776.0	795.0	815.0	834.0	854.0	939.0
	RPD	E _R	543.9	559.2	575.5	590.8	607.1	623.5	638.7	655.1	670.4	686.7	755.4
		R _R	739.0	759.7	781.5	802.2	824.0	845.8	866.6	888.4	909.1	930.9	1023.5

[Units: kNm, kN]

- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing temperature, RPD = DV (performance).
- Fender performance is subject to ±10% manufacturing tolerance (+10% for reaction force and -10% for energy).

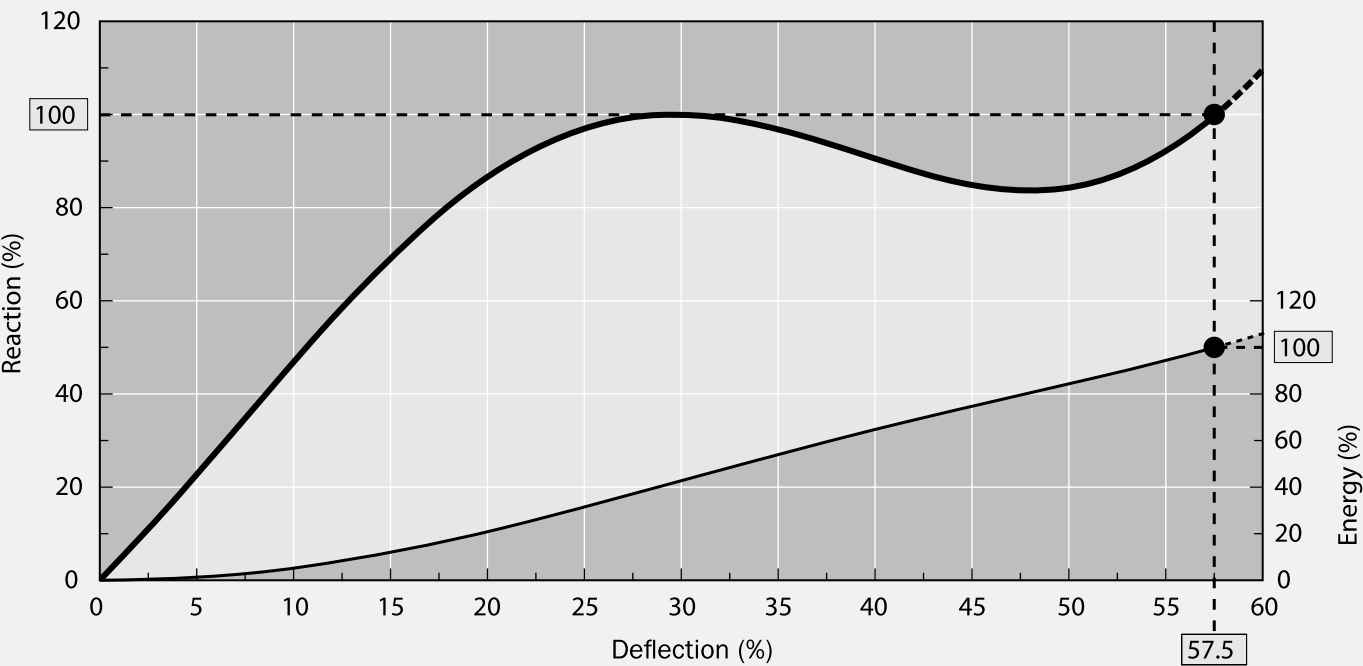
* Values are for a single element, 1000mm long.

Unit Elements

INTERMEDIATE DEFLECTIONS

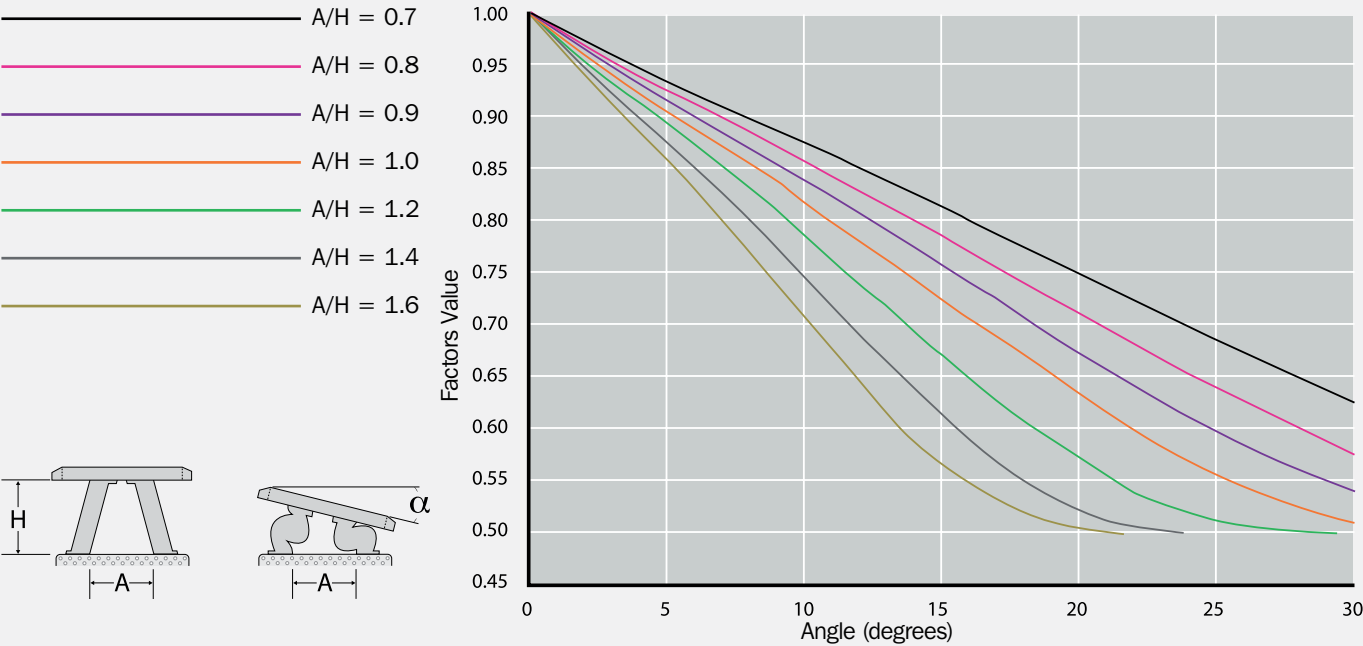
D _i (%)	0	5	10	15	20	25	30	35	40	45	50	55	57.5	62.5
E _i (%)	0	1	5	12	21	32	43	54	65	75	84	95	100	113
R _i (%)	0	23	47	69	87	97	100	97	90	85	84	92	100	121

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.



Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

Angle Factors (AF)



Unit Elements

ANGLE FACTORS (AF) TABLE – TRANVERSE LOAD

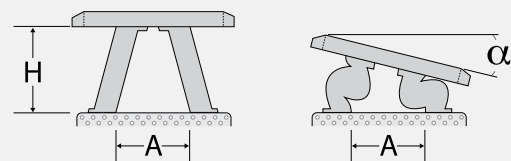
Energy Correction Factors

A/H \ α	0	5	6	7	8	9	10	12	15	20	25	30
0.750	1.000	0.932	0.919	0.907	0.894	0.882	0.869	0.844	0.804	0.735	0.666	0.605
1.000	1.000	0.911	0.894	0.877	0.861	0.843	0.826	0.789	0.733	0.639	0.562	0.515
1.100	1.000	0.902	0.884	0.866	0.847	0.827	0.808	0.767	0.703	0.603	0.532	0.502
1.200	1.000	0.894	0.874	0.854	0.833	0.811	0.789	0.743	0.674	0.572	0.512	
1.300	1.000	0.885	0.864	0.832	0.820	0.795	0.764	0.728	0.654	0.547	0.502	
1.400	1.000	0.877	0.853	0.829	0.804	0.777	0.750	0.696	0.617	0.524		
1.500	1.000	0.869	0.843	0.816	0.789	0.760	0.731	0.672	0.592	0.510		
1.600	1.000	0.860	0.832	0.803	0.773	0.742	0.711	0.649	0.569	0.502		
1.700	1.000	0.852	0.822	0.790	0.758	0.725	0.691	0.627	0.548			
1.800	1.000	0.843	0.811	0.777	0.742	0.707	0.671	0.605	0.531			
1.900	1.000	0.834	0.800	0.763	0.726	0.689	0.652	0.585	0.518			
2.000	1.000	0.825	0.788	0.750	0.710	0.671	0.633	0.567	0.508			
3.000	1.000	0.730	0.670	0.614	0.566	0.529	0.507					
4.000	1.000	0.632	0.565	0.520	0.501							
5.000	1.000	0.551	0.507									

Reaction Force Correction Factors

A/H \ α	0	5	6	7	8	9	10	12	15	20	25	30
0.750	1.000	0.989	0.981	0.974	0.967	0.959	0.951	0.940	0.965	0.997	0.990	0.933
1.000	1.000	0.979	0.967	0.956	0.945	0.940	0.951	0.974	0.998	0.972	0.851	0.674
1.100	1.000	0.975	0.961	0.948	0.938	0.950	0.963	0.986	1.000	0.932	0.759	0.555
1.200	1.000	0.970	0.954	0.940	0.947	0.961	0.974	0.995	0.993	0.875	0.657	
1.300	1.000	0.965	0.947	0.942	0.956	0.971	0.985	1.000	0.977	0.805	0.556	
1.400	1.000	0.959	0.940	0.949	0.966	0.981	0.993	0.999	0.950	0.726		
1.500	1.000	0.953	0.941	0.958	0.975	0.989	0.998	0.993	0.913	0.643		
1.600	1.000	0.948	0.947	0.966	0.983	0.995	1.000	0.980	0.868	0.561		
1.700	1.000	0.941	0.954	0.974	0.990	0.999	0.998	0.960	0.815			
1.800	1.000	0.943	0.961	0.981	0.995	1.000	0.992	0.934	0.756			
1.900	1.000	0.950	0.968	0.988	0.999	0.998	0.982	0.902	0.694			
2.000	1.000	0.956	0.975	0.993	1.000	0.992	0.967	0.865	0.631			
3.000	1.000	1.000	0.992	0.946	0.861	0.748	0.623					
4.000	1.000	0.964	0.860	0.705	0.540							
5.000	1.000	0.824	0.619									

- A/H ratios and angles not shown may be interpolated.
- Reaction force is the maximum generated with the compression cycle.
- Correction factors may be used for any size and compound of the UE fender element range.
- Correction factors are based on rated deflection at the most compressed end of the fender element.



Unit Elements

ANGLE FACTORS (AF) TABLE – LONGITUDINAL LOAD

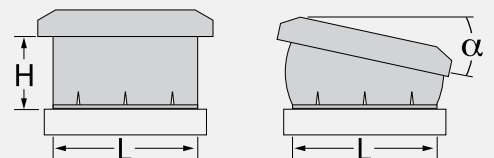
Energy Correction Factors

L/H \ α	0	5	6	7	8	9	10	12	15	20	25	30
0.750	1.000	0.930	0.917	0.904	0.891	0.878	0.866	0.841	0.803	0.739	0.675	0.612
1.000	1.000	0.908	0.891	0.874	0.857	0.840	0.823	0.789	0.737	0.648	0.562	0.486
1.100	1.000	0.899	0.881	0.862	0.843	0.825	0.806	0.768	0.709	0.611	0.519	0.443
1.200	1.000	0.891	0.870	0.850	0.830	0.809	0.789	0.746	0.682	0.574	0.479	
1.300	1.000	0.882	0.860	0.838	0.816	0.794	0.771	0.725	0.654	0.539	0.443	
1.400	1.000	0.874	0.850	0.826	0.802	0.778	0.753	0.702	0.626	0.505		
1.500	1.000	0.865	0.840	0.814	0.788	0.762	0.735	0.680	0.598	0.474		
1.600	1.000	0.857	0.830	0.802	0.774	0.745	0.717	0.658	0.570	0.445		
1.700	1.000	0.848	0.819	0.790	0.760	0.729	0.698	0.635	0.544			
1.800	1.000	0.840	0.809	0.777	0.745	0.713	0.679	0.613	0.518			
1.900	1.000	0.831	0.798	0.765	0.731	0.696	0.661	0.591	0.493			
2.000	1.000	0.823	0.788	0.752	0.716	0.679	0.642	0.569	0.470			
3.000	1.000	0.734	0.678	0.622	0.567	0.515	0.467					
4.000	1.000	0.640	0.566	0.497	0.437							
5.000	1.000	0.548	0.466									

Reaction Force Correction Factors

L/H \ α	0	5	6	7	8	9	10	12	15	20	25	30
0.750	1.000	0.912	0.901	0.892	0.885	0.881	0.877	0.875	0.881	0.902	0.920	0.922
1.000	1.000	0.895	0.885	0.879	0.876	0.875	0.877	0.885	0.903	0.923	0.907	0.849
1.100	1.000	0.890	0.881	0.877	0.875	0.877	0.880	0.892	0.912	0.921	0.880	0.792
1.200	1.000	0.885	0.878	0.875	0.876	0.880	0.885	0.899	0.918	0.912	0.841	
1.300	1.000	0.882	0.876	0.876	0.878	0.884	0.891	0.907	0.923	0.894	0.793	
1.400	1.000	0.879	0.875	0.877	0.881	0.889	0.897	0.913	0.923	0.868		
1.500	1.000	0.877	0.875	0.879	0.885	0.894	0.903	0.919	0.919	0.835		
1.600	1.000	0.876	0.876	0.881	0.890	0.900	0.909	0.922	0.911	0.796		
1.700	1.000	0.875	0.878	0.885	0.895	0.905	0.915	0.923	0.897			
1.800	1.000	0.875	0.880	0.889	0.900	0.911	0.919	0.922	0.879			
1.900	1.000	0.876	0.882	0.893	0.905	0.915	0.922	0.917	0.857			
2.000	1.000	0.877	0.885	0.897	0.909	0.919	0.923	0.910	0.830			
3.000	1.000	0.904	0.919	0.923	0.909	0.876	0.826					
4.000	1.000	0.923	0.909	0.861	0.784							
5.000	1.000	0.900	0.825									

- L/H ratios and angles not shown may be interpolated.
- Reaction force is the maximum generated with the compression cycle.
- Correction factors may be used for any size and compound of the UE fender element range.
- Correction factors are based on rated deflection at the most compressed end of the fender element.



Unit Elements

VELOCITY FACTOR (VF) TABLE

COMPRESSION TIME (SECONDS)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	VF	VF	VF
1	1.20	1.14	1.31
2	1.16	1.10	1.25
3	1.14	1.09	1.22
4	1.13	1.07	1.20
5	1.11	1.06	1.19
6	1.10	1.06	1.17
7	1.09	1.05	1.16
8	1.09	1.04	1.15
9	1.08	1.04	1.14
10	1.07	1.03	1.14
11	1.07	1.03	1.13
12	1.06	1.02	1.12
13	1.06	1.02	1.12
14	1.05	1.02	1.11
15	1.05	1.01	1.11
16	1.05	1.01	1.10
17	1.04	1.01	1.10
18	1.04	1.01	1.09
19	1.04	1.00	1.09
20	1.03	1.00	1.08

Compression time needs to be calculated using the following formula: $t = d/(f \cdot V_d)$

Where:

t = compression time (seconds)*

d = rated deflection (mm)

V_d = initial berthing velocity (mm/s)

f = 0.74 deceleration factor (Peak reaction force occurs at between 30% - 40% deflection, where there has been a deceleration due to energy absorption. f represents the factor associated with deceleration.)

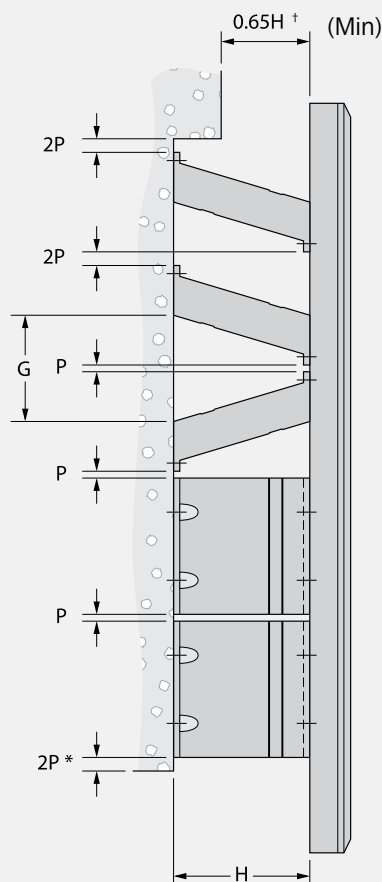
* Applicable for both partial deflection and rated deflection.

