



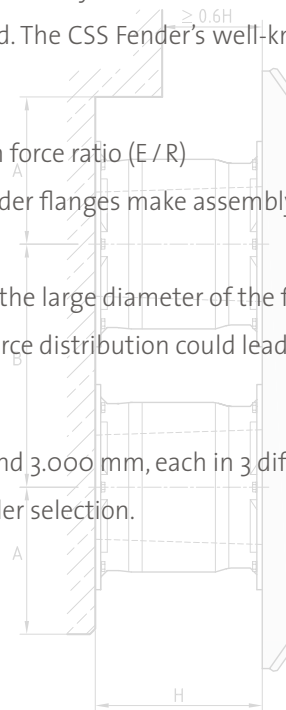
CSS CELL FENDERS

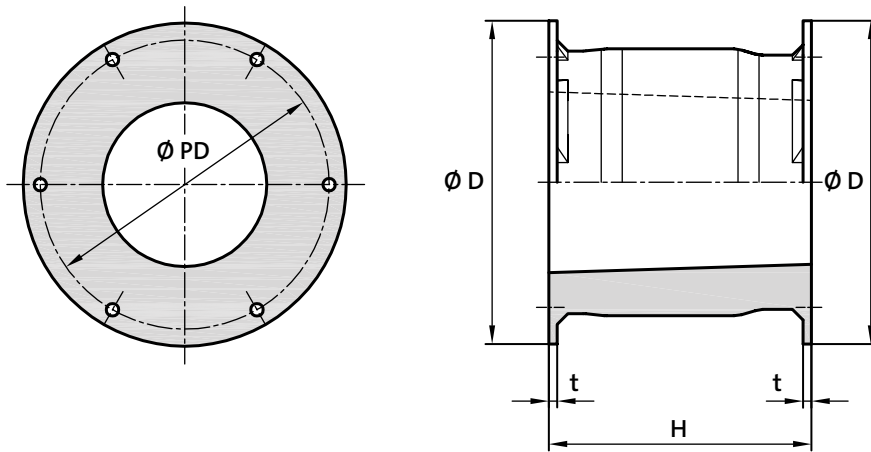
The CSS Cell Fender is a well established fender type. This fender has a hollow cylindrical body with fully rubber-embedded mounting flanges and is designed to deflect in an axial direction. Originally designed to replace Cylindrical Fenders, these fenders have more than 30 years track record with only some minor improvements over the years. Cell Fenders are very robust and have been used for decades in many ports around the world. The CSS Fender's well-known and admired characteristics include:

- ▶ Good energy absorption to reaction force ratio (E/R)
- ▶ Integrated and fully-embedded fender flanges make assembly & installation simple
- ▶ Good shear force resistance due to the large diameter of the fender flanges
- ▶ Large fender footprint with good force distribution could lead to relative light panel construction

Availability in heights between 400 and 3,000 mm, each in 3 different main hardness grades* for the most precise fender selection.

* Intermediate rubber grades see page 16–17





CSS CELL FENDER DIMENSIONS

Fender Size	H [mm]	Ø D [mm]	t [mm]	Ø PD [mm]	Anchors / Bolts	Weight [kg]
CSS 400	400	650	16	550	4 x M24	75
CSS 500	500	650	16	550	4 x M24	110
CSS 600	600	780	20	660	4 x M30	197
CSS 800	800	1050	27	900	6 x M30	432
CSS 1000	1000	1230	32	1100	6 x M36	760
CSS 1150	1150	1440	37	1300	6 x M42	1205
CSS 1250	1250	1600	40	1450	6 x M42	1550
CSS 1450	1450	1820	42	1650	6 x M48	2350
CSS 1600	1600	1960	45	1800	8 x M48	2940
CSS 1700	1700	2100	50	1900	8 x M56	3700
CSS 2000	2000	2200	50	2000	8 x M64	5310
CSS 2250	2250	2550	59	2300	10 x M64	7400
CSS 2500	2500	2950	69	2700	10 x M64	10280
CSS 3000	3000	3350	82	3150	12 x M76	18600

