



# FLOATING FENDERS



# CONTENTS

Pneumatic Fenders	1
Hydro Pneumatic Fenders	10
Foam Fenders	13
Donut Fenders	15
Load Deflection Testing	17
Photo Gallery	18



# PNEUMATIC FENDERS

Pneumatic Fenders are manufactured by lining and vulcanizing process under high pressure and temperature to ensure adequate bonding with each layer to ensure a trouble-free long life. Having a fully-capable in-house facility, IRM provides manufacturing and testing of Pneumatic fenders strictly per ISO 17357-1: 2014. These Pneumatic Fenders are offered as Sling Type OR generally equipped with a chain and tyre net assembly, with Lorry (Automobile) tyres or Aircraft tyres depending on the client's requirements.

IRM Pneumatic Fenders are offered with internal air pressure of 0.5 Kg/Cm<sup>2</sup> (50kPa) & 0.8 kg/cm<sup>2</sup> (80kPa)

## Salient Features of Pneumatic fenders:

- ISO17357-1 : 2014 complaint product
- Easy to install and maintain
- Low hull Pressure
- Inclined berthing up to 15 degrees
- No reduction or variation in performance over time
- Suitable for different tidal ranges
- Excellent compressibility & Elasticity

## Applications :

- Ship to Ship Transfer / Lightering Operation
- Shipyards (including Temporary Berthing)
- Lay-up of Vessels
- Navy/Defence Vessels
- Offshore

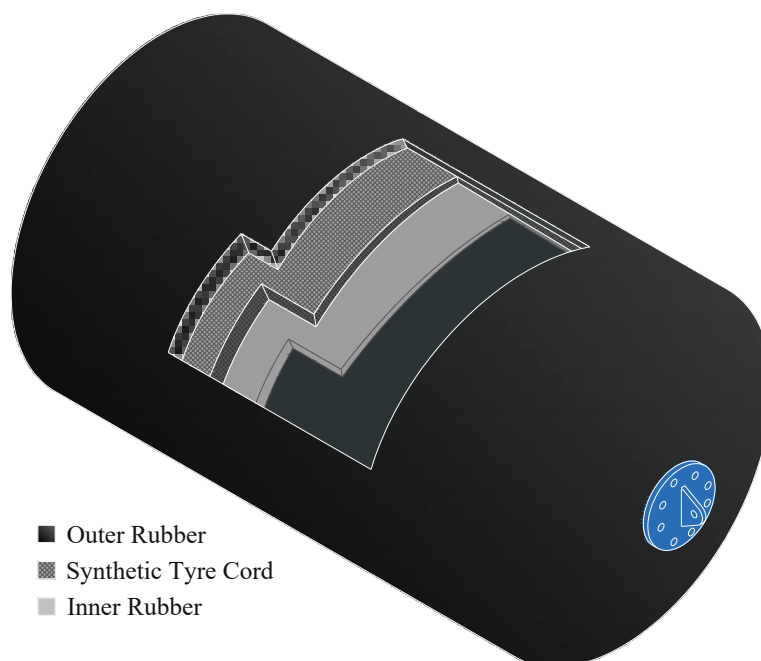
The unique characteristics of Pneumatic Fenders make them suitable Fender for Liquid cargo Vessel (VLCC/VLGC/FPSO/FSRU) and Navy vessels with very sensitive equipment.

## Construction of Pneumatic fender:

**Outer Rubber:** Highly crafted abrasion-resistant outer layer prevents any damage to the tyre cord layer and internal rubber layer from external forces.

**Synthetic tire-cord:** this reinforcement layer is applied at an angle to hold internal pressure and evenly distribute stresses on the Fender.

**Inner Rubber:** This layer ensures a positive seal to maintain the desired internal pressure.



# PNEUMATIC FENDERS

We offer pneumatic fenders in two types in compliance with international standard ISO 17357-1:2014 defined as Type I – chain-tyre-net (CTN) type fenders with lorry or aircraft tyre option and Type II – sling-type fenders.

The pneumatic fenders with white jewellery (white tyre chain net) are also supplied for navy applications on a made-to-order basis.

The type of Fender to be used depends on its application, usage, and facility requirements.



**Chain tyre net with Automobile tyre**

### **Type I: Chain-tyre-net type (Automobile tyre)**

Pneumatic Fenders with automobile (lorry) tyres are used for most common applications by vessels, shipyards, navy, vessel-layup or STS requirements.

We offer a net assembly design where a single tyre can be replaced if damaged, which curtails the need to replace complete chain assembly as many low-cost fender manufacturers provide.



**Chain tyre net with Aircraft tyre**

### **Type I: Chain-tyre-net type (Aircraft tyre)**

Pneumatic fenders with aircraft tyres are mainly used for offshore requirements, STS operations. This design is preferred where fenders must be in operation for a long time without maintenance downtime compared to automobile (lorry) tyres.



**Sling type fender**

### **Type II: Sling type**

Sling type fenders are generally used on docks and vessels, large tankers as less reaction force is required. These fenders are very economical and low maintenance as well as they are fast and easy to install.