Temperature Factor (TF) Table

TEMPERATURE (°C)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	TF	TF	TF
+50	0.916	0.914	0.918
+40	0.947	0.946	0.948
+30	0.978	0.978	0.979
+23	1.000	1.000	1.000
+10	1.030	1.025	1.038
+0	1.075	1.053	1.108
-10	1.130	1.080	1.206
-20	1.249	1.142	1.410
-30	1.540	1.315	1.877

Unit Elements

CLEARANCES



ELEMENT	P_{min}
UE 250 – UE 300	30
UE 400 – UE 1600	50

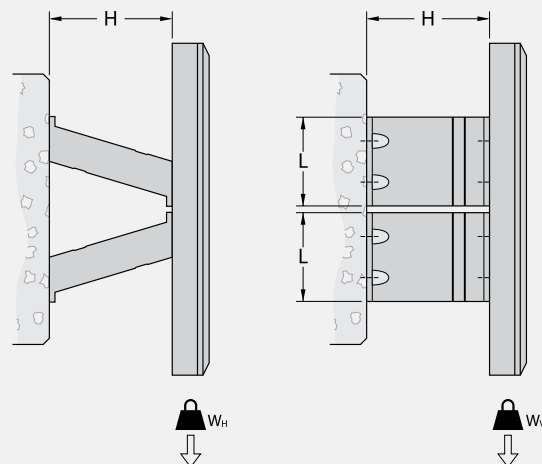
[Units: mm]

There must be enough space around and between Unit Element fenders and the steel panel to allow them to deflect without interference. Distances given in the above diagram are for guidance. Please ask if in doubt.

* Always check edge distances to suit concrete grade and reinforcement.

† Dimension does not allow for bow flares, berthing angles or other effects which may reduce clearances.

WEIGHT SUPPORT CAPACITY



Unit Element fenders can support a lot of weight. The table is a guide to the permitted weight of front panel before additional support chains may be required.

UE	PANEL WEIGHT (kg)	
	SINGLE OR MULTIPLE HORIZONTAL ($n \geq 1$)	SINGLE OR MULTIPLE VERTICAL ($n \geq 1$)
E1	$W_H \leq n \times 690 \times H \times L$	$W_V \leq n \times 1230 \times H \times L$
E2	$W_H \leq n \times 900 \times H \times L$	$W_V \leq n \times 1600 \times H \times L$
E3	$W_H \leq n \times 1170 \times H \times L$	$W_V \leq n \times 2080 \times H \times L$

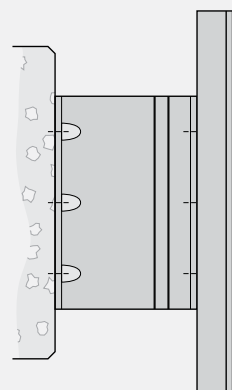
n = number of element pairs

W_H = panel weight (elements 'V' on elevation)

W_V = panel weight (elements 'V' on plan)

Interpolate for other grades

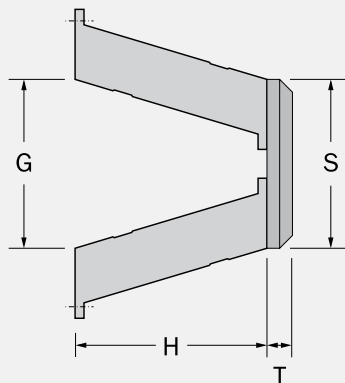
FENDERS IN TENSION



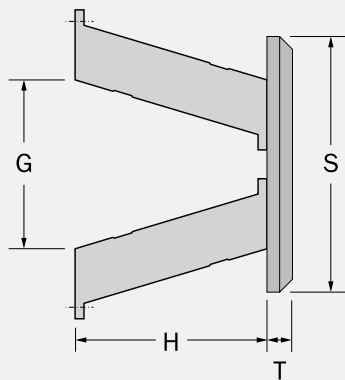
If the tensile load exceeds the rated reaction then tension chains may be required. Please ask for advice on the design of tension chains.

UE V-Fenders

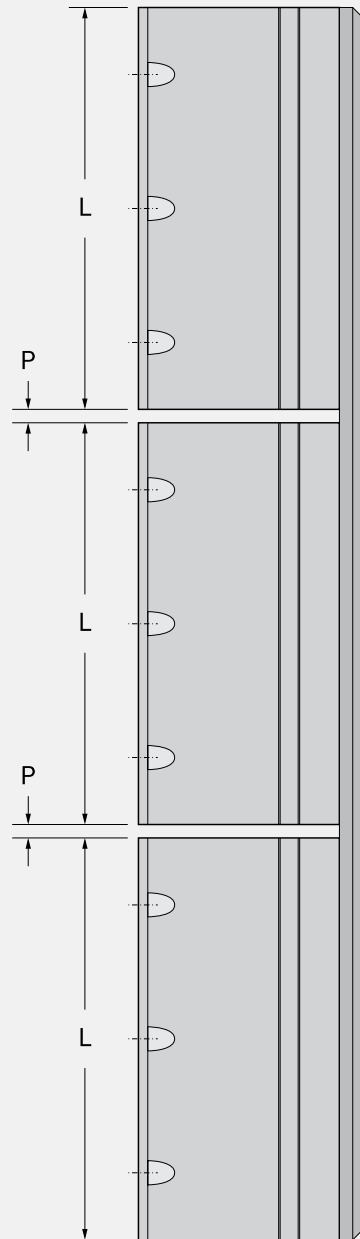
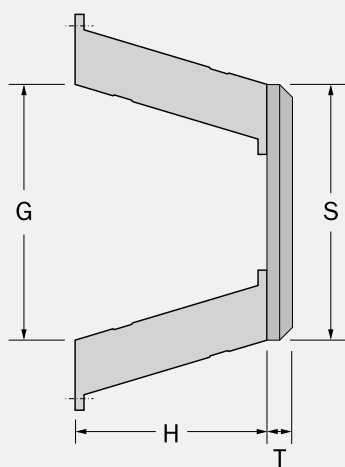
Type V1



Type V2



Type V3



Pairs of Unit Elements can be combined with a UHMW-PE shield into a V-shape to make a simple, economical and multi-purpose fender. The shield can be narrow or wide, and can also span several pairs of elements to make very long fenders. Please ask for advice about UE-V fenders which use UE 900 or larger elements.

ELEMENT	P _{min}
UE 250 – UE 300	30
UE 400 – UE 1600	50

[Units: mm]

ELEMENT	H	TYPE V1		TYPE V2		TYPE V3		P	T	ANCHORS
		S	G	S	G	S	G			
UE 250	250	250	250	460	250	460	460	30	70	M20
UE 300	300	290	290	550	290	550	550	30	70	M24
UE 400	400	370	370	690	370	690	690	50	80	M24
UE 500	500	440	440	830	440	830	830	50	90	M30
UE 550	550	470	470	890	470	890	890	50	90	M30
UE 600	600	500	500	950	500	950	950	50	90	M30
UE 700	700	590	590	1130	590	1130	1130	50	100	M36
UE 750	750	620	620	1190	620	1190	1190	50	100	M36
UE 800	800	640	640	1230	640	1230	1230	50	100	M36

[Units: mm]

Super Arch and Arch Fenders



Arch fenders are simple and rugged, providing reliable and trouble-free service for a wide variety of berths even under the most severe conditions.

The SAN / AN-fender is a traditional rubber faced unit whilst the SANP / ANP-fender can be fitted with either UHMW-PE face pads or connected to a steel panel.

FEATURES

- Simple one-piece design
- Strong and hard wearing
- Excellent shear performance
- Large range of standard sizes

APPLICATIONS

- RoRo berths
- General cargo
- Workboat harbors
- Barge and tug berths

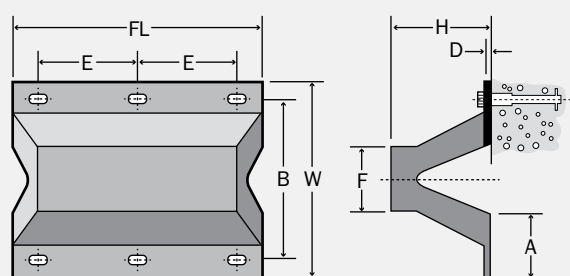
SAN / SANP Super Arch Fenders

DIMENSIONS

BODY DIMENSIONS SAN / SANP								WEIGHT (kg/m)	
H	A	B	W	F	D	P	Q	SAN	SANP
SAN/SANP 150	105	240	300	105	24	24	48	37	44
SAN/SANP 200	140	320	400	140	24	28	56	61	70
SAN/SANP 250	175	410	500	175	25	28	56	90	102
SAN/SANP 300	210	480	600	210	30	34	68	135	154
SAN/SANP 400	285	670	800	280	35	40	80	252	288
SAN/SANP 500	355	840	1000	350	40	46	92	363	409
SAN/SANP 600	425	1010	1200	420	45	52	104	543	607
SAN/SANP 800	565	1340	1600	560	50	60	120	931	1028
SAN/SANP 1000	710	1680	2000	700	60	60	120	1495	1633

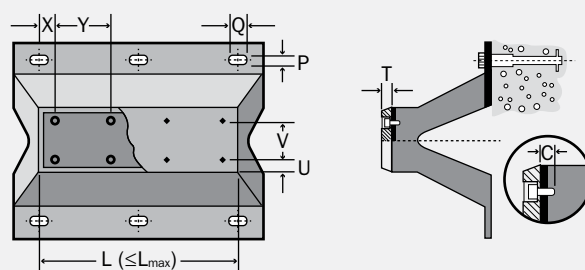
[Units: mm, kg/m]

SAN SUPER ARCH FENDER



$$FL = L + H \times 0.5$$

SANP SUPER ARCH FENDER



FOOT BOLTING DIMENSIONS

FENDER	ANCHORS / HEAD BOLTS ^	L = 1000		L = 1500		L = 2000		L = 2500		L = 3000	
		E	Qty	E	Qty	E	Qty	E	Qty	E	Qty
SAN/SANP 150	M20	855	4	675	6	620	8	750	8	715	10
SAN/SANP 200	M24	860	4	680	6	620	8	760	8	715	10
SAN/SANP 250	M24	865	4	680	6	620	8	780	8	715	10
SAN/SANP 300	M30	870	4	685	6	625	8	790	8	715	10
SAN/SANP 400	M36	900	4	700	6	635	8	800	8	725	10
SAN/SANP 500	M42	930	4	715	6	645	8	810	8	730	10
SAN/SANP 600	M48	930	4	725	6	650	8	820	8	740	10
SAN/SANP 800	M56	930	4	725	6	650	8	820	8	760	10
SAN/SANP 1000	M56	930	4	725	6	650	8	865	8	775	10

[Units: mm]

HEAD BOLTING DIMENSIONS

FENDER	U	V	C	UHMW-PE FACE PADS				STEEL FRAME	
				X	Y	T	BOLT SIZE	X	Y
SANP 150	52.5	0	20-30	60-70	330-410	30	M12	70-90	250-300
SANP 200	30	80	30-45	60-70	330-410	30	M16	70-90	250-300
SANP 250	30	115	30-45	70-85	330-415	30	M16	70-90	250-300
SANP 300	30	150	30-45	70-85	330-415	40	M16	70-90	250-300
SANP 400	40	200	30-50	70-85	330-415	40	M20	70-90	250-300
SANP 500	40	270	30-50	70-85	330-415	50	M20	70-90	250-300
SANP 600	40	340	35-60	70-85	330-415	50	M24	70-90	250-300
SANP 800	40	480	50-70	70-85	330-415	60	M30	70-90	250-300
SANP 1000	50	600	50-70	70-85	330-415	60	M30	70-90	250-300

Larger bolts are required when connecting SANP fenders to steel panels. Refer to your local offices.

[Units: mm]

^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

SAN / SANP Super Arch Fenders

PERFORMANCE DATA*

			E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9	E 2.0
150	CV	E	5.0	5.4	5.8	6.2	6.6	7.0	7.2	7.4	7.6	7.8	8.0
		R	86.0	89.6	93.2	96.8	100.4	104.0	107.4	110.8	114.2	117.6	121.0
	RPD	E _R	6.0	6.5	7.0	7.4	7.9	8.4	8.6	8.9	9.1	9.4	9.6
		R _R	103.2	107.5	111.8	116.2	120.5	124.8	128.9	133.0	137.0	141.1	145.2
200	CV	E	10.0	10.4	10.8	11.2	11.6	12.0	12.4	12.8	13.2	13.6	14.0
		R	114.0	118.8	123.6	128.4	133.2	138.0	142.8	147.6	152.4	157.2	162.0
	RPD	E _R	12.0	12.5	13.0	13.4	13.9	14.4	14.9	15.4	15.8	16.3	16.8
		R _R	136.8	142.6	148.3	154.1	159.8	165.6	171.4	177.1	182.9	188.6	194.4
250	CV	E	15.0	15.6	16.2	16.8	17.4	18.0	18.6	19.2	19.8	20.4	21.0
		R	143.0	149.0	155.0	161.0	167.0	173.0	178.8	184.6	190.4	196.2	202.0
	RPD	E _R	17.9	18.6	19.3	20.0	20.7	21.4	22.1	22.8	23.6	24.3	25.0
		R _R	170.2	177.3	184.5	191.6	198.7	205.9	212.8	219.7	226.6	233.5	240.4
300	CV	E	22.0	22.8	23.6	24.4	25.2	26.0	27.0	28.0	29.0	30.0	31.0
		R	171.0	178.2	185.4	192.6	199.8	207.0	214.2	221.4	228.6	235.8	243.0
	RPD	E _R	26.0	26.9	27.8	28.8	29.7	30.7	31.9	33.0	34.2	35.4	36.6
		R _R	201.8	210.3	218.8	227.3	235.8	244.3	252.8	261.3	269.7	278.2	286.7
400	CV	E	38.0	39.6	41.2	42.8	44.4	46.0	47.6	49.2	50.8	52.4	54.0
		R	229.0	238.4	247.8	257.2	266.6	276.0	285.6	295.2	304.8	314.4	324.0
	RPD	E _R	44.5	46.3	48.2	50.1	51.9	53.8	55.7	57.6	59.4	61.3	63.2
		R _R	267.9	278.9	289.9	300.9	311.9	322.9	334.2	345.4	356.6	367.8	379.1
500	CV	E	60.0	62.6	65.2	67.8	70.4	73.0	75.4	77.8	80.2	82.6	85.0
		R	286.0	297.8	309.6	321.4	333.2	345.0	357.0	369.0	381.0	393.0	405.0
	RPD	E _R	69.3	72.3	75.3	78.3	81.3	84.3	87.1	89.9	92.6	95.4	98.2
		R _R	330.3	344.0	357.6	371.2	384.8	398.5	412.3	426.2	440.1	453.9	467.8
600	CV	E	86.0	89.6	93.2	96.8	100.4	104.0	107.6	111.2	114.8	118.4	122.0
		R	343.0	357.2	371.4	385.6	399.8	414.0	428.4	442.8	457.2	471.6	486.0
	RPD	E _R	98.9	103.0	107.2	111.3	115.5	119.6	123.7	127.9	132.0	136.2	140.3
		R _R	394.5	410.8	427.1	443.4	459.8	476.1	492.7	509.2	525.8	542.3	558.9
800	CV	E	154.0	160.4	166.8	173.2	179.6	186.0	192.4	198.8	205.2	211.6	218.0
		R	457.0	476.0	495.0	514.0	533.0	552.0	571.2	590.4	609.6	628.8	648.0
	RPD	E _R	174.8	182.1	189.3	196.6	203.8	211.1	218.4	225.6	232.9	240.2	247.4
		R _R	518.7	540.3	561.8	583.4	605.0	626.5	648.3	670.1	691.9	713.7	735.5
1000	CV	E	240.0	250.0	260.0	270.0	280.0	290.0	300.0	310.0	320.0	330.0	340.0
		R	571.0	594.8	618.6	642.4	666.2	690.0	714.0	738.0	762.0	786.0	810.0
	RPD	E _R	268.8	280.0	291.2	302.4	313.6	324.8	336.0	347.2	358.4	369.6	380.8
		R _R	639.5	666.2	692.8	719.5	746.1	772.8	799.7	826.6	853.4	880.3	907.2

[Units: kNm, kN]

*Note:

- CV: performance data at slow speed constant velocity (2-8 cm/min) compression at 23 ±5°C temperature and 0° compression angle.
- RPD: Rated performance data, in accordance with PIANC with initial high speed berthing velocity 0.15 m/s.
 RPD = CV (performance) x VF (velocity factor for Natural and Synthetic rubber blend) x TF (temperature factor) x AF (angle factor).
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore TF = 1, AF = 1.

