GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

Marine Fenders

Focus On Berthing And Mooring Equipment

About us

Since 2004， GLEN has specialized in mooring and berthing equipment in the port industry. The products are certified by LR， DNVGL， ABS， CCS， and other classification societies. GLEN has become a member of PIANC and a leading supplier of quick release hooks， rubber fenders， and bollards in design， manufacturing， and commissioning in the Southeast Asian market. GLEN is the only company that could manufacture both mooring and berthing equipment in China.

Lloyd's Register

Certificate of Approval

This is to certify that the Management System of:

GLEN MARITIME（CHONGQING）ENGINEERING TECHNOLOGY LIMITED

has been approved by Lloyd's Register to the following standards:

ISO 9001:2015

The scope of this approval is applicable to:

Our core competencies are providing high-value consulting， project management， and remote preventive maintenance. GLEN has established a reliable quality management system and product delivery system as well as testing and maintenance services to ensure successful installations and ongoing service results.

- ISO 9001: 2015 Quality Management System Certificated By Lloyd‘s Register， UK.
- ISO 14000 environmental management system
- ISO 45001 occupation health safety management system.
- PIANC Certificate
- Lloyd's welding procedure qualification
- 1 invention， 6 patents and 5 soft publications
- Awarded the honor of “High-Tech Enterprise”

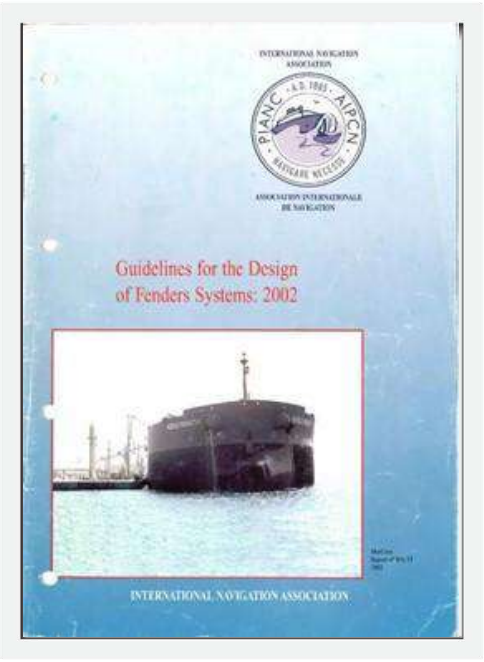
Our strategic goal is to be an international， refined， specialized and innovative enterprise in the next five years.

GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

Fender Design

PIANC Approach

All marine fender design according to PIANC 2002 Guidelines by working group-33 of Marcom (the Maritime Navigation Commission).



GLEN 's fender systems can be integrated with IntMoor™. IntMoor™ is a technology platform that for berthing, mooring, environmental monitoring, central control, etc., data-driven assets, giving stakeholders a holistic view of operations to power communication and decision making.

PIANC 2002, Type Approval & Test Protocols

Purchasers of rubber marine fenders must be sure to buy only from manufacturers that can absolutely guar anteethe required level of quality.

Type Approval

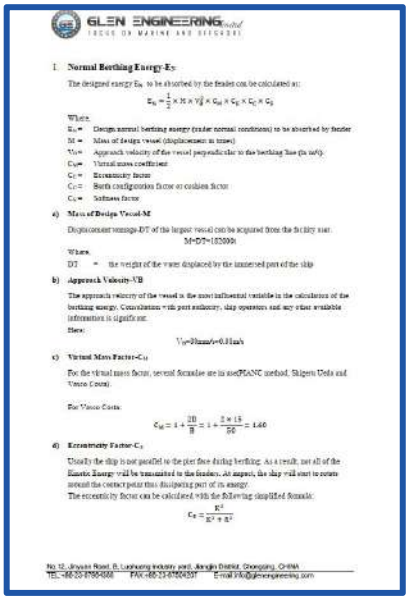
Product quality conforming to PIANC 2002 guidedines and ataining5.000 deflections, while only 3.000 deflections are being specified.

Compliance with PIANC 2002 Appendix A

Indicates that products are suitable for testing according to thetest and inspection methods defined by PIANC 2002 Appendix A

Technical support from Berthing energy calculation, Fender design selection and front panel design.

For consulation and concept stage: The berthing energy calculation could provide fender optimization advice.



1. **Normal Berthing Energy-E_N**

The designed energy E_N to be absorbed by the fender can be calculated as:

$$E_N = \frac{1}{2} \times M \times V_B^2 \times C_M \times C_E \times C_C \times C_S$$

Where,

E_N = Design normal berthing energy (under normal conditions) to be absorbed by fender
M = Mass of design vessel (displacement in tones)
V_B = Approach velocity of the vessel perpendicular to the berthing line (in m/s).
C_M = Virtual mass coefficient
C_E = Eccentricity factor
C_C = Berth configuration factor or cushion factor
C_S = Softness factor

a) **Mass of Design Vessel-M**

Displacement tonnage-DT of the largest vessel can be acquired from the facility site.

M=DT=182000t

Where,

DT = the weight of the water displaced by the immersed part of the ship

b) **Approach Velocity-VB**

The approach velocity of the vessel is the most influential variable in the calculation of the berthing energy. Consultation with port authority, ship operators and any other available information is significant.

Here:

V_B=0.1m/s=0.1m/s

c) **Virtual Mass Factor-C_M**

For the virtual mass factor, several formulae are in use(PIANC method, Shigeru Ueda and Vasco Costa).

For Vasco Costa:

$$C_M = 1 + \frac{2D}{B} = 1 + \frac{2 \times 15}{50} = 1.60$$

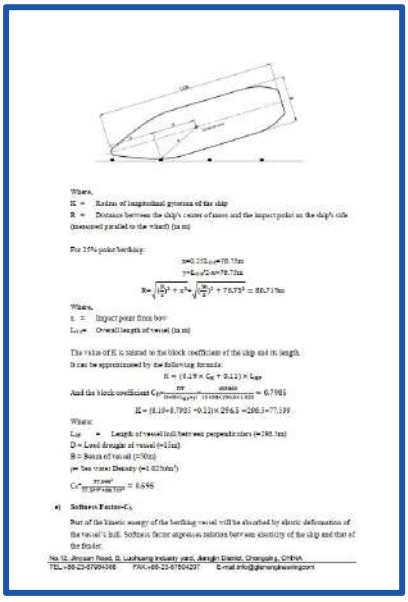
d) **Eccentricity Factor-C_E**

Usually the ship is not parallel to the pier face during berthing. As a result, not all of the Kinetic Energy will be transmitted to the fenders. At aspect, the ship will start to rotate around the contact point thus dissipating part of its energy.

The eccentricity factor can be calculated with the following simplified formula:

$$C_E = \frac{K^2}{K^2 + R^2}$$

No.12, Jinyuan Road, B, Liuzhuang Industry yard, Jiangjin District, Chongqing, CHINA
TEL:+86-23-67954368 FAX:+86-23-67954207 E-mail:info@glenengineering.com



Where,

K = Radius of longitudinal gyration of the ship
R = Distance between the ship's center of mass and the impact point on the ship's side (measured parallel to the wharf) (in m)

For 10% point berthing:

$$x=0.10L_{OA}=70.70m$$
$$y=L_{OA}/2=70.70m$$
$$R=\sqrt{\left(\frac{L}{2}\right)^2+x^2}=\sqrt{\left(\frac{L}{2}\right)^2+70.70^2}=86.71m$$

Where,

x = Impact point from bow
L_{OA} = Overall length of vessel (in m)

The value of K is related to the block coefficient of the ship and its length.

It can be approximated by the following formula:

$$K=(0.19\times C_B+0.11)\times L_{BP}$$

And the block coefficient $C_B=\frac{DT}{Density_{sea} \times L \times B \times D}=\frac{182000}{1.025 \times 296.5 \times 50 \times 15}=0.7981$

$$K=(0.19\times 0.7981+0.11)\times 296.5=296.5\times 0.199$$

Where:

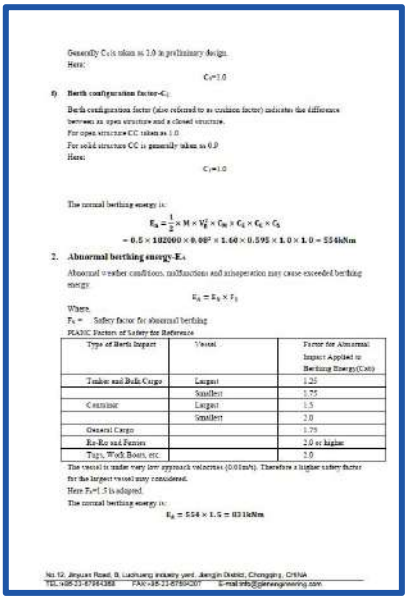
L_{BP} = Length of vessel (still between perpendiculars (=296.5m)
D = Load draught of vessel (=15m)
B = Beam of vessel (=50m)
ρ= Sea water Density (=1.025t/m³)

$C_B=\frac{DT/100}{D\times B\times L_{BP}}=0.595$

e) **Softness Factor-C_S**

Part of the kinetic energy of the berthing vessel will be absorbed by elastic deformation of the vessel's hull. Softness factor expresses relation between elasticity of the ship and that of the fender.

