



# Fender Systems

PRODUCT BROCHURE



# Fender Systems

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

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

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

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

Take a Smarter Approach to fender performance with Trelleborg.

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# A Smarter Approach at every stage

## A smarter approach to...

### CONSULTATION

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



### CONCEPTS

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



### DESIGN

Concepts are taken to our Engineering 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

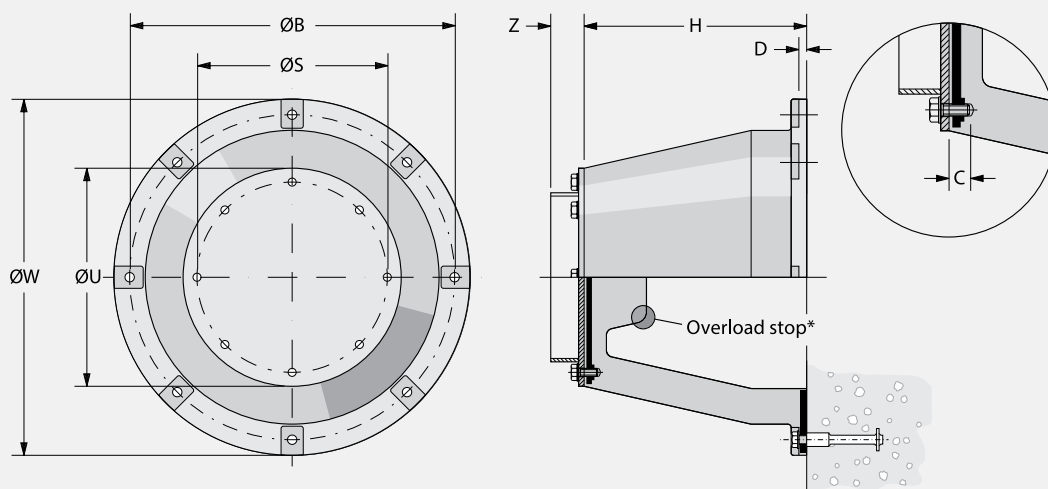
# Super Cone Fenders

## DIMENSIONS

	H	ØW	ØU	C	D	ØB	ØS	F0.9- 1.8 ANCHORS / HEAD BOLTS ^	F1.9- 3.1 ANCHORS / HEAD BOLTS ^	Z <sub>min</sub>	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 our 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 our local offices

[Units: mm]

# Super Cone Fenders

## PERFORMANCE DATA\*

			F 0.9 <sup>^</sup>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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]

Note: Refer to Index page 89 for 100% natural rubber in a compound.

# 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 <sub>R</sub>	14.2	14.4	14.6	14.8	15.1	15.3	15.5	15.8	16.0	16.2	18.6
		R <sub>R</sub>	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 <sub>R</sub>	22.3	22.8	23.2	23.7	24.2	24.6	25.1	25.5	26.0	26.5	28.8
		R <sub>R</sub>	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 <sub>R</sub>	32.9	33.6	34.3	35.0	35.7	36.6	37.5	38.4	39.3	40.3	43.7
		R <sub>R</sub>	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 <sub>R</sub>	62.9	64.5	66.1	67.6	69.2	70.8	72.4	74.0	75.6	77.2	84.0
		R <sub>R</sub>	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 <sub>R</sub>	83.8	85.8	87.8	89.9	91.9	94.0	96.0	98.1	100.1	102.2	112.4
		R <sub>R</sub>	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 <sub>R</sub>	105.1	108.5	111.9	115.3	118.7	122.0	125.4	128.8	132.2	135.6	149.2
		R <sub>R</sub>	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 <sub>R</sub>	189.3	193.8	198.2	202.7	207.2	211.7	216.2	220.6	225.1	229.6	253.1
		R <sub>R</sub>	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 <sub>R</sub>	279.3	286.6	293.9	301.3	308.6	315.7	322.8	329.9	337.0	344.1	378.5
		R <sub>R</sub>	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 <sub>R</sub>	342.8	351.8	360.9	370.0	379.0	388.3	397.6	406.9	416.1	425.4	467.4
		R <sub>R</sub>	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 <sub>R</sub>	390.1	400.6	411.2	421.7	432.3	442.6	453.0	463.3	473.7	484.0	532.4
		R <sub>R</sub>	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 <sub>R</sub>	460.0	472.3	484.7	497.0	509.3	521.6	533.9	546.3	558.6	570.9	628.1
		R <sub>R</sub>	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 <sub>R</sub>	534.4	548.6	562.8	577.1	591.3	605.5	619.8	634.0	648.2	662.5	729.3
		R <sub>R</sub>	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 <sup>^</sup>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	560.3	621.7	638.2	654.8	671.4	688	704.5	721.1	737.7	754.3	770.9	787.4
		R <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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	2913.0	3037.6	3133.4	3229.2	3325.0
	RPD	E <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	3707.6	4119.6	4229.5	4339.4	4449.4	4559.3	4669.2	4826.4	4983.6	5140.7	5297.9	5455.1

<sup>^</sup> Fender grades below F0.9 are available upon request.

[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.

# 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 <sub>R</sub>	615.9	632.2	648.6	664.9	681.3	697.6	714.0	730.3	746.7	763.0	839.3
		R <sub>R</sub>	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 <sub>R</sub>	710.7	729.2	747.7	766.3	784.8	803.3	821.9	840.4	858.9	877.5	965.7
		R <sub>R</sub>	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 <sub>R</sub>	809	830.5	852.1	873.6	895.2	916.7	938.3	959.8	981.4	1002.9	1104.1
		R <sub>R</sub>	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 <sub>R</sub>	923.2	947.2	971.2	995.2	1019.2	1043.1	1067.1	1091.1	1115.1	1139.1	1253.5
		R <sub>R</sub>	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 <sub>R</sub>	1164.9	1195.9	1226.9	1257.9	1289.0	1319.8	1350.6	1381.4	1412.2	1443.1	1587.4
		R <sub>R</sub>	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 <sub>R</sub>	1447.8	1486.3	1524.7	1563.2	1601.6	1639.9	1678.1	1716.3	1754.6	1792.8	1972.1
		R <sub>R</sub>	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 <sub>R</sub>	2143.2	2199.9	2256.6	2313.3	2370.1	2426.8	2483.5	2540.2	2596.9	2653.6	2919.0
		R <sub>R</sub>	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 <sub>R</sub>	3035.9	3116.4	3196.9	3277.4	3357.9	3438.2	3518.5	3598.8	3679.1	3759.5	4135.4
		R <sub>R</sub>	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 <sub>R</sub>	4138.2	4248.5	4358.7	4469.0	4579.2	4689.4	4799.7	4909.9	5020.2	5130.4	5643.4
		R <sub>R</sub>	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 <sub>R</sub>	5837.0	5992.4	6147.8	6303.2	6458.6	6614.0	6769.4	6924.8	7080.2	7235.6	7959.0
		R <sub>R</sub>	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 <sub>R</sub>	8006.4	8219.6	8432.9	8646.1	8859.4	9072.6	9285.9	9499.1	9712.4	9925.7	10917.9
		R <sub>R</sub>	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]

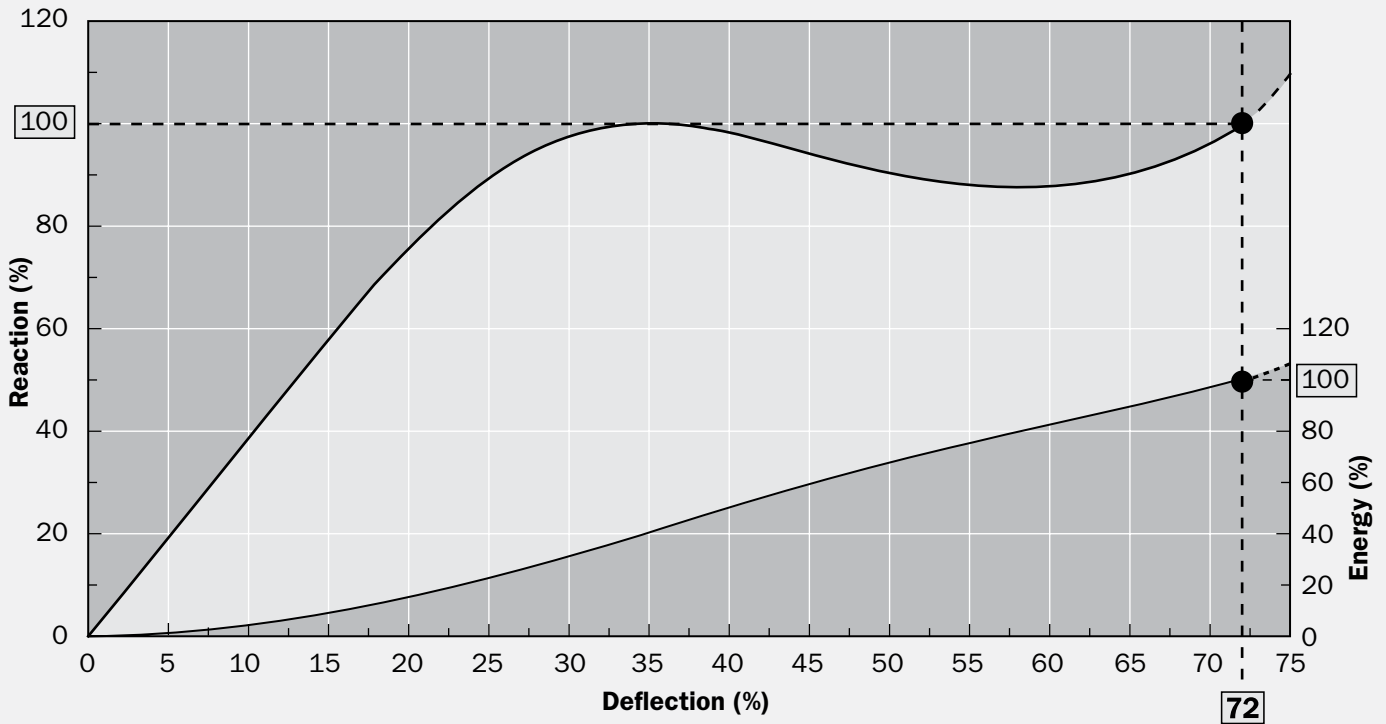
- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing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

# Super Cone Fenders

## INTERMEDIATE DEFLECTIONS

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

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

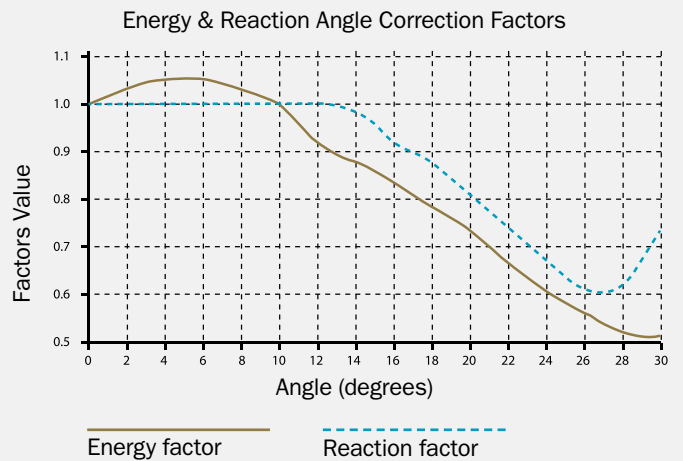


Generic curve shown. Actual curve geometry may vary depending on grade, temperature, velocity and angle.

### 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 (REFER TO APPENDIX A)	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.)

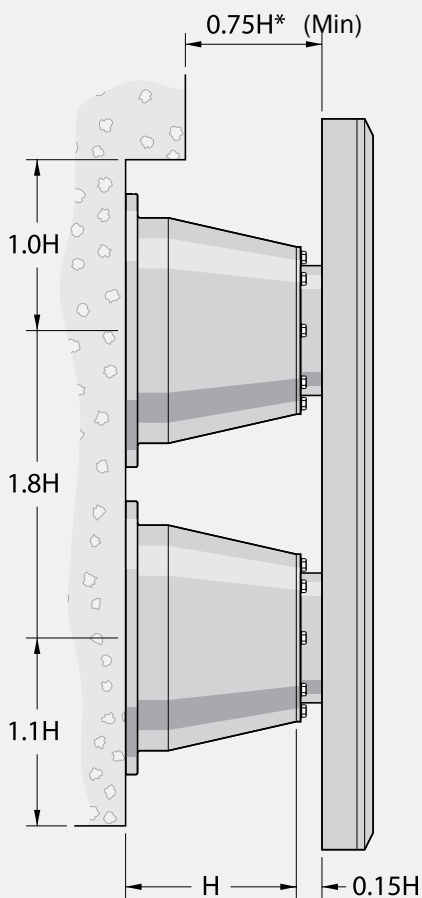
\* Applicable for both partial deflection and rated deflection.

## TEMPERATURE FACTOR (TF) TABLE

TEMPERATURE (°C)	BLEND OF NATURAL AND SYNTHETIC RUBBER (CATALOG COMPOUND)	100% NATURAL RUBBER (REFER TO APPENDIX A)	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.

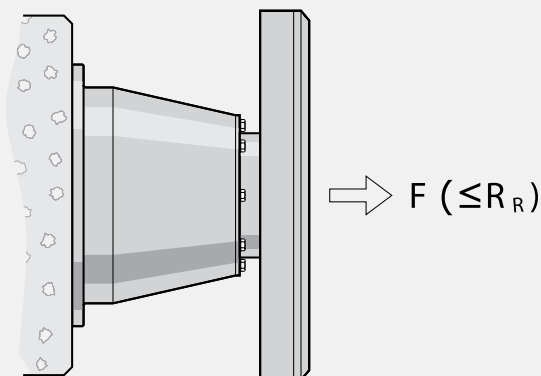
Distances given in the above diagram are for guidance. Please enquire if in doubt.

\*Does not allow for bow flares

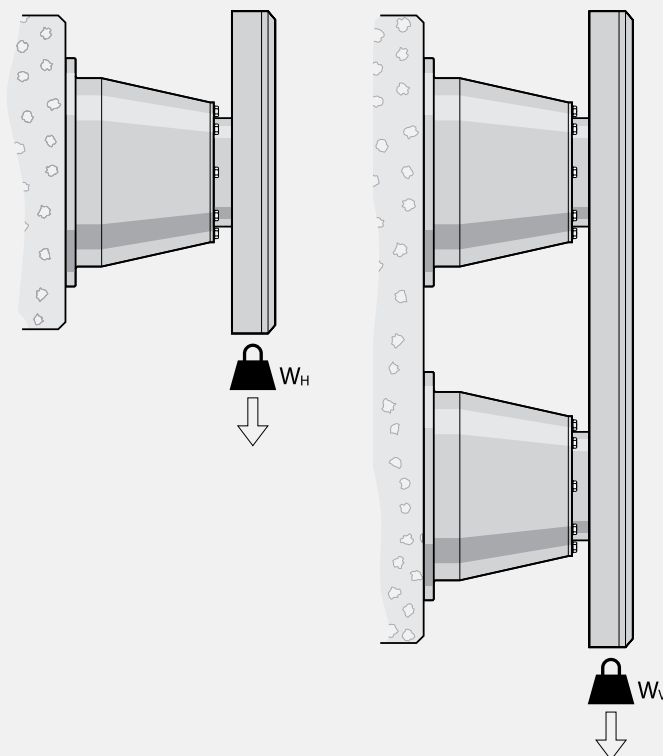
## TENSION

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 ≥ 1)	MULTIPLE VERTICAL (n ≥ 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

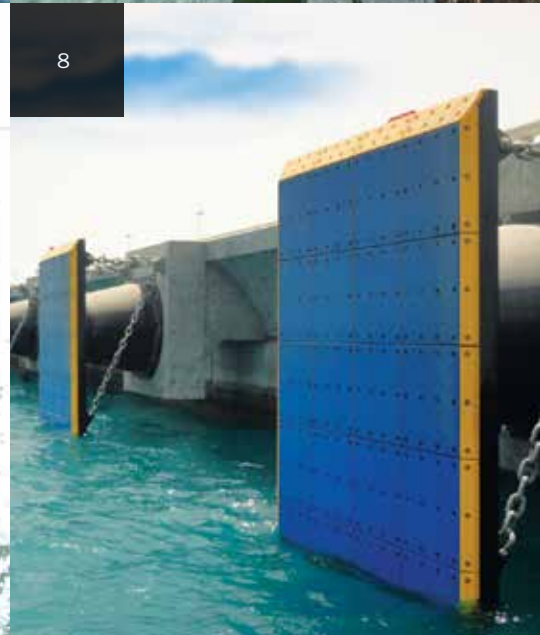
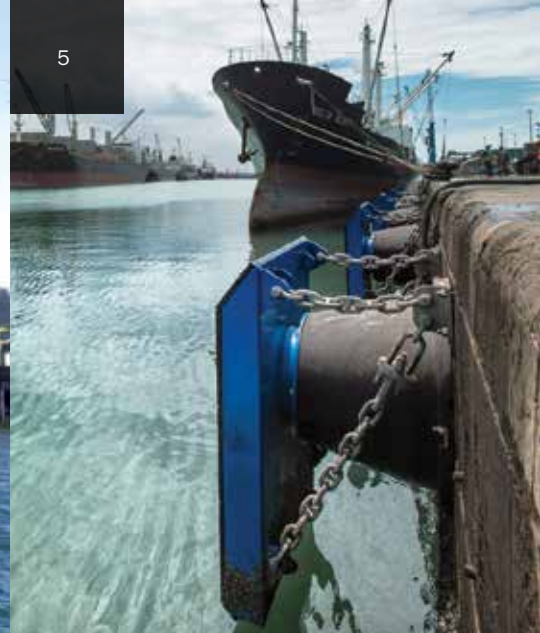
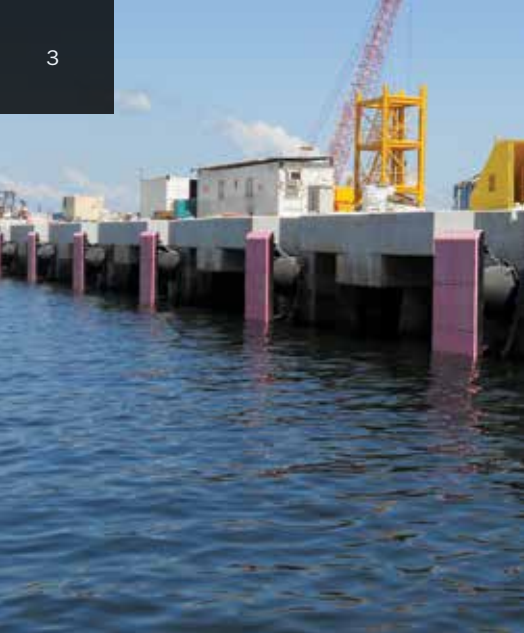
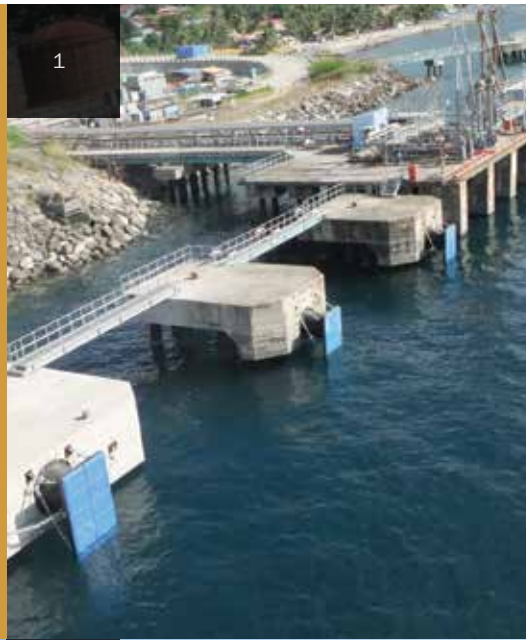
$W_H$  = Panel weight (single or multi-horizontal)