SAN / SANP Super Arch Fenders

PERFORMANCE DATA*

			E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0
150	CV	E	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8	10.0
		R	124.6	128.2	131.8	135.4	139.0	142.6	146.2	149.8	153.4	157.0
	RPD	E _R	9.8	10.1	10.3	10.6	10.8	11.0	11.3	11.5	11.8	12.0
		R _R	149.5	153.8	158.2	162.5	166.8	171.1	175.4	179.8	184.1	188.4
200	CV	E	14.4	14.8	15.2	15.6	16.0	16.4	16.8	17.2	17.6	18.0
		R	166.8	171.6	176.4	181.2	186.0	190.8	195.6	200.4	205.2	210.0
	RPD	E _R	17.3	17.8	18.2	18.7	19.2	19.7	20.2	20.6	21.1	21.6
		R _R	200.2	205.9	211.7	217.4	223.2	229.0	234.7	240.5	246.2	252.0
250	CV	E	21.4	21.8	22.2	22.6	23.0	24.0	25.0	26.0	27.0	28.0
		R	208.0	214.0	220.0	226.0	232.0	238.0	244.0	250.0	256.0	262.0
	RPD	E _R	25.5	25.9	26.4	26.9	27.4	28.6	29.8	30.9	32.1	33.3
		R _R	247.5	254.7	261.8	268.9	276.1	283.2	290.4	297.5	304.6	311.8
300	CV	E	31.8	32.6	33.4	34.2	35.0	36.0	37.0	38.0	39.0	40.0
		R	250.2	257.4	264.6	271.8	279.0	286.0	293.0	300.0	307.0	314.0
	RPD	E _R	37.5	38.5	39.4	40.4	41.3	42.5	43.7	44.8	46.0	47.2
		R _R	295.2	303.7	312.2	320.7	329.2	337.5	345.7	354.0	362.3	370.5
400	CV	E	55.6	57.2	58.8	60.4	62.0	63.6	65.2	66.8	68.4	70.0
		R	333.4	342.8	352.2	361.6	371.0	380.6	390.2	399.8	409.4	419.0
	RPD	E _R	65.1	66.9	68.8	70.7	72.5	74.4	76.3	78.2	80.0	81.9
		R _R	390.1	401.1	412.1	423.1	434.1	445.3	456.5	467.8	479.0	490.2
500	CV	E	87.6	90.2	92.8	95.4	98.0	100.4	102.8	105.2	107.6	110.0
		R	416.8	428.6	440.4	452.2	464.0	476.0	488.0	500.0	512.0	524.0
	RPD	E _R	101.2	104.2	107.2	110.2	113.2	116.0	118.7	121.5	124.3	127.1
		R _R	481.4	495.0	508.7	522.3	535.9	549.8	563.6	577.5	591.4	605.2
600	CV	E	125.6	129.2	132.8	136.4	140.0	143.6	147.2	150.8	154.4	158.0
		R	500.2	514.4	528.6	542.8	557.0	571.4	585.8	600.2	614.6	629.0
	RPD	E _R	144.4	148.6	152.7	156.9	161.0	165.1	169.3	173.4	177.6	181.7
		R _R	575.2	591.6	607.9	624.2	640.6	657.1	673.7	690.2	706.8	723.4
800	CV	E	224.4	230.8	237.2	243.6	250.0	256.4	262.8	269.2	275.6	282.0
		R	667.0	686.0	705.0	724.0	743.0	762.0	781.0	800.0	819.0	838.0
	RPD	E _R	254.7	262.0	269.2	276.5	283.8	291.0	298.3	305.5	312.8	320.1
		R _R	757.0	778.6	800.2	821.7	843.3	864.9	886.4	908.0	929.6	951.1
1000	CV	E	350.0	360.0	370.0	380.0	390.0	400.0	410.0	420.0	430.0	440.0
		R	833.8	857.6	881.4	905.2	929.0	952.8	976.6	1000.4	1024.2	1048.0
	RPD	E _R	392.0	403.2	414.4	425.6	436.8	448.0	459.2	470.4	481.6	492.8
		R _R	933.9	960.5	987.2	1013.8	1040.5	1067.1	1093.8	1120.4	1147.1	1173.8

[Units: kNm, kN]

- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing temperature, RPD = DV (performance).
- Fender performance is subject to ±10% manufacturing tolerance (+10% for reaction force and -10% for energy).

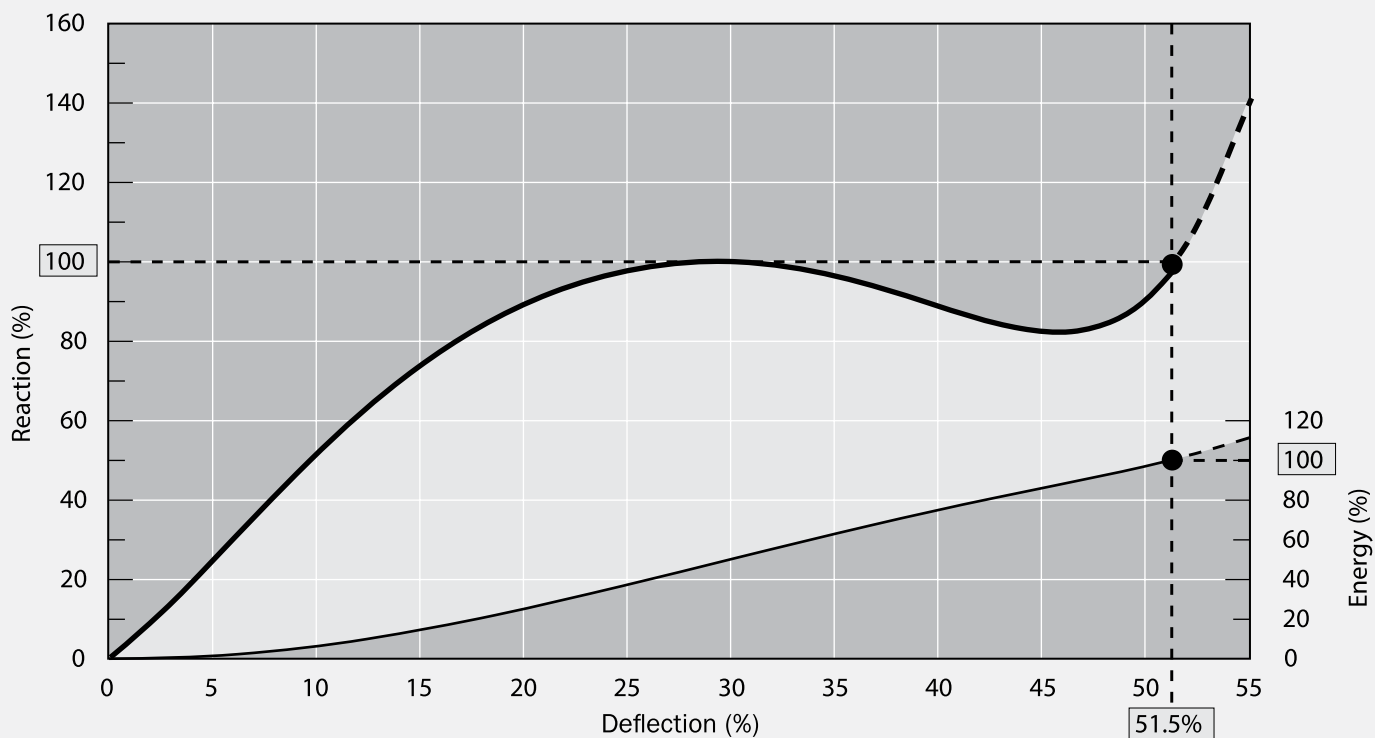
* Values are for 1000mm long.

SAN / SANP Super Arch Fenders

INTERMEDIATE DEFLECTIONS

D_i (%)	0	5	10	15	20	25	30	35	40	45	50	51.5	55
E_i (%)	0	1	6	14	25	37	50	63	74	85	96	100	111
R_i (%)	0	24	51	73	89	98	100	96	89	82	91	100	141

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.



Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

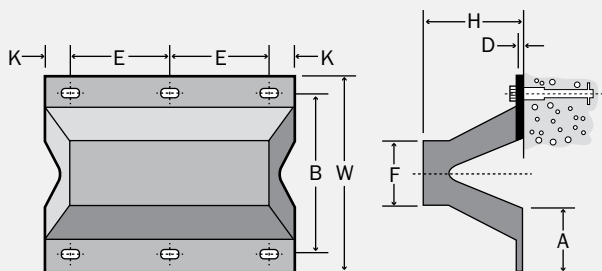
AN / ANP Arch Fenders

	L _{max}	H	A	B	W	F	D	K	E	PxQ	ANCHORS / HEAD BOLTS ^	WEIGHT	
												AN	ANP
AN / ANP 150	3000	150	108	240	326	98	16-20	50	500	20×40	M16	28	35
AN / ANP 200	3000	200	142	320	422	130	18-25	50	500	25×50	M20	48	62
AN / ANP 250	3500	250	164	400	500	163	20-30	62.5	500	28×56	M24	69	90
AN / ANP 300	3500	300	194	480	595	195	25-32	75	500	28×56	M24	107	128
AN / ANP 400	3500	400	266	640	808	260	25-32	100	500	35×70	M30	185	217
AN / ANP 500	3500	500	318	800	981	325	25-32	125	500	42×84	M36	278	352
AN / ANP 600	3000	600	373	960	1160	390	28-40	150	500	48×96	M42	411	488
AN / ANP 800	3000	800	499	1300	1550	520	41-50	200	500	54×108	M48	770	871
AN / ANP 1000	3000	1000	580	1550	1850	650	50-62	250	500	54×108	M48	1289	1390

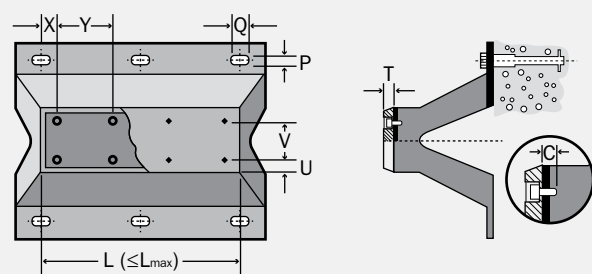
^ Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact Trelleborg Marine Systems' local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

[Units: mm, kg/m]

AN ARCH FENDER



ANP ARCH FENDER



	U	V	C	UHMW-PE FACE PADS				STEEL FRAME	
				X	Y	T	BOLT SIZE	X	Y
ANP 150	49	0	20 - 30	60 - 70	330 - 410	30	M16	70 - 90	250 - 300
ANP 200	65	0	30 - 45	60 - 70	330 - 410	30	M16	70 - 90	250 - 300
ANP 250	45	73	30 - 45	70 - 85	330 - 410	30	M16	70 - 90	250 - 300
ANP 300	50	95	30 - 45	70 - 85	330 - 410	40	M16	70 - 90	250 - 300
ANP 400	60	140	30 - 50	70 - 85	330 - 410	40	M16	70 - 90	250 - 300
ANP 500	65	195	30 - 50	70 - 85	330 - 410	50	M20	70 - 90	250 - 300
ANP 600	65	260	35 - 60	70 - 85	330 - 410	50	M20	70 - 90	250 - 300
ANP 800	70	380	50 - 70	70 - 85	330 - 410	60	M24	70 - 90	250 - 300
ANP 1000	80	490	50 - 70	70 - 85	330 - 410	60	M24	70 - 90	250 - 300

Larger bolts are required when connecting ANP fenders to steel panels. Refer TMS.

[Units: mm]

L	ANCHORS
1000	6 No
1500	8 No
2000	10 No
2500	12 No
3000	14 No
3500	16 No

Non-standard lengths, profiles and bolting patterns are available on request.

AN Arch Fenders

PERFORMANCE DATA*

			E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9
150	CV	E	4.3	4.4	4.6	4.7	4.9	5.0	5.1	5.2	5.4	5.5
		R	74.0	76.2	78.4	80.7	82.9	85.1	87.3	89.5	91.8	94.0
	RPD	E _R	5.2	5.3	5.5	5.7	5.8	6.0	6.1	6.3	6.4	6.6
		R _R	88.8	91.5	94.1	96.8	99.5	102.1	104.8	107.4	110.1	112.8
200	CV	E	7.6	7.8	8.1	8.3	8.6	8.8	9.0	9.3	9.5	9.8
		R	98.6	101.5	104.4	107.2	110.1	113.0	116.0	119.0	122.0	125.0
	RPD	E _R	9.1	9.4	9.7	10.0	10.3	10.6	10.8	11.1	11.4	11.7
		R _R	118.3	121.8	125.2	128.7	132.1	135.6	139.2	142.8	146.4	150.0
250	CV	E	11.9	12.3	12.7	13.0	13.4	13.8	14.2	14.5	14.9	15.2
		R	123.0	126.8	130.6	134.4	138.2	142.0	145.6	149.2	152.8	156.4
	RPD	E _R	14.2	14.6	15.1	15.5	16.0	16.4	16.9	17.3	17.7	18.1
		R _R	146.4	150.9	155.4	159.9	164.5	169.0	173.3	177.5	181.8	186.1
300	CV	E	17.1	17.6	18.2	18.7	19.3	19.8	20.3	20.9	21.4	22.0
		R	148.0	152.4	156.8	161.2	165.6	170.0	174.4	178.8	183.2	187.6
	RPD	E _R	20.2	20.8	21.5	22.1	22.7	23.4	24.0	24.6	25.3	25.9
		R _R	174.6	179.8	185.0	190.2	195.4	200.6	205.8	211.0	216.2	221.4
400	CV	E	30.5	31.5	32.4	33.4	34.3	35.3	36.2	37.2	38.1	39.1
		R	197.0	203.0	209.0	215.0	221.0	227.0	232.8	238.6	244.4	250.2
	RPD	E _R	35.7	36.8	37.9	39.1	40.2	41.3	42.4	43.5	44.6	45.7
		R _R	230.5	237.5	244.5	251.6	258.6	265.6	272.4	279.2	285.9	292.7
500	CV	E	47.6	49.1	50.6	52.0	53.5	55.0	56.5	58.0	59.4	60.9
		R	247.0	254.4	261.8	269.2	276.6	284.0	291.4	298.8	306.2	313.6
	RPD	E _R	55.0	56.7	58.4	60.1	61.8	63.5	65.2	66.9	68.7	70.4
		R _R	285.3	293.8	302.4	310.9	319.5	328.0	336.6	345.1	353.7	362.2
600	CV	E	68.6	70.7	72.9	75.0	77.2	79.3	81.4	83.5	85.7	87.8
		R	296.0	305.0	314.0	323.0	332.0	341.0	349.8	358.6	367.4	376.2
	RPD	E _R	78.9	81.4	83.8	86.3	88.7	91.2	93.6	96.1	98.5	100.9
		R _R	340.4	350.8	361.1	371.5	381.8	392.2	402.3	412.4	422.5	432.6
800	CV	E	122.0	125.8	129.6	133.4	137.2	141.0	144.8	148.6	152.4	156.2
		R	394.0	406.0	418.0	430.0	442.0	454.0	465.8	477.6	489.4	501.2
	RPD	E _R	138.5	142.8	147.1	151.4	155.7	160.0	164.3	168.7	173.0	177.3
		R _R	447.2	460.8	474.4	488.1	501.7	515.3	528.7	542.1	555.5	568.9
1000	CV	E	191.0	197.0	203.0	209.0	215.0	221.0	226.8	232.6	238.4	244.2
		R	493.0	507.8	522.6	537.4	552.2	567.0	581.8	596.6	611.4	626.2
	RPD	E _R	213.9	220.6	227.4	234.1	240.8	247.5	254.0	260.5	267.0	273.5
		R _R	552.2	568.7	585.3	601.9	618.5	635.0	651.6	668.2	684.8	701.3

[Units: kNm, kN]

*Note:

- CV: performance data at slow speed constant velocity (2-8 cm/min) compression at 23 ±5°C temperature and 0° compression angle.
- RPD: Rated performance data, in accordance with PIANC with initial high speed berthing velocity 0.15 m/s.
 RPD = CV (performance) x VF (velocity factor for Natural and Synthetic rubber blend) x TF (temperature factor) x AF (angle factor).
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore TF = 1, AF = 1.