# PNEUMATIC FENDERS

## PERFORMANCE DETAILS OF PNEUMATIC FENDER

## Performance of 50kPa Standard Sizes

NOMINAL SIZE	INITIAL INTERNAL PRESSURE	GUARANTEED ENERGY ABSORPTION (GEA)	REACTION FORCE AT GEA	HULL PRESSURE AT GEA	SAFETY VALVE SETTING PRESSURE	TESTING PRESSURE	Weight of CTN (Type-I)		WEIGHT OF SLING TYPE (TYPE-II)
							APPROX. WEIGHT OF FENDER BODY	APPROX. WEIGHT OF CHAIN TYRE NET	
Dia. X Length mm X mm	kPa	kNm	kN	kPa	kPa	kPa	kg	kg	kg
500 X 1000	50	6	64	132	-	200	28	-	31
600 X 1000	50	8	74	126	-	200	48	-	53
660 X 1160	50	10	94	128	-	200	56	-	62
700 X 1500	50	17	137	135	-	200	62	105	68
1000 X 1500	50	32	182	122	-	200	152	185	167
1000 X 2000	50	45	257	132	-	200	192	220	211
1200 X 2000	50	63	297	126	-	200	232	255	255
1350 X 2500	50	102	427	130	-	200	315	350	347
1500 X 3000	50	153	579	132	-	200	367	485	404
1700 X 3000	50	191	639	128	-	200	570	630	627
2000 X 3500	50	308	875	128	-	200	729	1195	802
2500 X 4000	50	663	1381	137	175	250	969	1600	1066
2500 X 5500	50	943	2019	148	175	250	1219	2340	1341
3300 X 4500	50	1175	1884	130	175	250	2160	2300	2376
3300 X 6500	50	1814	3015	146	175	250	2415	3280	2657
3300 X 10600	50	3067	5257	158	175	250	5220	4985	5742
4500 X 9000	50	4752	5747	146	175	250	5365	5475	5902
4500 X 12000	50	6473	7984	154	175	250	8760	7500	-
Dim. Tol. +10% / -5%		Manufacturing Tolerance ± 10%					Weight Tolerance ± 10%		

## PERFORMANCE DETAILS OF PNEUMATIC FENDER

## Performance of 80kPa Standard Sizes

NOMINAL SIZE	INITIAL INTERNAL PRESSURE	GUARANTEED ENERGY ABSORPTION (GEA)	REACTION FORCE AT GEA	HULL PRESSURE AT GEA	SAFETY VALVE SETTING PRESSURE	TESTING PRESSURE	Weight of CTN (Type-I)		WEIGHT OF SLING TYPE (TYPE-II)
							APPROX. WEIGHT OF FENDER BODY	APPROX. WEIGHT OF CHAIN TYRE NET	
Dia. X Length mm X mm	kPa	kNm	kN	kPa	kPa	kPa	kg	kg	kg
500 X 1000	80	8	85	174	-	250	31	-	34
600 X 1000	80	11	98	166	-	250	53	-	58
660 X 1160	80	16	138	168	-	250	62	-	68
700 X 1500	80	24	180	177	-	250	68	105	75
1000 X 1500	80	45	239	160	-	250	167	185	184
1000 X 2000	80	63	338	174	-	250	211	220	232
1200 X 2000	80	88	390	166	-	250	255	255	281
1350 X 2500	80	142	561	170	-	250	347	350	382
1500 X 3000	80	214	761	174	-	250	404	485	444
1700 X 3000	80	267	840	168	-	250	627	630	690
2000 X 3500	80	430	1150	168	-	250	802	1195	882
2500 X 4000	80	925	1815	180	230	300	1066	1600	1173
2500 X 5500	80	1317	2653	195	230	300	1341	2340	1475
3300 X 4500	80	1640	2476	171	230	300	2376	2300	2614
3300 X 6500	80	2532	3961	191	230	300	2657	3280	2923
3300 X 10600	80	4281	6907	208	230	300	5742	4985	6316
4500 X 9000	80	6633	7551	192	230	300	5902	5475	-
4500 X 12000	80	9037	10490	202	230	300	9636	7500	-
Dim. Tol. +10% / -5%		Manufacturing Tolerance ± 10%					Weight Tolerance ± 10%		