$W_V$  = 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

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Can support large panels

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Strong, well-proven design

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Ideal for low hull pressure systems

## APPLICATIONS

Oil and LNG facilities

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Bulk terminals

---

Offshore platforms

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Container berths

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RoRo and cruise terminals

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Multi-user berths

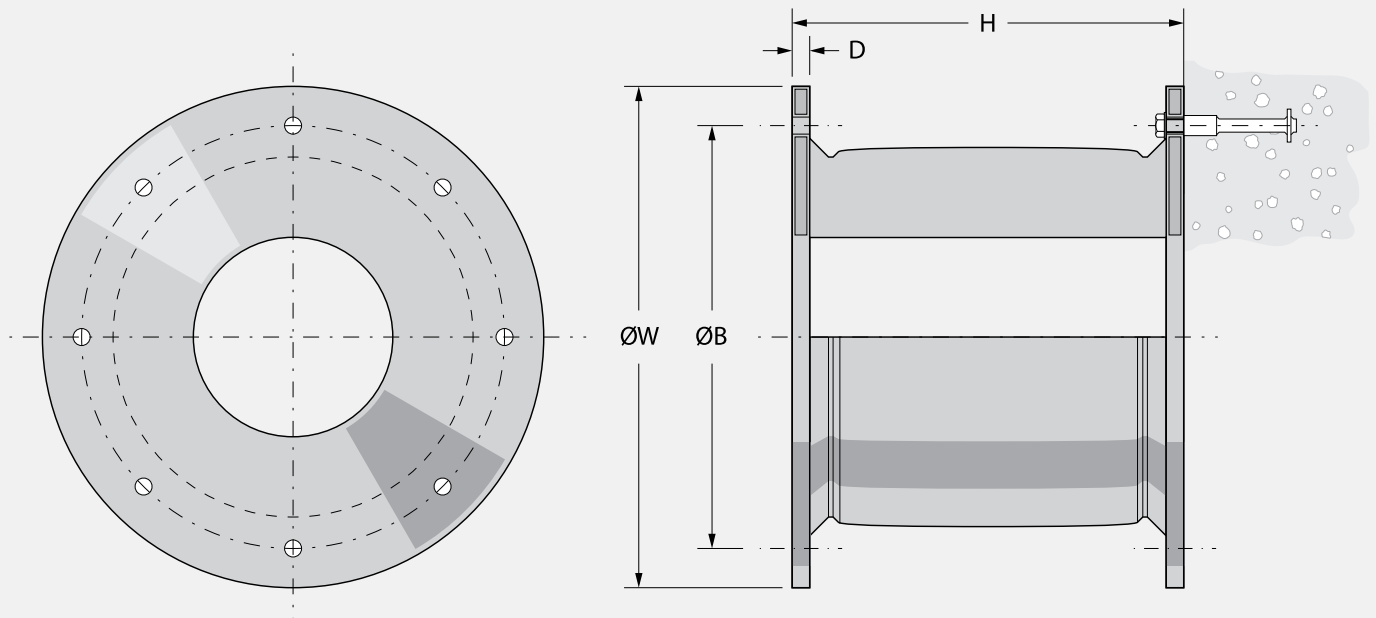
# SCK Cell Fenders

## DIMENSIONS

	H	ØW	ØB	D	ANCHORS / HEAD BOLTS <sup>^</sup>	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

<sup>^</sup> Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact our 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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	19.2	19.7	20.1	20.6	21.1	21.8	22.5	23.2	23.9	24.6	26.9
		R <sub>R</sub>	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 <sub>R</sub>	35.7	36.8	38.0	39.1	40.3	41.2	42.1	43.0	43.9	44.9	49.5
		R <sub>R</sub>	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 <sub>R</sub>	72.7	74.8	76.8	78.9	80.9	83.0	85.0	87.1	89.1	91.2	100.3
		R <sub>R</sub>	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 <sub>R</sub>	145.3	149.8	154.4	158.9	163.4	167.8	172.1	176.4	180.7	185.0	203.2
		R <sub>R</sub>	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 <sub>R</sub>	287.2	295.5	303.7	312.0	320.3	328.8	337.3	345.9	354.4	362.9	398.7
		R <sub>R</sub>	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 <sub>R</sub>	431.4	444.0	456.6	469.2	481.8	494.2	506.5	518.9	531.3	543.7	597.8
		R <sub>R</sub>	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 <sub>R</sub>	550.7	566.7	582.8	598.8	614.9	631.2	647.5	663.7	680.0	696.3	765.6
		R <sub>R</sub>	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 <sub>R</sub>	853.3	878.1	903.0	927.8	952.7	977.5	1002.4	1027.2	1052.1	1076.9	1183.7
		R <sub>R</sub>	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 <sub>R</sub>	1146.2	1179.6	1213.0	1246.3	1279.7	1313.0	1346.4	1379.7	1413.1	1446.4	1591.4
		R <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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 <sub>R</sub>	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:**

- 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  $TF = 1$ ,  $AF = 1$ .

# 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 <sub>R</sub>	1375.1	1415.0	1454.9	1494.8	1534.7	1574.8	1614.9	1655.1	1695.2	1735.3	1908.6
		R <sub>R</sub>	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 <sub>R</sub>	2207.8	2272.1	2336.4	2400.7	2465.0	2529.3	2593.5	2657.8	2722.1	2786.4	3064.8
		R <sub>R</sub>	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 <sub>R</sub>	3472.8	3574.0	3675.2	3776.5	3877.7	3978.7	4079.7	4180.7	4281.7	4382.7	4821.4
		R <sub>R</sub>	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 <sub>R</sub>	4719.8	4857.1	4994.5	5131.9	5269.3	5406.6	5544.0	5681.4	5818.8	5956.1	6551.9
		R <sub>R</sub>	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 <sub>R</sub>	7099.9	7300.2	7500.6	7700.9	7901.3	8101.6	8301.9	8502.3	8702.6	8903.0	9793.4
		R <sub>R</sub>	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]

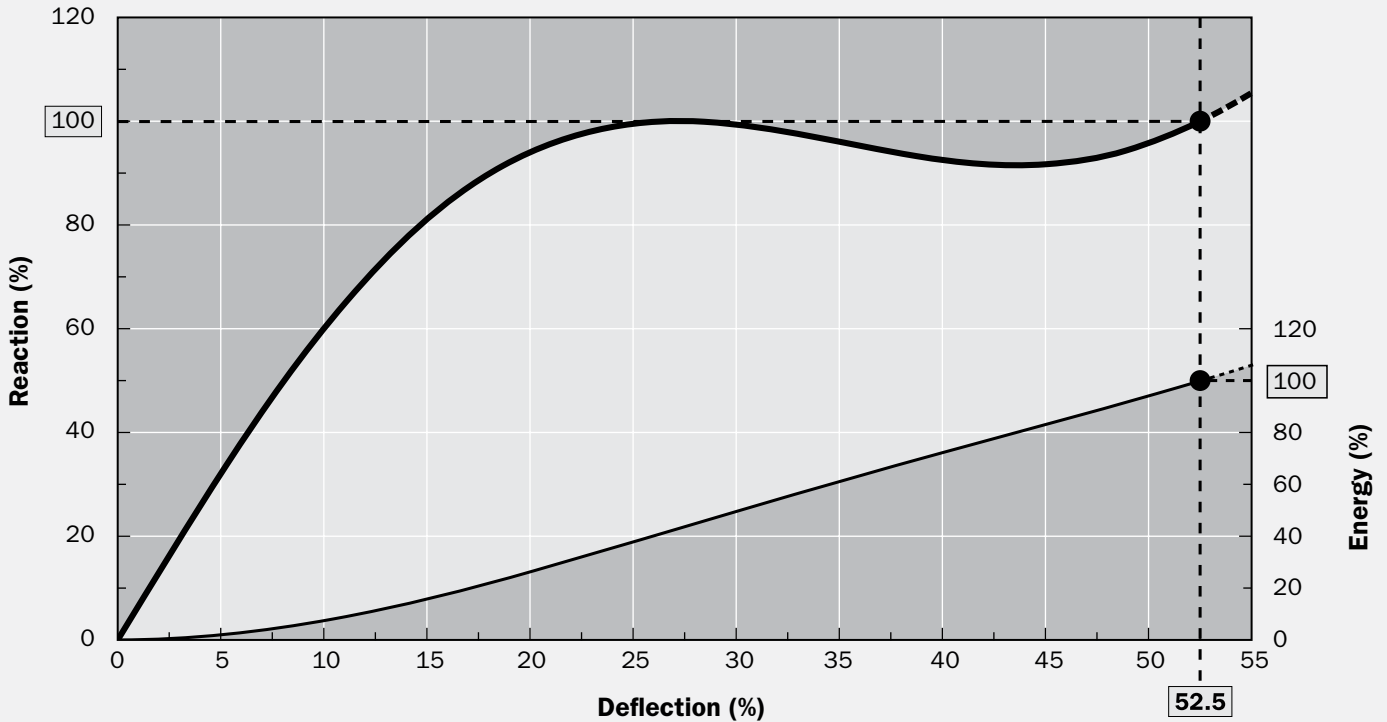
- For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
- If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s, 0° compression angle and 23 ±5°C testing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

# SCK Cell Fenders

## INTERMEDIATE DEFLECTIONS

<b>D<sub>i</sub> (%)</b>	0	5	10	15	20	25	30	35	40	45	50	<b>52.5</b>	55
<b>E<sub>i</sub> (%)</b>	0	2	7	16	26	38	50	61	72	83	94	<b>100</b>	106
<b>R<sub>i</sub> (%)</b>	0	32	60	81	94	99	99	96	92	92	96	<b>100</b>	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:  $t = d / (f * Vd)$

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.)

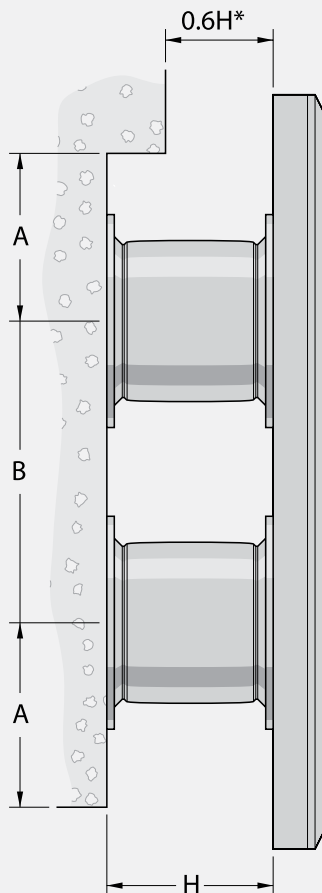
\* Applicable for both partial deflection and rated deflection.

## 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

# SCK Cell Fenders

## CLEARANCES



\*Does not allow for bow flares

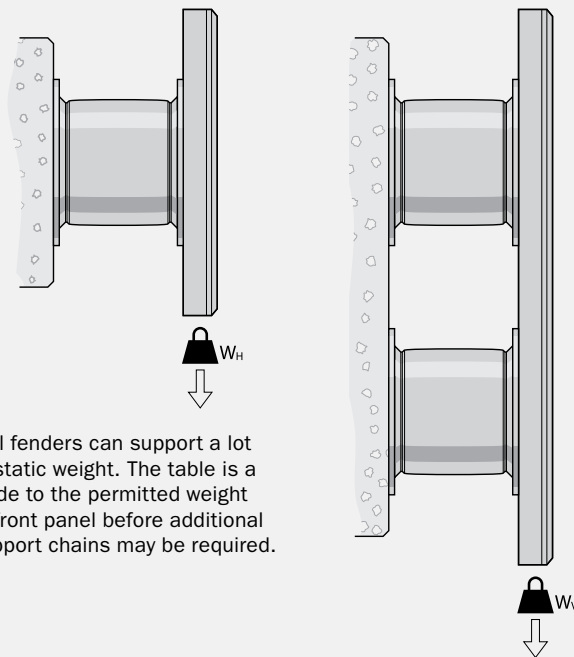
There must be enough space around and between the Cell fenders and the steel panel to allow them to deflect without interference.

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 ≥ 1)	MULTIPLE VERTICAL (n ≥ 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	$W_H \leq n \times 25 \times W^{0.6}$	$W_V \leq n \times 31.25 \times W^{0.6}$	

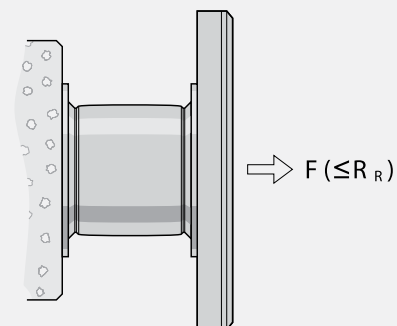
n = number of Cell fenders.

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 and MI elements solutions.**

FENDERS	FEATURES	APPLICATIONS
<b>MV Elements</b>	<ul style="list-style-type: none"> <li>Modular design system</li> <li>Many standard sizes</li> <li>High performance geometry</li> <li>Recessed fixings</li> <li>Long life, low maintenance</li> </ul>	<ul style="list-style-type: none"> <li>All vessel types which use the following systems:</li> <li>Fender piles</li> <li>V-fenders</li> <li>Multiple fenders</li> <li>Pivot pillars</li> <li>Parallel Motion (Torsion Arm)</li> </ul>
<b>MV V-Fenders</b>	<ul style="list-style-type: none"> <li>Simple, modular design</li> <li>Low-friction shield</li> <li>Non-marking face</li> <li>Reduced hull pressure</li> <li>Easy maintenance</li> </ul>	<ul style="list-style-type: none"> <li>General cargo quays</li> <li>Berthing dolphins</li> <li>Pontoon fendering</li> <li>Passenger ferry berths</li> <li>Offshore platforms</li> <li>Long fender walls</li> </ul>
<b>MI-2000 Elements</b>	<ul style="list-style-type: none"> <li>Modular design system</li> <li>Choice of lengths and rubber grades</li> <li>High performance and efficiency</li> <li>Long life, low maintenance</li> </ul>	<ul style="list-style-type: none"> <li>Ideal for larger vessels including:</li> <li>Tankers and LNG ships</li> <li>Bulk carriers</li> <li>Post-Panamax containers</li> <li>Mega cruise ships</li> </ul>

# 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
	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
	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
	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 fender performance and using a particular grade of steel. Please contact our local office for precise size, material and type for different grades of fenders pertaining to the project requirements..