AN Arch Fenders

PERFORMANCE DATA*

			E 2.0	E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0
150	CV	E	5.6	5.8	6.0	6.1	6.3	6.5	6.7	6.9	7.0	7.2	7.4
		R	96.2	99.4	102.5	105.7	108.8	112.0	115.0	118.0	121.0	124.0	127.0
	RPD	E _R	6.7	6.9	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.7	8.9
		R _R	115.4	119.2	123.0	126.8	130.6	134.4	138.0	141.6	145.2	148.8	152.4
200	CV	E	10.0	10.3	10.6	11.0	11.3	11.6	11.9	12.2	12.5	12.8	13.1
		R	128.0	132.2	136.4	140.6	144.8	149.0	153.0	157.0	161.0	165.0	169.0
	RPD	E _R	12.0	12.4	12.8	13.2	13.5	13.9	14.3	14.6	15.0	15.4	15.7
		R _R	153.6	158.6	163.7	168.7	173.8	178.8	183.6	188.4	193.2	198.0	202.8
250	CV	E	15.6	16.1	16.6	17.1	17.6	18.1	18.6	19.1	19.5	20.0	20.5
		R	160.0	165.2	170.4	175.6	180.8	186.0	191.0	196.0	201.0	206.0	211.0
	RPD	E _R	18.6	19.2	19.8	20.3	20.9	21.5	22.1	22.7	23.3	23.8	24.4
		R _R	190.4	196.6	202.8	209.0	215.2	221.3	227.3	233.2	239.2	245.1	251.1
300	CV	E	22.5	23.2	23.9	24.6	25.3	26.0	26.7	27.4	28.1	28.8	29.5
		R	192.0	198.2	204.4	210.6	216.8	223.0	229.0	235.0	241.0	247.0	253.0
	RPD	E _R	26.6	27.4	28.2	29.0	29.9	30.7	31.5	32.3	33.2	34.0	34.8
		R _R	226.6	233.9	241.2	248.5	255.8	263.1	270.2	277.3	284.4	291.5	298.5
400	CV	E	40.0	41.3	42.5	43.8	45.0	46.3	47.5	48.8	50.0	51.3	52.5
		R	256.0	264.2	272.4	280.6	288.8	297.0	305.2	313.4	321.6	329.8	338.0
	RPD	E _R	46.8	48.3	49.7	51.2	52.7	54.2	55.6	57.1	58.5	60.0	61.4
		R _R	299.5	309.1	318.7	328.3	337.9	347.5	357.1	366.7	376.3	385.9	395.5
500	CV	E	62.4	64.4	66.3	68.3	70.2	72.2	74.2	76.1	78.1	80.0	82.0
		R	321.0	331.2	341.4	351.6	361.8	372.0	382.0	392.0	402.0	412.0	422.0
	RPD	E _R	72.1	74.3	76.6	78.9	81.1	83.4	85.7	87.9	90.2	92.4	94.7
		R _R	370.8	382.5	394.3	406.1	417.9	429.7	441.2	452.8	464.3	475.9	487.4
600	CV	E	89.9	92.5	95.1	97.8	100.4	103.0	105.6	108.2	110.8	113.4	116.0
		R	385.0	397.2	409.4	421.6	433.8	446.0	458.2	470.4	482.6	494.8	507.0
	RPD	E _R	103.4	106.4	109.4	112.4	115.4	118.5	121.4	124.4	127.4	130.4	133.4
		R _R	442.8	456.8	470.8	484.8	498.9	512.9	526.9	541.0	555.0	569.0	583.1
800	CV	E	160.0	165.0	170.0	175.0	180.0	185.0	190.0	195.0	200.0	205.0	210.0
		R	513.0	529.2	545.4	561.6	577.8	594.0	610.2	626.4	642.6	658.8	675.0
	RPD	E _R	181.6	187.3	193.0	198.6	204.3	210.0	215.7	221.3	227.0	232.7	238.4
		R _R	582.3	600.6	619.0	637.4	655.8	674.2	692.6	711.0	729.4	747.7	766.1
1000	CV	E	250.0	257.8	265.6	273.4	281.2	289.0	296.8	304.6	312.4	320.2	328.0
		R	641.0	661.4	681.8	702.2	722.6	743.0	763.2	783.4	803.6	823.8	844.0
	RPD	E _R	280.0	288.7	297.5	306.2	314.9	323.7	332.4	341.2	349.9	358.6	367.4
		R _R	717.9	740.8	763.6	786.5	809.3	832.2	854.8	877.4	900.0	922.7	945.3

[Units: kNm, kN]

- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing temperature, RPD = DV (performance).
- Fender performance is subject to ±10% manufacturing tolerance (+10% for reaction force and -10% for energy).

* Values are for 1000mm long.

ANP Arch Fenders

PERFORMANCE DATA*

			E 1.0	E 1.1	E 1.2	E 1.3	E 1.4	E 1.5	E 1.6	E 1.7	E 1.8	E 1.9
150	CV	E	5.6	5.8	6.0	6.1	6.3	6.5	6.7	6.8	7.0	7.1
		R	88.8	91.4	94.1	96.7	99.4	102.0	104.6	107.2	109.8	112.4
	RPD	E _R	6.7	6.9	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6
		R _R	106.6	109.7	112.9	116.1	119.2	122.4	125.5	128.6	131.8	134.9
200	CV	E	9.9	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.4	12.7
		R	118.0	121.6	125.2	128.8	132.4	136.0	139.6	143.2	146.8	150.4
	RPD	E _R	11.9	12.2	12.6	13.0	13.3	13.7	14.1	14.4	14.8	15.2
		R _R	141.6	145.9	150.2	154.6	158.9	163.2	167.5	171.8	176.2	180.5
250	CV	E	15.6	16.1	16.5	17.0	17.4	17.9	18.4	18.8	19.3	19.7
		R	148.0	152.4	156.8	161.2	165.6	170.0	174.4	178.8	183.2	187.6
	RPD	E _R	18.6	19.1	19.7	20.2	20.8	21.3	21.8	22.4	22.9	23.5
		R _R	176.1	181.4	186.6	191.8	197.1	202.3	207.5	212.8	218.0	223.2
300	CV	E	22.4	23.1	23.8	24.4	25.1	25.8	26.5	27.1	27.8	28.4
		R	178.0	183.4	188.8	194.2	199.6	205.0	210.2	215.4	220.6	225.8
	RPD	E _R	26.4	27.2	28.0	28.8	29.6	30.4	31.2	32.0	32.8	33.6
		R _R	210.0	216.4	222.8	229.2	235.5	241.9	248.0	254.2	260.3	266.4
400	CV	E	39.8	41.0	42.2	43.4	44.6	45.8	47.0	48.2	49.3	50.5
		R	237.0	244.2	251.4	258.6	265.8	273.0	280.0	287.0	294.0	301.0
	RPD	E _R	46.6	48.0	49.4	50.8	52.2	53.6	55.0	56.3	57.7	59.1
		R _R	277.3	285.7	294.1	302.6	311.0	319.4	327.6	335.8	344.0	352.2
500	CV	E	62.1	64.0	65.9	67.7	69.6	71.5	73.4	75.2	77.1	78.9
		R	296.0	305.0	314.0	323.0	332.0	341.0	349.8	358.6	367.4	376.2
	RPD	E _R	71.7	73.9	76.1	78.2	80.4	82.6	84.7	86.9	89.0	91.2
		R _R	341.9	352.3	362.7	373.1	383.5	393.9	404.0	414.2	424.3	434.5
600	CV	E	89.3	92.0	94.8	97.5	100.3	103.0	105.6	108.2	110.8	113.4
		R	355.0	365.8	376.6	387.4	398.2	409.0	419.6	430.2	440.8	451.4
	RPD	E _R	102.7	105.8	109.0	112.1	115.3	118.5	121.4	124.4	127.4	130.4
		R _R	408.3	420.7	433.1	445.5	457.9	470.4	482.5	494.7	506.9	519.1
800	CV	E	159.0	163.8	168.6	173.4	178.2	183.0	187.8	192.6	197.4	202.2
		R	473.0	487.2	501.4	515.6	529.8	544.0	558.2	572.4	586.6	600.8
	RPD	E _R	180.5	185.9	191.4	196.8	202.3	207.7	213.2	218.6	224.0	229.5
		R _R	536.9	553.0	569.1	585.2	601.3	617.4	633.6	649.7	665.8	681.9
1000	CV	E	249.0	256.4	263.8	271.2	278.6	286.0	293.4	300.8	308.2	315.6
		R	592.0	609.8	627.6	645.4	663.2	681.0	698.6	716.2	733.8	751.4
	RPD	E _R	278.9	287.2	295.5	303.7	312.0	320.3	328.6	336.9	345.2	353.5
		R _R	663.0	683.0	702.9	722.8	742.8	762.7	782.4	802.1	821.9	841.6

[Units: kNm, kN]

*Note:

- CV: performance data at slow speed constant velocity (2-8 cm/min) compression at 23 ±5°C temperature and 0° compression angle.
- RPD: Rated performance data, in accordance with PIANC with initial high speed berthing velocity 0.15 m/s.
 $RPD = CV \text{ (performance)} \times VF \text{ (velocity factor for Natural and Synthetic rubber blend)} \times TF \text{ (temperature factor)} \times AF \text{ (angle factor)}$
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore $TF = 1$, $AF = 1$.

ANP Arch Fenders

PERFORMANCE DATA*

			E 2.0	E 2.1	E 2.2	E 2.3	E 2.4	E 2.5	E 2.6	E 2.7	E 2.8	E 2.9	E 3.0
150	CV	E	7.3	7.5	7.7	8.0	8.2	8.4	8.6	8.8	9.1	9.3	9.5
		R	115.0	118.6	122.2	125.8	129.4	133.0	136.4	139.8	143.2	146.6	150.0
	RPD	E _R	8.8	9.0	9.3	9.6	9.8	10.1	10.3	10.6	10.9	11.1	11.4
		R _R	138.0	142.3	146.6	151.0	155.3	159.6	163.7	167.8	171.8	175.9	180.0
200	CV	E	13.0	13.4	13.8	14.1	14.5	14.9	15.3	15.7	16.0	16.4	16.8
		R	154.0	158.6	163.2	167.8	172.4	177.0	181.6	186.2	190.8	195.4	200.0
	RPD	E _R	15.6	16.1	16.5	17.0	17.4	17.9	18.3	18.8	19.2	19.7	20.2
		R _R	184.8	190.3	195.8	201.4	206.9	212.4	217.9	223.4	229.0	234.5	240.0
250	CV	E	20.2	20.8	21.4	22.1	22.7	23.3	23.9	24.5	25.1	25.7	26.3
		R	192.0	197.8	203.6	209.4	215.2	221.0	226.8	232.6	238.4	244.2	250.0
	RPD	E _R	24.0	24.8	25.5	26.3	27.0	27.7	28.4	29.2	29.9	30.6	31.3
		R _R	228.5	235.4	242.3	249.2	256.1	263.0	269.9	276.8	283.7	290.6	297.5
300	CV	E	29.1	30.0	30.9	31.7	32.6	33.5	34.4	35.2	36.1	36.9	37.8
		R	231.0	238.0	245.0	252.0	259.0	266.0	272.8	279.6	286.4	293.2	300.0
	RPD	E _R	34.3	35.4	36.4	37.5	38.5	39.5	40.5	41.6	42.6	43.6	44.6
		R _R	272.6	280.8	289.1	297.4	305.6	313.9	321.9	329.9	338.0	346.0	354.0
400	CV	E	51.7	53.3	54.8	56.4	57.9	59.5	61.0	62.6	64.1	65.7	67.2
		R	308.0	317.2	326.4	335.6	344.8	354.0	363.2	372.4	381.6	390.8	400.0
	RPD	E _R	60.5	62.3	64.1	66.0	67.8	69.6	71.4	73.2	75.0	76.8	78.6
		R _R	360.4	371.1	381.9	392.7	403.4	414.2	424.9	435.7	446.5	457.2	468.0
500	CV	E	80.8	83.2	85.6	88.1	90.5	92.9	95.3	97.7	100.2	102.6	105.0
		R	385.0	396.6	408.2	419.8	431.4	443.0	454.4	465.8	477.2	488.6	500.0
	RPD	E _R	93.3	96.1	98.9	101.7	104.5	107.3	110.1	112.9	115.7	118.5	121.3
		R _R	444.7	458.1	471.5	484.9	498.3	511.7	524.8	538.0	551.2	564.3	577.5
600	CV	E	116.0	119.6	123.2	126.8	130.4	134.0	137.4	140.8	144.2	147.6	151.0
		R	462.0	475.8	489.6	503.4	517.2	531.0	544.8	558.6	572.4	586.2	600.0
	RPD	E _R	133.4	137.5	141.7	145.8	150.0	154.1	158.0	161.9	165.8	169.7	173.7
		R _R	531.3	547.2	563.0	578.9	594.8	610.7	626.5	642.4	658.3	674.1	690.0
800	CV	E	207.0	213.2	219.4	225.6	231.8	238.0	244.2	250.4	256.6	262.8	269.0
		R	615.0	633.6	652.2	670.8	689.4	708.0	726.4	744.8	763.2	781.6	800.0
	RPD	E _R	234.9	242.0	249.0	256.1	263.1	270.1	277.2	284.2	291.2	298.3	305.3
		R _R	698.0	719.1	740.2	761.4	782.5	803.6	824.5	845.3	866.2	887.1	908.0
1000	CV	E	323.0	213.2	342.6	352.4	362.2	372.0	381.6	391.2	400.8	410.4	420.0
		R	769.0	792.2	815.4	838.6	861.8	885.0	908.0	931.0	954.0	977.0	1000.0
	RPD	E _R	361.8	238.8	383.7	394.7	405.7	416.6	427.4	438.1	448.9	459.6	470.4
		R _R	861.3	887.3	913.2	939.2	965.2	991.2	1017.0	1042.7	1068.5	1094.2	1120.0

[Units: kNm, kN]

- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing temperature, RPD = DV (performance).
- Fender performance is subject to ±10% manufacturing tolerance (+10% for reaction force and -10% for energy).

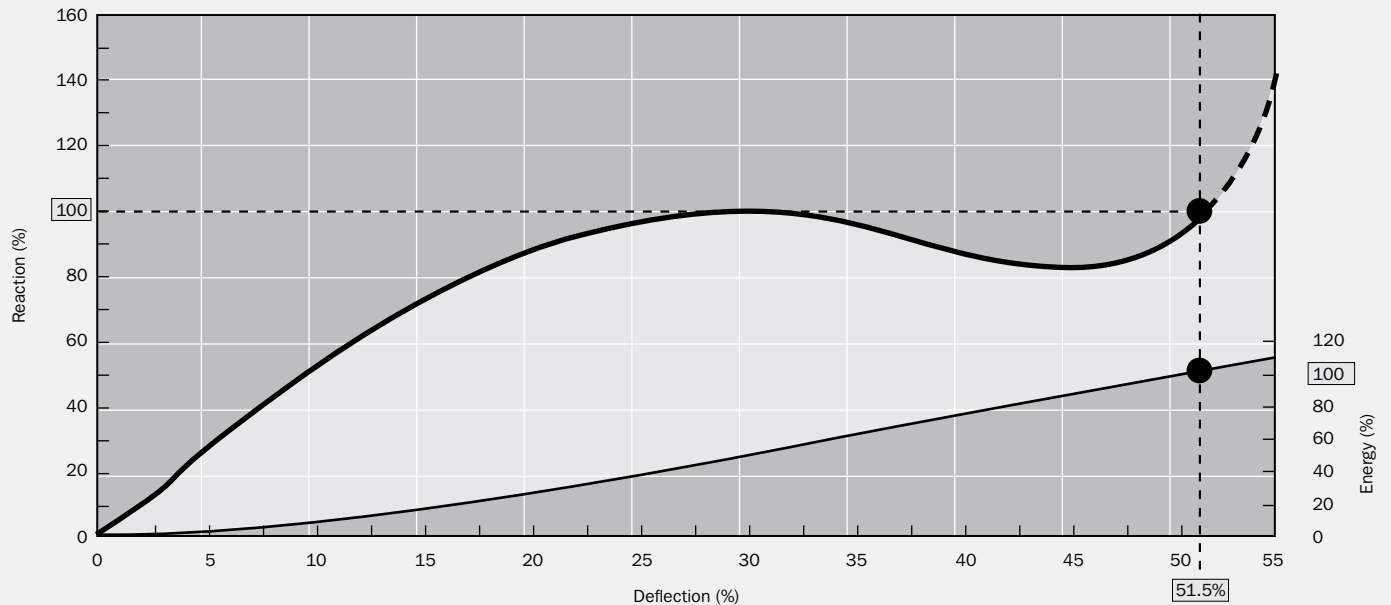
* Values are for 1000mm long.