No.12, Jinyuan Road, B, Liuzhuang Industry yard, Jiangjin District, Chongqing, CHINA
TEL:+86-23-67954368 FAX:+86-23-67954207 E-mail:info@glenengineering.com



Generally C_S is taken as 1.0 in preliminary design.
Here:

C_S=1.0

f) **Berth configuration factor-C_C**

Berth configuration factor (also referred to as cushion factor) indicates the difference between an open structure and a closed structure.
For open structure CC taken as 1.0
For solid structure CC is generally taken as 0.9
Here:

C_C=1.0

The normal berthing energy is:

$$E_N = \frac{1}{2} \times M \times V_B^2 \times C_M \times C_E \times C_C \times C_S$$
$$= 0.5 \times 182000 \times 0.08^2 \times 1.60 \times 0.595 \times 1.0 \times 1.0 = 554kNm$$

2. **Abnormal berthing energy-E_A**

Abnormal weather conditions, malfunctions and misoperation may cause exceeded berthing energy.

$$E_A = E_N \times F_S$$

Where,

F_S = Safety factor for abnormal berthing

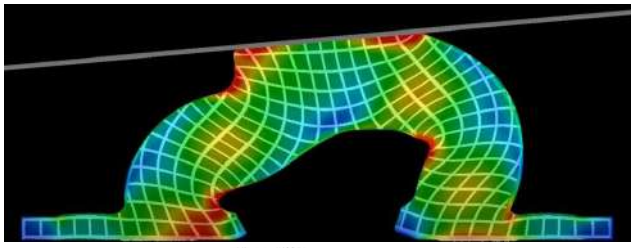
PIANC Factors of Safety for Reference

Type of Berth Impact	Vessel	Factor for Abnormal Impact Applied to Berthing Energy(Cats)
Tanker and Bulk Cargo	Largest	1.25
	Smallest	1.75
Container	Largest	1.5
	Smallest	2.0
General Cargo		1.75
Ro-Ro and Ferries		2.0 or higher
Tugs, Work Boats, etc.		2.0

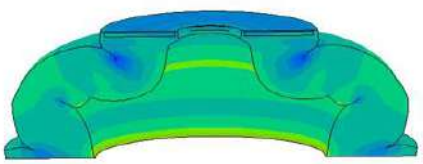
The vessel is under very low approach velocities (0.01m/s). Therefore a higher safety factor for the largest vessel may considered.
Here F_S=1.5 is adopted.
The normal berthing energy is:

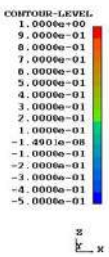
$$E_A = 554 \times 1.5 = 831kNm$$

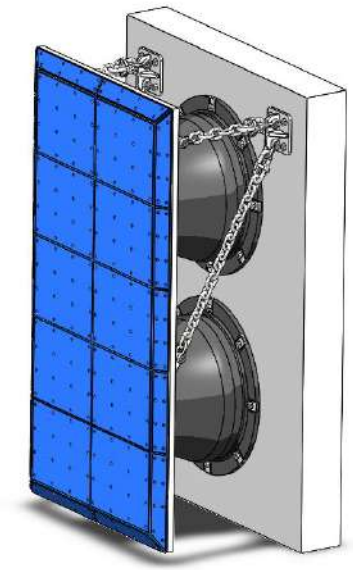
For the design stage: marine fender selection base on FEM and 3D CAD design.



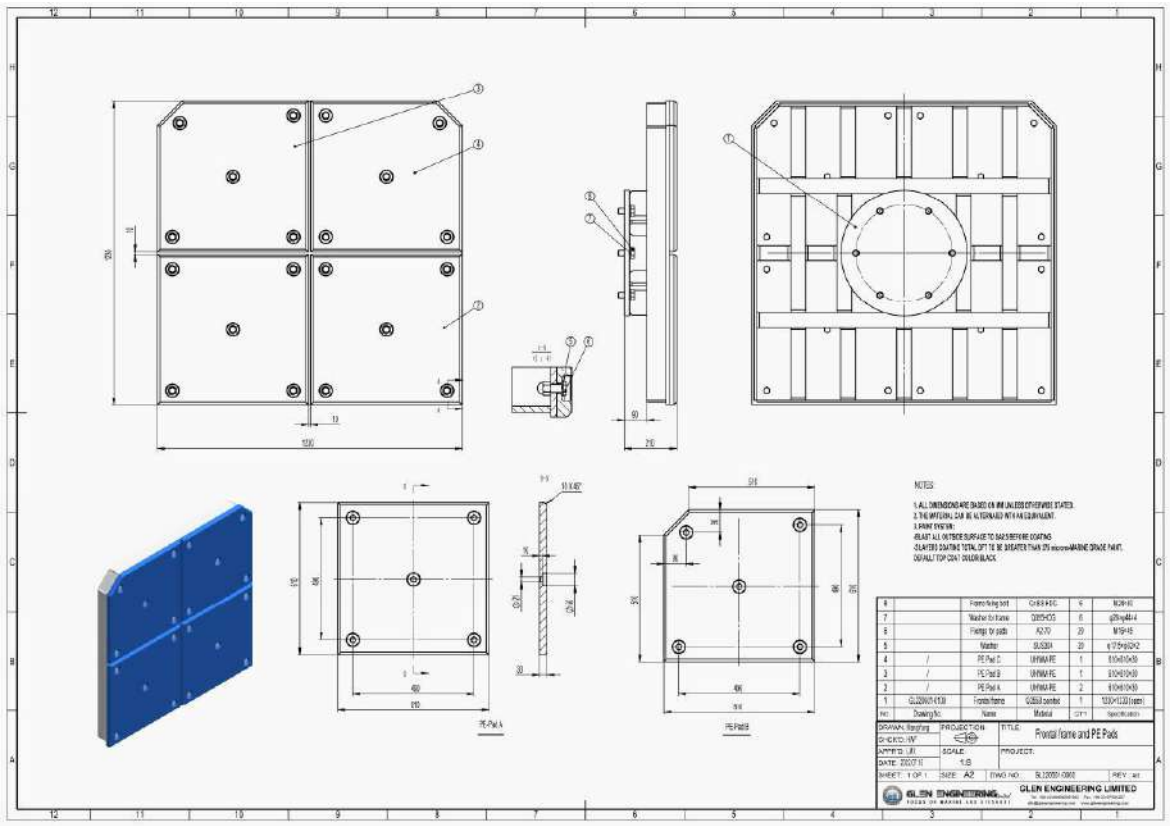
Comp. 40%







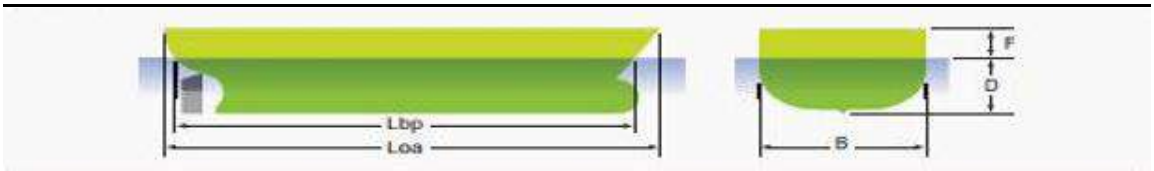
For manufacture stage: The manufacture detail drawings for frontal panel for local structure to save the transportation cost.



Design Team

Project requirements sheet

GENERAL	
Project	
Poet	
Country	
Contractor	
Consultant	



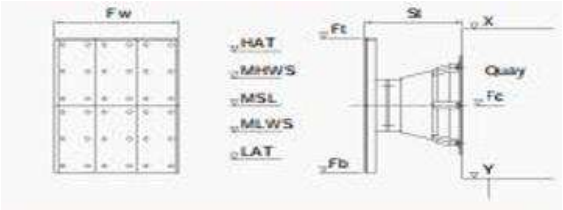
VESSEL DETAILS		
Vessel Type	Maximum vessel	Minimum vessel
Deadweight	(ton)	(ton)
LENGTH Over All (loa)	(ton)	(ton)
Length Between Perps(lbp)	(m)	(m)
Beam(b)	(m)	(m)
Draft(D)	(m)	(m)
Freeboard(F)	(m)	(m)
Hull Pressure	(ton/m²)	(ton/m²)
Ship's Belt		

BERTHING CONDITIONS		
	Maximum vessel	Minimum vessel
Berthing Mode	Side berthing · dolphin berthing · end berthing · other	Side berthing · dolphin berthing · end berthing · other
Berthing Speed	(m/sec)	(m/sec)
Berthing Angle	(deg)	(deg)
Abnor Mal Berthing Factor		

BERTH DETAILS

Structure		Elevation	
Quay Type	Solid (gravity, sheet · pile, cell type,etc) Flexible (pier,dolphin,etc)	Tidal range	(m)
		Highest astronomic tide(HAT)	(m)
		Mean high water spering (MHWS)	(m)
		Mean sea level (MSL)	(m)
		Mean low water spring (MLWS)	(m)
Length Of Berth	(m)	Lowest astronomic tide(LAT)	(m)
Fender Or Dolphin Spacing	(m)	Installation area · top(X)	(m)
Allowable Fender Reaction	(kN)	Installation area · bottom(Y)	(m)

Fender Position	
Steel Frame · Top(ft)	(m)
Center Of Rubber Fender(fe)	(m)
Steel Frame · Bottom(fw)	(m)
Width of steel frame(Fw)	(m)
Stand · Off(st)	(m)



FURTHER INFORMATION AVAILABLE FORM			
Name		Tel	
Position		Fax	
Company		Address	
E · mail			

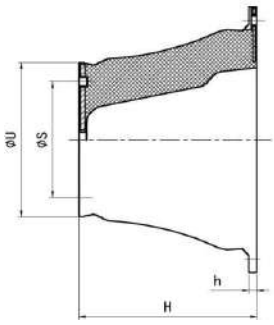
GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

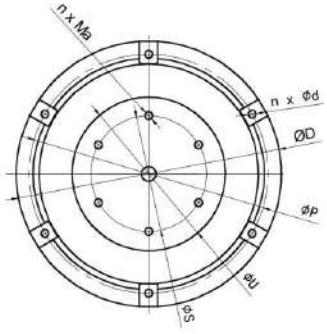
Fender Types & Specification

Cone Fender

Features

- Endure server shear force
- Structure is more reasonable
- Can support large panels and suitable for low hull pressure vessels





Specification

Type	Specification								
	H	U	S	P	D	n	Ma	d	h
GCO 500	500	425	325	675	750	4	M24	30	25
GCO 600	600	510	390	810	900	6	M24	30	27
GCO 700	700	595	455	945	1050	6	M30	38	32
GCO 800	800	680	520	1080	1200	6	M36	44	36
GCO 900	900	765	585	1215	1350	6	M36	44	41
GCO 1000	1000	850	650	1350	1500	6	M42	50	45
GCO 1100	1100	935	715	1485	1650	6	M42	50	50
GCO 1150	1150	998	750	1550	1725	6	M42	50	52
GCO 1200	1200	1020	780	1620	1800	8	M42	50	54
GCO 1300	1300	1105	845	1755	1950	8	M48	60	59
GCO 1400	1400	1190	930	1890	2100	8	M48	60	66
GCO 1600	1600	1360	1060	2160	2400	8	M48	70	72
GCO 1800	1800	1530	1190	2430	2700	10	M56	76	78

Unit：mm

Performance

Type	70% Rated Deflection							
	Super High Reaction Force(FS)		High Reaction Force (FH)		Standard ReactionForce(FO)		Low ReactionForce(FL)	
	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption
GCO 500	342	80.6	273	64.3	204	47.9	168	37.7
GCO 600	490	160	390	130	289	95.9	230	76.5
GCO 700	665	240	532	185	320	153	314	122
GCO 800	879	375	720	300	512	229	410	183
GCO 900	1099	504	879	407	648	312	518	260
GCO 1000	1366	682	1100	552	800	446	641	357
GCO 1100	1459	847	1169	663	946	505	816	416
GCO 1150	1799	1050	1420	900	1059	679	847	543
GCO 1200	1883	1115	1526	971	1128	719	908	571
GCO 1300	2168	1617	1739	1336	1346	1064	1148	765
GCO 1400	2300	1720	1840	1376	1472	1101	1173	877
GCO 1600	3084	2467	2313	1974	1850	1579	1446	1259
GCO 1800	3825	3609	3060	2887	2449	2309	1950	1840