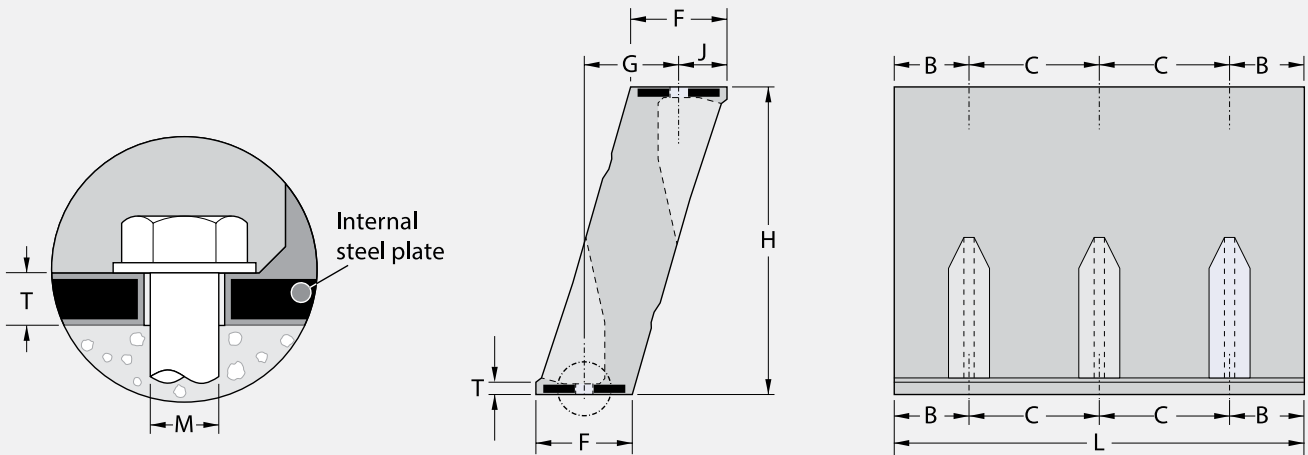
# MV Elements

## 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	250							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	250							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	250							4 + 4	2228

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

[Units: mm, kg]



# MV 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
300	E	6.9	7.6	7.9	8.1	8.3	8.6	8.8	9	9.2	9.5	9.7	9.9
	R	54.8	60.8	62.7	64.5	66.3	68.1	70	71.8	73.6	75.4	77.3	79.1
400	E	11.9	13.3	13.7	14.1	14.5	14.9	15.3	15.7	16.1	16.5	16.8	17.2
	R	72.8	80.9	83.3	85.7	88.2	90.6	93	95.4	97.9	100	102	105
500	E	19.8	22	22.6	23.3	23.9	24.6	25.2	25.9	26.6	27.2	27.9	28.5
	R	91.1	101	104.2	107	110	113	116	119	122	125	128	131
550	E	24.2	26.9	27.7	28.5	29.3	30.1	30.9	31.7	32.5	33.3	34.1	34.9
	R	100	111	114	117	121	124	127	131	134	137	141	144
600	E	28.6	31.8	32.7	33.7	34.7	35.6	36.6	37.5	38.5	39.4	40.4	41.3
	R	109	121	125	128	132	136	139	143	147	150	154	158
750	E	44.6	49.6	51.1	52.6	54	55.5	57	58.5	60	61.5	63	64.5
	R	136	151	156	160	165	170	174	179	183	188	192	197
800	E	51.1	56.8	58.5	60.2	61.9	63.6	65.3	67	68.7	70.4	72.1	73.8
	R	145	161	166	171	176	181	186	190	195	200	205	210
1000	E	79.7	88.6	91.2	93.9	96.5	99.2	101	104	107	109	112	115
	R	182	202	208	214	220	226	232	238	244	251	257	263
1250	E	124	138	142	146	150	154	158	163	167	171	175	179
	R	227	253	260	268	275	283	290	298	306	313	321	328
1450	E	167	185	191	197	202	208	213	219	224	230	236	241
	R	263	293	302	310	319	328	337	346	354	363	372	381
1600	E	203	226	233	239	246	253	260	267	273	280	287	294
	R	291	323	333	343	353	362	372	382	391	401	411	421

		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
300	E	10.2	10.5	10.8	11.1	11.4	11.7	12.0	12.3	12.6	12.9	14.2
	R	81.5	83.8	86.2	88.6	91.0	93.3	95.7	98.1	100	102	113
400	E	17.8	18.3	18.8	19.3	19.8	20.4	20.9	21.4	21.9	22.4	24.7
	R	108	111	114	117	120	124	127	130	133	136	150
500	E	29.4	30.3	31.1	32.0	32.8	33.7	34.5	35.4	36.2	37.1	40.8
	R	135	139	143	147	151	155	159	163	167	171	188
550	E	36.0	37.0	38.1	39.1	40.2	41.2	42.3	43.3	44.4	45.4	50.0
	R	148	153	157	161	166	170	174	179	183	187	206
600	E	42.6	43.8	45.1	46.3	47.5	48.8	50.0	51.3	52.5	53.7	59.1
	R	162	167	172	176	181	186	191	195	200	205	225
750	E	66.4	68.3	70.3	72.2	74.1	76.1	78.0	79.9	81.9	83.8	92.2
	R	203	209	215	221	226	232	238	244	250	256	282
800	E	76	78.2	80.5	82.7	84.9	87.1	89.3	91.5	93.7	96	105
	R	216	222	229	235	241	248	254	260	267	273	300
1000	E	118	122	125	129	132	135	139	142	146	149	164
	R	271	278	286	294	302	310	318	326	334	342	376
1250	E	185	190	195	201	206	211	217	222	228	233	256
	R	338	348	358	368	378	388	398	407	417	427	470
1450	E	248	256	263	270	277	285	292	299	306	314	345
	R	392	404	415	427	438	449	461	472	484	495	545
1600	E	303	311	320	329	338	347	356	364	373	382	420
	R	433	446	459	471	484	496	509	522	534	547	602

[Units: kNm, kN]

\*Note:

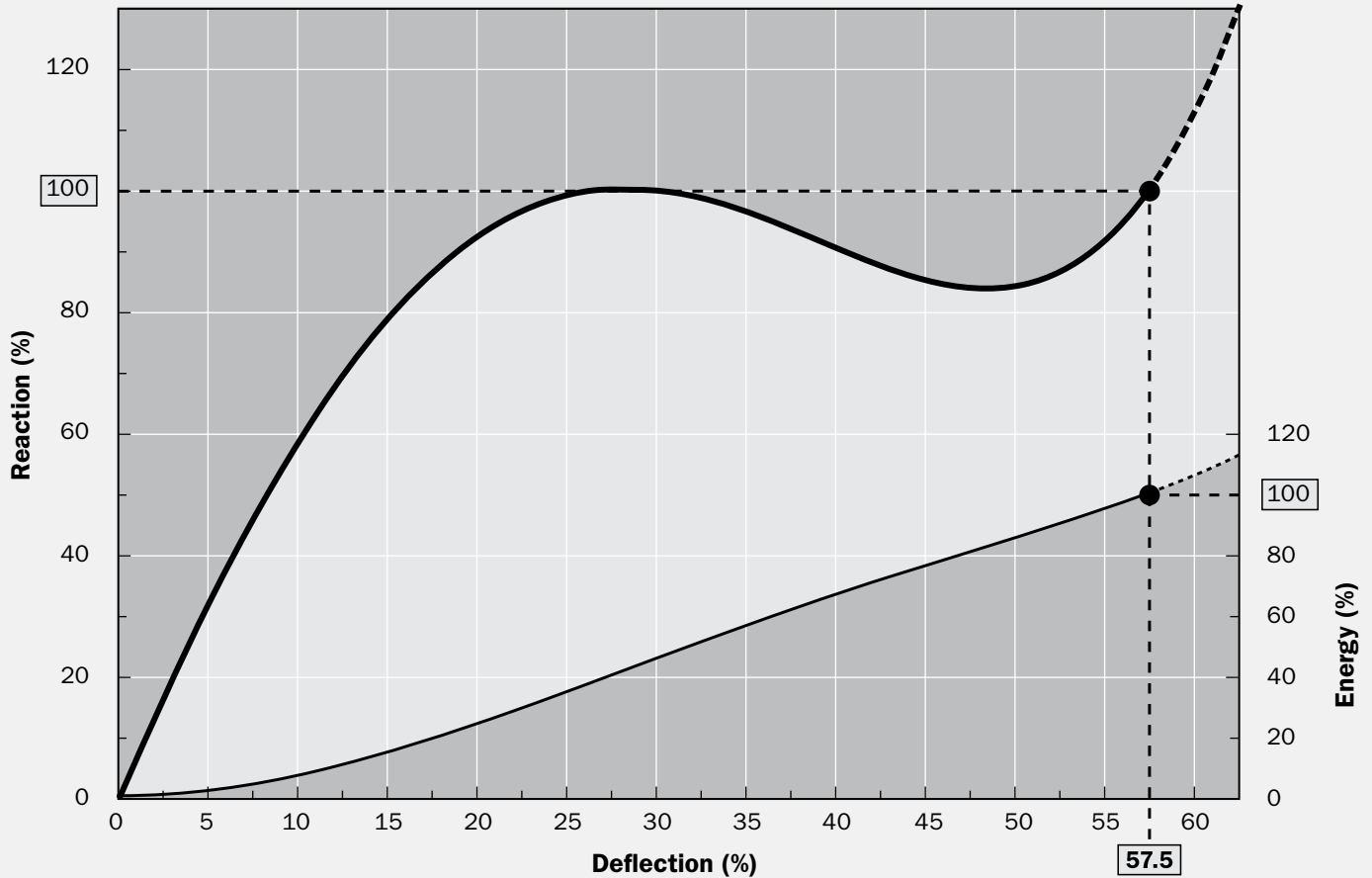
1. CV: Performance data at slow speed constant velocity (2-8 cm/min) compression at  $23 \pm 5^\circ\text{C}$  temperature and  $0^\circ$  compression angle.
2. For other initial berthing velocities, temperature and berthing angle, VF/ TF/ AF should be calculated separately and apply on CV performance to come to the final performance.
3. If fenders are tested in decreasing velocity (DV) mode at initial velocity 0.15 m/s,  $0^\circ$  compression angle and  $23 \pm 5^\circ\text{C}$  testing temperature, RPD = DV (performance).
4. Fender performance is subject to  $\pm 10\%$  manufacturing tolerance (+10% for reaction force and -10% for energy).
5. CV performance is based on a rubber compound blend of natural and synthetic rubber.

# MV Elements

## INTERMEDIATE DEFLECTIONS

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

# MV Elements

## VELOCITY FACTOR (VF) TABLE

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

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

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
	TF	TF
+50	0.916	0.914
+40	0.947	0.946
+30	0.978	0.978
+23	1.000	1.000
+10	1.030	1.025
+0	1.075	1.053
-10	1.130	1.080
-20	1.249	1.142
-30	1.540	1.315

Contact Trelleborg for the performance data and use of 100% Natural MV Elements.

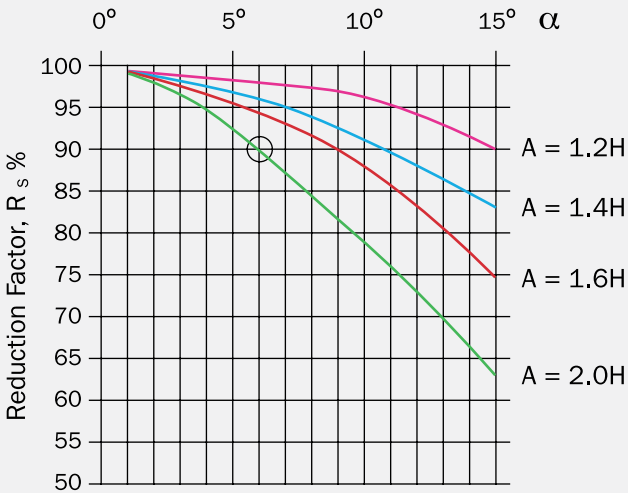
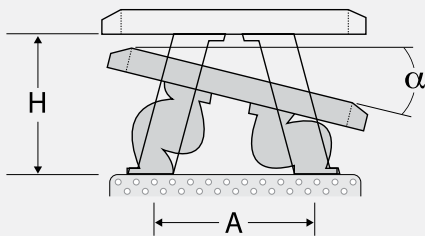
# MV Elements

## 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 E3.0  
 Energy absorption  $E = 2 \times 149 \times 2\text{m} = 596 \text{ kNm}$   
 Angular berthing  $6^\circ$   
 $A = 2.0 H$   
 Reduction factor  $R_s = 0.9$   
 Energy absorption  $E_{6^\circ} = 0.9 \times 596 = 536.4 \text{ kNm}$



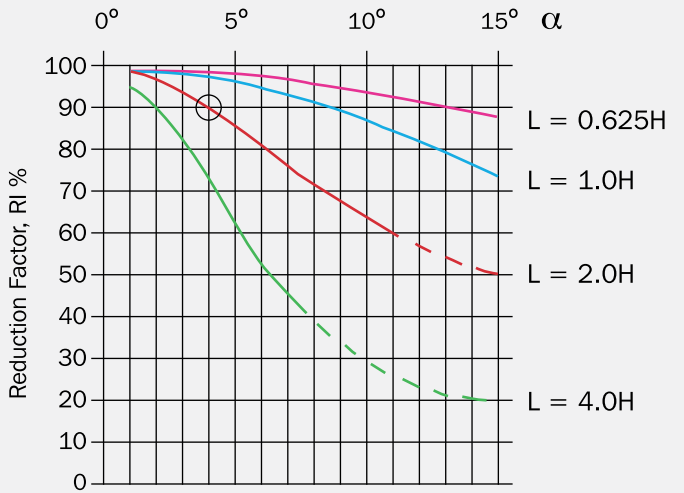
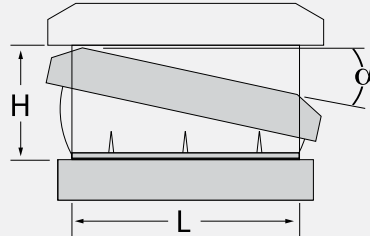
- The above curves are valid for all MV-element sizes.
- The characteristics consider an average rated reaction force and therefore the reaction force should always be the same as  $0^\circ$  compression.
- For ratios and angles not given, one may interpolate.
- In the case of both transverse and longitudinal 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 E2.0  
 Energy absorption  $E = 2 \times 64.5 \times 1.5\text{m} = 193.5 \text{ kNm}$   
 Angular berthing  $4^\circ$   
 $L = 2.0 H$   
 Reduction factor  $R_l = 0.9$   
 Energy absorption  $E_{4^\circ} = 0.9 \times 193.5 = 174.15 \text{ kNm}$



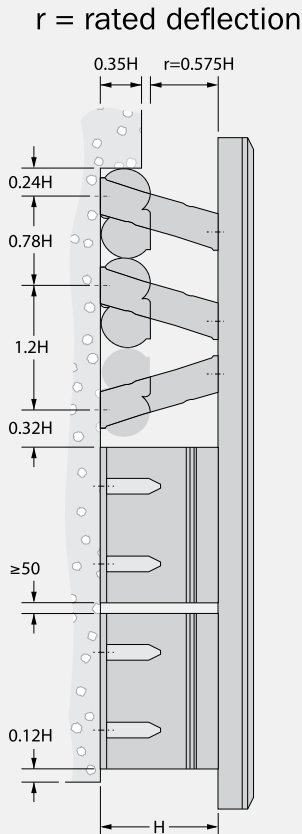
Example  
 Bow radius gives transverse  $\alpha = 6^\circ ; R_s = 0.9$   
 Flare gives longitudinal  $\alpha = 4^\circ ; R_l = 0.9$   
 $R_{\text{total}} = 0.9 \times 0.9 = 0.81$

# 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.

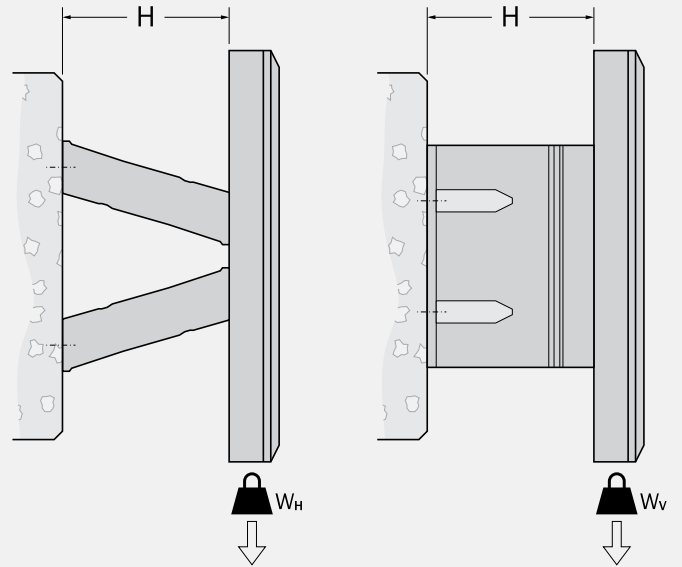
Distances given in the diagram are for guidance. If in doubt, contact your local office.



## WEIGHT SUPPORT

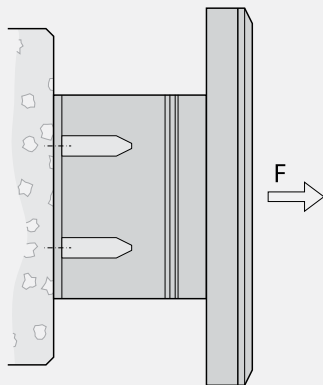
MV-elements can support a lot of weight.

Please contact Trelleborg for full weight support details.



## TENSION

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



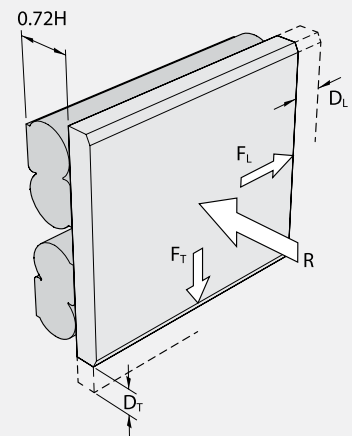
## SHEAR STIFFNESS

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

$$D_L \approx 0.39 \times \mu \times H$$

$$D_T \approx 0.82 \times \mu \times H$$

Where,  
 $H = \text{fender height}$   
 $\mu = \text{friction coefficient}$





# MV V-Fenders

## DIMENSIONS

H	T(min)	So	M <sub>w</sub>	S <sub>w</sub>	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

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.