AN Arch Fenders

INTERMEDIATE DEFLECTIONS

D _i (%)	0	5	10	15	20	25	30	35	40	45	50	51.5	55
E _i (%)	0	1	6	14	25	37	50	63	74	85	96	100	111
R _i (%)	0	24	51	73	89	98	100	96	89	82	91	100	141

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.

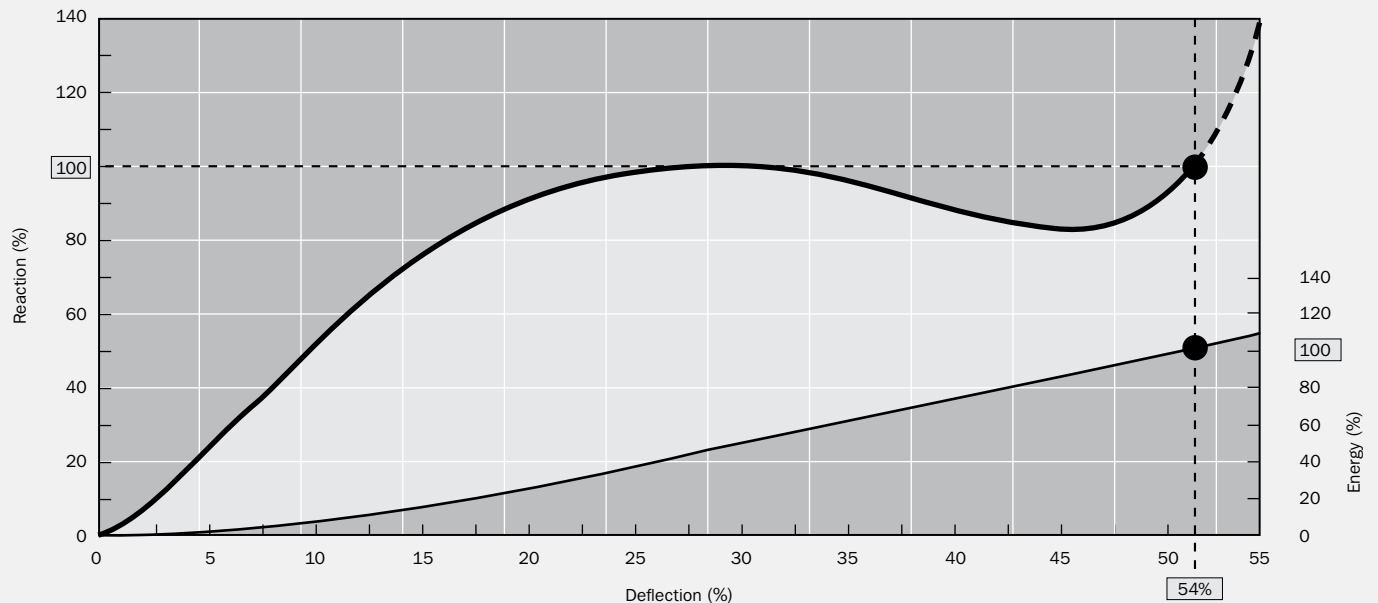


ANP Arch Fenders

INTERMEDIATE DEFLECTIONS

D _i (%)	0	5	10	15	20	25	30	35	40	45	50	54	57.5
E _i (%)	0	1	6	13	23	34	46	58	70	81	91	100	110
R _i (%)	0	23	49	71	87	96	100	98	92	84	84	100	139

Nominal rated deflection may vary at RPD. Refer to the Performance Tolerances table in the Fender Application Design Manual.



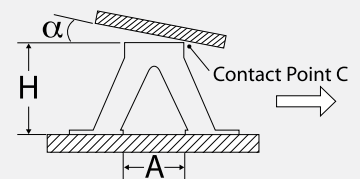
Super Arch and Arch Fenders

ANGLE FACTORS (AF) – TRANSVERSE LOAD

Energy Correction Factors

A/H		DEFLECTION % AT POINT C	REACTION CORRECTION FACTOR	ENERGY CORRECTION FACTOR
3	α	57.5	1.000	0.999
5		57.5	0.991	0.987
6		57.5	0.986	0.973
7		57.5	0.980	0.960
8		57.5	0.974	0.947
9		57.5	0.967	0.934
10		57.5	0.959	0.922
12		57.5	0.962	0.896
15		57.5	0.986	0.857
20		57.5	1.001	0.787
25		57.5	0.999	0.716
30		57.5	0.969	0.649

- Reaction force is the maximum generated within the compression cycle.
- Correction factors may be used for any size and compound of the Arch and Super Arch Fender range.



Super Arch and Arch Fenders

ANGLE FACTORS (AF) – LONGITUDINAL LOAD

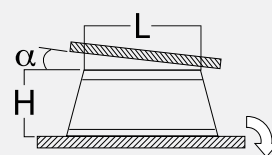
Energy Correction Factors

L/H \ α	0	5	6	7	8	9	10	12	15	20	25	30
0.750	1.000	0.924	0.910	0.896	0.882	0.868	0.854	0.825	0.781	0.706	0.632	0.563
1.000	1.000	0.901	0.882	0.863	0.844	0.824	0.805	0.765	0.703	0.602	0.509	0.434
1.100	1.000	0.891	0.870	0.850	0.828	0.807	0.785	0.740	0.672	0.561	0.466	0.394
1.200	1.000	0.882	0.859	0.836	0.812	0.788	0.764	0.715	0.640	0.522	0.428	0.361
1.300	1.000	0.872	0.847	0.822	0.796	0.770	0.743	0.689	0.608	0.486	0.395	0.334
1.400	1.000	0.863	0.836	0.808	0.780	0.751	0.722	0.663	0.578	0.453	0.367	0.310
1.500	1.000	0.853	0.824	0.794	0.764	0.733	0.701	0.638	0.547	0.423	0.342	0.289
1.600	1.000	0.844	0.812	0.780	0.747	0.714	0.680	0.613	0.518	0.396	0.321	0.271
1.700	1.000	0.834	0.800	0.766	0.730	0.695	0.659	0.588	0.491	0.373	0.302	0.255
1.800	1.000	0.824	0.788	0.751	0.713	0.675	0.637	0.564	0.465	0.352	0.285	0.241
1.900	1.000	0.814	0.776	0.736	0.696	0.656	0.616	0.540	0.441	0.334	0.270	0.228
2.000	1.000	0.804	0.763	0.722	0.679	0.637	0.595	0.517	0.419	0.317	0.257	0.217
3.000	1.000	0.700	0.636	0.574	0.515	0.462	0.416	0.348	0.279	0.211	0.171	0.145
4.000	1.000	0.594	0.514	0.445	0.390	0.347	0.312	0.261	0.209	0.159	0.128	0.108
5.000	1.000	0.495	0.415	0.356	0.312	0.277	0.250	0.209	0.168	0.127	0.103	0.087

Reaction Force Correction Factors

L/H \ α	0	5	6	7	8	9	10	12	15	20	25	30
0.750	1.000	0.873	0.866	0.862	0.862	0.864	0.867	0.878	0.896	0.921	0.926	0.907
1.000	1.000	0.863	0.862	0.865	0.870	0.878	0.886	0.903	0.922	0.921	0.817	0.777
1.100	1.000	0.862	0.863	0.869	0.876	0.885	0.895	0.912	0.926	0.907	0.824	0.708
1.200	1.000	0.862	0.866	0.873	0.883	0.893	0.903	0.919	0.927	0.882	0.767	0.649
1.300	1.000	0.863	0.869	0.879	0.890	0.900	0.911	0.924	0.923	0.849	0.709	0.600
1.400	1.000	0.865	0.873	0.885	0.897	0.908	0.917	0.927	0.914	0.806	0.658	0.556
1.500	1.000	0.867	0.878	0.891	0.903	0.914	0.922	0.927	0.899	0.759	0.614	0.519
1.600	1.000	0.871	0.883	0.897	0.909	0.919	0.925	0.924	0.879	0.712	0.576	0.487
1.700	1.000	0.874	0.888	0.903	0.915	0.923	0.927	0.917	0.854	0.670	0.542	0.458
1.800	1.000	0.878	0.893	0.908	0.919	0.926	0.927	0.908	0.823	0.632	0.512	0.433
1.900	1.000	0.882	0.899	0.913	0.923	0.927	0.924	0.894	0.789	0.599	0.485	0.410
2.000	1.000	0.887	0.903	0.917	0.925	0.927	0.920	0.878	0.752	0.569	0.461	0.389
3.000	1.000	0.922	0.927	0.912	0.876	0.819	0.747	0.624	0.501	0.379	0.307	0.260
4.000	1.000	0.919	0.876	0.795	0.699	0.622	0.561	0.468	0.376	0.285	0.230	0.195
5.000	1.000	0.858	0.745	0.639	0.560	0.498	0.448	0.375	0.301	0.228	0.184	0.156

- Reaction force is the maximum generated within the compression cycle.
- Correction factors may be used for any size and compound of the Arch and Super Arch Fender range.



Super Arch and Arch Fenders

VELOCITY FACTOR (VF) TABLE

COMPRESSION TIME (SECONDS)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	VF	VF	VF
1	1.20	1.14	1.31
2	1.16	1.10	1.25
3	1.14	1.09	1.22
4	1.13	1.07	1.20
5	1.11	1.06	1.19
6	1.10	1.06	1.17
7	1.09	1.05	1.16
8	1.09	1.04	1.15
9	1.08	1.04	1.14
10	1.07	1.03	1.14
11	1.07	1.03	1.13
12	1.06	1.02	1.12
13	1.06	1.02	1.12
14	1.05	1.02	1.11
15	1.05	1.01	1.11
16	1.05	1.01	1.10
17	1.04	1.01	1.10
18	1.04	1.01	1.09
19	1.04	1.00	1.09
20	1.03	1.00	1.08

Compression time needs to be calculated using the following formula: $t = d/(f \cdot V_d)$

Where:

t = compression time (seconds)*

d = rated deflection (mm)

V_d = initial berthing velocity (mm/s)

f = 0.74 deceleration factor (Peak reaction force occurs at between 30% - 40% deflection, where there has been a deceleration due to energy absorption. f represents the factor associated with deceleration).

* Applicable for both partial deflection and rated deflection.

TEMPERATURE FACTOR (TF) TABLE

TEMPERATURE (°C)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER	100% SYNTHETIC RUBBER (SBR)
	TF	TF	TF
+50	0.916	0.914	0.918
+40	0.947	0.946	0.948
+30	0.978	0.978	0.979
+23	1.000	1.000	1.000
+10	1.030	1.025	1.038
+0	1.075	1.053	1.108
-10	1.130	1.080	1.206
-20	1.249	1.142	1.410
-30	1.540	1.315	1.877

Corner Arch Fenders

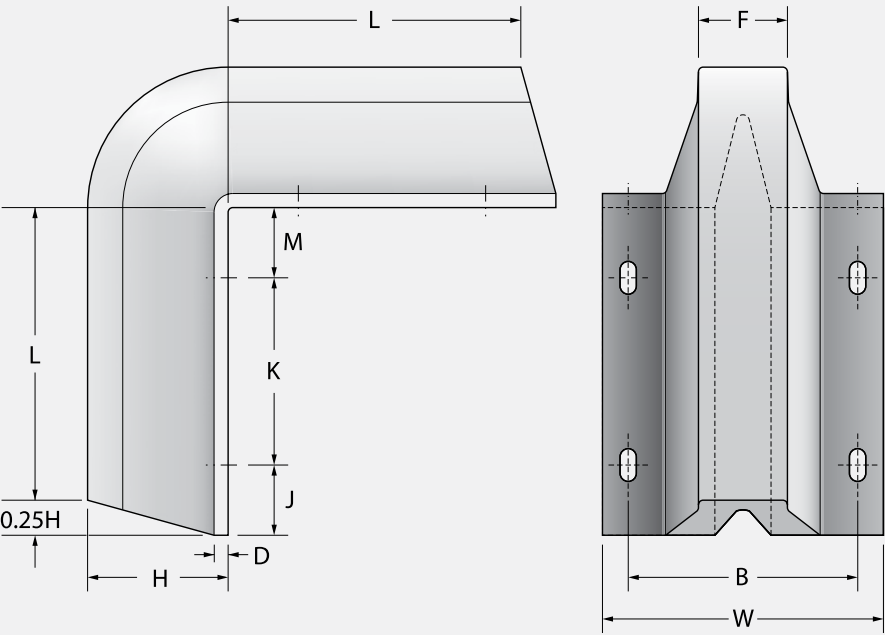


Berth corners are very difficult to protect. Corner Arch fenders are available in three standard sizes and provide a simple, easily installed solution to prevent damage from smaller vessels.

DIMENSIONS

	H	L	W	B	D	F	J	K	M	ANCHOR	WEIGHT
CA 150	150	1000	300	240	25	95	110	690	237	8 × M20	80
CA 250	250	750	500	410	40	160	130	420	262	8 × M24	142
CA 300	300	625	600	490	44	190	140	360	320	8 × M30	208

[Units: mm, kg]



Other corner fender solutions (contact your local office)

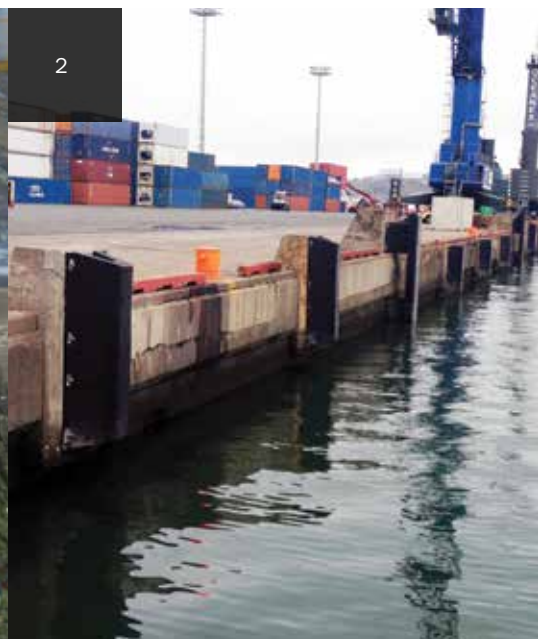


1. NEW ZEALAND
2. USA
3. AZERBAIJAN
4. OMAN
5. HONG KONG
6. PHILIPPINES
7. POLAND
8. POLAND

1



2



3



4



5



6



7



8



Parallel Motion Fenders



Parallel Motion technology can reduce reaction forces by up to 60% compared with traditional designs.

The panel always remains vertical but can cope with large berthing angles – even at 20° there is usually no loss in energy absorption. Parallel Motion is a specialist fender system and its selection can only be used in consultation with local offices.

Increasing energy, reducing reaction

By using two Super Cones back-to-back, the deflection and energy both increase whilst reaction forces stay low. Reduced loads compared to conventional fenders mean less stress in the structure, allowing smaller piles and less concrete to be used.

As Parallel Motion Fenders are mostly pre-assembled in the factory, installation is simple and fast. Maintenance is minimal too – contributing to the low service life cost of Parallel Motion technology.