Unit：mm

Type	72% Maximum Deflection							
	Super High Force(FS)		High Reaction force(FH)		Standard Reaction Force(FO)		Low Reaction Force(FL)	
	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption
GCO 500	388	91.8	317	71.4	237	51	197	41.8
GCO 600	553	164	438	132	325	106	263	86.7
GCO 700	705	248	579	196	435	157	348	127
GCO 800	949	388	850	322	588	257	437	212
GCO 900	1213	527	976	440	717	341	569	275
GCO 1000	1537	750	1237	600	900	488	712	388
GCO 1100	1601	882	1284	695	1039	538	850	441
GCO 1150	2025	1125	1625	957	1175	731	937	600
GCO 1200	2086	1172	1698	1018	1252	754	1005	599
GCO 1300	2358	1673	1938	1387	1567	1099	1224	816
GCO 1400	2556	1791	2045	1433	1636	1147	1304	914
GCO 1600	3213	2570	2410	2056	1927	1645	1606	1311
GCO 1800	4249	3760	3400	3007	2720	2406	2168	1918

Unit：mm

Note: Performance tolerance is ±10%.

Correction factors

- The correction factors are for abnormal berthing conditions.

Angular compression factor		Temperature factor		Velocity factor	
Angle(°)	AF	Temperature(℃)	TF	Time (second)	VF
0	1.000	50	0.882	1	1.005
3	0.977	40	0.926	2	1.002
5	0.951	30	0.969	3	1.001
8	0.909	23	1.000	4	1.001
10	0.883	10	1.056	5	1.000
15	0.810	0	1.099	6	1.000
20	0.652	-10	1.143	8	1.000
		-20	1.186	≥10	1.000
		-30	1.230		

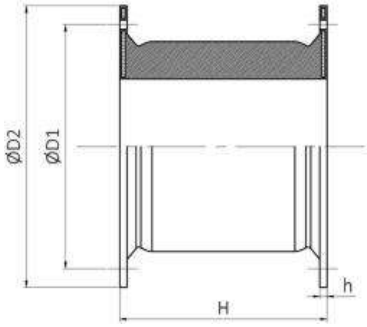
Unit：mm

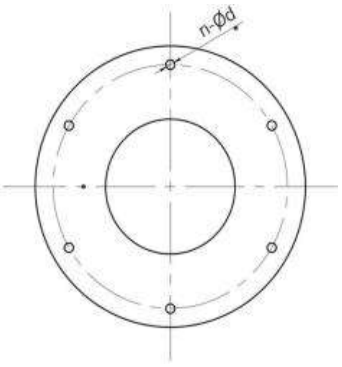
Note: Above factors are from PIANC， only for reference.

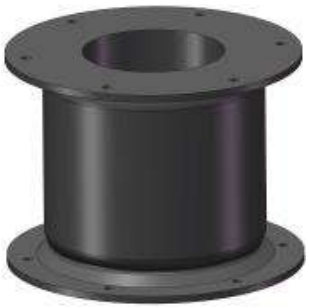
Cone Fender

Features

- Low reaction force and high capability of energy absorption
- Applicable for ships with different sizes
- Support large panels and suitable for low hull pressure vessels







Specification

Type	Specification					
	H	D1	D2	h	Holes(n)	d
GSC 400H	400	550	650	25	4	30
GSC 500H	500	550	650	25	4	32
GSC 630H	630	700	840	30	4	39
GSC 800H	800	900	1050	30	6	40
GSC 1000H	1000	1100	1300	35	6	47
GSC 1150H	1150	1300	1500	40	6	50
GSC 1250H	1250	1450	1650	45	6	53
GSC 1450H	1450	1650	1850	47	6	61
GSC 1600H	1600	1800	2000	50	8	61
GSC 1700H	1700	1900	2100	55	8	66
GSC 2000H	2000	2000	2200	55	8	74
GSC 2250H	2250	2300	2550	60	10	74
GSC 2500H	2500	2700	2950	70	10	90
GSC 3000H	3000	3150	3350	75	12	90

Unit：mm

Note: Other specification out of the series can be produced upon request.

Performance

Type	52.5% Rated Deflection									
	Super High Reaction Force(FE)		Super High Reaction Force(FS)		High Reaction Force(FH)		Standard Reaction Force(FO)		Low Reaction Force(FL)	
	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption
GSC 400H	112	19.4	97.9	17.3	85	14.3	65.3	11.2	52	9.2
GSC 500H	186	40.8	165	36.7	143	30.6	110	23.5	87.7	18.4
GSC 630H	296	81.6	263	73.4	229	63.2	175	47.9	141	38.8
GSC 800H	473	166	420	148	341	128	281	97.9	215.2	76.5
GSC 1000H	752	331	668	293	578	254	445	195	356	156
GSC 1150H	995	502	882	446	765	387	590	297	471	238
GSC 1250H	1176	645	1042	572	903	496	696	382	557	305
GSC 1450H	1582	1007	1404	894	1217	775	936	597	750	477
GSC 1600H	1926	1353	1710	1201	1482	1040	1139	802	912	641
GSC 1700H	2174	1623	1930	1441	1673	1249	1287	960	1029	768
GSC 2000H	3000	2643	2671	2346	2315	2034	1781	1565	1426	1252
GSC 2250H	4228	4177	3753	3701	3252	3213	2503	2473	2127	2101
GSC 2500H	5220	5730	4634	5087	4016	4408	3089	3392	2625	2883
GSC 3000H	-	-	-	-	5801	7605	4400	5790	3751	4995

Unit：mm

Type	55% Maximum Deflection									
	Super High Reaction Force(FE)		Super High Reaction Force(FS)		High Reaction Force(FH)		Standard Reaction Force(FO)		Low Reaction Force(FL)	
	Reaction force	Energy Absorption	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption	Reaction force	Energy absorption
GSC 400H	128	21.4	114	18.4	98.9	15.3	76.5	12.2	60	9.7
GSC 500H	214	43.9	191	38.8	163	32.6	128	25.5	101	19.4
GSC 630H	315	86.7	280	77.5	242	68.3	186	51	150	40.8
GSC 800H	503	177	446	156	386	135	298	104	230	79.6
GSC 1000H	800	350	710	310	615	269	472	207	379	166
GSC 1150H	1058	531	938	472	814	409	626	315	501	252
GSC 1250H	1250	682	1109	606	961	526	740	404	593	322
GSC 1450H	1682	1066	1493	947	1294	820	996	631	797	505
GSC 1600H	2047	1433	1817	1272	1575	1102	1213	849	969	678
GSC 1700H	2311	1719	2052	1525	1778	1326	1369	1017	1095	814
GSC 2000H	3199	2798	2839	2484	2461	2153	1893	1657	1515	1325
GSC 2250H	4494	4424	3989	3925	3458	3403	2659	2617	2260	2224
GSC 2500H	5550	6068	4926	5386	4266	4668	3284	3590	2792	3052
GSC3000H	-	-	-	-	6751	7671	5201	6149	4301	5297

Note: Performance tolerance is ±10%.

Unit：mm

Correction factors

- The correction factors are for abnormal berthing conditions.

Angular compression factor		Temperature factor		Velocity factor	
Angle(°)	AF	Temperature(℃)	TF	Time(second)	VF
0	1.000	50	0.882	1	1.005
3	0.977	40	0.926	2	1.002
5	0.951	30	0.969	3	1.001
8	0.909	23	1.000	4	1.001
10	0.883	10	1.056	5	1.000
15	0.810	0	1.099	6	1.000
20	0.652	-10	1.143	8	1.000
		-20	1.186	≥10	1.000
		-30	1.230		

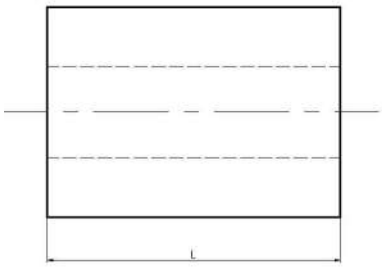
Unit：mm

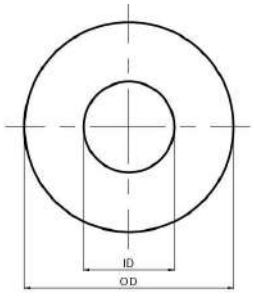
Note：Above factors are from PIANC， only for reference.

Cylindrical Fender

Features

- Low reaction force and hull pressure， reasonable energy absorption
- Applicable for rolling and pitching of berthing vessels
- Applicable for ships with different sizes
- Easy to install and maintain





Specification

Type	GCY 150	GCY 200	GCY 250	GCY 300	GCY 350	GCY 400	GCY 500	GCY 600	GCY 700	GCY 800	GCY 900
OD(mm)	150	200	250	300	350	400	500	600	700	800	900
ID(mm)	75	100	125	150	175	200	250	300	350	400	450
WT(kg/m)	17	41	48	70	95	124	193	278	379	495	626

Unit：mm

Type	GCY 1000	GCY 1100	GCY 1200	GCY 1300	GCY 1400	GCY 1500	GCY 1600	GCY 1700	GCY 1800	GCY 1900	GCY 2000
OD(mm)	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
ID(mm)	500	550	600	650	700	750	800	850	900	950	1000
WT(kg/m)	773	935	1102	1306	1514	1739	1978	2233	2503	2790	3091

Unit：mm

Note:Other specification out of the series can be produced upon request.