PERFORMANCE TABLE CSS CELL FENDERS (RPD = Rated Performance Data in acc. with PIANC)

Fender Size	E/R	Rubber Grade / Performance Value	G 0.9	G 1.0	G 1.1	G 1.2	G 1.3	G 1.4	G 1.5	G 1.6	G 1.7	G 1.8
CSS 400	0.17	Energy Reaction	9 50	10 56	10 59	11 63	12 67	12 70	13 74	13 77	14 81	15 84
CSS 500	0.22	Energy Reaction	18 83	19 87	20 91	21 96	22 100	23 105	24 109	25 115	27 122	28 128
CSS 600	0.30	Energy Reaction	31 119	33 126	35 132	36 138	38 144	40 151	41 157	44 166	46 176	49 185
CSS 800	0.35	Energy Reaction	75 211	79 223	82 234	86 245	90 256	94 267	98 279	104 295	110 312	116 329
CSS 1000	0.44	Energy Reaction	145 331	153 348	161 366	168 383	176 401	184 418	191 435	203 462	214 488	226 514
CSS 1150	0.51	Energy Reaction	222 438	233 461	245 484	257 507	268 530	280 553	291 576	309 610	326 645	344 679
CSS 1250	0.55	Energy Reaction	284 517	299 544	314 571	329 598	343 626	359 653	374 680	396 720	419 761	441 802
CSS 1450	0.64	Energy Reaction	444 694	467 732	490 768	514 805	537 842	560 878	584 915	619 969	654 1024	689 1078
CSS 1600	0.70	Energy Reaction	596 846	628 891	659 937	690 982	721 1027	753 1073	785 1118	832 1185	879 1251	926 1318
CSS 1700	0.75	Energy Reaction	714 961	751 1010	789 1059	827 1108	864 1157	902 1206	940 1255	997 1332	1054 1404	1110 1484
CSS 2000	0.88	Energy Reaction	1165 1322	1226 1393	1287 1463	1348 1534	1408 1604	1469 1675	1530 1746	1622 1860	1714 1953	1806 2057
CSS 2250	0.99	Energy Reaction	1659 1676	1746 1765	1832 1854	1918 1942	2005 2030	2091 2118	2177 2207	2309 2338	2440 2469	2571 2601
CSS 2500	1.10	Energy Reaction	2544 2317	2826 2574	2976 2711	3026 2847	3275 2983	3425 3120	3575 3256	3724 3392	3874 3528	4024 3665
CSS 3000	1.15	Energy Reaction	3795 3310	4217 3678	4452 3879	4688 4080	4923 4281	5158 4482	5394 4683	5629 4884	5865 5085	6100 5286

Performance values are for single units. Standard tolerance of +/- 10% Energy absorption in kNm, Reaction force in kN at rated deflection of 52,5%, max. deflection 55%.