FEATURES

Ultra-low reaction

Non-tilt frontal panel

No performance loss at large berthing angles

Easy and fast to install

Minimal maintenance

APPLICATIONS

RoRo and fast ferry berths

LNG and tanker terminals

Naval facilities

High tidal zones

Monopile or ‘soft’ structures

1. AUSTRALIA

2. UNITED KINGDOM

3. UNITED KINGDOM

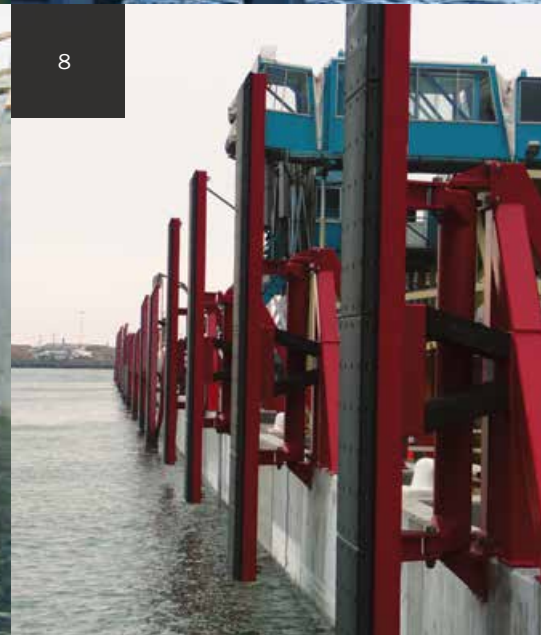
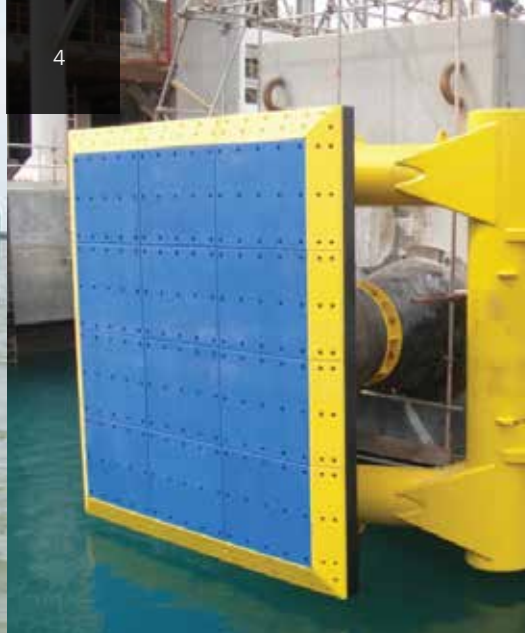
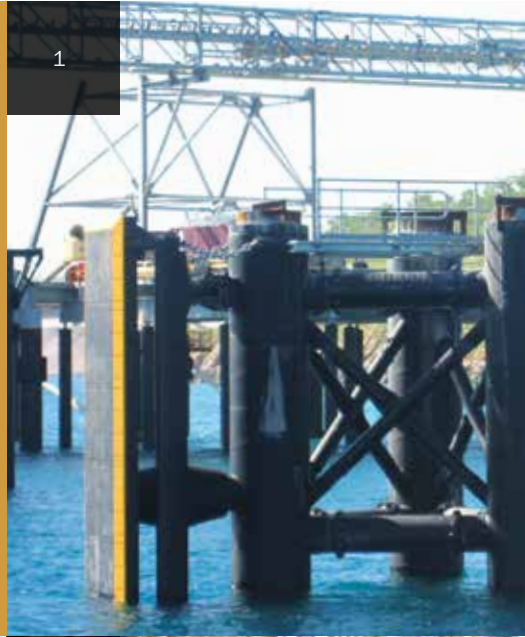
4. QATAR

5. SWEDEN

6. UNITED KINGDOM

7. NORWAY

8. DENMARK



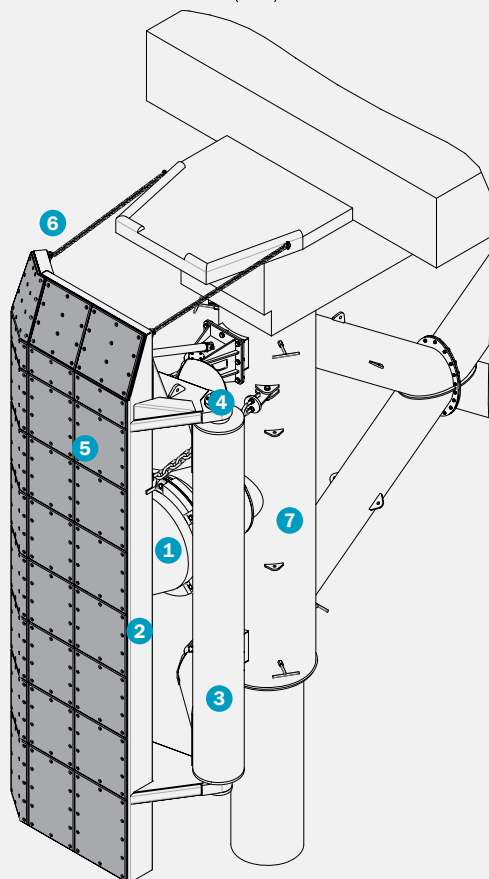
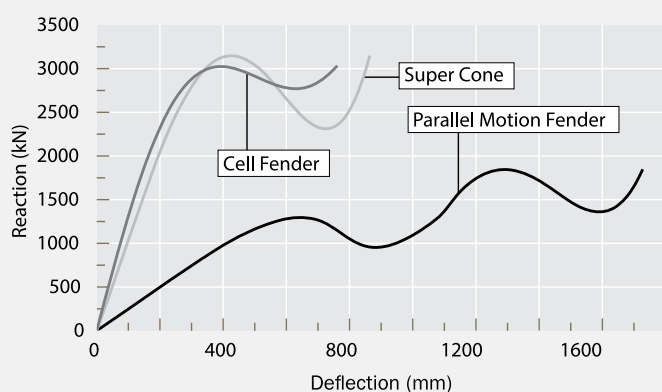
Parallel Motion Fenders

COMPARISON OF PMF AND CONVENTIONAL FENDERS

TYPE	E (kNm)			R (kN)	ϵ_{20}
	0°	10°	20°	RPD	
Parallel Motion Fender PMF1200 (F3.1 & F1.9)	2186.6	2186.6	2186.6	1955.5	100%
Super Cone 2 × SCN1200 (F2.8)	2182.2	2182.2	1612.6	3347.20	43%
Cell Fender 2 × SCK1450 (E3.0)	2153.2	1901.3	1403.9	3381.20	37%

Note:

1. ϵ_{20} = Relative Efficiency at 20° angle compared to PMF.
2. Performance at RPD.
3. Performance PMF softer cone taken at 75% deflection.



1 Rubber fender units

Shown here are two Super Cones mounted in a back-to-back 'Twin-Series' configuration.

2 Closed box panel (frame)

Fully sealed, pressure tested design. Shown with optional lead-in bevels which are designed to suit each case.

3 Torsion tube and arm assembly

Also closed-box construction, the tube and arms keep the panel vertical whatever level impact loads are applied.

4 Hinge units

The maintenance-free stainless steel pins and bearings allow free rotation to accommodate berthing angles, also eliminating moments in the hinge pin.

5 UHMW-PE face pads

Trelleborg 'Double Sintered' UHMW-PE face pads are standard to minimize friction and maximize service intervals.

6 Check chains (optional)

Check chains act as rope deflectors to stop ropes from snagging, and to help with some large angle berthings.

7 Pile jackets (optional)

Purpose designed for every project, pile jackets are factory built for a perfect fit to the fender onsite. They can strengthen the structure and double as a corrosion barrier in the vulnerable splash zone. Jackets are also available for monopile systems.



PARALLEL MOTION FENDERS, SWEDEN

Pivot Fenders



Pivot fenders is an alternative and cost effective solution to the parallel motion fender type of applications.

FEATURES

Simple and robust design

Few fender elements are required compared to normal fender systems

Simple assembly on site

Parallel motion function

APPLICATIONS

Belted vessel

Roro ferries

Cruise terminal

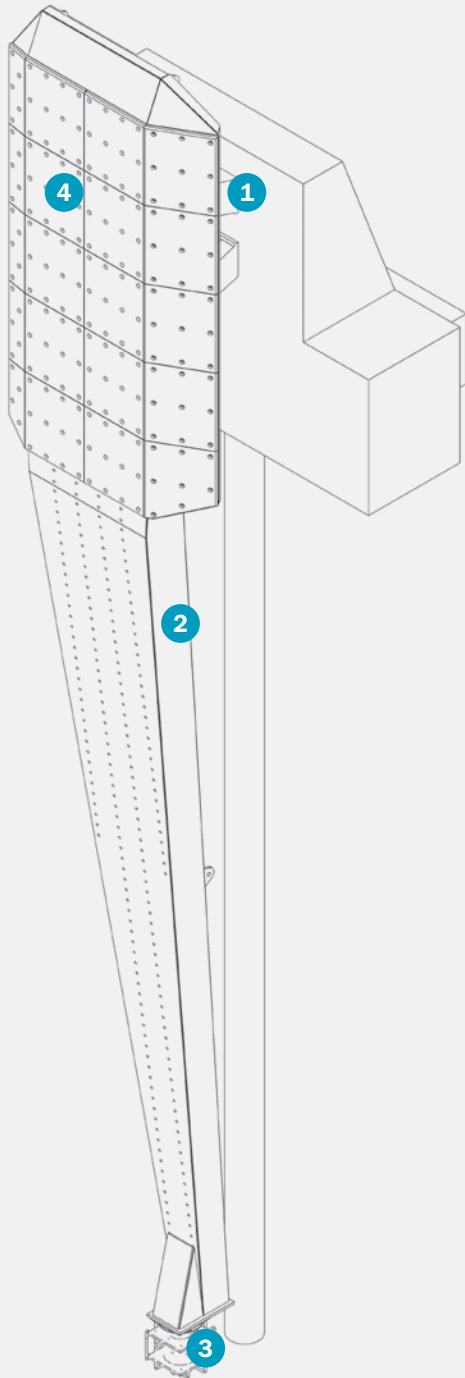
Ports with wide tidal variation

Pivot Fenders

It has a featured long legged panel normally fastened in a box at seabed level, allowing parallel movement of the panel when vessels are berthing.

It is a useful solution for ports in which belted ships are commonly operated. Due to its unique design, pivot fender system allows the fender to rotate and follow the ship's berthing angle.

The advantage of this design is that the energy absorbing rubber units absorb the full berthing energy irrespective of the point of contact of the vessel on the panel. However, the reaction force generated by the fender towards the vessel side will vary depending upon the point of contact.



1 Rubber fender units

MV type shown

2 Pivot steel panel

3 Bottom connection

Different solutions available. Please contact Trelleborg Marine Systems for further information.

4 Wear pads

Standard UHMW-PE thickness at 50-80 mm

Flexible Wall (Type I)



Individual fender systems are connected via steel hinges on their panels to create a flexible wall of fender system. The steel hinges between fender panels prevent the vessel from hitting the berthing structure at all times.

FEATURES

Increases port performance and safety

Small fender can be used compared to normal user design

Steel hinges can be used to connect the steel panels as opposed to using chain links

Well proven design helps to reduce fender size

APPLICATIONS

Roro ferries

Belted vessels

Cruise terminal

Container vessel

Offshore platforms

Flexible Wall (Type II)



Another type of flexible wall that Trelleborg Marine Systems offers is leg fenders (MV, UE or Arch fenders) with the UHMW-PE shield placed continuously next to each other.

This special design ensures the fender system is continually built along the quay. This can also be built on a corner with a special rubber connector, making sure that even corners with radius are safely protected.

FEATURES

Increases port performance and safety
Continuous UHMW-PE shield

APPLICATIONS

Pier ends
Exposed dolphins

Slide-In, Slide-Out Fender Systems



Utilizing removable sliding panels, the patented ‘Slide-In, Slide-Out’ (SISO) fender system has been designed to significantly reduce the time and effort taken to complete a fender wear pad change-out.

Unlike traditional fender frame systems where ultra-high-molecular-weight polyethylene (UHMW-PE) wear pads are assembled directly onto a fixed frontal frame via a bolt fastening arrangement, the UHMW-PE wear pads are bolted onto two stainless steel removable panels. These panels are then inserted into a guide rail on the front face of the fixed frontal frame.

The sliding panels can then be easily lifted out of the frontal frame and replacements reinserted within a couple of hours – reducing downtime on the berth and keeping operations running punctually.

The original panels can then be transported onshore for maintenance and have their wear pads replaced, ready to be used as spares for the next fender wear pad change-out operation.

The system also reduces the safety risks and downtime associated with completing a pad replacement procedure from either a workboat or when using a maintenance scaffold system.

FEATURES

Removable sliding panels

Replaceable wear pads

Simple and quick maintenance

APPLICATIONS

General cargo berths

Bulk terminals

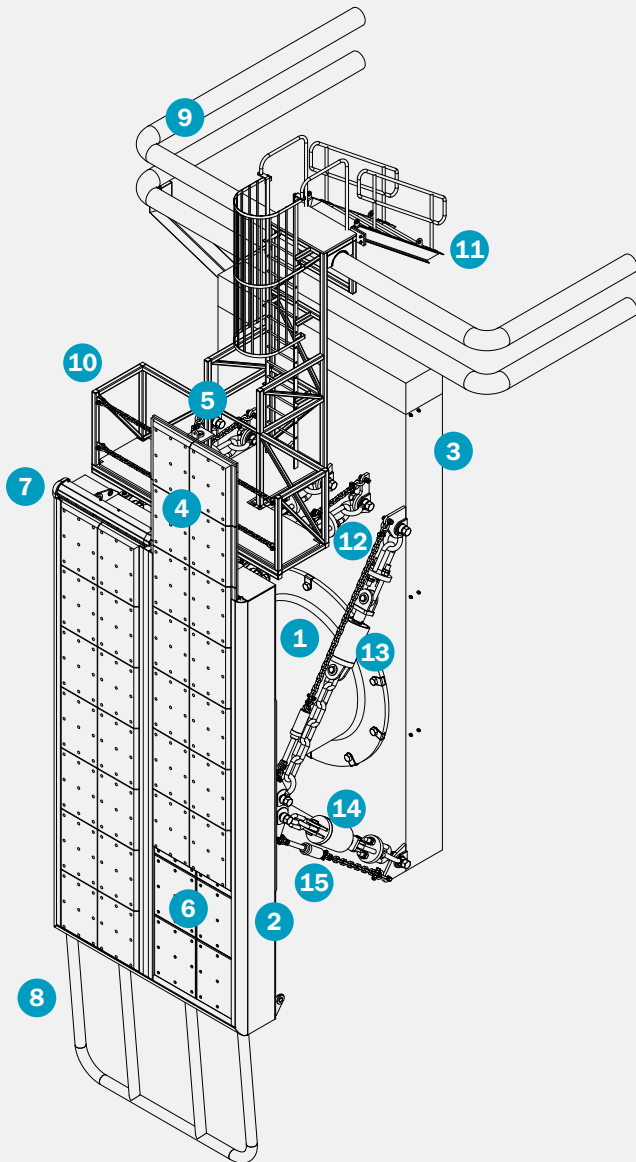
Oil and LNG facilities

Container berths

RoRo and cruise terminals

Parallel motion systems

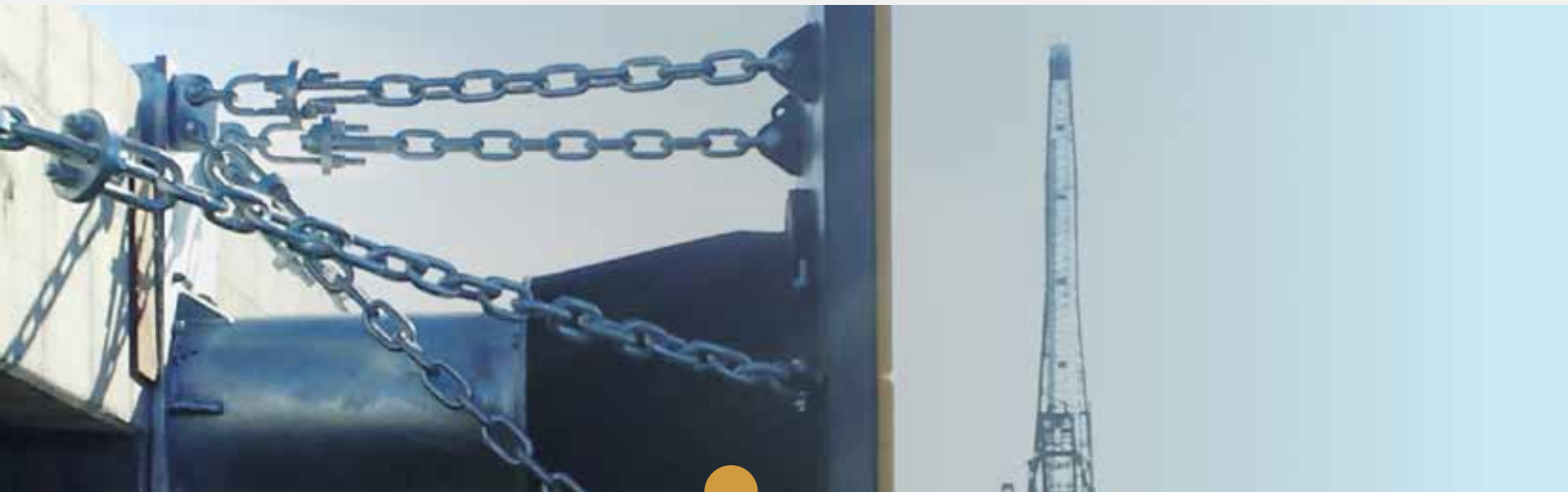
Slide-in, Slide-out Fender Systems



- 1 Rubber fender unit**
SCK type shown here but SCN types can also be used.
- 2 Closed box panel (frame) with SISO guide channel**
Fully sealed, pressure tested design with guide channels to hold sliding panels in place.
- 3 Dolphin headstock**
Fully sealed, pressure tested design with chain lug points and fender mounting ferrules.