Performance

Performance Specification	50% Rated Deflection			
	Reaction Force(kN)		Energy Absorption(kNm)	
	RO Standard Type	RH High Reaction ForceType	RO Standard Type	RH High Reaction ForceType
GCY 150	45	75	1.5	2
GCY 200	61	97	2.7	4
GCY 250	77	122	4.1	6.6
GCY 300	91	146	6.1	9
GCY 350	106	170	8.2	13
GCY 400	121	195	10.2	17
GCY 500	151	244	16.3	26.5
GCY 600	183	292	24.5	27.5
GCY 700	212	341	31.6	51
GCY 800	242	391	41.8	67.3
GCY 900	273	439	53	85.7
GCY 1000	303	489	65.3	1105
GCY 1100	338	539	78.5	132
GCY 1200	370	585	96.9	155
GCY 1300	400	635	110	183
GCY 1400	430	683	131	212
GCY 1500	460	732	150	243
GCY 1600	491	792	180	288
GCY 1700	521	840	210	345
GCY 1800	552	889	252	414
GCY 1900	581	938	294	497
GCY 2000	666	1075	327	596

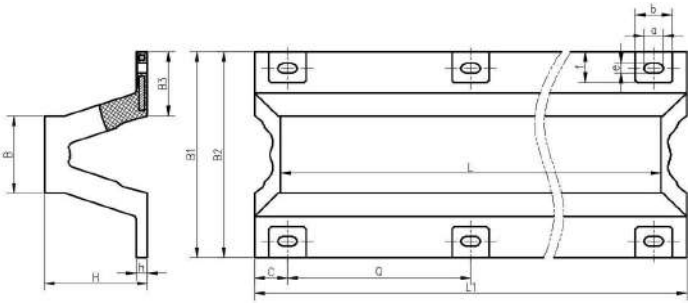
Unit：mm

Note: Performance tolerance is ±10%.

Arch Fender

Features

- Low reaction force and high energy absorption.
- Easy installation and convenient replacement.



Specification

Type	H	L	L1	B	B1	B2	B3	C	Q	h	a	b	e	f
GSA 150x1000	150	1000	1075	98	240	300	96	110	855	22.5	50	95	25	55
GSA 150x1500	150	1500	1575	98	240	300	96	112.5	675	22.5	50	95	25	55
GSA 150x2000	150	2000	2075	98	240	300	96	215	620	22.5	50	95	25	55
GSA 150x2500	150	2500	2575	98	240	300	96	220	785	22.5	50	95	25	55
GSA 150x3000	150	3000	3075	98	240	300	96	215	715	22.5	50	95	25	55
GSA 150x3500	150	3500	3575	98	240	300	96	220	671	22.5	50	95	25	55
GSA 200x1000	200	1000	1100	145	320	400	128	120	860	30	58	105	29	75
GSA 200x1500	200	1500	1600	145	320	400	128	120	680	30	58	105	29	75
GSA 200x2000	200	2000	2100	145	320	400	128	120	620	30	58	105	29	75
GSA 200x2500	200	2500	2600	145	320	400	128	122.5	785	30	58	105	29	75
GSA 200x3000	200	3000	3100	145	320	400	128	120	715	30	58	105	29	75
GSA 200x3500	200	3500	3600	145	320	400	128	120	672	30	58	105	29	75
GSA 250x1000	250	1000	1125	164	410	500	160	130	865	30	64	125	32	90
GSA 250x1500	250	1500	1625	164	410	500	160	132.5	680	30	64	125	32	90
GSA 250x2000	250	2000	2125	164	410	500	160	132.5	620	30	64	125	32	90

Type	H	L	L1	B	B1	B2	B3	C	Q	h	a	b	e	f
GSA 250x2500	250	2500	2625	164	410	500	160	127.5	790	30	64	125	32	90
GSA 250x3000	250	3000	3125	164	410	500	160	132.5	715	30	64	125	32	90
GSA 250x3500	250	3500	3625	164	410	500	160	130	673	30	64	125	32	90
GSA 300x1000	300	1000	1150	225	490	600	195	140	870	33	70	140	35	105
GSA 300x1500	300	1500	1650	225	490	600	195	140	685	33	70	140	35	105
GSA 300x2000	300	2000	2150	225	490	600	195	137.5	625	33	70	140	35	105
GSA 300x2500	300	2500	2650	225	490	600	195	140	790	33	70	140	35	105
GSA 300x3000	300	3000	3150	225	490	600	195	145	715	33	70	140	35	105
GSA 300x3500	300	3500	3650	225	490	600	195	140	674	33	70	140	35	105
GSA 400x1000	400	1000	1200	300	670	800	260	150	900	40	82	165	41	120
GSA 400x1500	400	1500	1700	300	670	800	260	150	700	40	82	165	41	120
GSA 400x2000	400	2000	2200	300	670	800	260	147.5	635	40	82	165	41	120
GSA 400x2500	400	2500	2700	300	670	800	260	150	800	40	82	165	41	120
GSA 400x3000	400	3000	3200	300	670	800	260	150	725	40	82	165	41	120
GSA 400x3500	400	3500	3700	300	670	800	260	150	680	40	82	165	41	120
GSA 500x1000	500	1000	1250	375	840	1000	325	160	930	45	94	180	47	140
GSA 500x1500	500	1500	1750	375	840	1000	325	160	715	45	94	180	47	140
GSA 500x2000	500	2000	2250	375	840	1000	325	157.5	645	45	94	180	47	140
GSA 500x2500	500	2500	2750	375	840	1000	325	160	810	45	94	180	47	140
GSA 500x3000	500	3000	3250	375	840	1000	325	165	730	45	94	180	47	140
GSA 500x3500	500	3500	3750	375	840	1000	325	160	686	45	94	180	47	140
GSA 600x1000	600	1000	1300	450	1010	1200	390	170	960	54	100	195	50	160
GSA 600x1500	600	1500	1800	450	1010	1200	390	170	730	54	100	195	50	160
GSA 600x2000	600	2000	2300	450	1010	1200	390	167.5	655	54	100	195	50	160
GSA 600x2500	600	2500	2800	450	1010	1200	390	170	820	54	100	195	50	160
GSA 600x3000	600	3000	3300	450	1010	1200	390	170	740	54	100	195	50	160
GSA 600x3500	600	3500	3800	450	1010	1200	390	170	692	54	100	195	50	160
GSA 800x1000	800	1000	1400	600	1340	1600	520	180	1040	72	136	270	68	260
GSA 800x1500	800	1500	1900	600	1340	1600	520	180	770	72	136	270	68	260
GSA 800x2000	800	2000	2400	600	1340	1600	520	180	680	72	136	270	68	260
GSA 800x2500	800	2500	2900	600	1340	1600	520	182.5	845	72	136	270	68	260
GSA 800x3000	800	3000	3400	600	1340	1600	520	180	760	72	136	270	68	260
GSA 1000x1000	1000	1000	1500	750	1680	2000	650	200	1100	90	136	290	68	300

Unit：mm

Note: Other specification out of the series can be produced upon request.

Performance

Performance Specification	52.5% Rated Deflection			
	Reaction Force(kN)		Energy Absorption(kNm)	
	RO Standard Type	RH High Reaction ForceType	RO Standard Type	RH High Reaction ForceType
GSA 150	87.7	147	4.1	6.1
GSA 200	114	156	8.2	11.2
GSA 250	179	216	18.8	22.8
GSA 300	209	254	25.5	31.6
GSA 400	281	339	46.9	57.1
GSA 500	351	423	73.4	89.5
GSA 600	420	508	106	129
GSA 800	561	677	189	228
GSA 1000	703	846	295	356

Unit：mm

Performance Specification	55% Rated Deflection			
	Reaction Force(kN)		Energy Absorption(kNm)	
	RO Standard Type	RH High Reaction ForceType	RO Standard Type	RH High Reaction Force Type
GSA 150	117	157	5.1	7.1
GSA 200	156	208	9.2	12.2
GSA 250	249	300	19.8	24
GSA 300	300	353	27.4	33.7
GSA 400	361	469	50	61.2
GSA 500	487	588	78.5	94.9
GSA 600	590	706	113	138
GSA 800	779	940	202	254
GSA 1000	975	1176	317	381

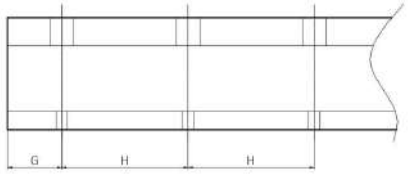
Unit：mm

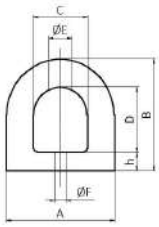
Note：Performance tolerance is ±10%.

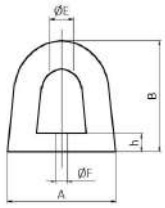
D Fender

Features

- Easy for installation and maintenance.
- Reasonable reaction force with high energy absorption







Specification

Type	Dimensions							
	A	B	C	D	E	F	G	H
GD 200x200	200	200	100	100	62	30	100~150	325~460
GD 300x300	300	300	150	150	65	32	100~150	325~600
GD 400x400	400	400	200	200	87	39	150	425~460
GD 500x500	500	500	250	200	97	45	150	325~600

Unit：mm

Note: Other specification out of the series can be produced upon request.

Performance

Type	50% Rated Deflection	
	Reaction Force	Energy Absorption
GD 200x200	207	8
GD 300x300	294	12
GD 400x400	383	20
GD 500x500	451	31

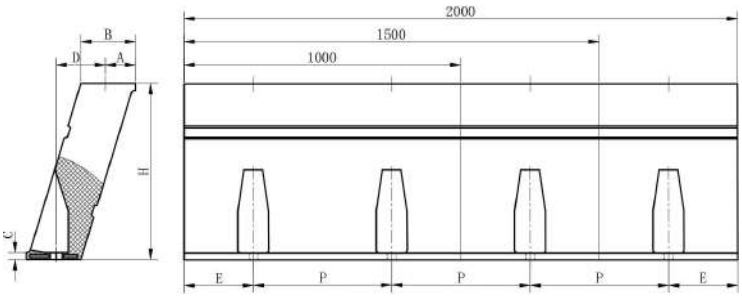
Unit：mm

Note: Performance tolerance is ±10%

Unit Element Fender

Features

- Low reaction force and high energy absorption.
- Unit element fendercan be combined into different types and sizes of fender system upon required performance.
- Optimum performance can be achieved at perpendicular or angular compression
- Easy installation and low maintenance



Specification

Type	A	B	C	D	H	E	P
GUE 300	47	94	15	94	300	250	500
GUE 400	63	125	17	124	400	250	500
GUE 500	87	158	20	142	500	250	500
GUE 550	87	172	20	170	550	250	500
GUE 600	87	188	20	199	600	250	500
GUE 750	118	235	26	230	750	250	500
GUE 800	129	250	26	240	800	250	500
GUE 1000	162	322	31	310	1000	250	500
GUE 1250	202	401	36	388	1250	250	500
GUE 1450	228	454	41	454	1450	250	500
GUE 1600	257	500	55	480	1600	250	500

Unit：mm

Note: Other specification out of the series can be produced upon request.