# PNEUMATIC FENDERS

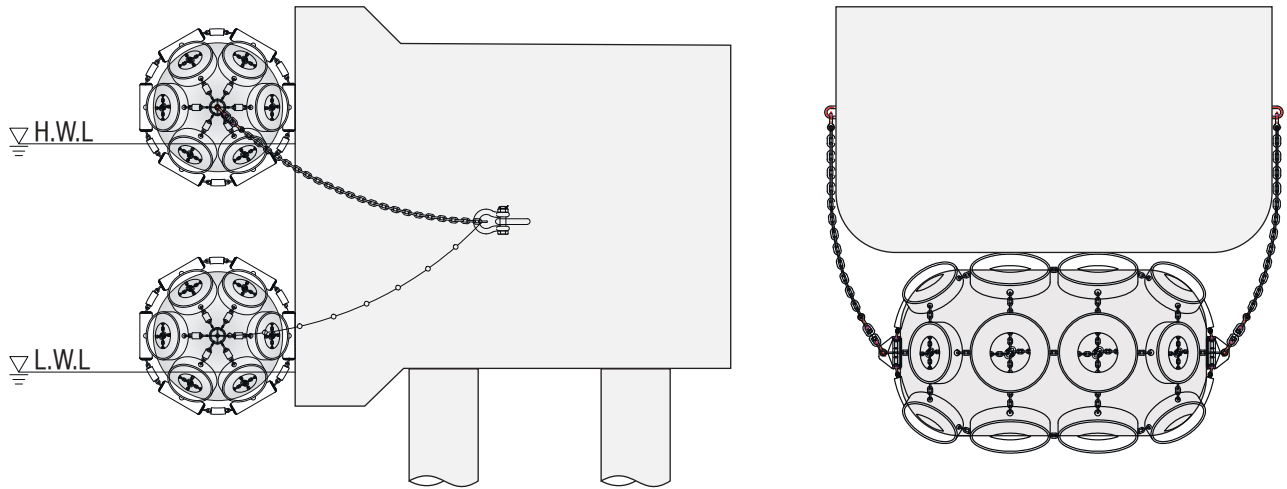


# PNEUMATIC FENDERS

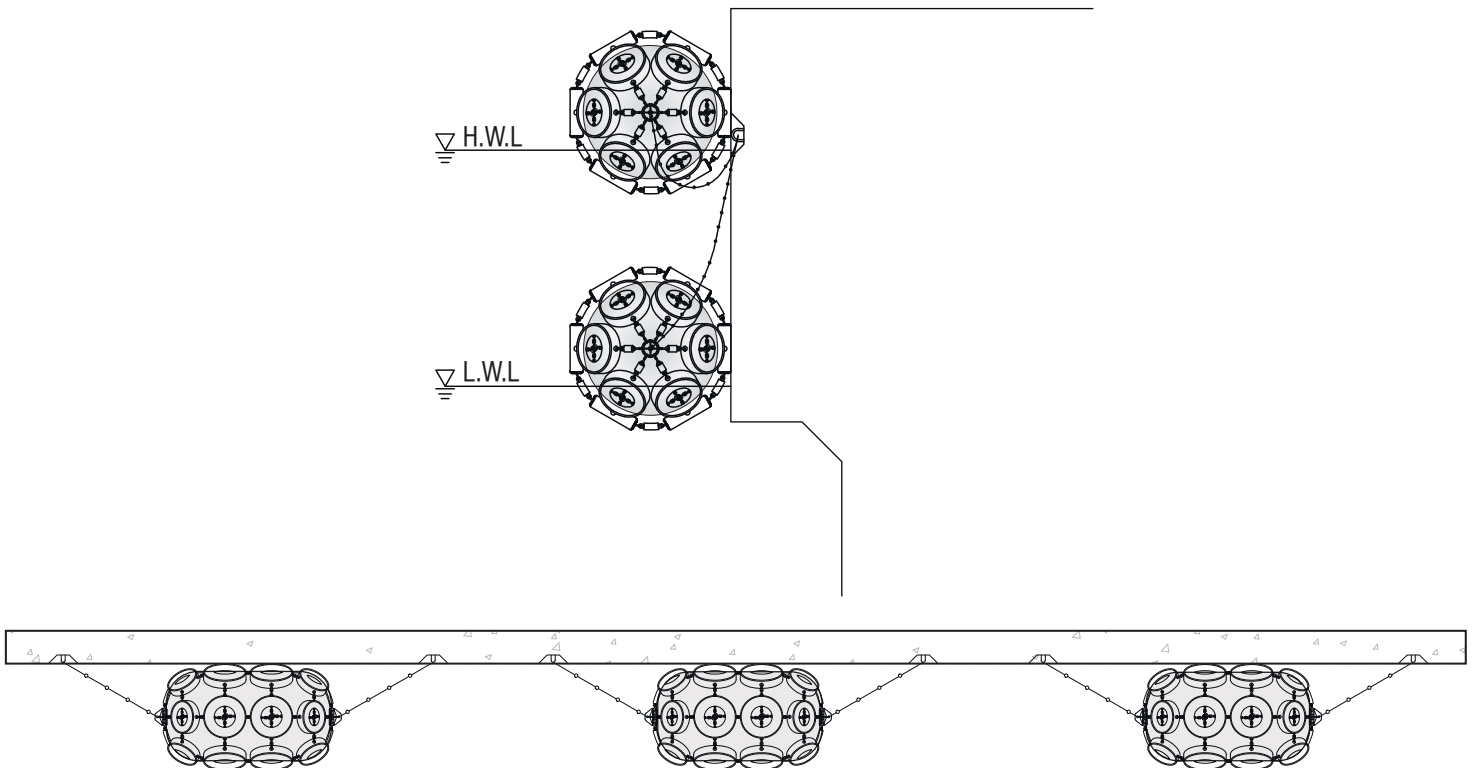
## INSTALLATION EXAMPLE:

The fenders can be installed by the following methods as shown in the image below, followed by the recommended joints/assemblies as given in the table of the next section.