- 4 Slide-in, Slide-out (SISO) panel**
Removable panel with UHMW-PE wear pads. Allows rapid changeout of wear pads by replacing entire panel with a replacement panel.
- 5 Jacking and lifting points**
Allows SISO panel to be released from marine growth and lifted out for refurbishment.
- 6 Low friction inner pads**
Inner UHMW-PE pads to allow SISO panel to slide.
- 7 Corner protector**
Protects vessels from impacting fender frame corner.
- 8 Rope guard**
Prevents mooring lines from getting caught underneath fender panel.
- 9 Hawser rail**
- 10 Access platform**
Allows quick land-based access to release mechanisms for SISO system. Can be lifted into place by small crane for rapid deployment and designed to suit any type of wharf/dolphin structure.
- 11 Approach stairs**
Can be deployed quickly in conjunction with access platform and designed to suit any type of wharf/dolphin structure.
- 12 Tension chain system**
- 13 Weight chain system**
Shown here with optional chain shock absorber.
- 14 Uplift chain system**
Shown here with optional chain shock absorber.
- 15 Detention chain system**
Allows controlled release of tension in tension, weight or uplift chain systems during changeout procedures using hydraulics.

Accessories

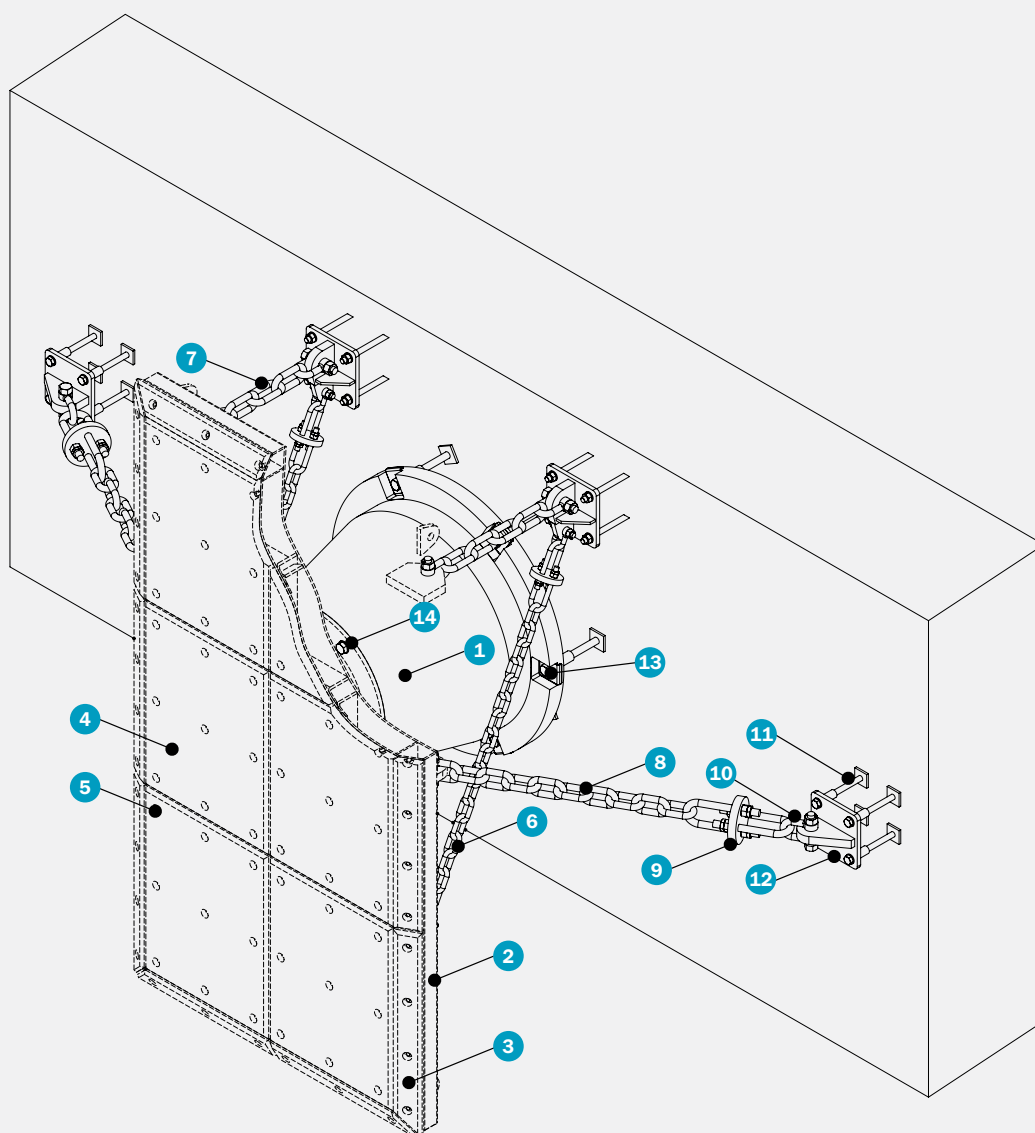


All our accessories are procured from a pre-approved, reputable supplier. We ensure that our suppliers use the highest grade of raw materials to produce the best quality products and we test accessories quality when they arrive with us.

Our ultra high molecular weight polyethylene (UHMW-PE) is the first choice material for facing steel fender panels and other heavy duty applications.

We can also supply both open link or stud link chains in several grade strengths. Accessories such as shackles and U-anchors are also available. The nominal breaking load (NBL) of these items is matched to chains of similar capacity. Chains and accessories are galvanized as standard. Chain brackets may also be supplied in an optional painted finish.

Fender Accessories



1 Super cone fender

2 Steel frontal frame

3 Chamfered edge on frontal frame

4 UHMW-PE facing pads

5 Fixing bolts for UHMW-PE pads

6 Weight chain

7 Tension chain

8 Shear chain

9 Chain tensioner

10 Chain shackle

11 NC3 type anchor

12 Bracket

13 Foot bolt

14 Head bolt

Fender Panels

Fender panels are just as important as the rubber units on high performance systems. That's why every panel can be purpose designed using structural analysis programs and 3D CAD modelling for optimum strength.

Fender panels distribute reaction forces to provide low hull pressures and cope with large tidal variations. They can also be designed to resist line loads from belted ships, or even point loads in special cases. Optional lead-in bevels reduce the snagging risk, whilst brackets (where required) provide highly secure connection points for chains.

Closed box designs are used almost exclusively – all fully sealed and pressure checked. Corrosion protection is provided by high durability C5M class paint systems to ISO 12944, and additional corrosion allowances can be designed in where required.

FEATURES AND OPTIONS

- Closed box steel structure
- Internal structural members
- Blind boss fender connections
- Pressure tested for water tightness
- C5M modified epoxy paint*
- Polyurethane topcoat (RAL5005 blue)†
- Studs for UHMW-PE face pads
- Chain brackets
- Lifting points
- Lead-in bevels and chamfers

* Other options available

† Alternative colours on request

SPECIFICATION AND DESIGN OF PANELS

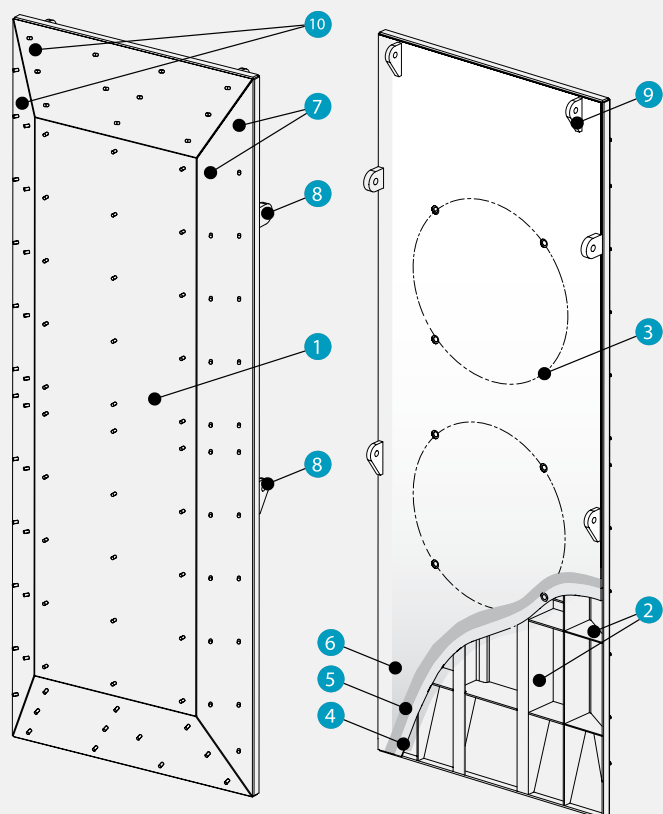
Panel specifications and designs should consider:

- Hull pressures and tidal range
- Lead-in bevels and chamfers
- Bending moment and shear
- Local buckling
- Limit state load factors
- Steel grade
- Permissible stresses
- Weld sizes and types
- Pressure test method
- Rubber fender connections
- UHMW-PE attachment
- Chain connections
- Lifting points
- Paint systems
- Corrosion allowance
- Maintenance and service life

Fender Panels

- 1 Closed box steel structure
- 2 Internal structural members
- 3 Blind boss fender connections
- 4 Shot blasted steel (SA2.5)
- 5 C5M modified epoxy paint*
- 6 Polyurethane topcoat (RAL5005 blue)†
- 7 Studs for UHMW-PE face pads
- 8 Chain brackets
- 9 Lifting points
- 10 Lead-in bevels and chamfers*

* Other options available † Alternative colours on request



STEEL PROPERTIES

STANDARD	GRADE	YIELD STRENGTH (min)		TENSILE STRENGTH (min)		TEST TEMPERATURE OF (v-notched) CHARPY IMPACT TEST	
		N/mm ²	psi	N/mm ²	psi	°C	°F
GB/T 700	Q235B	235	34000	375	54000	20	68
	Q275B	275	40000	490	71000	20	68
GB/T 1591	Q345B	345	50000	470	68000	20	68
	Q345C	345	50000	470	68000	0	32
EN 10025	S235JR (1.0038)	235	34000	360	52000	20	68
	S275JR (1.0044)	275	40000	420	61000	20	68
	S355J2 (1.0570)	355	51000	510	74000	-20	-4
	S355J0 (1.0553)	355	51000	510	74000	0	32
JIS G-3101	SS400	235	34000	402	58000	0	32
	SS490	275	40000	402	58000	0	32
	SM490	314	46000	490	71000	0	32
ASTM	A-36	250	36000	400	58000	0	32
	A-572	345	50000	450	65000	0	32

The national standards of France and Germany have been replaced by EN 10025. In the UK, BS4360 has been replaced by BS EN 10025. The table above is for guidance only and is not comprehensive. Actual specifications should be consulted in all cases for the full specifications of steel grades listed and other similar grades.

STEEL THICKNESS

(in accordance with PIANC 2002)

EXPOSED BOTH FACES	≥ 12
EXPOSED ONE FACE	≥ 9
INTERNAL (NOT EXPOSED)	≥ 8

[Units: mm]

Corresponding minimum panel thickness will be 140–160mm (excluding UHMW-PE face pads) and often much greater.

TYPICAL PANEL WEIGHTS

LIGHT DUTY	200 – 250
MEDIUM DUTY	250 – 300
HEAVY DUTY	300 – 400
EXTREME DUTY	≥ 400

[Units: kg/m²]

Ultra High Molecular Weight Polyethylene (UHMW-PE)

The contact face of a fender panel helps to determine the lifetime maintenance costs of a fender installation. UHMW-PE is the best material available for such applications. It uniquely combines low friction, impact strength, non-marking characteristics and resistance to wear, temperature extremes, seawater and marine borers. UHMW-PE is molded into plates at extremely high pressure and is a totally homogeneous material which is available in many sizes and thicknesses. These plates can be cut, machined and drilled to suit any type of panel or shield.

FEATURES

Very low friction coefficient

Excellent abrasion resistance

UV and ozone resistant

Does not rot, split or crack

100% recyclable

APPLICATIONS

Fender panel (frame) face pads

Rubbing strips

V-fender shields

Lock entrance and wall protection

Bridge buttress protection

Beltings on workboats

PROPERTY	TEST METHOD	UNIT	TYPICAL VALUE	
			VIRGIN	REGENERATED
Density	ISO 1183-1	g/cm ³	0.94 – 0.95	0.95 – 0.96
Notched Impact Strength (Charpy)	ISO 11542-2	kJ/m ²	140 – 170	100 – 130
Abrasion Index (Sand-slurry)	ISO/DIS 15527(Draft)	100	100 – 110	130 – 150
Yield Strength	ISO/R 50mm/min	N/mm ²	15 – 20	15 – 20
Elongation at Break*	ISO/R 50mm/min	%	> 50	> 50
Dynamic Friction (PE-Steel)	Pm = 1N/mm ² V = 10m/min	–	0.15	0.15
Hardness	ISO 868 / DIN 53505 3s value, 6mm sample	Shore D	63	63 – 66
Operating Temperature	–	°C	–80 to +80	–80 to +80
Thermal Expansion	DIN 53752	K ⁻¹	≈ 2 × 10 ⁻⁴	≈ 2 × 10 ⁻⁴
Molecular Weight	Viscometric	g/mol	4,200,000	4,200,000
Melting Point	ASTM D3418	°C	137 – 143	137 – 143

All values for black, UV stabilized material. Values for colored materials will vary.
Actual properties will be confirmed on order.

* Alternative test methods such as ASTM 0638 give higher values circa 350%.

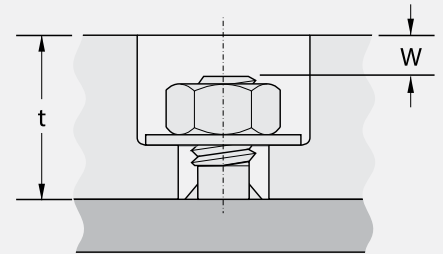
Ultra High Molecular Weight Polyethylene (UHMW-PE)

WEAR ALLOWANCES

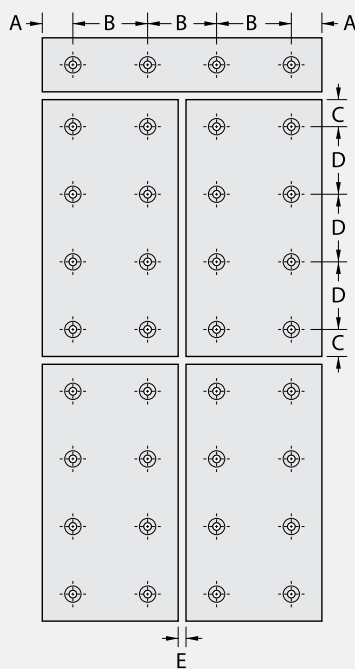
APPLICATION	t (mm)	W* (mm)	BOLT
Light duty	30	3 – 5	M16
Medium duty	40	7 – 10	M16 – M20
	50	10 – 15	
Heavy duty	60	15 – 19	M24 – M30
	70	18 – 25	
	80	22 – 32	
Extreme duty	90	25 – 36	M30 – M36
	100	28 – 40	

* Where allowances are typical values, actual wear allowance may vary due to fixing detail. Small increases in facing thickness can greatly extend service life for minimal extra cost.

[Units: mm]



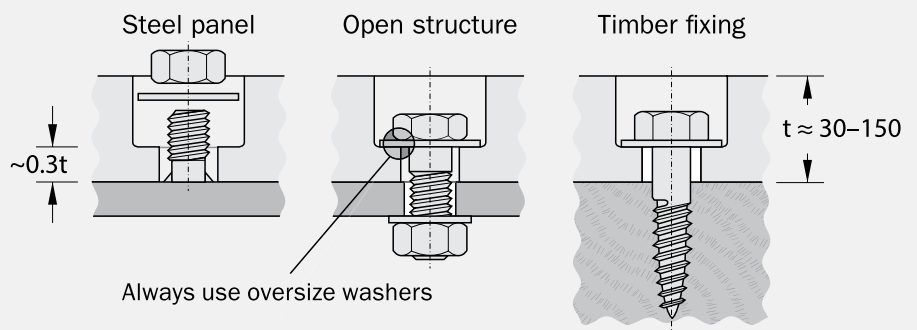
TYPICAL DIMENSIONS



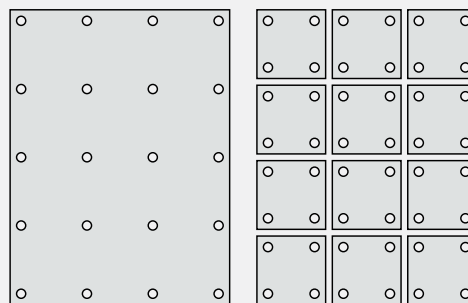
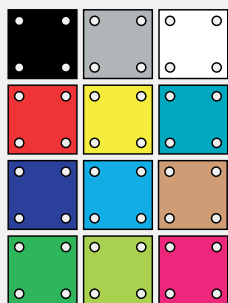
A	45 – 80
B	250 – 350
C	45 – 80
D	300 – 450
E	5 – 10

[Units: mm]

Dimensions will depend on pad thickness and application.