Performance

Performance Specification	57.5% Rated Deflection			
	Reaction Force(kN)		Energy Absorption(kNm)	
	RO Standard Type	RH High Reaction ForceType	RO Standard Type	RH High Reaction ForceType
GUE 300	110	15	161	22
GUE 400	150	27	215	39
GUE 500	187	43	267	61
GUE 550	206	52	294	75
GUE 600	224	62	320	89
GUE 750	282	96	402	137
GUE 1000	374	172	534	245
GUE 1250	467	268	667	383
GUE 1450	543	361	775	516
GUE 1600	599	440	855	628

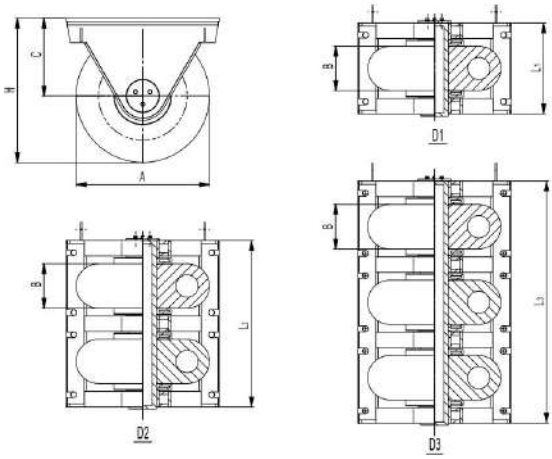
Unit：mm

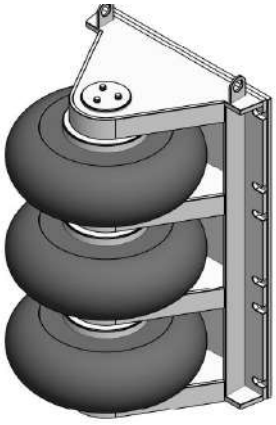
Note: Performance tolerance is ±10%.

Roller Fender

Features

- Low reaction force and high energy absorption.
- Roller fender performance is free from the influence of ship inclining and berthing.
- 3. Applicable for dry docks and other restricted channels





Specification

Type	Dimensions						
	A	B	C	H	L 1	L 2	L 3
600×200	600	200	320	620	420	770	1120
750×250	750	250	400	775	510	935	1360
900×300	900	300	480	930	610	1120	1630
1200×400	1200	400	640	1240	820	1500	2180
1500×500	1500	500	800	1550	1010	1850	2690
1800×600	1800	600	960	1860	1210	2215	3220
2100×700	2100	700	1155	2205	1410	2590	3770
2400×800	2400	800	1280	2480	1610	2950	4290
2700×900	2700	900	1440	2790	1810	-	-
3000×1000	3000	1000	1600	3100	2010	-	-

Unit：mm

Note: Other specification out of the series can be produced upon request.

Performance

Type	Max deflection	G1		G2		G3	
		Reaction Force	Energy Absorption	Reaction Force	Energy Absorption	Reaction Force	Energy Absorption
600×200	125	67	2	134	5	202	7
750×250	159	105	5	210	9	315	14
900×300	185	151	8	302	16	453	24
1200×400	260	269	19	539	39	814	58
1500×500	325	419	38	843	76	1264	113
1800×600	390	608	65	1215	130	1823	196
2100×700	455	823	102	1647	204	2470	306
2400×800	510	1108	140	2156	280	3234	420
2700×900	578	1362	220	2724	439	4087	659
3000×1000	640	1676	302	3352	604	5027	906

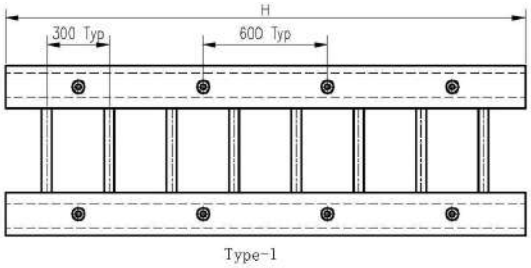
Unit：mm

Note: Performance tolerance is ±10%.

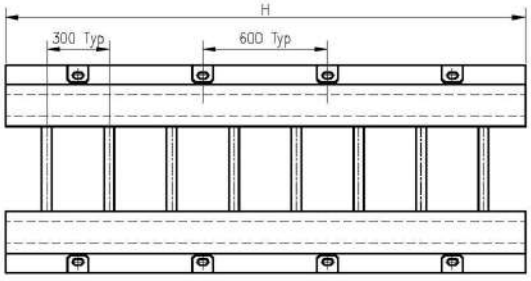
Rubber Ladder

Features

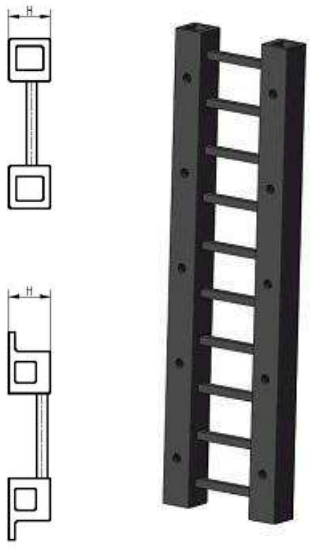
- Durable and tough with high corrosion resistance.
- Steps are anti-skid and available in various length as per requirement.
- Easy to install with low maintenance.



Type-1



Type-2



Specification

Specification	Height	Length							
200H	200H	900	1200	1500	1800	2100	2400	2700	3000
250H	250H	900	1200	1500	1800	2100	2400	2700	3000
300H	300H	900	1200	1500	1800	2100	2400	2700	3000
400H	400H	900	1200	1500	1800	2100	2400	2700	3000

Unit：mm

Note: Other specification out of the series can be produced upon request.

SD Rubber Fender

Features

- Easy for installation and maintenance.
- Reasonable reaction force with high energy absorption.
- Applicable for all kinds of wharf， dry dock and shipboard

Specification

Type	Dimension(mm)				
	A	B	C	D	Reference Weight(kg/m)
GG 150x150	150	150	75	75	23
GG 200x200	200	200	100	100	40
GG 300x300	300	300	150	150	90
GG 400x400	400	400	200	200	160
GG 500x500	500	500	250	250	251

Unit：mm

Note: Other specification out of the series can be produced upon request.

Performance

Type	Rated Deflection	
	Reaction Force(kN)	Energy Absorption(kNm)
GG 150x150	117	3.83
GG 200x200	156	6.85
GG 300x300	234	15.4
GG 400x400	312	27.4
GG 500x500	42.8	251

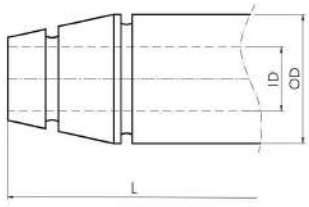
Unit：mm

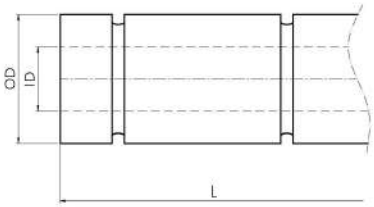
Note: Performance tolerance is ±10%.

Tugboat Fender

Features

- Tugboat fenders are mainly used at various port operation tugs. Installed at bow， board and aft，Glen's tugboat fenders is reasonable in structure design and advanced in production procedure which can obtain good performance， long service life and easy installation.





Specification/Dimension

Type	Outer Diameter (OD mm)	Inner Diameter (ID mm)	Length (L mm)
GC 300	300	100、150	3000~26000
GC 400	400	100、150、200	
GC 500	500	150、200、220、250	
GC 600	600	200、220、300、350	
GC 700	700	220、250、300、350	
GC 800	800	300、350、400	
GC 900	900	350、400、450	

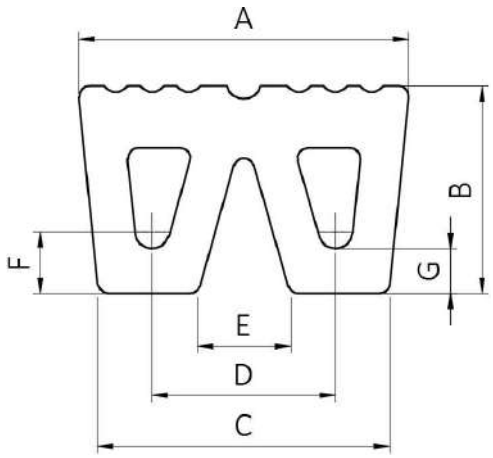
Unit：mm

Note: Other specification out of the series can be produced upon request.

W Rubber Fender

Features

- Special for ship and can be curved around bow.
- Large contact area and low surface pressure.



Specification

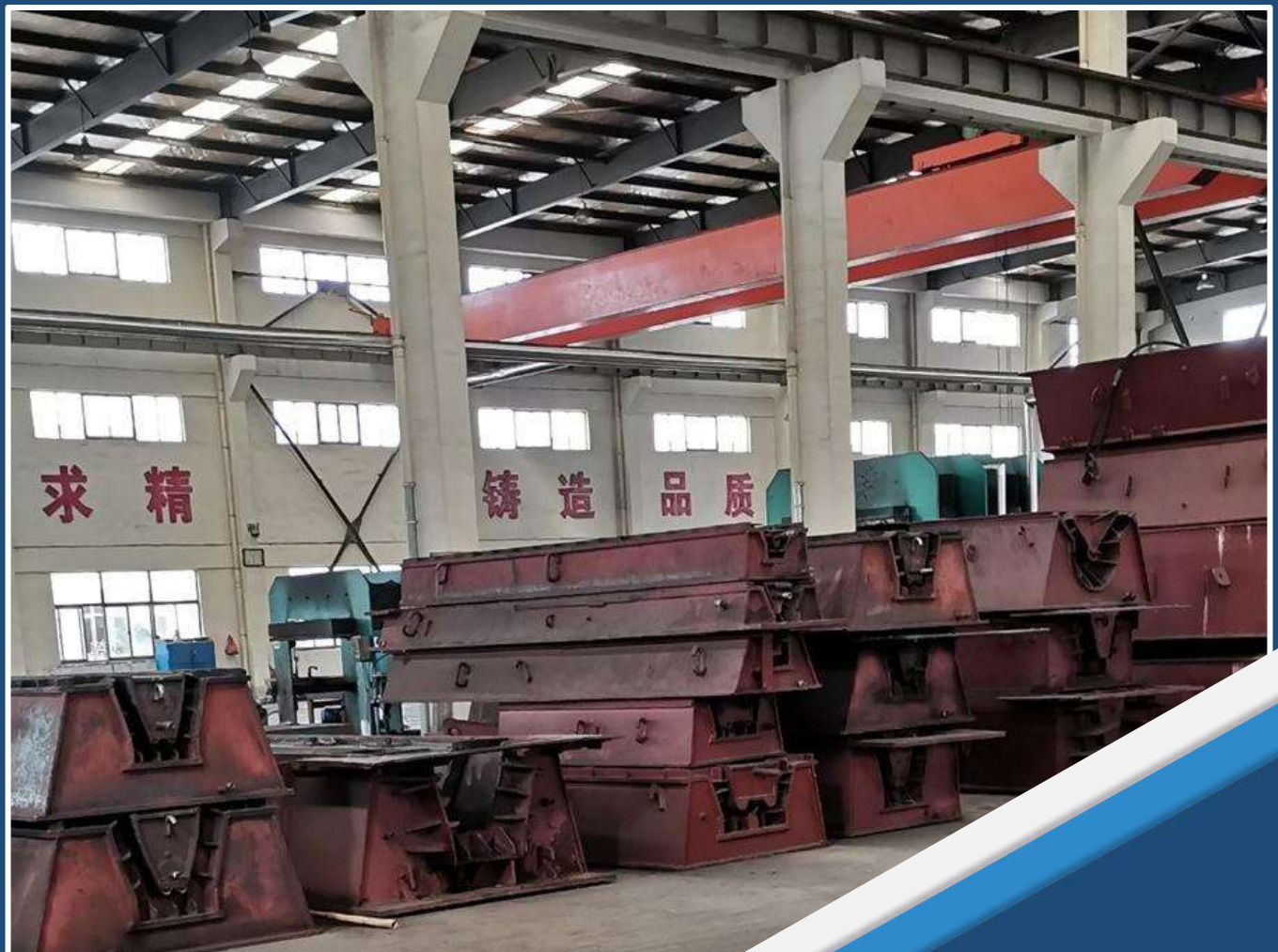
Type	Dimensions(mm)							
	A	B	C	D	E	F	G	Max. Length
GW 320-200	320	200	280	180	100	67	50	3000
GW 400-250	400	250	350	220	110	75	55	3000
GW 480-300	480	300	420	270	145	90	65	3000
GW 500-450	500	450	420	270	145	100	75	3000