### a) Dolphin Jetty



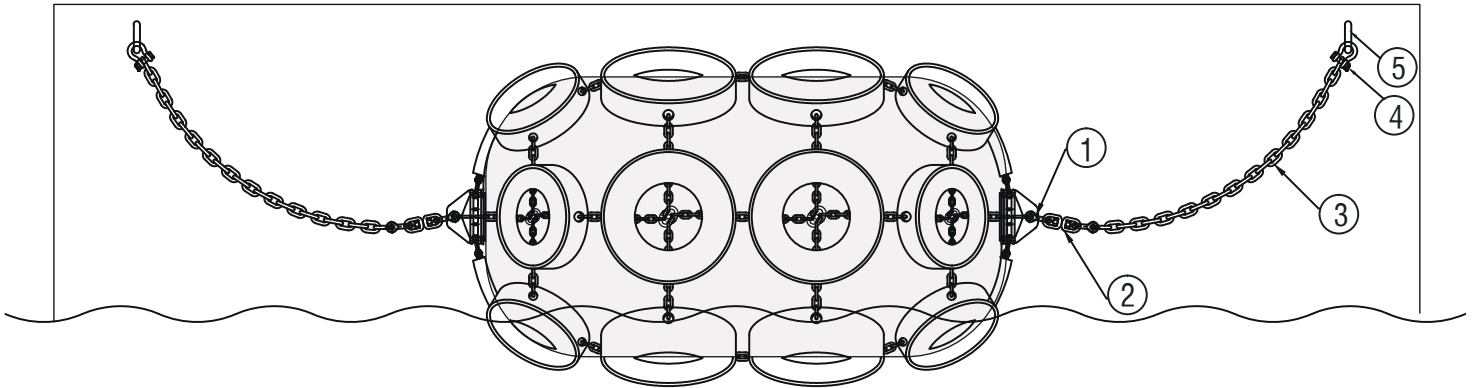
### b) Continuous Jetty





# PNEUMATIC FENDERS

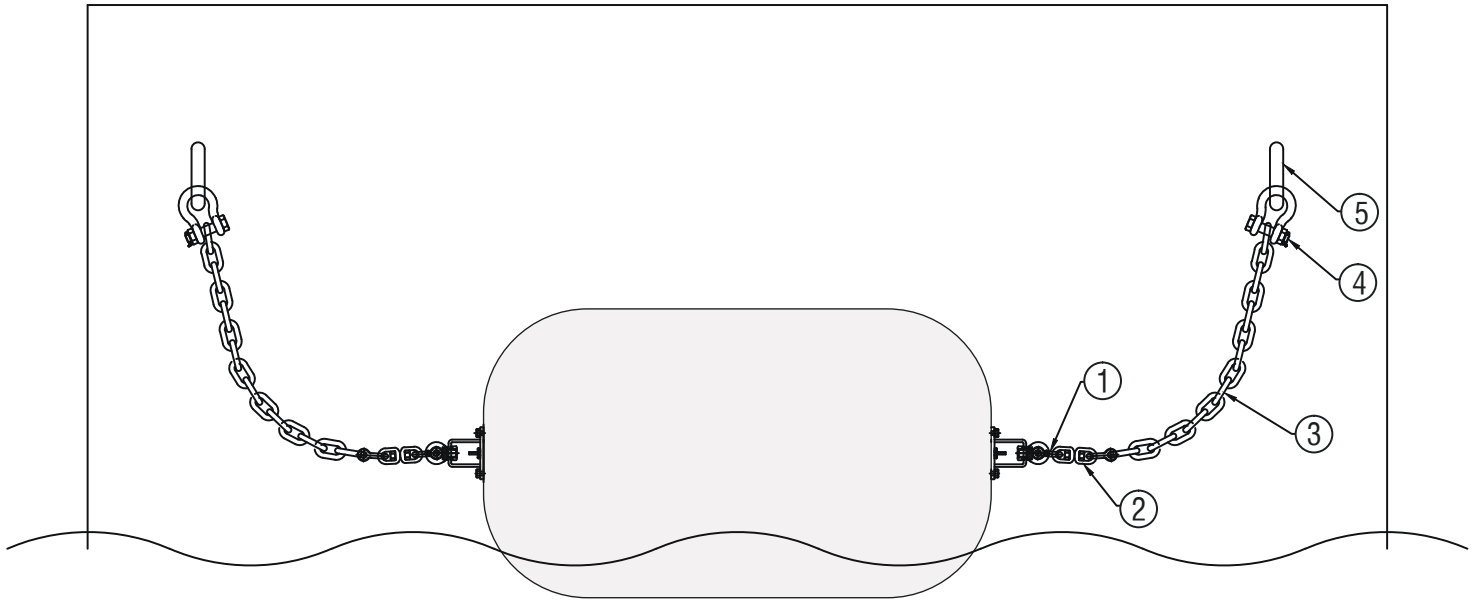
## INSTALLATION EXAMPLE:



## INSTALLATION RECOMMENDATION FOR CHAIN NET TYPE (TYPE I)

NOMINAL SIZE DIA. X LENGTH	Parts		1 1ST/2ND SHACKLE DIAMETER	2 SWIVEL DIAMETER	3 GUY ROPE (6X36-G IWRC) DIAMETER	4 3RD SHACKLE DIAMETER	5 ANCHOR DIAMETER
	TYPE	INITIAL PRESSURE					
mm X mm		kPa	mm	mm	mm	mm	mm
500 X 1000	I	50	25	25	16	16	25
600 X 1000	I	50	25	25	16	16	25
660 X 1160	I	50	25	25	16	16	25
700 X 1500	I	50	25	25	16	16	25
1000 X 1500	I	50	25	25	16	16	25
1000 X 2000	I	50	25	25	16	16	25
1200 X 2000	I	50	25	25	16	16	25
1350 X 2500	I	50	25	25	18	16	25
1500 X 3000	I	50	25	25	20	19	32
1700 X 3000	I	50	25	25	22	19	32
2000 X 3500	I	50	25	25	24	22	32
2500 X 4000	I	50	38	38	30	26	42
2500 X 5500	I	50	38	38	34	32	44
3300 X 4500	I	50	38	38	34	30	44
3300 X 6500	I	50	38	38	42	38	55
3300 X 10600	I	50	38	38	52	48	75
4500 X 9000	I	50	38	38	54	50	75
4500 X 12000	I	50	38	38	65	58	80