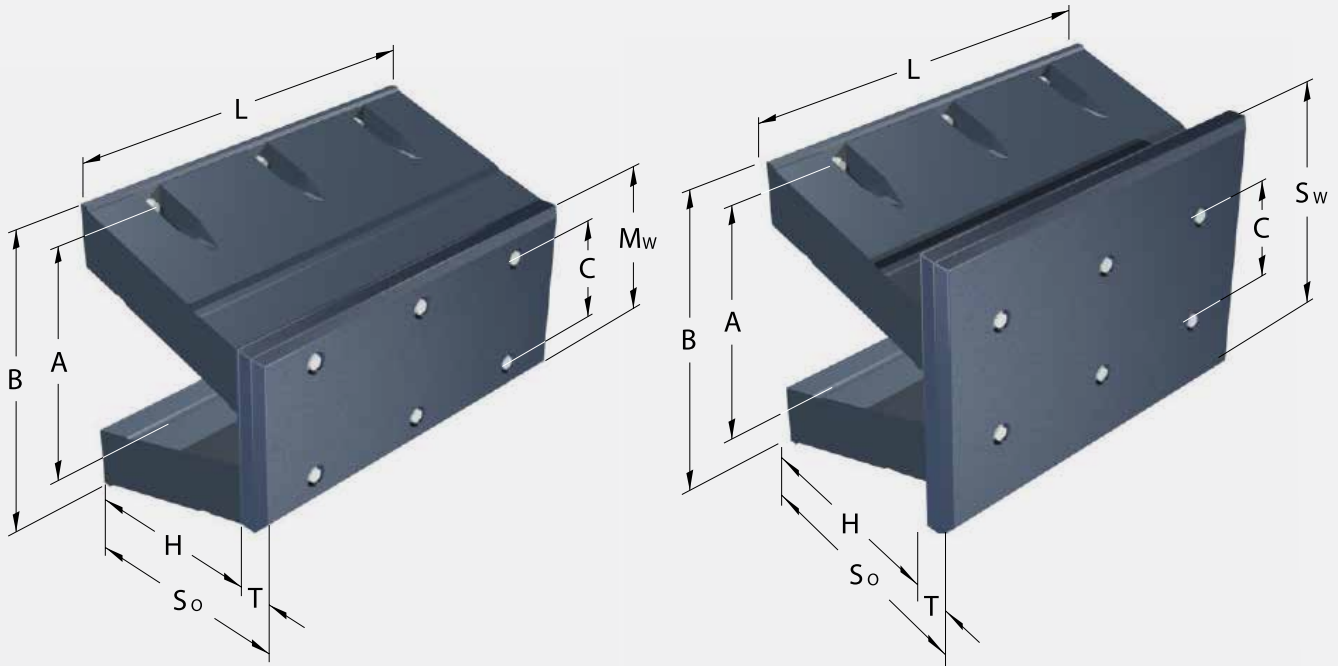
For performance MV-Fender, see performance table MV Elements page 28. For the MV-V Fender performance, consider 2 elements (pair).

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.



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.

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



# 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

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Strong and hard wearing

---

Excellent shear performance

---

Large range of standard sizes

## APPLICATIONS

RoRo berths

---

General cargo

---

Workboat harbors

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Barge and tug berths

# SAN / SANP Super Arch Fenders

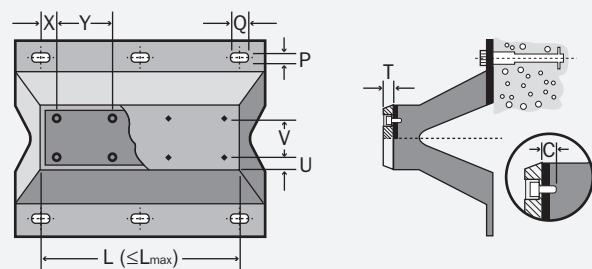
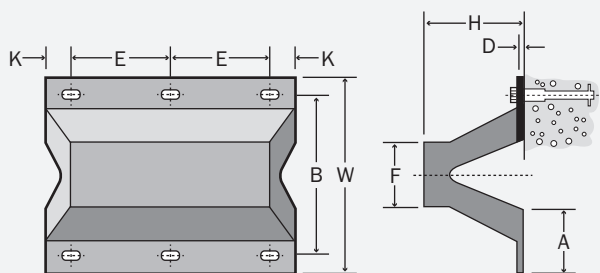
## DIMENSIONS

BODY DIMENSIONS SAN / SANP									WEIGHT (kg/m)	
H	A	B	W	F	D	K	P	Q	SAN	SANP
SAN/SANP 150	98	240	300	112	24	50	24	48	37	44
SAN/SANP 200	130	320	400	150	24	50	28	56	61	70
SAN/SANP 250	162.5	410	500	187.5	25	62.5	28	56	90	102
SAN/SANP 300	195	480	600	225	30	75	34	68	135	154
SAN/SANP 400	260	670	800	300	35	100	40	80	252	288
SAN/SANP 500	325	840	1000	375	40	125	46	92	363	409
SAN/SANP 600	390	1010	1200	450	45	150	52	104	543	607
SAN/SANP 800	520	1340	1600	600	50	200	60	120	931	1028
SAN/SANP 1000	650	1680	2000	750	60	250	60	120	1495	1633

[Units: mm, kg/m]

### SAN SUPER ARCH FENDER

### SANP SUPER ARCH FENDER



### FOOT BOLTING DIMENSIONS

FENDER	ANCHORS / HEAD BOLTS <sup>^</sup>	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]

<sup>^</sup> Fender anchors / head bolts indicated are based on fenders Pre-Set Design Criteria using a particular grade of steel. Please contact our 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 <sub>R</sub>	6.0	6.5	7.0	7.4	7.9	8.4	8.6	8.9	9.1	9.4	9.6
		R <sub>R</sub>	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 <sub>R</sub>	12.0	12.5	13.0	13.4	13.9	14.4	14.9	15.4	15.8	16.3	16.8
		R <sub>R</sub>	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 <sub>R</sub>	17.9	18.6	19.3	20.0	20.7	21.4	22.1	22.8	23.6	24.3	25.0
		R <sub>R</sub>	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 <sub>R</sub>	26.0	26.9	27.8	28.8	29.7	30.7	31.9	33.0	34.2	35.4	36.6
		R <sub>R</sub>	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 <sub>R</sub>	44.5	46.3	48.2	50.1	51.9	53.8	55.7	57.6	59.4	61.3	63.2
		R <sub>R</sub>	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 <sub>R</sub>	69.3	72.3	75.3	78.3	81.3	84.3	87.1	89.9	92.6	95.4	98.2
		R <sub>R</sub>	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 <sub>R</sub>	98.9	103.0	107.2	111.3	115.5	119.6	123.7	127.9	132.0	136.2	140.3
		R <sub>R</sub>	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 <sub>R</sub>	174.8	182.1	189.3	196.6	203.8	211.1	218.4	225.6	232.9	240.2	247.4
		R <sub>R</sub>	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 <sub>R</sub>	268.8	280.0	291.2	302.4	313.6	324.8	336.0	347.2	358.4	369.6	380.8
		R <sub>R</sub>	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.  
 $RPD = CV \text{ (performance)} \times VF \text{ (velocity factor for Natural and Synthetic rubber blend)} \times TF \text{ (temperature factor)} \times AF \text{ (angle factor)}$ .  
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore  $TF = 1$ ,  $AF = 1$ .

# 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 <sub>R</sub>	9.8	10.1	10.3	10.6	10.8	11.0	11.3	11.5	11.8	12.0
		R <sub>R</sub>	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 <sub>R</sub>	17.3	17.8	18.2	18.7	19.2	19.7	20.2	20.6	21.1	21.6
		R <sub>R</sub>	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 <sub>R</sub>	25.5	25.9	26.4	26.9	27.4	28.6	29.8	30.9	32.1	33.3
		R <sub>R</sub>	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 <sub>R</sub>	37.5	38.5	39.4	40.4	41.3	42.5	43.7	44.8	46.0	47.2
		R <sub>R</sub>	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 <sub>R</sub>	65.1	66.9	68.8	70.7	72.5	74.4	76.3	78.2	80.0	81.9
		R <sub>R</sub>	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 <sub>R</sub>	101.2	104.2	107.2	110.2	113.2	116.0	118.7	121.5	124.3	127.1
		R <sub>R</sub>	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 <sub>R</sub>	144.4	148.6	152.7	156.9	161.0	165.1	169.3	173.4	177.6	181.7
		R <sub>R</sub>	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 <sub>R</sub>	254.7	262.0	269.2	276.5	283.8	291.0	298.3	305.5	312.8	320.1
		R <sub>R</sub>	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 <sub>R</sub>	392.0	403.2	414.4	425.6	436.8	448.0	459.2	470.4	481.6	492.8
		R <sub>R</sub>	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).
- CV performance is based on a rubber compound blend of natural and synthetic rubber.

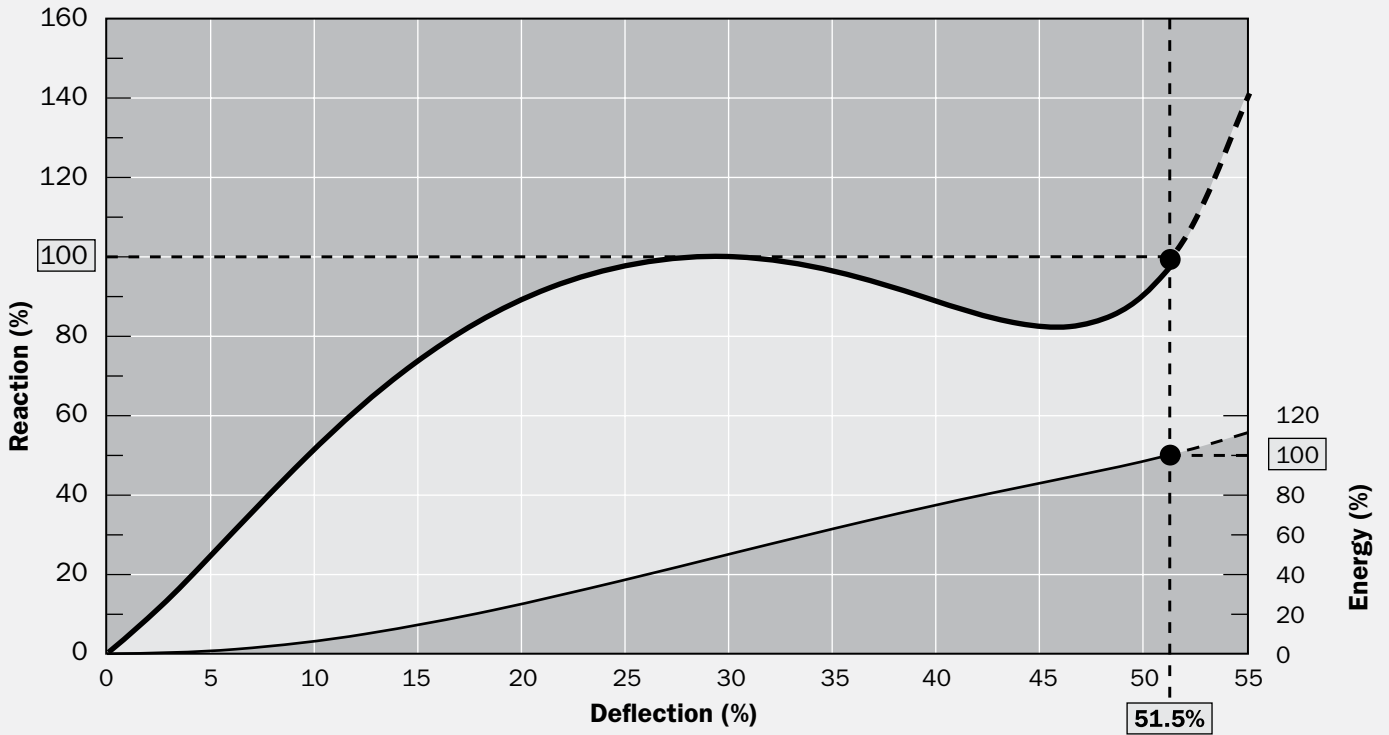
\* Values are per 1000mm of length L.

# SAN / SANP Super Arch Fenders

## INTERMEDIATE DEFLECTIONS

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

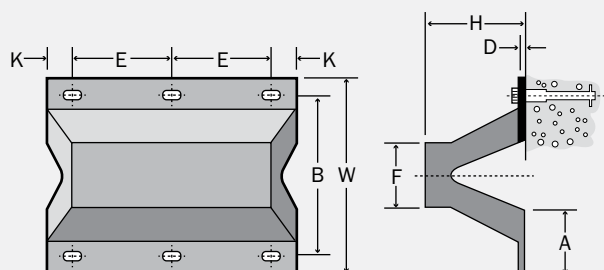
# AN / ANP Arch Fenders

	L <sub>max</sub>	H	A	B	W	F	D	K	E	P×Q	ANCHORS / HEAD BOLTS <sup>^</sup>	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

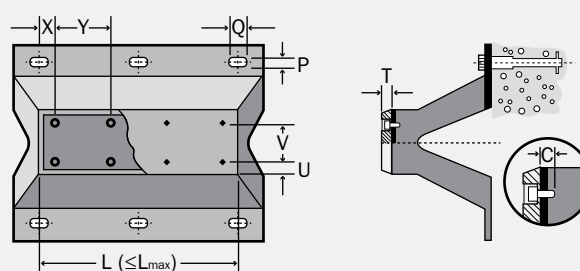
<sup>^</sup> Fender anchors / head bolts indicated are based on fenders RDP performance using a particular grade of steel. Please contact our local office for precise size, material and type for different grades of fenders pertaining to the project requirements.

[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 / 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	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 <sub>R</sub>	5.2	5.3	5.5	5.7	5.8	6.0	6.1	6.3	6.4	6.6
		R <sub>R</sub>	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 <sub>R</sub>	9.1	9.4	9.7	10.0	10.3	10.6	10.8	11.1	11.4	11.7
		R <sub>R</sub>	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 <sub>R</sub>	14.2	14.6	15.1	15.5	16.0	16.4	16.9	17.3	17.7	18.1
		R <sub>R</sub>	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 <sub>R</sub>	20.2	20.8	21.5	22.1	22.7	23.4	24.0	24.6	25.3	25.9
		R <sub>R</sub>	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 <sub>R</sub>	35.7	36.8	37.9	39.1	40.2	41.3	42.4	43.5	44.6	45.7
		R <sub>R</sub>	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 <sub>R</sub>	55.0	56.7	58.4	60.1	61.8	63.5	65.2	66.9	68.7	70.4
		R <sub>R</sub>	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 <sub>R</sub>	78.9	81.4	83.8	86.3	88.7	91.2	93.6	96.1	98.5	100.9
		R <sub>R</sub>	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 <sub>R</sub>	138.5	142.8	147.1	151.4	155.7	160.0	164.3	168.7	173.0	177.3
		R <sub>R</sub>	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 <sub>R</sub>	213.9	220.6	227.4	234.1	240.8	247.5	254.0	260.5	267.0	273.5
		R <sub>R</sub>	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.  
 $RPD = CV \text{ (performance)} \times VF \text{ (velocity factor for Natural and Synthetic rubber blend)} \times TF \text{ (temperature factor)} \times AF \text{ (angle factor)}$   
 RPD is reported at 23 ±5°C temperature and 0° compression angle, therefore  $TF = 1$ ,  $AF = 1$ .

# AN / 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	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 <sub>R</sub>	6.7	6.9	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.7	8.9
		R <sub>R</sub>	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 <sub>R</sub>	12.0	12.4	12.8	13.2	13.5	13.9	14.3	14.6	15.0	15.4	15.7
		R <sub>R</sub>	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 <sub>R</sub>	18.6	19.2	19.8	20.3	20.9	21.5	22.1	22.7	23.3	23.8	24.4
		R <sub>R</sub>	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 <sub>R</sub>	26.6	27.4	28.2	29.0	29.9	30.7	31.5	32.3	33.2	34.0	34.8
		R <sub>R</sub>	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 <sub>R</sub>	46.8	48.3	49.7	51.2	52.7	54.2	55.6	57.1	58.5	60.0	61.4
		R <sub>R</sub>	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 <sub>R</sub>	72.1	74.3	76.6	78.9	81.1	83.4	85.7	87.9	90.2	92.4	94.7
		R <sub>R</sub>	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 <sub>R</sub>	103.4	106.4	109.4	112.4	115.4	118.5	121.4	124.4	127.4	130.4	133.4
		R <sub>R</sub>	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 <sub>R</sub>	181.6	187.3	193.0	198.6	204.3	210.0	215.7	221.3	227.0	232.7	238.4
		R <sub>R</sub>	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 <sub>R</sub>	280.0	288.7	297.5	306.2	314.9	323.7	332.4	341.2	349.9	358.6	367.4
		R <sub>R</sub>	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).
- CV performance is based on a rubber compound blend of natural and synthetic rubber.

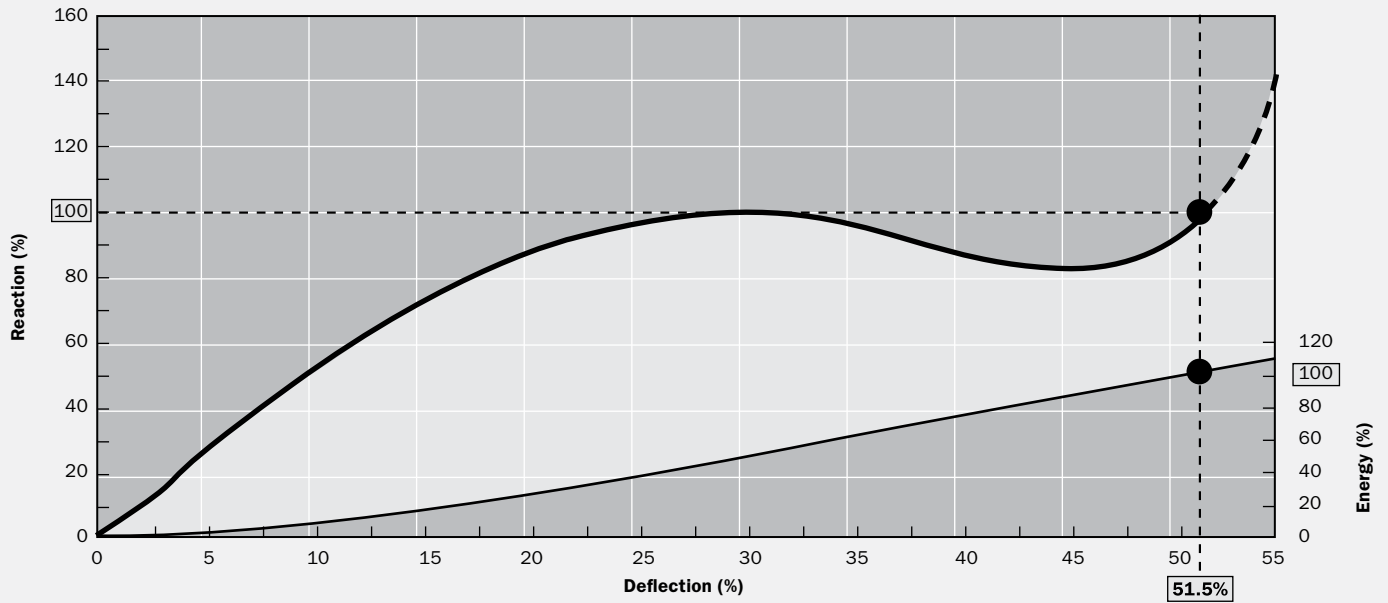
\* Values are per 1000mm of length L.