Unit：mm

Note: Other specification out of the series can be produced upon request.

GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

Manufacture

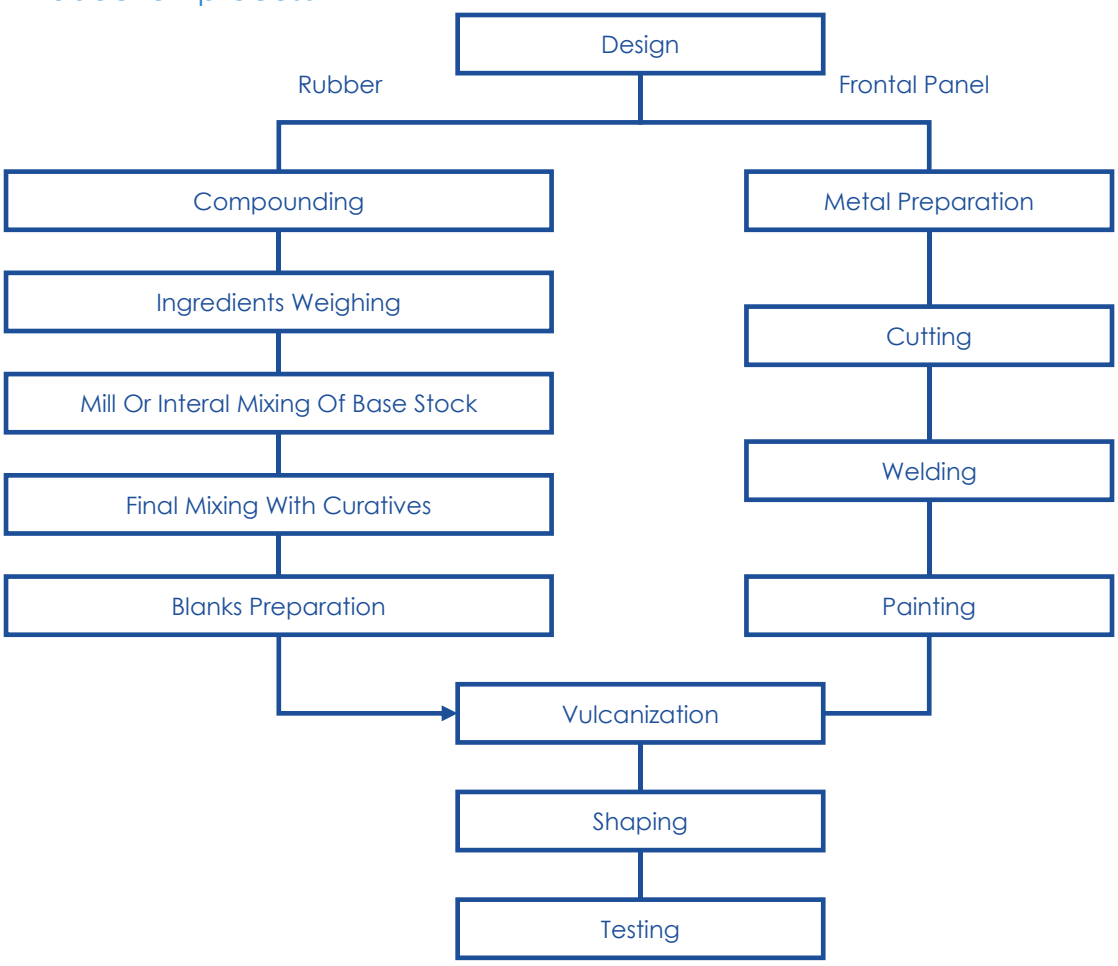


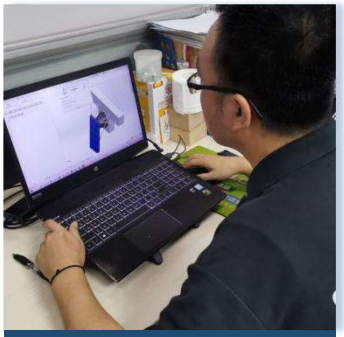
- In marine fender manufacturing， the ratio of components is very important to the performance and most of our regional agents have a clear understanding of it.
- However， the manufacturing process plays a decisive role in the quality， they know very little about that.
- The following is a visualization of our production process.

GLEN Manufacture Standards

- PIANC2002， ASTM D2000， EAU 2004， ROM 2.0-11 (2012)
- BS6349 (2014) D 2000， eau 2004， ROM 2.0-11 (2012)
- BS 6349(2014)，
- HG/T 2866-2016

Production process



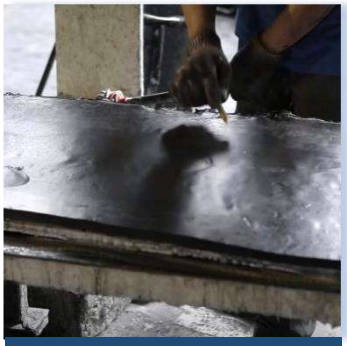


Design

Compounding

Ingredients weighting

Mill or Interal mixing of base stock



Final mixing with curatives

Blanks preparation

Vulcanization

Shaping

Testing

Cutting

Welding

Primer

GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

Performance Testing

Testing guarantees that the performance and physical properties of the final fender meet individual project requirements as well as international standards， which is why the client should consult with the manufacturer and put a strong focus on this phase of fender manufacturing.

Testing Procedures

Material Test

- The rubber samples that are needed for the material testing are taken from the finalized compound and are precisely prepared and then cured in the laboratory.
- Afterward， they are tested for their physical properties under strict laboratory conditions， including tensile and bonding strength， compression set， hardness， elongation， tear and abrasion resistance， chemical and ozone resistance， and aging.

No.	Property		Testing Standard	Standard Value
1	Tensile Strength		GB/T528，I； ASTM D412 Die C； ISO 37； Din53504；AS 1180.2； BS903.A2；JIS K62551 Item 3	≥16Mpa
2	Elongation at break		GB/T528，I； ASTM D412 Die C； ISO 37； Din53504；AS 1180.2； BS903.A 2；JIS K62551 Item 3	≥300%
3	Compression Set (70℃， 22h， 20%)		GB/T7759，I； ASTM D395 ；ISO 815； Din53517；AS 1683.13B；BS903.A 6；JIS K6262 Item 10	≤30%
4	Hardness (Shore A)		GB/T531； ASTM D2240； ISO 815；Din53505AS 1683.15.2；BS903.A 26； JIS K6301 Item 5 A Tester	≤ 82Ddgreee
5	Tear resistance Die B		GB/T529，Crescent Test Piece；ASTMD624；ISO34.1；Din 53507； AS 1683.12；BS903.A3； JIS K6301 Item 9A Test Piece A	≥70N/mm
6	Ozone resistance (50 pphm at 40oC at 20% strain at for 96hours)		GB/T13642； ASTM D1149；ISO 34.1； Din53509 AS 1683.24； BS903.A43	No cracking Visible by eye
7	Abrasion resistance (Method B 1000 Revolutions)		GB9867； BS903.A 9；DIN53516	≤0.5CC
8	Bond strength of steel to rubber Method B		HG4-854； BS903.A21	≥7N/mm
9	Hot air aging	Variation ratio of tensile strength	GB/T3512； ASTM D412 Die C； ISO 37； Din53504；AS 1180.2；BS903.A 19； JIS K6301 Item 3	≤30%
		Variation ratio of elongation at break	GB/T3512； ASTM D412 Die C； ISO 37； Din53504AS 1180.2；BS903.A 19； JIS K6301 Item 3	≤30%

Chemical composition test

- Chemical composition testing is useful to determine the composition of rubber compounds in fenders.
- Chemical composition includes a couple of key indicators to determine the quality of rubber used in the fender.

Test	Standard	Specification
Density	ASTM D6370	Max 1.20 g/cc
Polymer %	ASTM D6370	Min 45%
Carbon Black %	ASTM D297	Min 20%
Ash %	ASTM D297	Max 7%
Rubber to filler ratio	-	> 1.2

Visual Checking

- Visually inspect the final fenders to check their appearance for cracks or defects. If the fenders show minor appearance salience， the product is retouched.
- Generally， appearance prominence does not affect performance. Fenders may have surface flow marks. As long as they are not too extensive， this is common.
- If they're just a matter of aesthetics， they don't affect quality. Otherwise， the customer must consult the maker if the defect area is large.

Fender Dimensions Inspection

Dimensional Check

- The dimensions are checked and compared to the Shop drawings and should be within the manufacturer's tolerance.
- When measuring the dimensions on the production site， thermal expansion and contraction need to be considered.
- Deviations between fenders are rare since they have been produced in the same mold.