# PNEUMATIC FENDERS

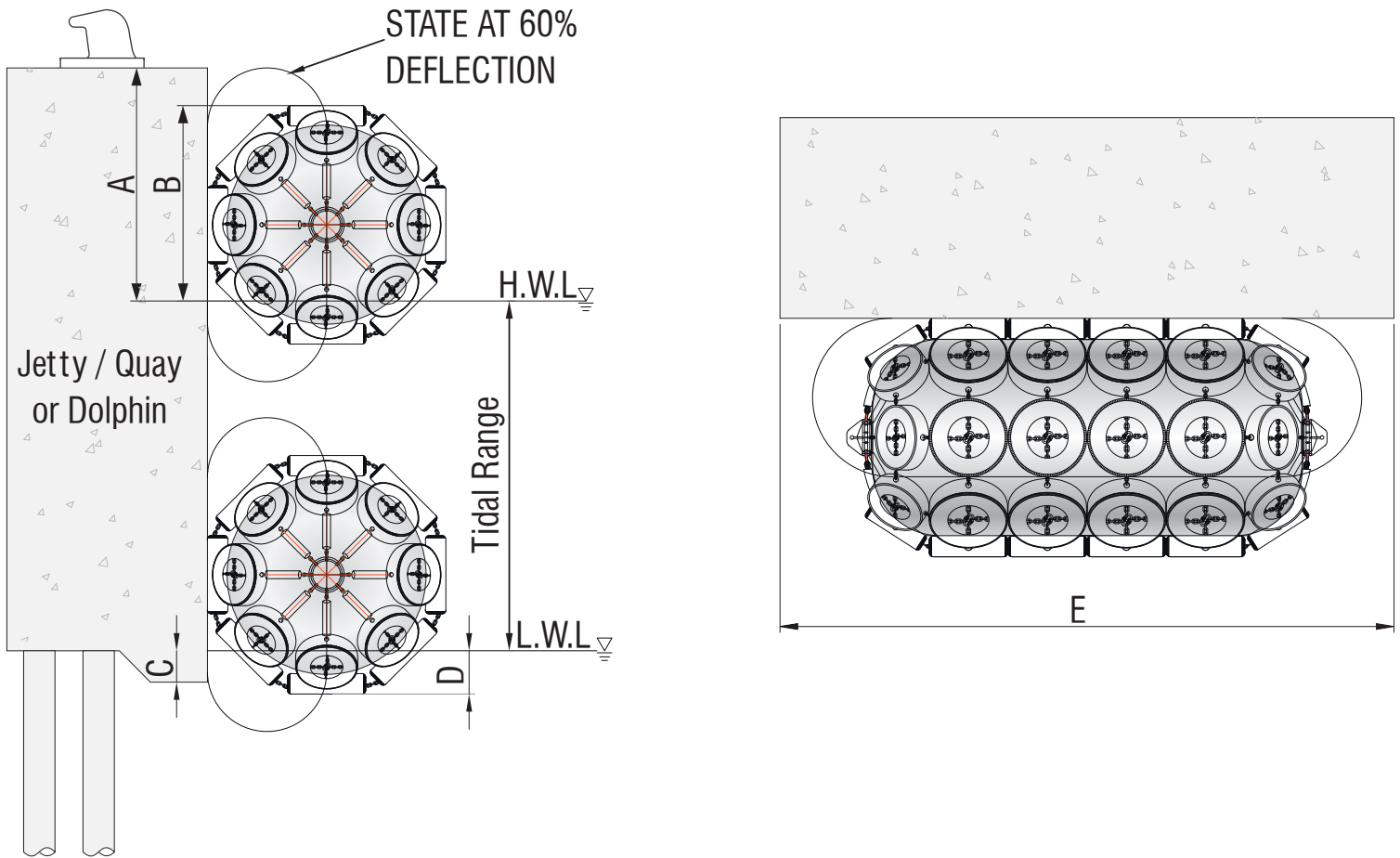


## INSTALLATION RECOMMENDATION FOR SLING TYPE (TYPE II)

NOMINAL SIZE DIA. X LENGTH	PARTS		1 1ST/2ND SHACKLE DIAMETER	2 SWIVEL DIAMETER	3 GUY ROPE (6X36-G IWRC) DIAMETER	4 3RD SHACKLE DIAMETER	5 ANCHOR DIAMETER	
	TYPE	INITIAL PRESSURE						
mm X mm		kPa	mm	mm	mm	mm	mm	
500 X 1000	II	50	25	25	16	16	22	25
600 X 1000	II	50	25	25	16	16	22	25
660 X 1160	II	50	25	25	16	16	22	25
700 X 1500	II	50	25	25	16	16	22	25
1000 X 1500	II	50	25	25	16	16	22	25
1000 X 2000	II	50	25	25	16	16	22	25
1200 X 2000	II	50	25	25	16	16	22	25
1350 X 2500	II	50	25	25	18	16	22	25
1500 X 3000	II	50	25	25	20	19	24	32
1700 X 3000	II	50	25	25	22	19	24	32
2000 X 3500	II	50	25	25	24	22	26	32
2500 X 4000	II	50	38	38	30	26	32	42
2500 X 5500	II	50	38	38	34	32	34	44
3300 X 4500	II	50	38	38	34	30	36	44
3300 X 6500	II	50	38	38	42	38	44	55
3300 X 10600	II	50	38	38	52	48	-	75