# AN / ANP Arch Fenders

## INTERMEDIATE DEFLECTIONS

<b>D<sub>i</sub> (%)</b>	0	5	10	15	20	25	30	35	40	45	50	51.5	55
<b>E<sub>i</sub> (%)</b>	0	1	6	14	25	37	50	63	74	85	96	100	111
<b>R<sub>i</sub> (%)</b>	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.



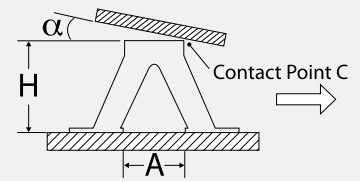
# Super Arch and Arch Fenders

## ANGLE FACTORS (AF) – TRANVERSE LOAD

### Energy Correction Factors

A/H	$\alpha$	DEFLECTION % AT POINT C	REACTION CORRECTION FACTOR	ENERGY CORRECTION FACTOR
3		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

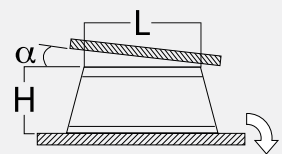
### Energy Correction Factors

L/H \ $\alpha$	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 \ $\alpha$	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

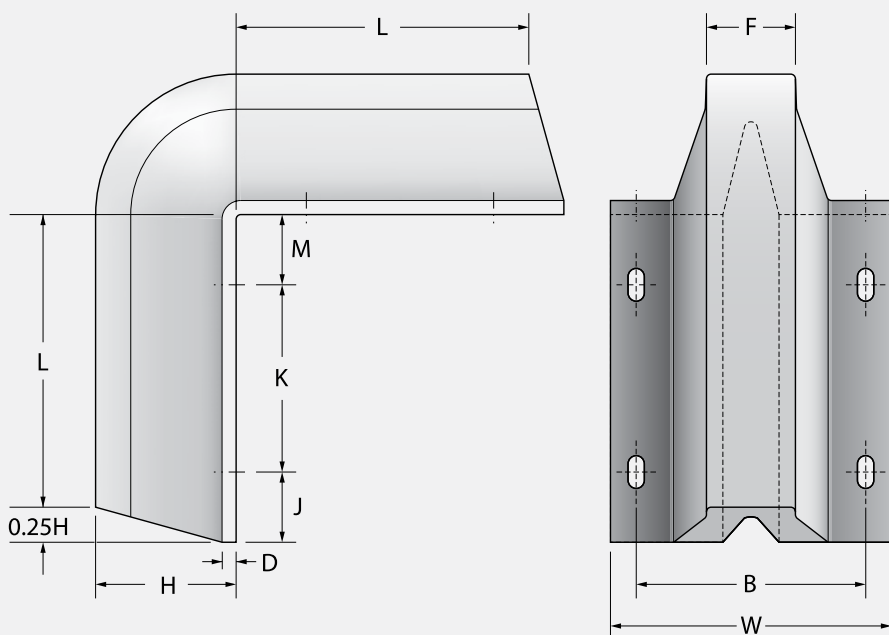


Berth corners are very difficult to protect. Corner Arch fenders are available in three standard sizes and provide a simple, easily installed solution to prevent damage from smaller vessels.

### 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

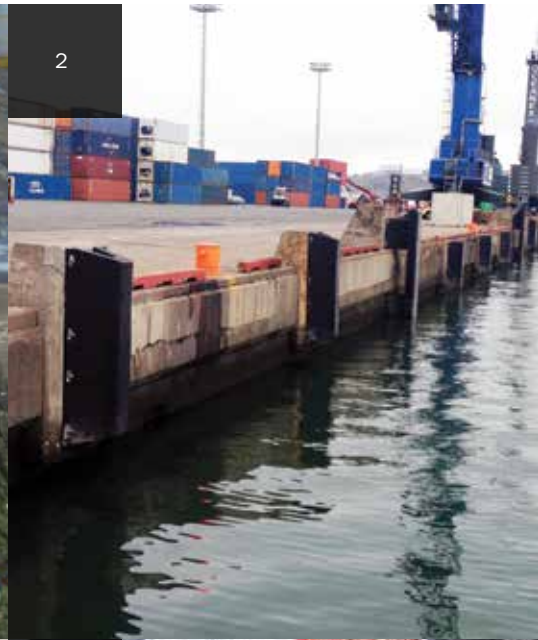
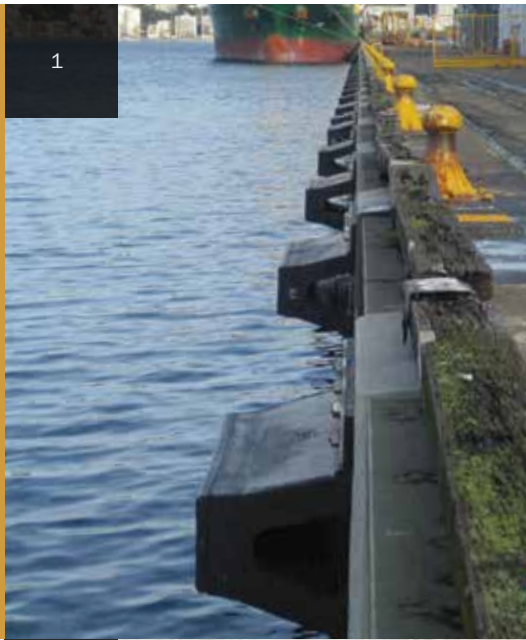
[Units: mm, kg]



### 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





# 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**

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Ultra-low reaction

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Non-tilt frontal panel

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No performance loss at large berthing angles

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Easy and fast to install

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Minimal maintenance

## **APPLICATIONS**

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RoRo and fast ferry berths

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LNG and tanker terminals

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Naval facilities

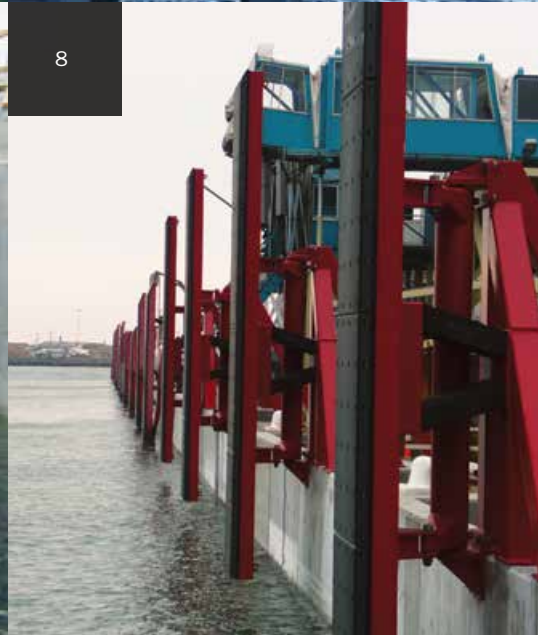
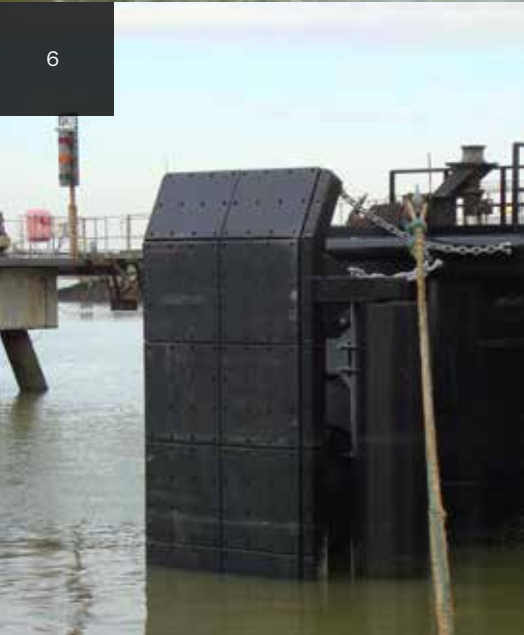
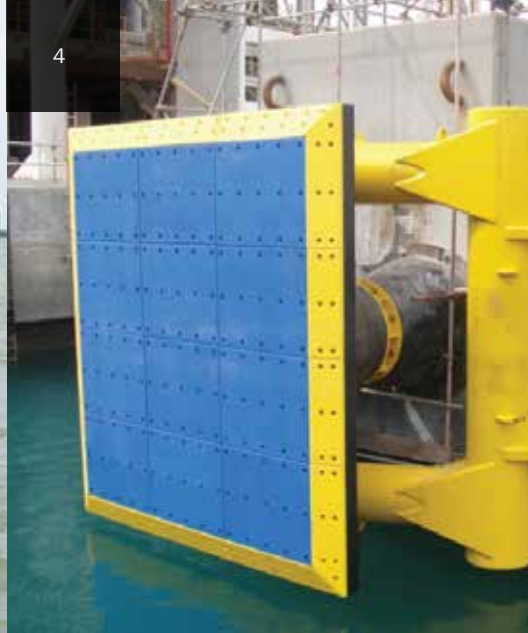
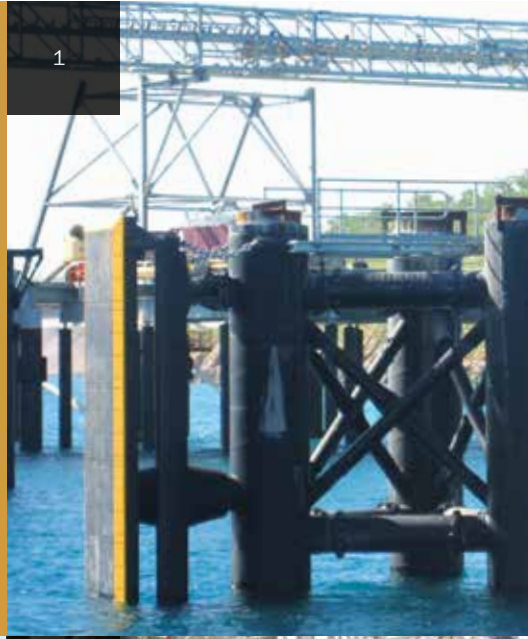
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High tidal zones

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Monopile or 'soft' structures

- 1. AUSTRALIA
- 2. UNITED KINGDOM
- 3. UNITED KINGDOM
- 4. QATAR
- 5. SWEDEN
- 6. UNITED KINGDOM
- 7. NORWAY
- 8. DENMARK



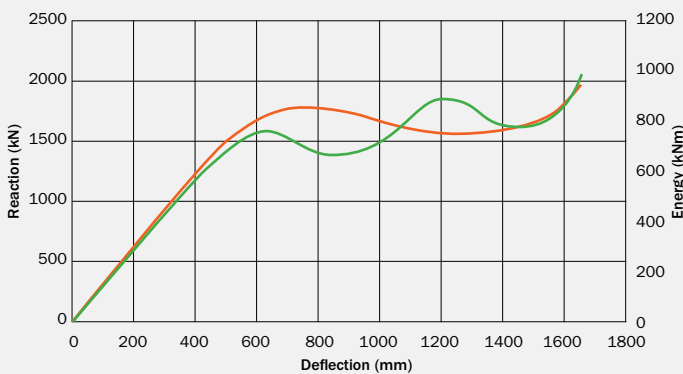
# Parallel Motion Fenders

## COMPARISON OF PMF AND CONVENTIONAL FENDERS

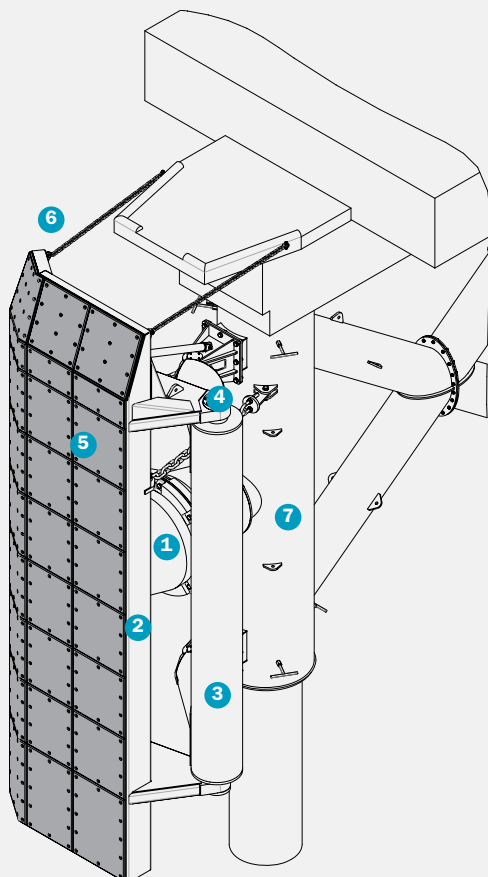
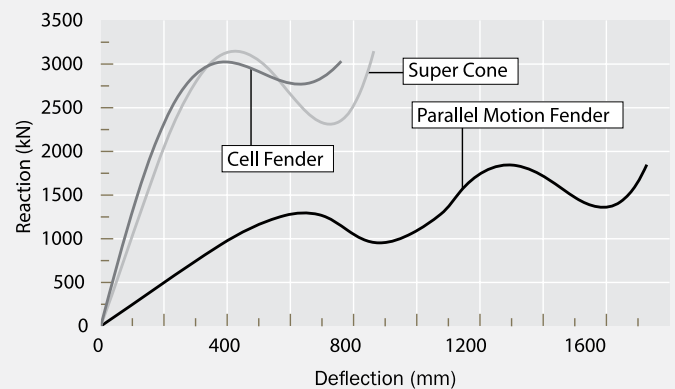
TYPE	E (kNm)			R (kN)	$\epsilon_{20}$
	0°	10°	20°	RPD	
Parallel Motion Fender PMF1200 (F3.1 & F1.9)	2186.6	2186.6	2186.6	1955.5	100%
Super Cone 2 × SCN1200 (F2.8)	2182.2	2182.2	1612.6	3347.2	43%
Cell Fender 2 × SCK1450 (E3.0)	2153.2	1901.3	1403.9	3381.2	37%

Note:

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



— Similar Grades  
— Different Grades



### 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

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Few fender elements are required compared to normal fender systems

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Simple assembly on site

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Parallel motion function

## APPLICATIONS

Belted vessel

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Roro ferries

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Cruise terminal

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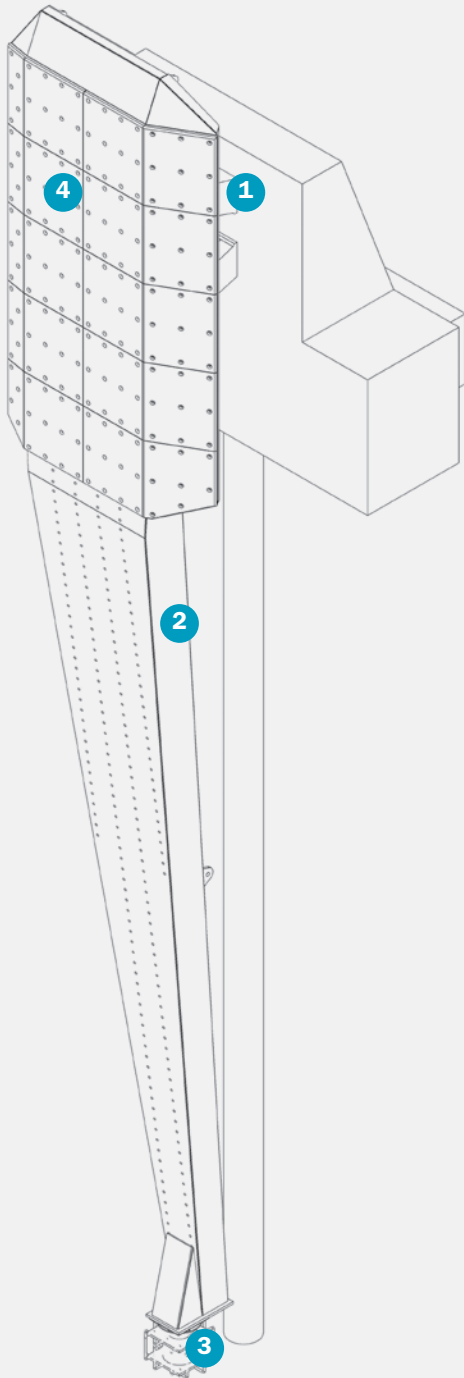
Ports with wide tidal variation

## 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

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- 2 Pivot steel panel**

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- 3 Bottom connection**  
Different solutions available. Please contact us 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 and Infrastructure 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.