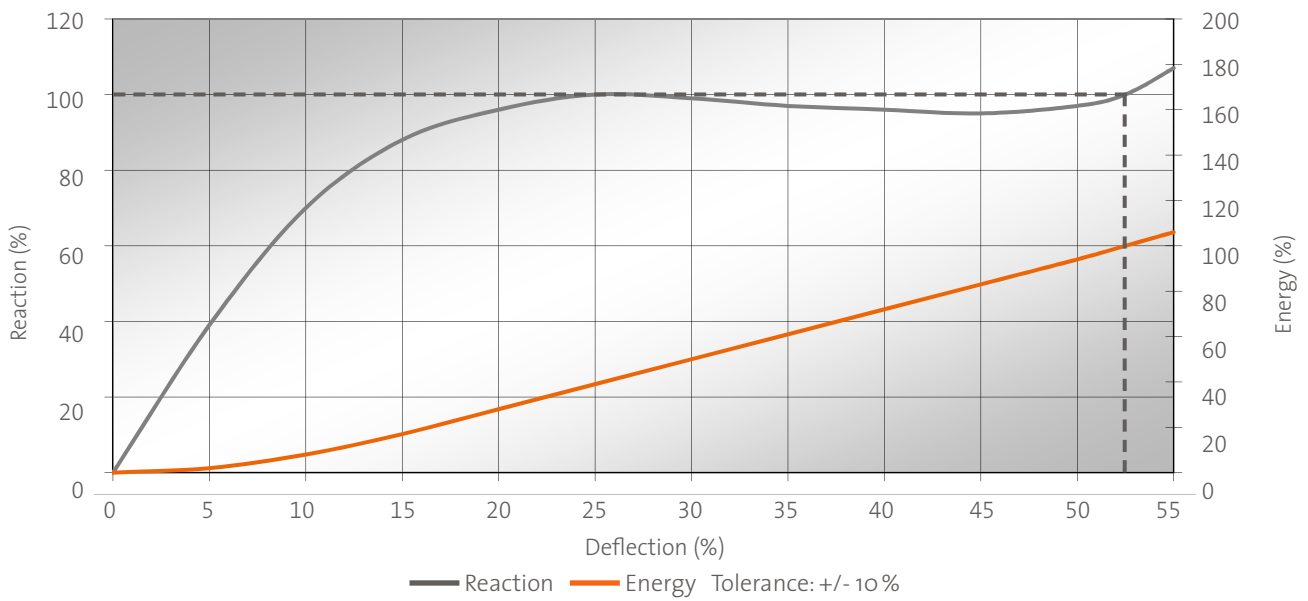


Container Terminal, Khalifa Port, Abu Dhabi

G 1.9	G 2.0	G 2.1	G 2.2	G 2.3	G 2.4	G 2.5	G 2.6	G 2.7	G 2.8	G 2.9	G 3.0	G 3.1	Fender Size
15	16	16	17	17	18	18	19	19	20	20	21	23	CSS 400
88	91	94	97	99	102	104	107	110	112	115	118	129	
30	31	32	33	34	35	36	37	38	39	40	41	42	CSS 500
135	141	146	150	154	159	163	167	171	176	180	184	189	
51	54	55	57	59	60	62	64	65	67	68	70	72	CSS 600
195	204	210	217	223	229	235	241	247	253	259	265	271	
122	128	132	136	140	144	148	151	155	158	162	166	169	CSS 800
345	362	373	385	400	407	418	428	439	450	460	471	481	
238	249	257	264	272	280	287	295	302	309	316	324	331	CSS 1000
540	566	583	601	618	636	653	670	686	703	719	736	752	
361	379	390	402	413	425	436	448	459	470	481	492	504	CSS 1150
714	748	765	794	817	840	863	885	907	920	942	973	995	
464	486	501	516	531	546	561	575	590	604	618	633	647	CSS 1250
843	884	911	938	965	993	1020	1045	1071	1096	1122	1147	1173	
724	759	782	806	829	852	876	899	922	945	968	991	1020	CSS 1450
1132	1187	1224	1261	1298	1336	1373	1408	1444	1479	1514	1550	1584	
973	1020	1051	1083	1114	1145	1177	1206	1236	1265	1295	1324	1353	CSS 1600
1385	1451	1495	1538	1580	1624	1667	1710	1753	1797	1840	1883	1926	
1169	1226	1263	1300	1338	1375	1412	1448	1482	1518	1553	1589	1624	CSS 1700
1561	1638	1687	1736	1784	1834	1883	1932	1980	2030	2079	2128	2177	
1898	1991	2052	2112	2173	2234	2295	2354	2413	2471	2530	2589	2648	CSS 2000
2161	2265	2334	2403	2471	2540	2609	2675	2742	2809	2875	2942	3009	
2703	2834	2922	3011	3099	3187	3275	3358	3440	3523	3604	3687	3770	CSS 2250
2732	2864	2952	3040	3128	3215	3305	3389	3474	3558	3642	3727	3808	
4173	4323	4452	4582	4712	4841	4971	5101	5230	5360	5490	5619	6181	CSS 2500
3801	3937	4056	4174	4292	4410	4528	4647	4765	4883	5001	5119	5631	
6335	6571	6761	6952	7143	7334	7525	7716	7906	8097	8288	8479	9327	CSS 3000
5487	5688	5856	6023	6191	6358	6526	6693	6860	7028	7195	7363	8099	