Performance Tolerance

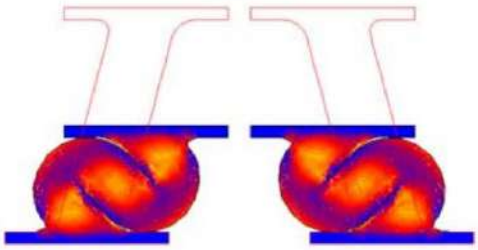
Fender Type	Dimensions	Tolerance
Molded fenders	All dimensions	±3% or ±2 mm*
	Bolt hole spacing	±4 mm (non-cumulative)
Cylindrical fenders	Outside diameter	±4%
	Inside diameter	±4%
	Length	±30 mm
Pneumatic fender	Length and width	-2% +4%
UHMW-PE face pads	Length and width	±5 mm (cut pads)
	Length and width	±20 mm (uncut sheets)
	Thickness (planed) : ≤ 30 mm	±0.2 mm
	31 – 100 mm	±0.3 mm
	≥ 101 mm	±0.5 mm
	Thickness (unplaned) : ≤ 30 mm	±2.5 mm
	31 – 100 mm	±4.0 mm
	≥ 101 mm	±6.0 mm
	Drilled hole centers	±2 mm (non-cumulative)
	Counterbore depth	±2 mm (under-head depth)

Unit：mm

Performance Test

- Performance testing， also known as the factory acceptance test (FAT)， is performed on the final product to ensure that it fulfills the performance requirements. Typically， and if the client and the manufacturer do not agree otherwise， a 10% random selection of final fenders is tested.

Performance Tolerance



Fender Type	Parameter	Tolerance
Cone， Cell， Arch， Unit Element， Cylindrical， Foam-filled， Pneumatic	Reaction， Energy	10%
Extruded	Reaction， Energy	10%
D type， W type， Tugboat type	Reaction	20%

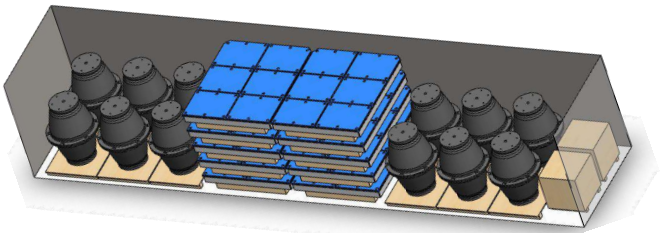
Front panel test

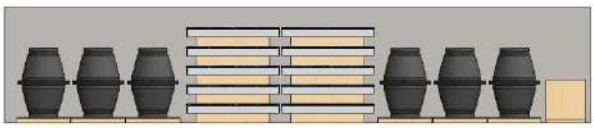
- NDT test
- Hydrostatictest.

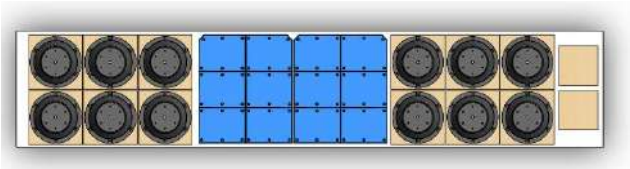
GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

Installation

Delivery and Unloading





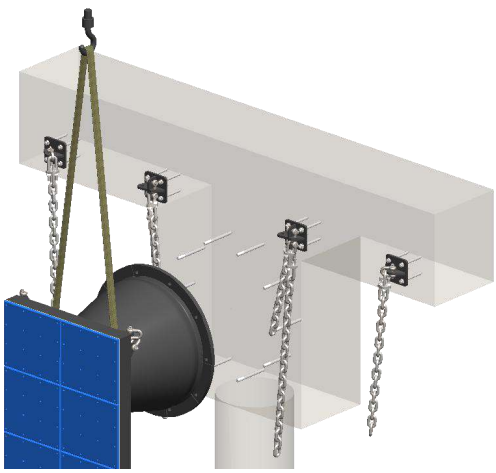


Loading plan for rubber fender body and accessary (UHMW pad， Front panel，Chain， fixing) is issued by Glen engineer

Container load and Truck load general arrangement drawing

Material and Lifting equipment

1. To prevent products from bumping against each other during transportation, GLEN uses materials mainly including timber, rubber blocks for spacing.
2. Use suitable lifting equipment for cargo unloading, including Forklift or crane (the tower crane, a mobile crane or a barge crane)



Determine the position of the rubber fenders， front panel， and accessories according to the shipping plan. Select suitable flat trucks， cranes， forklifts， hooks， and lifting slings for unloading. During the unloading process， please follow:

- Use the correct unloading method according to the type of product packaging: pallets are unloaded by forklifts， and large-sized fenders and front panels are unloaded with forklifts and cranes.
- Unprotected hooks and forklifts will damage the product
- Find a suitable lifting position (lifting lug， groove， etc.) according to the loading plan， and the product is always in a horizontal position during the unloading process
- The goods should be placed on pallets， wooden racks， etc.
- Any material (Rubber fenders, front panels, and other accessories)can not be stacked on the front panels directly.Any product's surface is damaged, shall be repaired in time to prevent corrosion.

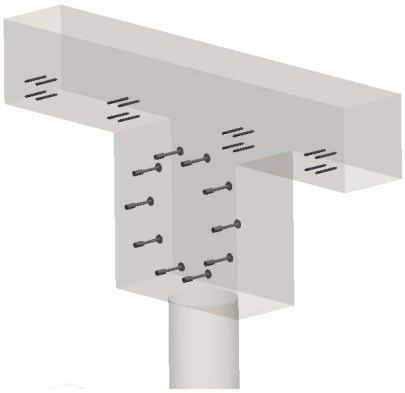
Reminder:

- During the loading and unloading process of the rubber fender, it is necessary to adopt the correct hoisting method. The rubber fender and accessories should be protected and kept clean to avoid stabbing or scratching with hard objects. The rubber fender and the front panels shall be firmly placed.
- The cargo must be securely lashed; no move or loose during the whole transportation
- The cargo arrives at the designated unloading place. Please use suitable lifting equipment and a flat truck to avoid damage and collision for the rubber fender, front panels, and accessories.
- Extra-high (2600mm) or extra-wide (2300mm) rubber fenders and front panels must be transported in special containers such as flat-rack and open-top containers.

Installation - Cone and Cell rubber fenders

Before installation

- All anchor bolts， U-type bolts， and brackets need to be pre-embedded according to drawing in advance
- The rubber fender system must be pre-assembled (rubber fenders， front panel， anchor chains， etc.)



Installation steps

- Drawing Check
- Assembling Fender to Frontal Frame
- Embedded parts Check
- Assembling Frontal frame & fender unit to wharf structure
- Equipment and Material Preparation
- Assembling chain systems to wharf structure

Equipment and material preparation

- Lifting equipment and corresponding shackles， lifting slings， etc.
- Personal Protective Equipment and Tools
- Flat land， space， and location
- Wooden pallets， wooden strips， etc.

Attention:

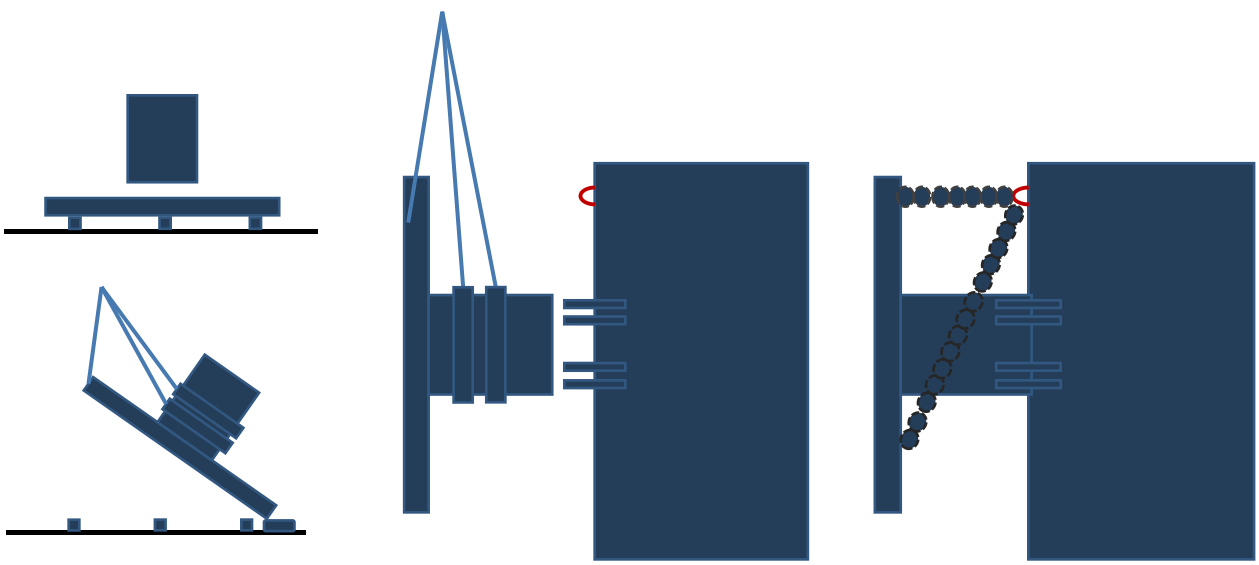
- Proper personal protection.
- Before installation， check the product list to ensure that all product components are in place.
- The crane supports the rubber fender system throughout the installation process until all parts are properly installed.
- Before installing the anchor chain， please measure the distance between the front panel and the wharf structure， ensure the distance is the same， and use the correct anchor chain assembly.
- Check all installation position to ensure that it is consistent with the drawings.
- Please follow the standard installation process for the installation method. In case of any special situation， please consult the supplier.
- After completing the installation， please check it again according to the installation work instructions.

Standard installation procedure

- According to the design drawings， check and confirm the installation position (bolt hole position， anchor bolt position， bracket， U-bolt， etc.)， and ensure that the position of the anchor hole is consistent with the drawing.
  a. Check the Anchor bolt hole is consistent with the drawing
  b. Check the bracket is in the same position as the drawing
  c. Check the U-bolt position is consistent with the drawing
- Place the front panel on a flat road(the UMHW-PE plate facing down)， and place a protective wooden board or wooden strip on the road to prevent the UMHW-PE plate from being scratched (note that the placement position should be close to the installation position)
- Place the rubber fender on the front panel according to the drawing， then fix it with the matching bolts
- Place a buffer device (cotton pad， wooden board， or wooden support) at the end of the front panel， and hoist the fender system in the vertical direction by the crane. Please refer to the direction of the drawing.
- Lift the front panel by the lug and side hole， then lift the rubber fender by two belt
- Lift the fender system to the installation position， align the wharf pre-embedded bolts to the fender body， and insert them into the flange holes
- All nuts and washers are pre-screwed on the bolts， be careful not to fix them now
- Fix the bolts on either side of the top， reserve 2-3mm on bolts， and do not tighten
- After fixing the other direction bolts， tighten the upper and diagonal bolts and then tighten the other bolts
- Anchor chain installation: install the chain on the bracket， the front panel， and adjust the length through the tensioner or shackle， etc.