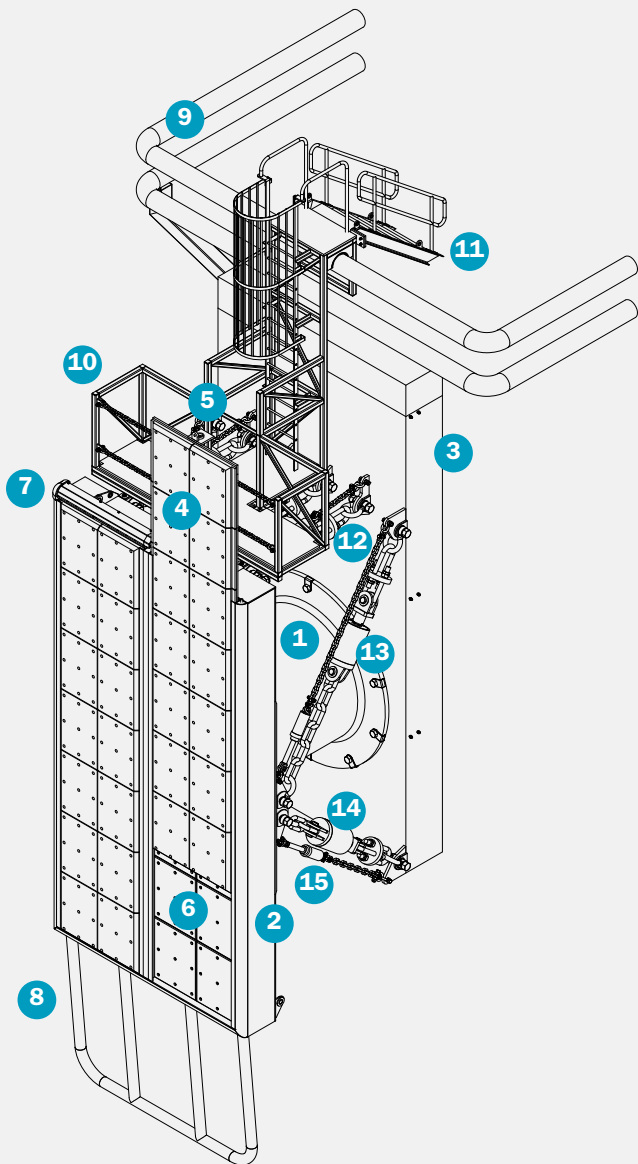
## FEATURES

- 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.

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- 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**

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- 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.

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- 11 Approach stairs**  
Can be deployed quickly in conjunction with access platform and designed to suit any type of wharf/dolphin structure.

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- 12 Tension chain system**

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- 13 Weight chain system**  
Shown here with optional chain shock absorber.

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- 14 Uplift chain system**  
Shown here with optional chain shock absorber.

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- 15 Detention chain system**  
Allows controlled release of tension in tension, weight or uplift chain systems during changeout procedures using hydraulics.

# Accessories

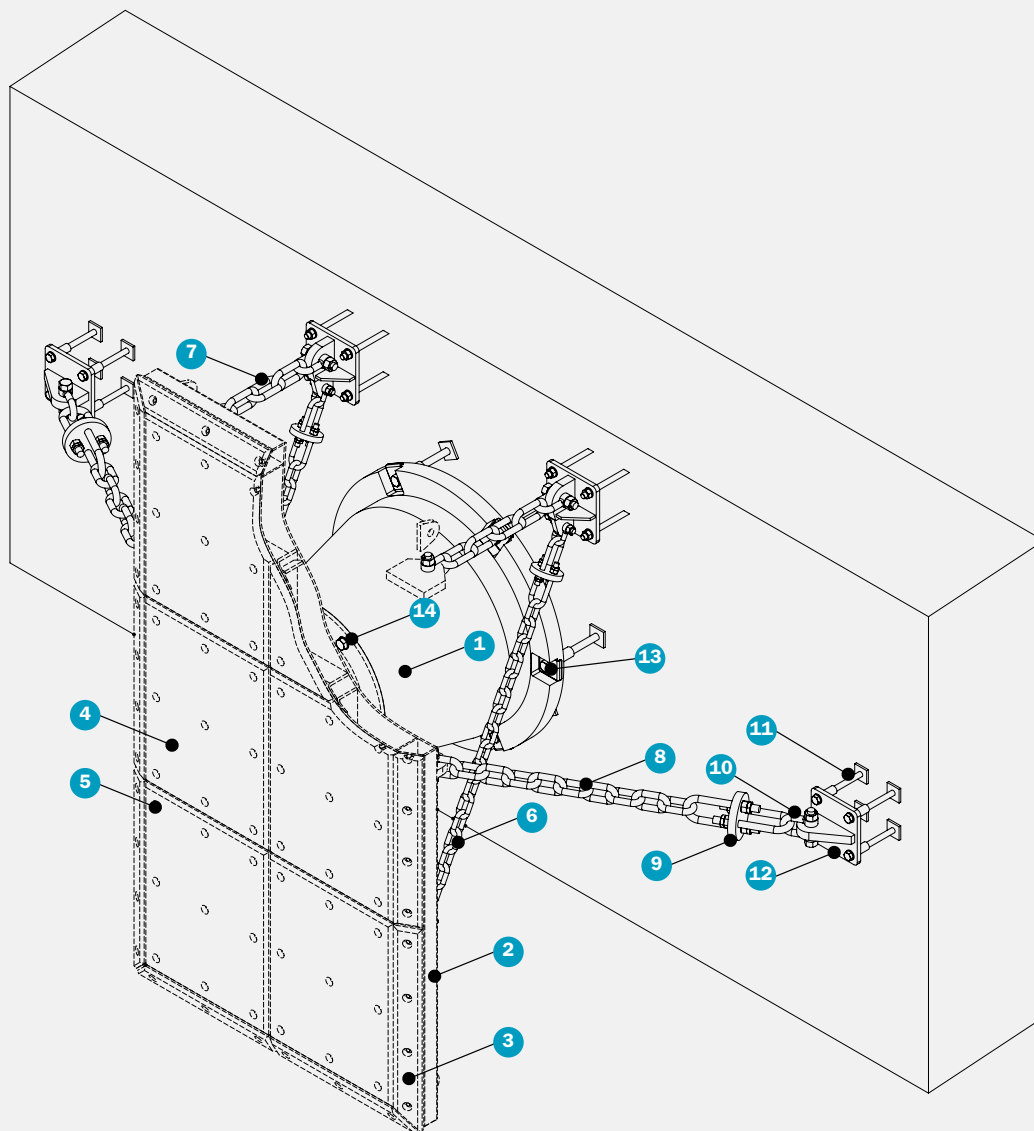


All our accessories are procured from a pre-approved, reputable supplier. We ensure that our suppliers use the highest grade of raw materials to produce the best quality products and we test accessories quality when they arrive with us.

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

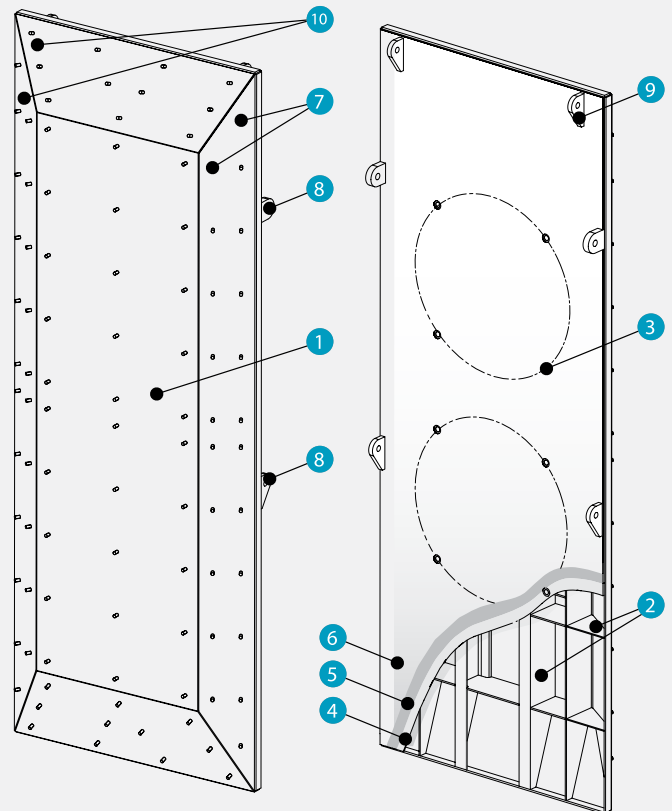
Panel specifications and designs should consider:

- 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 <sup>2</sup>	psi	N/mm <sup>2</sup>	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/m<sup>2</sup>]

# 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

## TYPICAL PROPERTY OF UHMW-PE PADS

PROPERTY	TEST METHOD	UNIT	TYPICAL VALUE	
			VIRGIN	REGENERATED
Density	ISO 1183-1	g/cm <sup>3</sup>	0.94 – 0.95	0.95 – 0.96
Notched Impact Strength (Charpy)	ISO 11542-2	kJ/m <sup>2</sup>	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 <sup>2</sup>	15 – 20	15 – 20
Elongation at Break*	ISO/R 50mm/min	%	> 50	> 50
Dynamic Friction (PE-Steel)	Pm = 1N/mm <sup>2</sup> 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 <sup>-1</sup>	≈ 2 × 10 <sup>-4</sup>	≈ 2 × 10 <sup>-4</sup>
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.

The above properties need to be tested by an external testing laboratory.

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

## UHMW-PE PADS ADDITIONAL TESTS AND SPECIFICATIONS

TEST	TEST STANDARD	CONDITION	REQUIREMENT
Mass Melt-flow rate (MFI)	ISO 1133	@190°C, 21.6kg	0 – 0.1g/10min. (Avg of two tests)
% Crystallinity (2nd heating cycle)	ISO11357-3	In DSC: heat from 0°C to 180°C in N2 with a heating rate of 10°C/min, keep isothermal for 5 min. Then cooled to 0°C in N2 with a heating rate of 10°C/min, keep isothermal for 5 min. Heat to 180°C in N2 with a heating rate of 10°C/min.	50 ± 5% (Avg of two samples. The variation between the samples should be less than 5%)
Peak Melting temperature	ISO11357-3	In DSC: Same as above	135 ± 4°C (same as above)
Abrasion resistance (sand slurry test)	Sample preparation: ISO11542 Testing: ISO15527 (modified test conditions) Reference specimen: VN: 2300 ml/g	1480 r/min rotation rate and run at 15°C for 4 hours. (Avg. of two samples testing values)	90 – 125
Double notch Charpy Impact strength	Sample preparation: ISO11542-2 Testing: ISO11542-2	14° ± 2° V-notch on both sides 120 x 15 x 10mm, Impact energy : 50J.	110 – 260 KJ/sq. m (two moulded samples, (<5% variation in results)

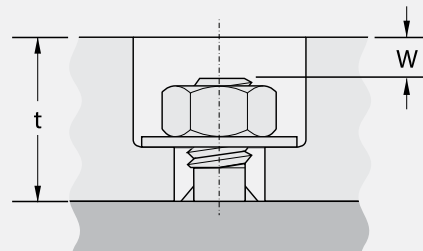
Sample frequency: 1 samples/ molding

Size: cut from the actual product (100mmW x 100mmL x min.10mm thick)

# Ultra High Molecular Weight Polyethylene (UHMW-PE)

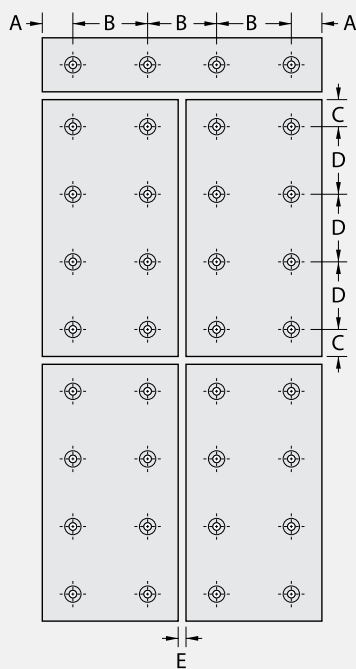
## WEAR ALLOWANCES

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]

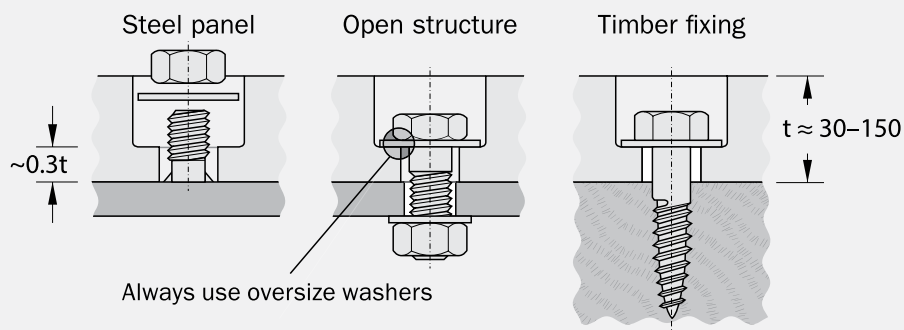
## TYPICAL DIMENSIONS



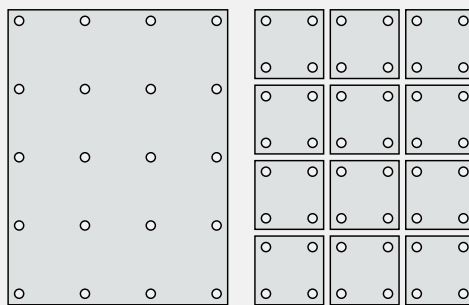
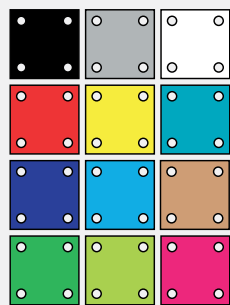
A	45 – 80
B	250 – 350
C	45 – 80
D	300 – 450
E	5 – 10

[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

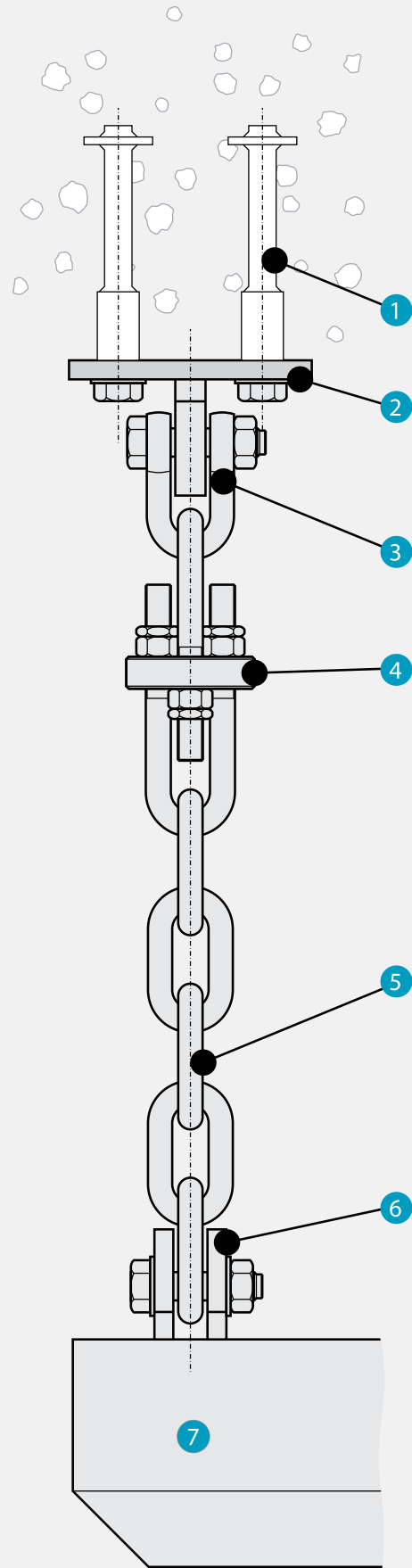
- Choice of open or stud link chains
- Various link lengths available
- Proof load tested and certified
- Galvanized as standard
- Variety of matched accessories

## APPLICATIONS

- Large fender panels
- Cylindrical fenders
- Floating fender moorings
- Safety applications
- Lifting and installing

## TYPICAL CHAIN SYSTEM

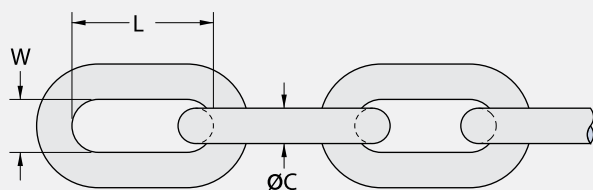
- 1 Anchors and fixing bolts
- 2 Chain bracket
- 3 Alloy D or bow-shackle with safety pin
- 4 Chain tensioner
- 5 Open or stud link chain
- 6 Frontal frame bracket
- 7 Frontal frame



# Chains

## OPEN LINK CHAINS

ØC		CHAIN DIMENSIONS		U2 OPEN LINK CHAIN		U3 OPEN LINK CHAIN		WEIGHT
		L	W	PROOF LOAD	BREAKING LOAD	PROOF LOAD	BREAKING LOAD	
Inch	mm	mm	mm	kN	kN	kN	kN	kg
1/2	12.5	50	19	41.2	82.6	56.4	112.8	0.17
9/16	14	56	21	51.0	101.9	70.8	141.5	0.22
5/8	16	64	24	66.2	132.3	92.4	184.8	0.32
11/16	17.5	70	26	78.9	157.8	110.6	221.1	0.45
3/4	19	76	29	93.6	187.2	130.3	260.6	0.54
13/16	20.5	82	31	108.6	217.3	151.7	303.4	0.72
7/8	22	88	33	125.4	250.9	174.4	349.4	0.84
15/16	24	96	36	149.9	298.9	207.9	415.8	1.20
1-1/16	26	104	39	175.4	350.8	244.0	488.0	1.39
1-1/8	28	112	42	203.8	406.7	283.0	566.0	1.72
1-3/16	30	120	45	234.2	467.5	324.9	649.8	2.13
1-1/4	32	128	48	265.6	531.2	369.6	739.3	2.58
1-5/16	34	136	51	299.9	599.8	417.3	834.6	3.11
1-7/16	36	144	54	336.1	672.3	467.8	935.7	3.68
1-1/2	38	152	57	374.4	748.7	521.3	1042.5	4.32
1-9/16	40	160	60	414.5	829.1	577.6	1155.2	5.02
1-5/8	42	168	63	457.7	915.3	636.8	1273.6	5.81
1-3/4	44	176	66	502.7	999.6	698.9	1398.0	7.10
1-13/16	46	184	69	548.8	1097.6	763.9	1527.8	7.64
1-7/8	48	192	72	597.8	1195.6	831.7	1663.5	8.69
2	50	200	75	648.8	1293.6	902.5	1805.0	9.80
2-1/16	52	208	78	697.6	1395.3	976.1	1952.3	11.14
2-1/8	54	216	81	752.3	1504.7	1052.7	2105.4	12.98
2-3/16	56	224	84	809.1	1618.2	1132.1	2264.2	13.86
2-5/16	58	232	87	867.9	1735.8	1214.4	2428.8	15.42
2-3/8	60	240	90	928.8	1857.6	1299.6	2599.2	17.07
2-7/16	62	248	93	991.8	1983.5	1387.7	2775.4	18.78
2-1/2	64	256	96	1056.8	2113.5	1478.7	2957.3	21.52
2-9/16	66	264	99	1123.9	2247.7	1572.5	3145.0	22.82
2-11/16	68	272	102	1193.0	2386.0	1669.3	3338.5	24.74
2-3/4	70	280	105	1264.2	2528.4	1768.9	3537.8	27.23



MBL = Minimum Breaking Load (kN)

NBL = Nominal Breaking Load (kN)

Tolerance: all dimensions  $\pm 2.5\%$

Contact Trelleborg for 3.0D, 3.5D & 5.0D chain links.