GENERIC PERFORMANCE CURVE CSS CELL FENDERS



FENDER PERFORMANCE AT INTERMEDIATE DEFLECTION

Deflection in % of original fender height	0	5	10	15	20	25	30	35	40	45	50	52.5	55
Energy absorption in % of original value	0	2	8	17	28	39	50	62	72	83	94	100	106
Reaction Force in % of original value	0	39	70	88	96	100	99	97	96	95	97	100	107

TEMPERATURE FACTOR

Temperature in °C	-30	-20	-10	0	10	23	30	40	50	60
Correction Factor	1.559	1.375	1.182	1.083	1.034	1	0.976	0.945	0.918	0.917

VELOCITY FACTOR

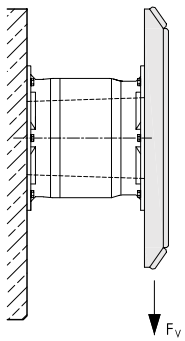
Compression Time in sec.	1	2	3	4	5	6	7	8	≥10
Correction Factor	1.050	1.020	1.012	1.005	1.000	1.000	1.000	1.000	1.000

ANGLE FACTOR

Compression Angle in °	0	3	4	5	6	7	8	9	10	15	20
at 52,5 % Deflection											
Energy Correction Factor	100	98	97	95	94	92	91	90	88	80	65
Reaction Force Correction Factor	100	100	100	100	100	100	100	100	100	100	100
at 55 % Deflection											
Energy Correction Factor	106	104	102	101	100	98	97	96	94	86	72
Reaction Force Correction Factor	106	106	106	106	106	106	106	106	106	106	106

WEIGHT SUPPORT CAPACITY

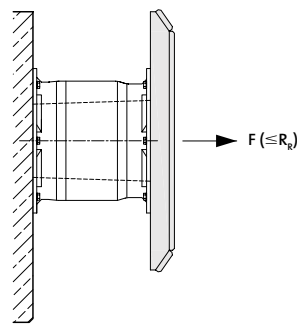
The CSS Fender can support a significant amount of weight. As a rule of thumb, we recommend to



add weight support chains if the panel weight exceeds the weight of the rubber body.

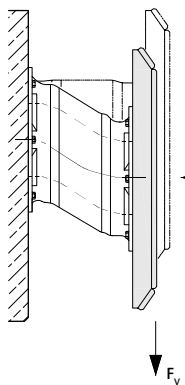
TENSION

Tension chains are recommended when tensile loads might exceed the rated reaction force of the rubber fender. Please contact us for detailed advice.



SHEAR

CSS Fenders are stable against horizontal and vertical shear forces. However depending on the



application and layout of the system shear chains might become necessary. Please contact us for further information.

CLEARANCES

The fender design should allow for:

- ▶ increased diameter of CSS Fenders during compression
- ▶ sufficient clearance of front panel
- ▶ minimum edge distance for anchoring
- ▶ angular compression

Fender Size	H [mm]	ED [mm]	j [mm]	i [mm]
CSS 400	400	480	700	240
CSS 500	500	510	700	300
CSS 600	600	570	880	360
CSS 800	800	700	1120	480
CSS 1000	1000	850	1500	600
CSS 1150	1150	990	1730	690
CSS 1250	1250	1060	1870	750
CSS 1450	1450	1200	2180	870
CSS 1600	1600	1270	2400	960
CSS 1700	1700	1470	2550	1020
CSS 2000	2000	1560	2880	1200
CSS 2250	2250	1710	3360	1350
CSS 2500	2500	1910	3730	1500
CSS 3000	3000	2240	4500	1800