Note:

- During the installation process， the crane always supports the weight of the entire fender system and releases the crane operation after completing all installations.
- The bolt torque should be based on the standard torque value.



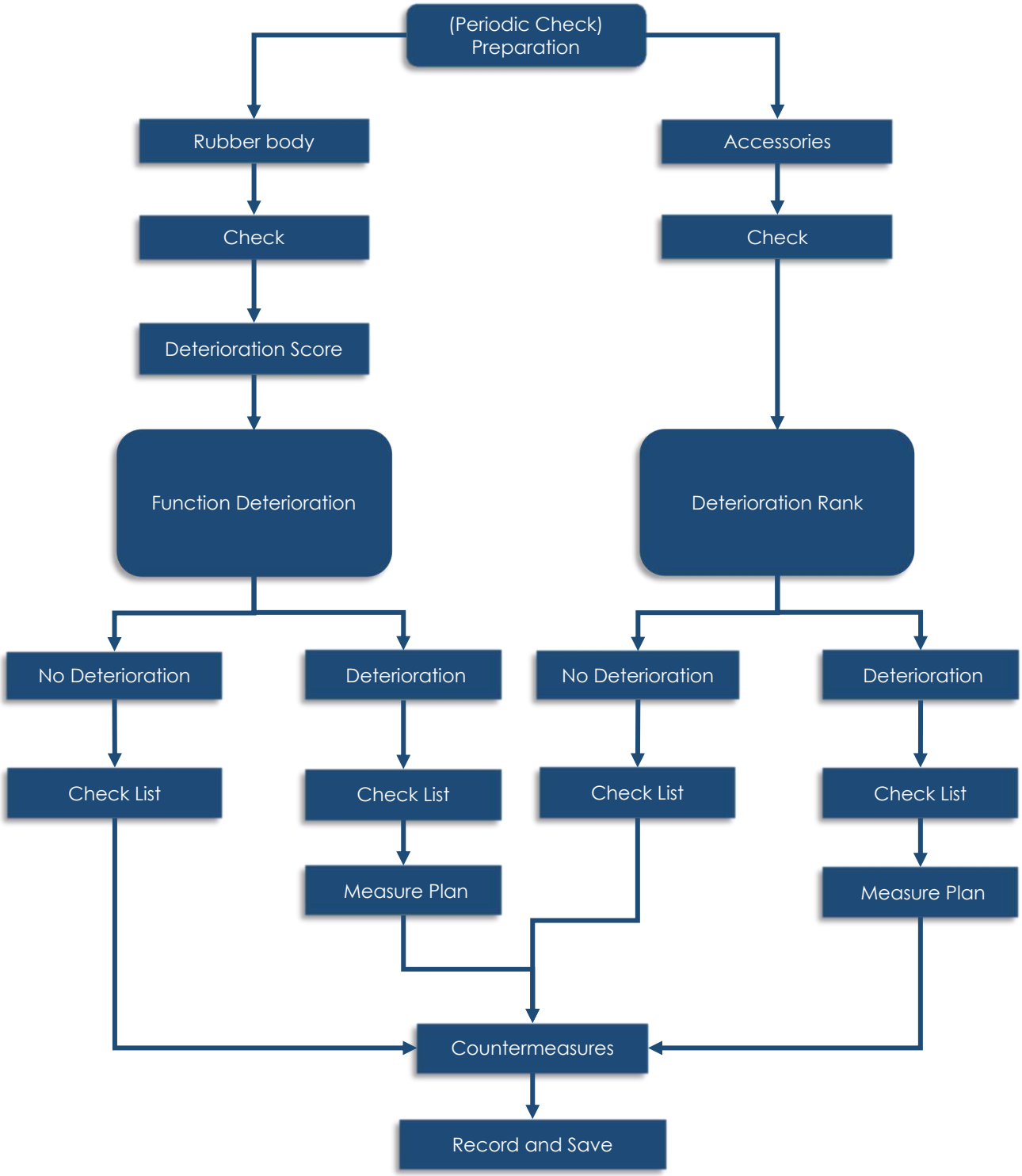
Maintainence

General

- The rubber fender should have its function properly maintained based on the maintenance plan so that a mooring facility and port transportation facility will meet the required performance over a service period. In the maintenance and management of rubber fenders， the conditions under which equipment is placed， such as natural and usage conditions， structural characteristics， material characteristics， etc.， are considered.
- After appropriate checks and diagnoses of damage and deterioration to rubber fenders， such as aging and functional evaluation based on the results， the necessary measures will be appropriately performed.

Method of maintenance management for rubber fenders	
Necessity of the maintenance management plan	Since rubber fenders are used under harsh natural conditions， they need to be maintained and managed in a planned and appropriate manner because their functions will deteriorate during the service period of the facility due to material damage， ageing and so on.
Conditions and characteristics of maintenance and management	For maintenance and management of rubber fenders， it is necessary to plan appropriately in consideration of the characteristics of the members constituting the materials， difficulty of checks， the types and quality of the used materials， the natural conditions surrounding the equipment， usage importance， future plans of facilities， diagnosis， substitution and countermeasure work.
Necessary measures	Maintenance and management of rubber fenders refers to a series of procedures for accurately grasping damage and deterioration over time by appropriate checks and diagnoses， comprehensively evaluating the results，and taking appropriate measures.As a result of the functional evaluation of rubber fenders， the necessary measures are standardized to restore function or replace but also include operational measures of restriction and emergency measures for securing safety.

The Basic Flow For Implementing Maintenance



Inspection implementation content

General

- In the implementation of checks and diagnoses， to ensure the objectivity， reliability， and consistency of the results， check and diagnosis items， must be defined in advance.
- This section covers the inspection schedule and procedure as specified in the below tables for the following critical parts：Rubber fender body Fixing Parts UHMW PE pad Steel frame Chain system Support system

Inspection schedule & procedure

Major parts	Inspection	Illustrate	Action	Repair point
Rubber fender body	rubber Tears	The rubber body cannot be repaired on site，and it is determined whether to replace it according to the functional damage。 1. Function will deteriorate if left unchecked 2.Functional deterioration started 3.Significant functional deterioration	Clean（Do not use petroleum based product） Replace	
	Permanent deformation			
	Cracks			
	Separation			
	Ozone cracks			
	Burns			
	Bolt hole damage			
Fixing Parts	Loose	1. Loose， Bent， Missing and/or Cut 2.Corrosion observed 3.No deterioration	Rust removal New painting Replace	
	Bent			
	Missing			
	Cut			
	Corroded			
UHMW PE pad	Abrasion Wear	1.Cut， missing and/or burned. Severe abrasion and wear reaching to the bolt head. 2.Minor abrasion or wear was observed， but further use is possible 3.No deterioration	Tighten the loose fasteners Replace	
	Loose			
	Cut			
	Missing			
	Burned			
Steel frame	Deformation	1.The deformation is too large for further use.Widespread severe corrosion accompanied by a decrease in steel plate thickness. 2.Miner deformation but can be used continuously. Corrosion is observed but partial 3.No deformation. No paint deterioration and almost no corrosion	Rust removal New painting Replace	
	Coating			
	Corrosion			
Chain system	Loose	1. Loose， Bent， Missing and/or Cut 2.Corrosion observed 3.No deterioration	Straightening chain Rust removal New painting Tighten the Loose chain Replace	
	Bent			
	Cut			
	Corroded			
Support system	Bent	1.Significant bends， cuts or corrosion；further use is impossible 2.Bent and corroded， but further use possible 3.No deterioration	Rust removal New painting Replace	
	Cut			
	Corroded			

Maintenance Period

Initial check

The initial checks are conducted to assess the condition of the rubber fenders immediately after installation or at the start of the maintenance stage. Using a scale for measurement is ideal， but when this is difficult，measurement by visual observation may be acceptable.

Daily check

The daily check is a routine inspection of a rubber fender to assess the deterioration of the fender by daily protocol. If deterioration is detected， it is necessary to proceed to the implementation of occasional inspection and diagnosis. The daily check corresponds to a protocol that a manager or user of fenders carries out on a daily basis and is carried out to pay regular attention to any damage or deterioration. The inspection method， in this case ， maybe visual inspection by walking.

Periodic check

Periodic checks and diagnoses are conducted regularly to determine any deterioration， to detect the occurrence as quickly as possible， and any progress of deterioration caused by the use of rubber fenders. Periodic checks and diagnoses should be carried out systematically and continuously based on a predetermined inspection plan. They should be conducted at least once a year or planned appropriately according to the importance of the facility.

Using a scale for measuring and determining the deterioration of a fender is desirable， but if this is difficult，the visual measurement may be used.

Item	1-3 Month	3-6 Month	6-12 Month
Rubber fender body	Visual inpsection		Corrosion inspection
Fixing Parts		Visual inpsection	Physical inspection Corrosion inspection
UHMW PE pad	Visual inpsection	Physical inspection	Physical inspection
Steel frame	Visual inpsection	Physical inspection Corrosion inspection	Physical inspection Corrosion inspection
Chain system	Visual inpsection	Visual inpsection	Physical inspection
Support system	Visual inpsection	Physical inspection Corrosion inspection	Physical inspection Corrosion inspection

Occasional check

Occasional checks and diagnoses are conducted to confirm the damage of fenders when deterioration is recognized during daily inspection， abnormal berthing， excessive vessel motion， etc.， or when there is a possibility of being affected by an earthquake， tsunami， or fire， etc.

In carrying out occasional checks and diagnoses， it is necessary to measure the deterioration in the rubber fender according to the periodic check and diagnosis and confirm the degree of deterioration.

GLEN ENGINEERING limited
FOCUS ON MARINE AND OFFSHORE

MARINE FENDERS

GLEN ENGINEERING

Contact

GLEN MARITIME (CHONGQING) ENGINEERING TECHNOLOGY LIMITED

Address: No. 139， Songpai Road， Yubei District， Chongqing， China

Email: info@glenengineering.com

Tel: +86-23-67964368-802

Fax: +86-23-67504207

www.glenengineering.com