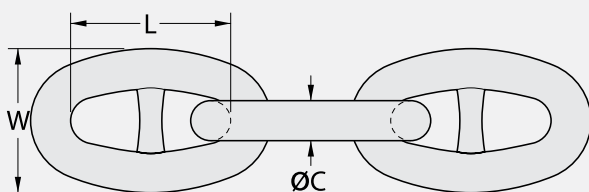
# Chains

## OPEN LINK CHAINS

### 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

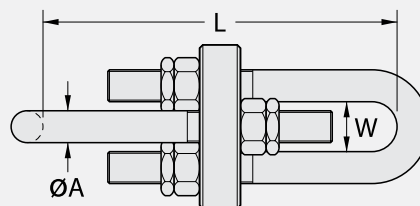
[Units: mm, kg/link, kN]

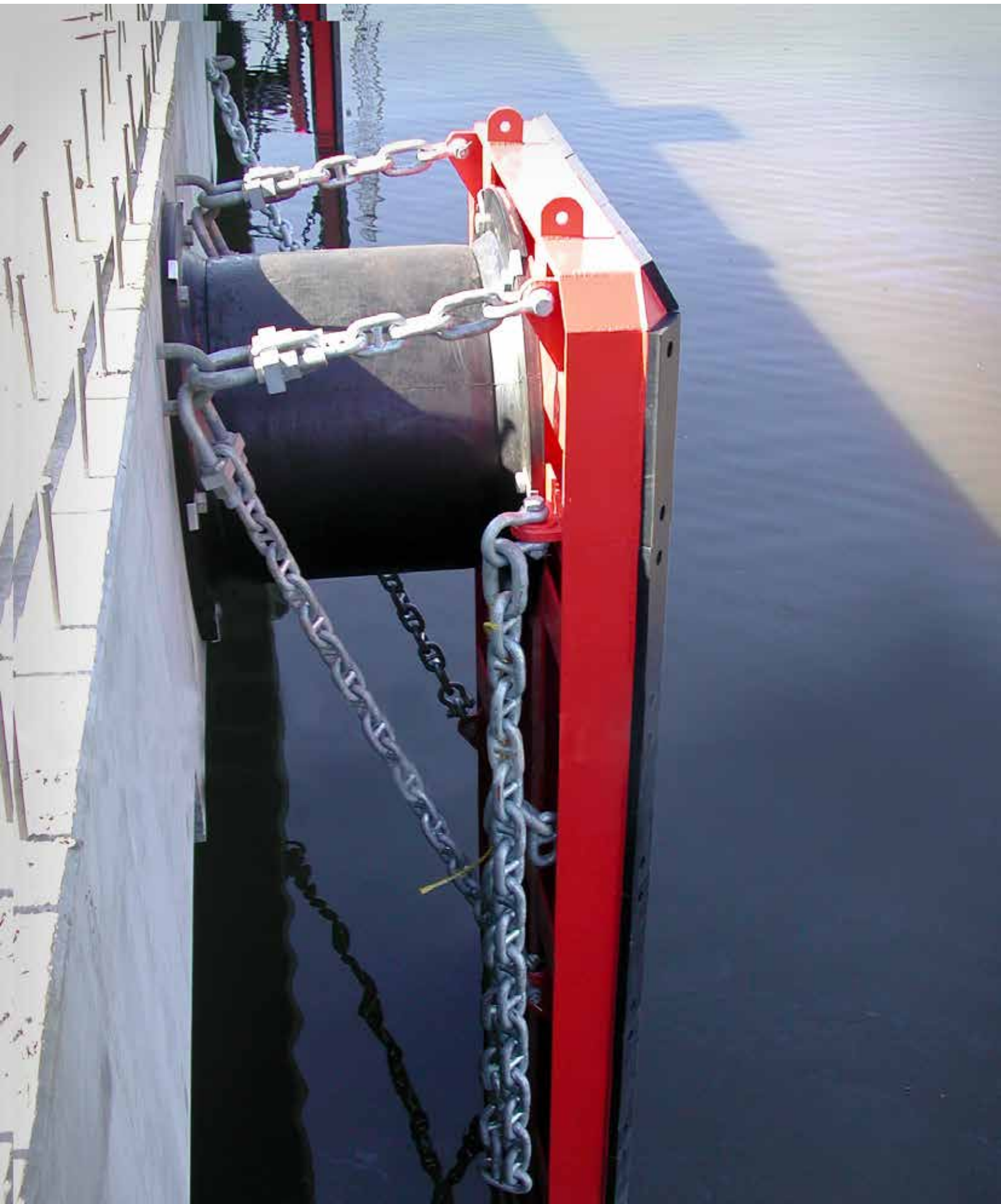


### CHAIN TENSIONERS

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]



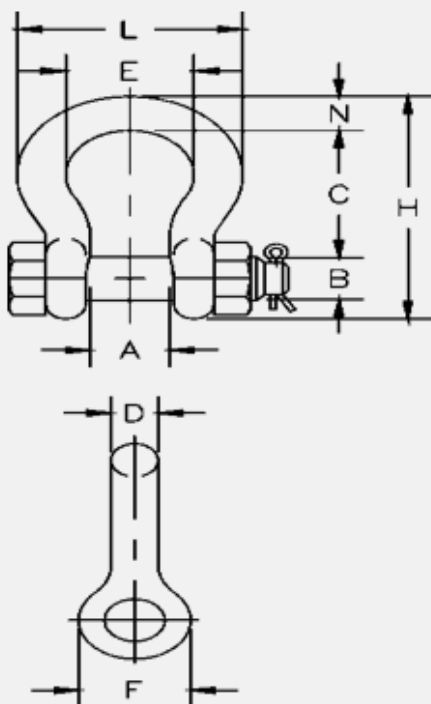


# High Strength Shackles

## G-2130

NOMINAL SIZE (IN") (BODY DIMENSION)	WORKING LOAD LIMIT ( T ) *	NBL (kN)	WEIGHT EACH (kg)	DIMENSIONS (mm)								
				A	B (Ø Pin)	C	D (Ø BODY)	E	F	H	L	N
3/16	+1/3	19.9	0.03	9.65	6.35	22.4	4.85	15.2	14.2	37.3	24.9	4.85
1/4	1/2	29.9	0.05	11.9	7.85	28.7	6.35	19.8	15.5	46.7	32.5	6.35
5/16	3/4	44.9	0.1	13.5	9.65	31	7.85	21.3	19.1	53	37.3	7.85
3/8	1	59.8	0.15	16.8	11.2	36.6	9.65	26.2	23.1	63	45.2	9.65
7/16	1-1/2	89.8	0.22	19.1	12.7	42.9	11.2	29.5	26.9	74	51.5	11.2
1/2	2	119.7	0.36	20.6	16	47.8	12.7	33.3	30.2	83.5	58.5	12.7
5/8	3-1/4	194.5	0.76	26.9	19.1	60.5	16	42.9	38.1	106	74.5	17.5
3/4	4-3/4	284.2	1.23	31.8	22.4	71.5	19.1	51	46	126	89	20.6
7/8	6-1/2	388.9	1.79	36.6	25.4	84	22.4	58	53	148	102	24.6
1	8-1/2	508.6	2.57	42.9	28.7	95.5	25.4	68.5	60.5	167	119	26.9
1-1/8	9-1/2	568.5	3.75	46	31.8	108	28.7	74	68.5	190	131	31.8
1-1/4	12	718.1	5.31	51.5	35.1	119	31.8	82.5	76	210	146	35.1
1-3/8	13-1/2	807.95	7.18	57	38.1	133	35.1	92	84	233	162	38.1
1-1/2	17	1017.3	9.43	60.5	41.4	146	38.1	98.5	92	254	175	41.1
1-3/4	25	1496.0	15.4	73	51	178	44.5	127	106	313	225	57
2	35	2094.4	23.7	82.5	57	197	51	146	122	348	253	61
2-1/2	55	3291.2	44.6	105	70	267	66.5	184	145	453	327	79.5
3	85	5086.5	70	127	82.5	330	76	200	165	546	365	92
3-1/2	120	7180.9	120	133	95.5	372	92	229	203	626	419	105
4	150	7779.3	153	140	108	368	104	254	229	653	468	116

Note : Shackle details are based on G-2130 & G-2150.

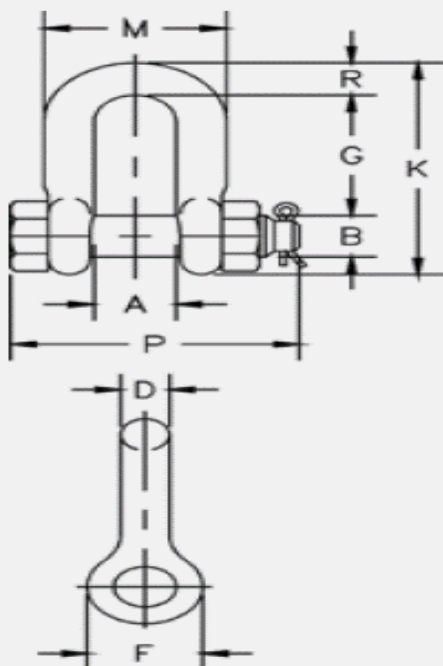


# High Strength Shackles

## G-2150

NOMINAL SIZE (IN") (BODY DIMENSION)	WORKING LOAD LIMIT (T) *	NBL (kN)	WEIGHT EACH (kg)	DIMENSIONS (mm)								
				A	B (Ø Pin)	D (Ø BODY)	F	G	K	M	P	R
1/4	1/2	29.9	0.06	11.9	7.85	6.35	15.5	19.1	40.4	24.6	39.6	6.35
5/16	3/4	44.9	0.1	13.5	9.65	7.85	19.1	25.4	48.5	29.5	46.2	7.85
3/8	1	59.8	0.15	16.8	11.2	9.65	23.1	31	58.5	35.8	55	9.65
7/16	1-1/2	89.8	0.22	19.1	12.7	11.2	26.9	36.1	67.5	41.1	63.5	11.2
1/2	2	119.7	0.34	20.6	16	12.7	30.2	41.4	77	46	71	12.7
5/8	3-1/4	194.5	0.67	26.9	19.1	16	38.1	51	95.5	58.5	89.5	16
3/4	4-3/4	284.2	1.14	31.8	22.4	19.1	46	60.5	115	70	103	20.6
7/8	6-1/2	29.9	1.74	36.6	25.4	22.4	53	71.5	135	81	120	24.6
1	8-1/2	508.6	2.52	42.9	28.7	25.4	60.5	81	151	93.5	135	25.4
1-1/8	9-1/2	568.5	3.45	46	31.8	28.7	68.5	91	172	103	150	31.8
1-1/4	12	718.1	4.9	51.5	35.1	31.8	76	100	191	115	165	35.1
1-3/8	13-1/2	807.9	6.24	57	38.1	35.1	84	111	210	127	183	38.1
1-1/2	17	1017.3	8.39	60.5	41.4	38.1	92	122	230	137	196	41.1
1-3/4	25	1496.0	14.2	73	51	44.5	106	146	279	162	230	54
2	35	2094.40	21.2	82.5	57	51	122	172	312	184	264	51
2-1/2	55	3291.3	38.6	105	70	66.5	145	203	377	238	344	66.5
3	85	5086.5	56	127	82.5	76	165	216	429	279	419	89

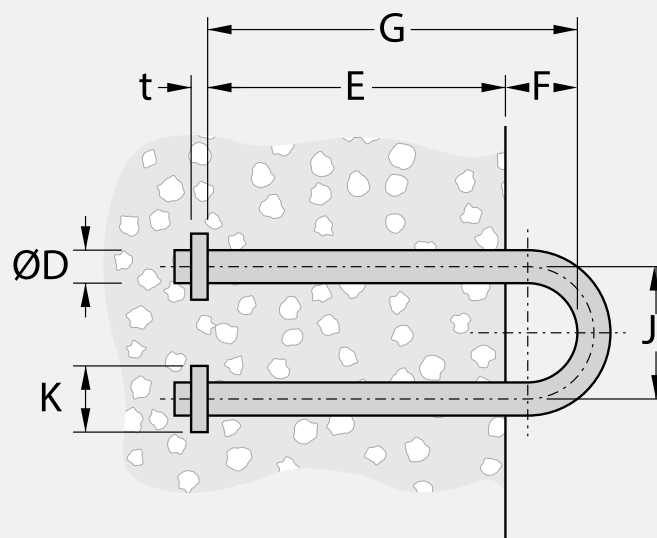
Note : Shackle details are based on G-2130 & G-2150.



## 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]

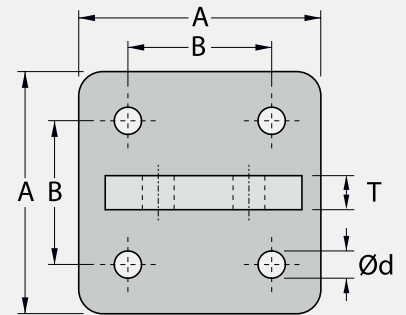
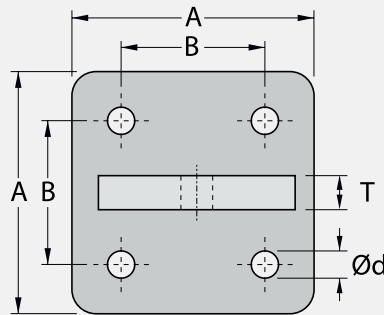
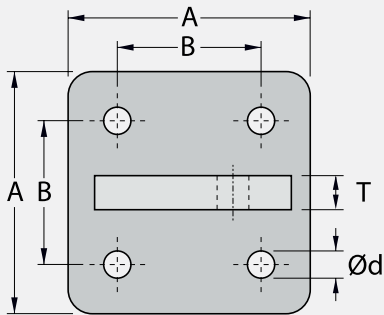


# Brackets

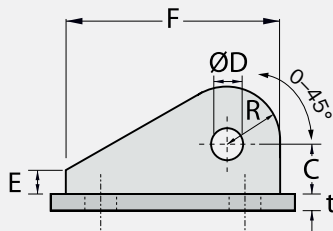
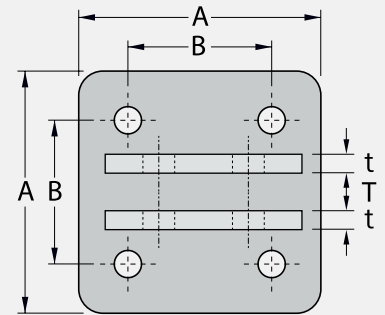
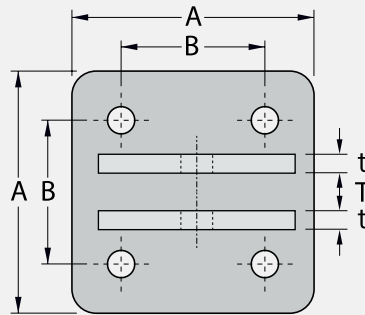
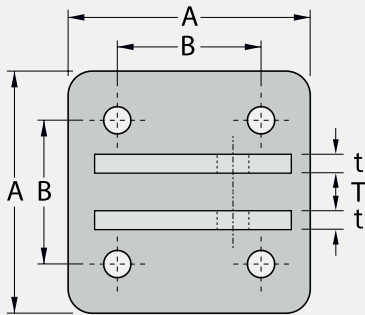
A	B	C	E		F	Ød	R	t	T	SINGLE LUG		TWIN LUG		ANCHOR
			CB1/CB3	CB2						SHACKLE	ØD	BOLT PIN	ØD	
190	110	40	20	75	160	24	40	15	30	19	28	M24 x 90	28	2/4 x M20
220	130	45	20	90	190	24	50	15	30	22	28	M24 x 90	28	2/4 x M20
250	150	50	25	100	210	28	55	20	40	25	36	M30 x 120	36	2/4 x M24
280	160	60	25	115	240	28	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]

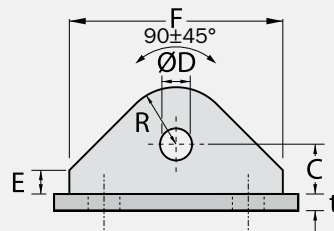
## S-Series



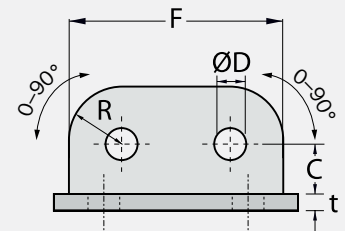
## T-Series



**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 our local office.



# Fender Fixings

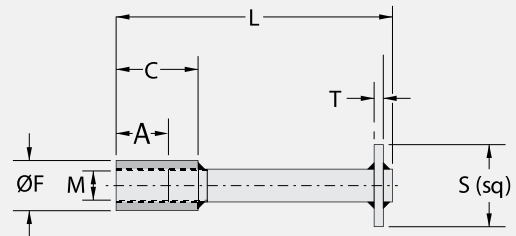
## NC3 ANCHORS

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

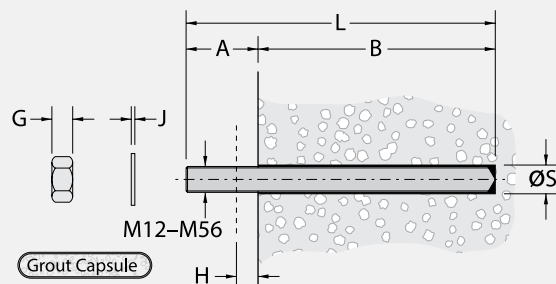
THREAD	B	E	G	J	L (typ.)	ØS	CAPSULE	WEIGHT
M12	110	5 – 8	10	2.5	–	15	1 × C12	0.15
M16	140	6 – 9	13	3	175	20	1 × C16	0.26
M20	170	6 – 9	16	3	240	25	1 × C20	0.57
M24	210	8 – 12	19	4	270	28	1 × C24	0.92
M27	240	8 – 12	22	4	330	30	1 × C24	1.42
M30	280	8 – 12	24	4	360	35	1 × C30	1.91
M36	330	10 – 15	29	5	420	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.