# PNEUMATIC FENDERS

## JETTY DIMENSION REQUIRED FOR INSTALLATION



SIZE	INITIAL PRESSURE (KPA)	A	B	C	D	E
		mm	mm	mm	mm	mm
500 X 1000	50	420	320	160	139	1300
600 X 1000	50	530	410	150	166	1300
660 X 1160	50	550	451	165	160	1650
700 X 1500	50	530	390	270	423	1950
1000 X 1500	50	840	640	300	419	1950
1000 X 2000	50	890	690	250	512	2600
1200 X 2000	50	1060	820	320	420	2600
1350 X 2500	50	1250	980	290	453	3250
1500 X 3000	50	1410	1110	310	470	3900
1700 X 3000	50	1620	1280	320	516	3900
2000 X 3500	50	1920	1520	360	597	4550
2500 X 4000	50	2440	1940	420	511	5200
2500 X 5500	50	2460	1960	400	707	7150
3300 X 4500	50	3300	2640	480	509	5850
3300 X 6500	50	3360	2700	420	650	8450
3300 X 10600	50	3400	2740	380	1164	13780
4500 X 9000	50	4660	3760	480	665	11700
4500 X 12000	50	4710	3810	430	997	15600

# PNEUMATIC FENDERS

## INSPECTION TEST PLAN

Test Type	According to Standard	Description
Rubber Compound Test	ISO 17357-1:2014 (Table 3)	Properties of rubber is tested for its tensile strength, elongation, hardness and tear to with stand it self from the abrasion and external forces.
Tyre Cord Test	ISO 17357-1:2014 (Annexure A)	Synthetic tyre cord is used in our fenders so the physical properties of the tyre cord is tested to match the standard values
Visual & Dimension Inspection	ISO 17357-1:2014 (Section 9.3)	Average of two dimensions taken at the middle of the fender should fall under the following tolerances, Length: + 10% , -5% Diameter: + 10% , -5%
Air Leakage Test	ISO 17357-1:2014 (Section 9.4)	The test is carried out to check for any leakage when the fender is filled at its initial internal pressure for 30mins or more.
Hydrostatic Test*	ISO 17357-1:2014 (Section 9.5)	Hydrostatic test is carried out at 0% deflection at pressure given in the standard for 10 mins to check any leakage of water and any defects. The Temporary Elongation both circumferentially and longitudinally should not be more than 10%. *Frequency of the test shall be one per 20 fenders of each size and pressure on continuous production.
Safety Valve Calibration	ISO 17357-1:2014 (Table 4 & 5)	These are checked at the given pressure in the standard for the performance.
Marking	ISO 17357-1:2014 (Section 10)	Markings such as size, pressure, manufacturer etc., is checked for the letter height mentioned in the standard for the clear identification of the fender.

## MATERIAL PROPERTIES

Sr No.	Test Item	Test Method	Required Value	
			Outer Rubber	Inner Rubber
1	Before ageing	-	-	-
1.1	Tensile strength	ISO 37:2011	18 MPa or more	10 MPa or more
1.2	Elongation	ISO 37:2011	400% or more	400% or more
1.3	Hardness	ISO 7619-1:2010	60 ± 10 (Durometer hardness Type A)	50 ± 10 (Durometer hardness Type A)
2	After ageing	ISO 188:2011	Air oven ageing, 70°C ± 1°C, 96	Air oven aging, 70°C ± 1°C, 96 h
2.1	Tensile Strength	ISO 37:2011	Not less than 80% of the original property	Not less than 80% of the original property
2.2	Elongation	ISO 37:2011	Not less than 80% of the original property	Not less than 80% of the original property
2.3	Hardness	ISO 7619-1:2010	Not to exceed the original property by more than 8	Not to exceed the original property by more than 8
3	Tear	ISO 34-1:2010	400 N/cm or more	No requirement
4	Compression set	ISO 815-1:2008	30% (70°C ± 1°C for 22 h) or less	No requirement
5	Static ozone aging test	ISO 1431-1:2012	No cracks after elongation by 20% and exposure to 50 pphm at 40°C for 96 h	No requirement

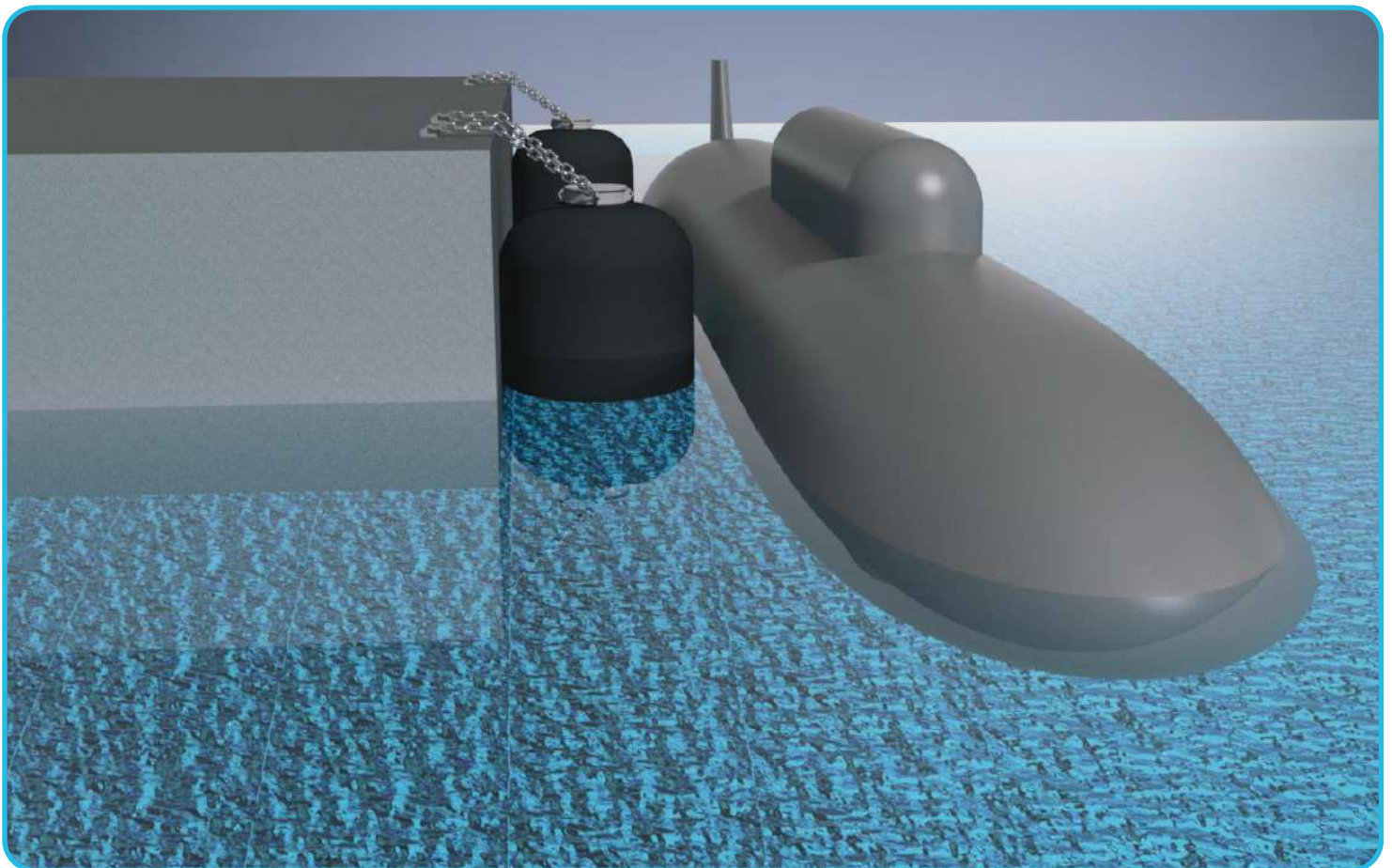
a pphm: Parts of ozone per hundred million of air by volume.