LARGE PADS VS SMALL PADS



Larger pads are usually more robust but smaller pads are easier and cheaper to replace.

The standard color is black, but UHMW-PE is available in many other colours if required.

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

Choice of open or stud link chains

Various link lengths available

Proof load tested and certified

Galvanized as standard

Variety of matched accessories

APPLICATIONS

Large fender panels

Cylindrical fenders

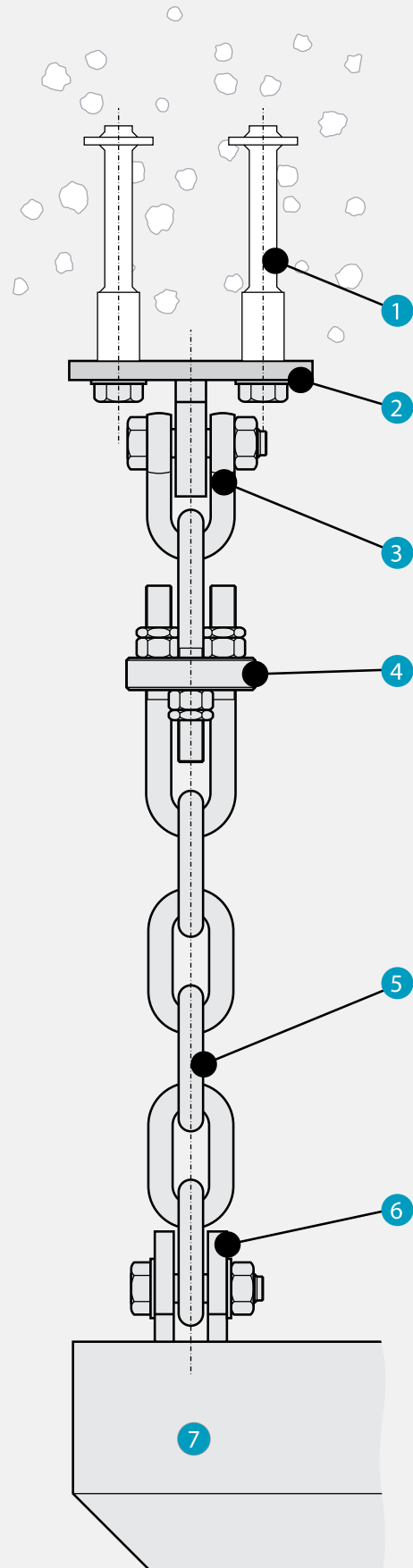
Floating fender moorings

Safety applications

Lifting and installing

TYPICAL CHAIN SYSTEM

- 1 Anchors and fixing bolts
- 2 Chain bracket
- 3 Alloy D or bow-shackle with safety pin
- 4 Chain tensioner
- 5 Open or stud link chain
- 6 Frontal frame bracket
- 7 Frontal frame

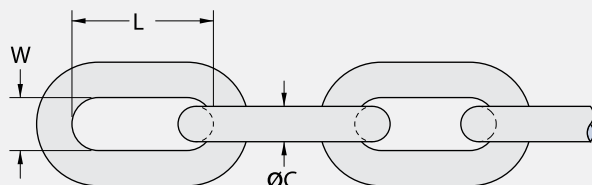


Chains

OPEN LINK CHAINS

ØC	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	16	1900	2380
60	180	78	14	210	84	15	240	84	17	300	90	20	2260	2770

[Units: mm, kg/link, kN]



MBL = Minimum Breaking Load (kN)

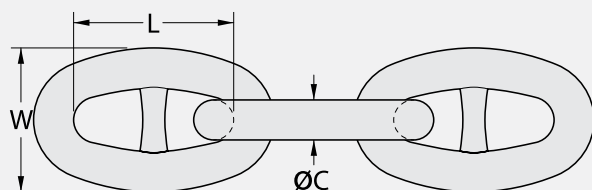
NBL = Nominal Breaking Load (kN)

Tolerance: all dimensions $\pm 2.5\%$

STUD LINK CHAINS

ØC	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

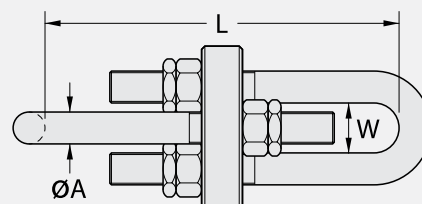
[Units: mm, kg/link, kN]



CHAIN TENSIONERS

CHAIN SIZE	ØA	L	W	WEIGHT
16	M16	200-240	40	2.7
18	M18	220-280	45	2.5
20	M20	235-305	50	5.3
22	M22	265-345	56	6.6
22	M24	280-370	60	8.8
25	M27	310-420	68	12
30	M30	345-465	76	17
32	M33	385-525	82	21
35	M36	420-560	90	27
40	M42	480-650	106	45
45	M48	545-745	120	64
50	M52	595-805	130	80
55	M56	640-880	140	99
60	M60	685-945	150	122
60	M64	730-1010	160	147

[Units: mm, kg]

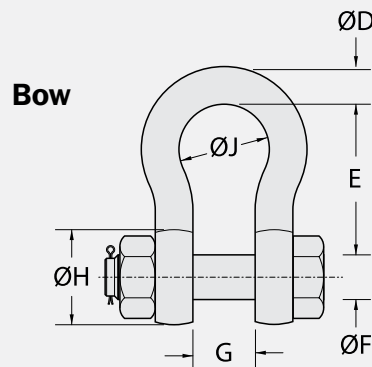
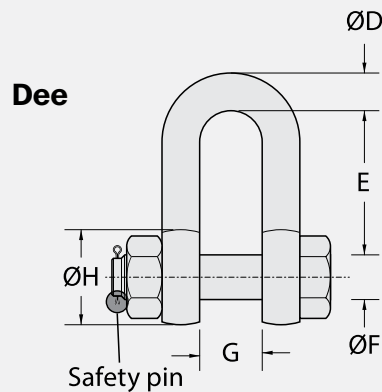


High Strength Shackles

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

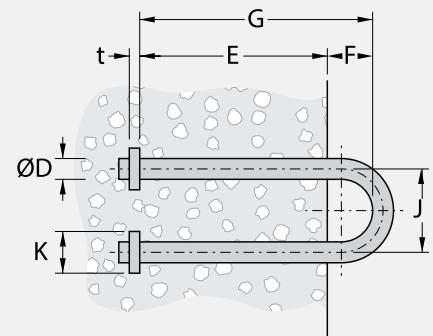
[Units: mm, kg, kN]



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]

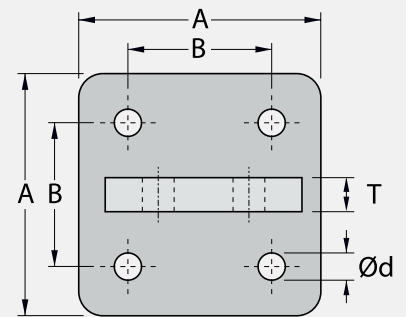
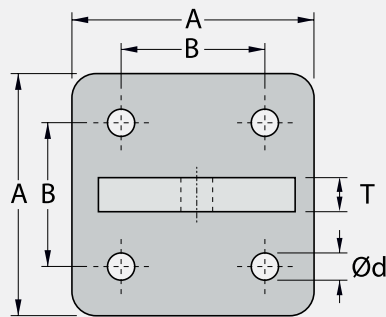
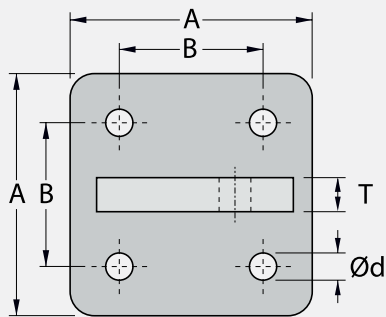


Brackets

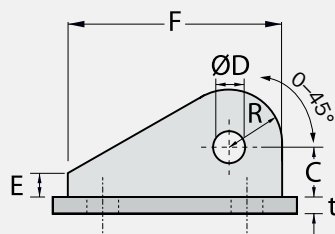
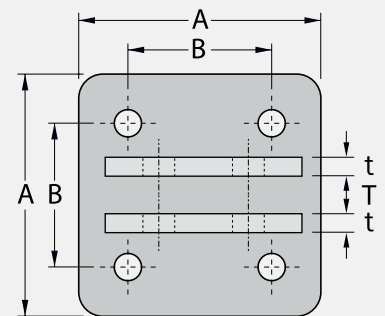
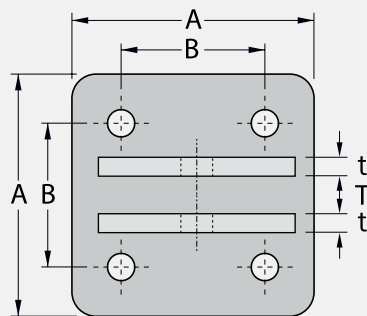
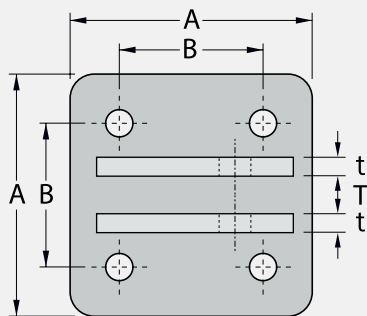
A	B	C	E		F	Ød	R	t	T	SINGLE LUG		TWIN LUG		ANCHOR
			CB1/CB3	CB2						SHACKLE	ØD	BOLT PIN	ØD	
190	110	40	20	75	160	24	40	15	30	19	28	M24 x 90	28	2/4 x M20
220	130	45	20	90	190	24	50	15	30	22	28	M24 x 90	28	2/4 x M20
250	150	50	25	100	210	28	55	20	40	25	36	M30 x 120	36	2/4 x M24
280	160	60	25	115	240	28	65	20	40	28	36	M30 x 120	36	2/4 x M24
320	190	65	35	130	270	36	75	25	45	32	42	M36 x 140	42	2/4 x M30
350	210	70	35	140	300	36	80	25	50	35	42	M36 x 140	42	2/4 x M30
380	220	80	35	155	320	42	85	30	50	38	50	M42 x 160	50	2/4 x M36
420	250	85	40	170	360	42	95	30	60	42	50	M42 x 170	50	2/4 x M36
440	260	90	40	180	360	50	100	30	60	44	60	M48 x 180	60	2/4 x M42

[Units: mm, kN]

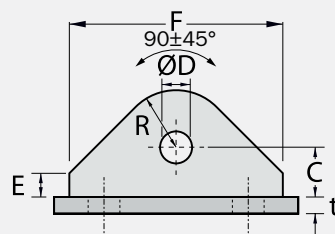
S-Series



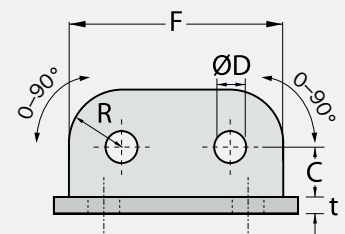
T-Series



CB1



CB2



CB3

- 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' local office.

Fender Fixings

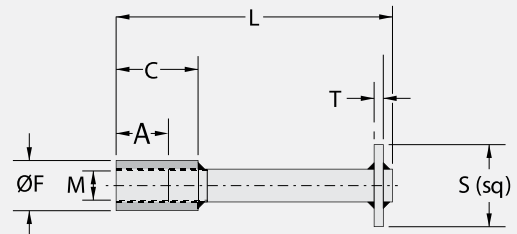
NC3 ANCHORS

THREAD	A	C	ØF	L	S (sq)	T	WEIGHT
M20	40	60	30	200	63	10	1.1
M22	44	66	32	225	63	10	1.4
M24	48	73	36	250	75	10	1.9
M27	54	84	40	265	75	10	2.4
M30	60	95	45	270	100	10	3.5
M36	72	112	54	320	100	12	5.5
M42	84	134	63	360	100	12	8.1
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	WEIGHT
M12	110	5 – 8	10	2.5	–	15	1 × C12	0.15
M16	140	6 – 9	13	3	175	20	1 × C16	0.26
M20	170	6 – 9	16	3	240	25	1 × C20	0.57
M24	210	8 – 12	19	4	270	28	1 × C24	0.92
M27	240	8 – 12	22	4	330	30	1 × C24	1.42
M30	280	8 – 12	24	4	360	35	1 × C30	1.91
M36	330	10 – 15	29	5	420	40	1 × C30	3.21
M42	420	14 – 21	34	7	500	50	2 × C30	5.21
M48	480	16 – 24	38	8	580	54	2 × C30 + 1 × C24	7.90
M56	560	18 – 27	45	9	–	64	4 × C30	13.0

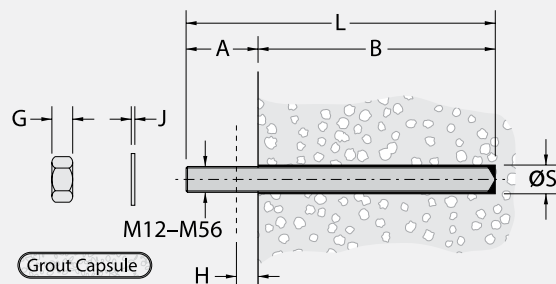
A = E + G + H + J, rounded up to nearest 10mm.

E = clear threads after assembly.

H = clamping thickness of fender.

[Units: mm, kg]

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.

Fender Fixings

BOLTS, NUTS AND WASHERS

SIZE	THREAD AREA *	WASHERS †				NUTS #			TYPICAL THREAD LENGTHS ‡		THREAD PITCH
	(mm ²)	OD	ID	t	WEIGHT	AF	T	WEIGHT	L ≤ 125	L > 125	
M16	157	30	18	3	0.01	24	13	0.04	38	44	2.0
M20	245	37	22	3	0.02	30	16	0.07	46	52	2.5
M24	353	44	26	4	0.03	36	19	0.12	54	60	3.0
M27	459	52	29	4	0.05	41	22	0.23	60	66	3.0
M30	561	56	33	4	0.06	46	24	0.24	66	72	3.5
M36	817	66	39	5	0.09	55	29	0.40	78	84	4.0
M42	1120	78	45	7	0.18	65	34	0.63	90	96	4.5
M48	1470	92	52	8	0.28	75	38	0.90	102	108	5.0
M56	2030	105	62	9	0.40	85	45	1.43	118	124	5.5
M64	2680	115	70	9	0.45	95	51	2.09	134	140	6.0

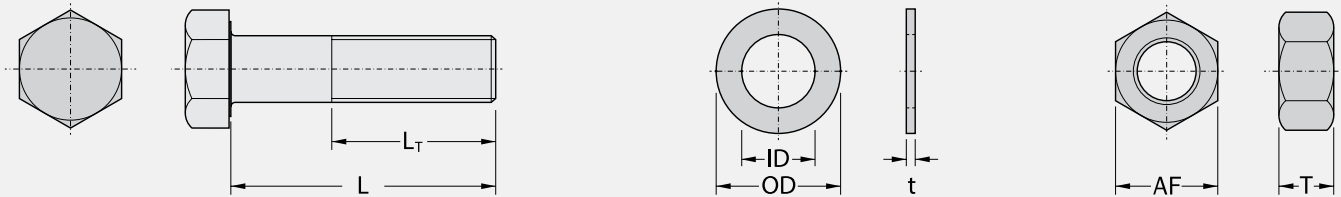
* Standard bolts given according to DIN933.

[Units: mm, kg]

† Standard washers given according to DIN125. Larger OD washers available on request.

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

Standard nuts given according to DIN934.



GRADES

	ISO 898 GALVANIZED		ISO 356 STAINLESS STEEL *	
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 Fender Application Design 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 galvanized or various stainless steels.

DISCLAIMER

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

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

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