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.

[Units: mm, kg]

# Fender Fixings

## BOLTS, NUTS AND WASHERS

SIZE	THREAD AREA *	WASHERS †				NUTS #			TYPICAL THREAD LENGTHS ‡		THREAD PITCH
	(mm <sup>2</sup> )	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

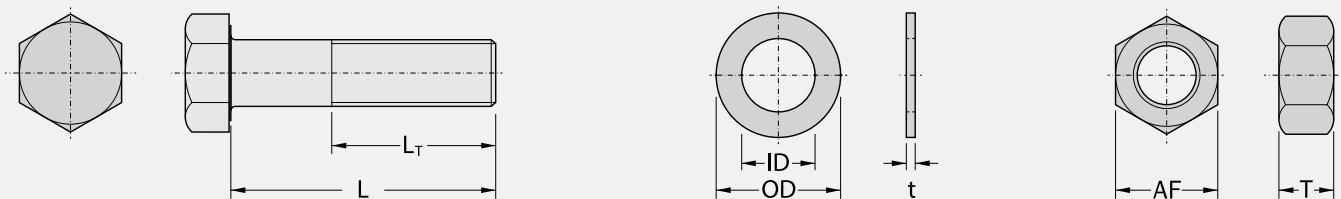
\* Standard bolts given according to DIN933.

[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 *	
	4.6	8.8	A-50 †	A-70 †
Bolt grade	4.6	8.8	A-50 †	A-70 †
Nut grade	4	8	A-50 †	A-70 †
Tensile strength (MPa)	400	800	500	700
0.2% yield stress (MPa)	240	640	210	450

\* Refer to Fender Application Design Manual for further details about PREN and galling.

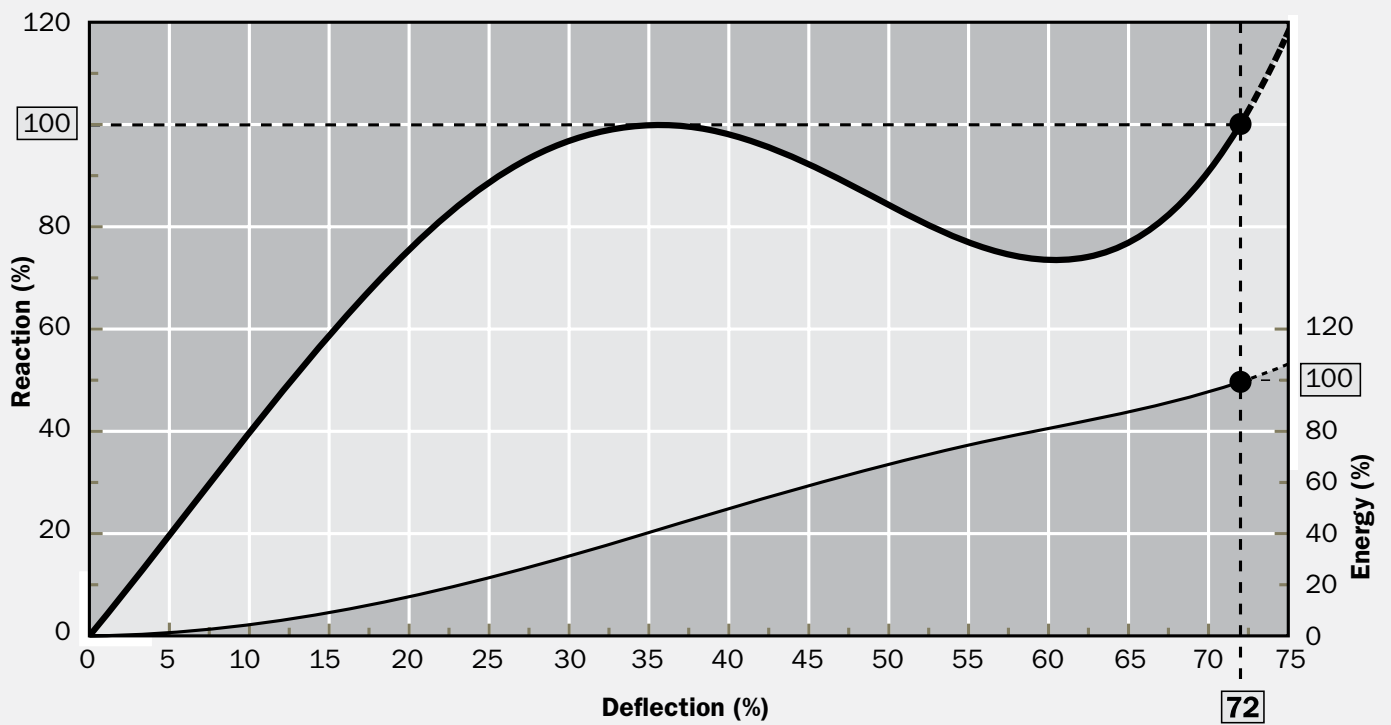
† Size ≤ M39 unless agreed with manufacturer.

‡ 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.

# Appendix A

## Super Cone Fenders (100% NR) CV PERFORMANCE DATA\*



Standard manufacturing and performance tolerances apply.

# Super Cone Fenders

## CV PERFORMANCE DATA\*

		E0.9	E1.0	E1.1	E1.2	E1.3	E1.4	E1.5	E1.6	E1.7	E1.8	E1.9	E2.0
SCN 300	E <sub>R</sub>	7.7	8.6	8.9	9.2	9.5	9.8	10.1	10.4	10.6	10.9	11.2	11.5
	R <sub>R</sub>	59	65	67	68	70	72	74	75	77	79	80	82
SCN 350	E <sub>R</sub>	12.5	13.9	14.4	14.8	15.3	15.7	16.2	16.7	17.1	17.6	18.0	18.5
	R <sub>R</sub>	80	89	91	93	96	98	100	102	104	107	109	111
SCN 400	E <sub>R</sub>	18.6	20.7	21.4	22.1	22.8	23.5	24.2	24.8	25.5	26.2	26.9	27.6
	R <sub>R</sub>	104	116	119	122	125	128	131	133	136	139	142	145
SCN 500	E <sub>R</sub>	36.5	40.5	41.9	43.2	44.6	45.9	47.3	48.6	50.0	51.3	52.7	54.0
	R <sub>R</sub>	164	182	187	191	196	200	205	209	214	218	223	227
SCN 550	E <sub>R</sub>	49	54	56	58	59	61	63	65	67	68	70	72
	R <sub>R</sub>	198	220	226	231	237	242	248	253	259	264	270	275
SCN 600	E <sub>R</sub>	63	70	72	74	76	78	80	82	84	86	88	90
	R <sub>R</sub>	225	250	257	263	270	276	283	289	296	302	309	315
SCN 700	E <sub>R</sub>	117	130	134	137	141	144	148	151	155	158	162	165
	R <sub>R</sub>	320	355	365	374	384	393	403	412	422	431	441	450
SCN 800	E <sub>R</sub>	171	190	196	201	207	212	218	223	229	234	240	245
	R <sub>R</sub>	419	465	478	490	503	515	528	540	553	565	578	590
SCN 900	E <sub>R</sub>	248	275	282	289	296	303	310	317	324	331	338	345
	R <sub>R</sub>	527	585	601	617	633	649	665	681	697	713	729	745
SCN 950	E <sub>R</sub>	291	322	331	339	348	356	364	373	381	390	398	407
	R <sub>R</sub>	588	653	671	688	706	724	742	759	777	795	813	830
SCN 1000	E <sub>R</sub>	338	375	385	395	405	415	425	435	445	455	465	475
	R <sub>R</sub>	653	725	745	764	784	803	823	842	862	881	901	920
SCN 1050	E <sub>R</sub>	392	435	447	458	470	481	493	504	516	527	539	550
	R <sub>R</sub>	720	800	822	843	865	886	908	929	951	972	994	1015
SCN 1100	E <sub>R</sub>	450	500	514	527	541	554	568	581	595	608	622	635
	R <sub>R</sub>	788	875	899	923	947	971	995	1019	1043	1067	1091	1115
SCN 1200	E <sub>R</sub>	585	650	668	685	703	720	738	755	773	790	808	825
	R <sub>R</sub>	941	1045	1073	1101	1129	1157	1185	1213	1241	1269	1297	1325
SCN 1300	E <sub>R</sub>	743	825	847	869	891	913	935	957	979	1001	1023	1045
	R <sub>R</sub>	1103	1225	1258	1291	1324	1357	1390	1423	1456	1489	1522	1555
SCN 1400	E <sub>R</sub>	927	1030	1058	1085	1113	1140	1168	1195	1223	1250	1278	1305
	R <sub>R</sub>	1278	1420	1459	1497	1536	1574	1613	1651	1690	1728	1767	1805
SCN 1600	E <sub>R</sub>	1382	1535	1577	1618	1660	1701	1743	1784	1826	1867	1909	1950
	R <sub>R</sub>	1670	1855	1905	1955	2005	2055	2105	2155	2205	2255	2305	2355
SCN 1800	E <sub>R</sub>	1967	2185	2244	2303	2362	2421	2480	2539	2598	2657	2716	2775
	R <sub>R</sub>	2115	2350	2413	2476	2539	2602	2665	2728	2791	2854	2917	2980
SCN 2000	E <sub>R</sub>	2700	3000	3080	3160	3240	3320	3400	3480	3560	3640	3720	3800
	R <sub>R</sub>	2610	2900	2978	3056	3134	3212	3290	3368	3446	3524	3602	3680

\*in accordance with PIANC.

[Units: kNm, kN]

# Super Cone Fenders

## CV PERFORMANCE DATA\*

		E2.1	E2.2	E2.3	E2.4	E2.5	E2.6	E2.7	E2.8	E2.9	E3.0	E3.1
SCN 300	E <sub>R</sub>	11.8	12.1	12.4	12.7	13.0	13.3	13.5	13.8	14.1	14.4	15.9
	R <sub>R</sub>	84	86	89	91	93	95	97	100	102	104	114
SCN 350	E <sub>R</sub>	19.0	19.4	19.9	20.3	20.8	21.3	21.7	22.2	22.6	23.1	25.4
	R <sub>R</sub>	114	117	120	123	126	129	132	135	138	141	155
SCN 400	E <sub>R</sub>	28.3	29.0	29.7	30.4	31.1	31.8	32.5	33.2	33.9	34.6	38.1
	R <sub>R</sub>	149	153	157	161	165	169	173	177	181	185	204
SCN 500	E <sub>R</sub>	55.4	56.7	58.1	59.4	60.8	62.2	63.5	64.9	66.2	67.6	74.4
	R <sub>R</sub>	233	239	246	252	258	264	270	277	283	289	318
SCN 550	E <sub>R</sub>	74	76	77	79	81	83	85	86	88	90	99
	R <sub>R</sub>	283	290	298	305	313	320	328	335	343	350	385
SCN 600	E <sub>R</sub>	93	96	99	102	105	108	111	114	117	120	132
	R <sub>R</sub>	324	332	341	349	358	366	375	383	392	400	440
SCN 700	E <sub>R</sub>	169	173	177	181	185	189	193	197	201	205	226
	R <sub>R</sub>	462	474	486	498	510	522	534	546	558	570	627
SCN 800	E <sub>R</sub>	252	258	265	271	278	284	291	297	304	310	341
	R <sub>R</sub>	606	621	637	652	668	683	699	714	730	745	820
SCN 900	E <sub>R</sub>	355	364	374	383	393	402	412	421	431	440	484
	R <sub>R</sub>	765	785	805	825	845	865	885	905	925	945	1040
SCN 950	E <sub>R</sub>	418	429	440	451	463	473	485	496	507	518	570
	R <sub>R</sub>	853	875	897	919	941	963	986	1008	1030	1052	1158
SCN 1000	E <sub>R</sub>	488	501	514	527	540	553	566	579	592	605	666
	R <sub>R</sub>	945	969	994	1018	1043	1067	1092	1116	1141	1165	1282
SCN 1050	E <sub>R</sub>	565	580	595	610	625	640	655	670	685	700	770
	R <sub>R</sub>	1042	1069	1096	1123	1150	1177	1204	1231	1258	1285	1414
SCN 1100	E <sub>R</sub>	652	669	686	703	720	737	754	771	788	805	886
	R <sub>R</sub>	1145	1174	1204	1233	1263	1292	1322	1351	1381	1410	1551
SCN 1200	E <sub>R</sub>	847	869	891	913	935	957	979	1001	1023	1045	1150
	R <sub>R</sub>	1361	1396	1432	1467	1503	1538	1574	1609	1645	1680	1848
SCN 1300	E <sub>R</sub>	1074	1102	1131	1159	1188	1216	1245	1273	1302	1330	1463
	R <sub>R</sub>	1597	1638	1680	1721	1763	1804	1846	1887	1929	1970	2167
SCN 1400	E <sub>R</sub>	1341	1376	1412	1447	1483	1518	1554	1589	1625	1660	1826
	R <sub>R</sub>	1853	1901	1949	1997	2045	2093	2141	2189	2237	2285	2514
SCN 1600	E <sub>R</sub>	2003	2056	2109	2162	2215	2268	2321	2374	2427	2480	2728
	R <sub>R</sub>	2418	2480	2543	2605	2668	2730	2793	2855	2918	2980	3278
SCN 1800	E <sub>R</sub>	2851	2926	3002	3077	3153	3228	3304	3379	3455	3530	3883
	R <sub>R</sub>	3060	3139	3219	3298	3378	3457	3537	3616	3696	3775	4153
SCN 2000	E <sub>R</sub>	3904	4008	4112	4216	4320	4424	4528	4632	4736	4840	5324
	R <sub>R</sub>	3778	3876	3974	4072	4170	4268	4366	4464	4562	4660	5126

\*in accordance with PIANC.

[Units: kNm, kN]

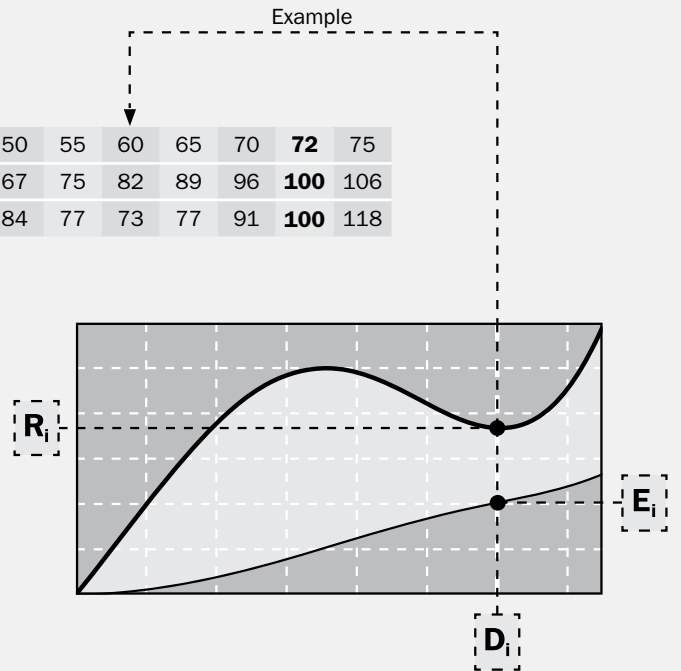
# Super Cone Fenders

## CV PERFORMANCE DATA\*

### INTERMEDIATE DEFLECTIONS

<b>D<sub>i</sub> (%)</b>	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	<b>72</b>	75
<b>E<sub>i</sub> (%)</b>	0	1	4	8	15	22	31	40	50	59	67	75	82	89	96	<b>100</b>	106
<b>R<sub>i</sub> (%)</b>	0	19	39	59	75	89	97	100	98	92	84	77	73	77	91	<b>100</b>	118

Nominal rated deflection may vary at RPD.



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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 and Infrastructure.

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