## HYDRO PNEUMATIC FENDERS

Hydro-Pneumatic Fenders are best employed for submarines. One of the most important criteria for using Hydro-Pneumatic Fenders is high energy absorption capacity and low reaction force, a vital factor for submarine applications. The Hydro-Pneumatic Fender provides a better contact area vertically which cannot be achieved through any other fendering systems and hence makes the Hydro-Pneumatic Fender the most ideal for submarine use.

### Special Features:

- Performance can be adjusted by altering the air to water ratio.
- Required draft can be adjusted to suit berthing.
- Low hull pressure.
- Self-adjustment during tidal variation.
- Low installation and maintenance cost.



# HYDRO PNEUMATIC FENDERS



# HYDRO PNEUMATIC FENDERS

## PERFORMANCE TABLE

MODEL NO	NOMINAL SIZE	ENERGY ABSORPTION (GEA)	REACTION FORCE	BALLAST WEIGHT
	DIA. X LENGTH	E	R	W
	mm X mm	kNm	kN	kg
DHP 1030	1000 x 3000	14.7	90.2	500
DHP 1240	1200 x 4000	40.2	152.0	500
DHP 1545	1500 x 4500	55.9	211.8	1000
DHP 1560	1500 x 6000	57.9	309.9	1000
DHP 1772	1700 x 7200	145.1	600.2	1500
DHP 2060	2000 x 6000	160.8	586.4	2000
DHP 2555	2500 x 5500	235.4	696.3	2150
DHP 3365	3300 x 6500	620.8	1214.1	3000
DHP 33106	3300 x 10600	795.3	1513.2	5000
DHP 45120	4500 x 12000	1057.2	1979.0	9000

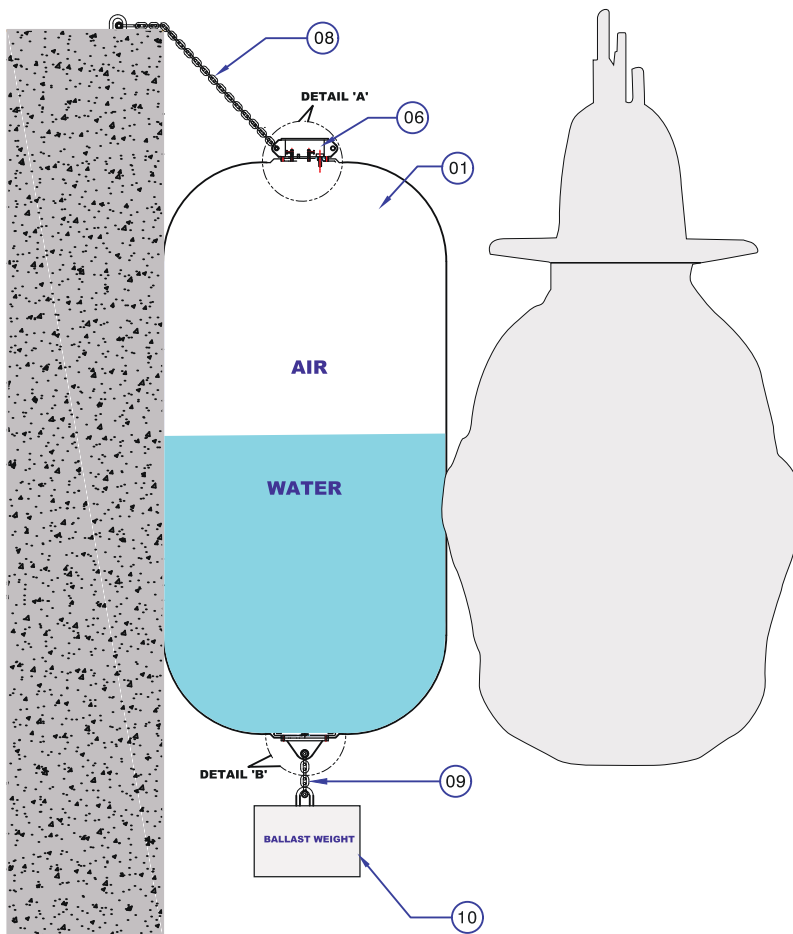
THE ABOVE PERFORMANCE VALUES ARE BASED ON THE FOLLOWING:

AIR : WATER PROPORTION : 40 : 60

INTERNAL AIR PRESSURE : 0.5 bar

THE PERFORMANCE OF THE HYDRO - PNEUMATIC FENDERS CAN BE VARIED BY ADJUSTING THE AIR WATER RATIO AND INTERNAL PRESSURE.

## ACCESSORIES



1. RUBBER FENDER BODY
2. SAFETY VALVE
3. WATER CHARGING VALVE
4. AIR CHARGING VALVE
5. PRESSURE CHECK VALVE
6. UPPER HOUSING
7. LOWER TOWING RING
8. GUY CHAINS
9. BALLAST CHAIN
10. BALLAST WEIGHT

Note : For more details refer to our manufacturing drawing

## FOAM FENDERS

IRM Foam Fenders are manufactured from a high-quality foam covered by tough polyurethane skin. IRM manufactures Foam Fender as an alternative to the standard Pneumatic Fender. The performance of foam-filled fenders can be modified by changing the grades of foam. Hence Foam Fenders can be designed and manufactured for specific applications, which also gives more flexibility to Foam Fenders in meeting different requirements of berthing energy and reaction force for the exact size of Fender. Foam Fenders can also be equipped with chain and tyre nets in case of rough applications.

Since there is no air pressure inside the Foam Fenders, there is no risk of deflating, bursting or sinking; It also eliminates any end fittings like safety valves, ball valves; Which further reduces the maintenance of Foam Fenders compared to Pneumatic Fenders.

### Key Attributes :

- Low Hull Pressure.
- Can be manufactured in special sizes for specific purpose.
- Performance can be altered by changing the grade of foam.
- Available in non-staining colours.
- Quite easy to install, dismantle and re-locate.
- Low maintenance.
- Robust and Unsinkable design.

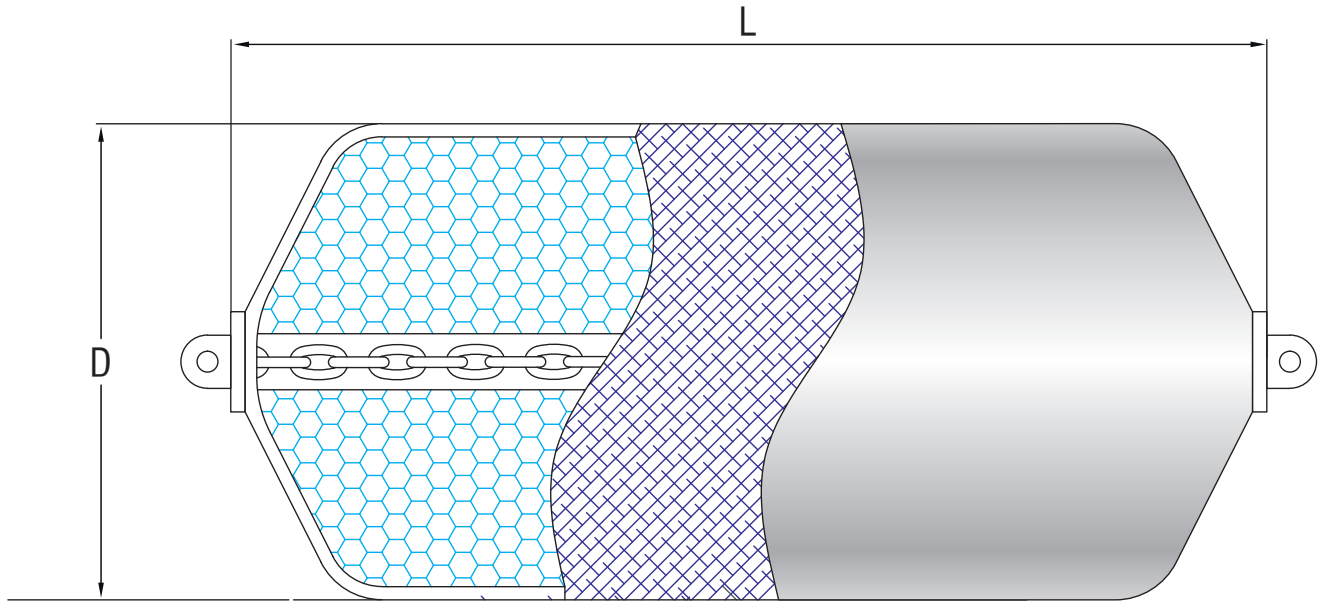
### Applications :

All types of Berths, Jetties, Vessels, Naval applications, Ship-to-Ship transfer, and many more.





# FOAM FENDERS



Closed Cell Foam Core
  Nylon Reinforcement
  Polyurethane Skin

## PERFORMANCE TABLE

Dimension (in Mtr.)	50% Deflection		60% Deflection		Weight (Approximate) (±10% or suitable tolerance)
	Energy	Reaction	Energy	Reaction	
(DxL)	KNM	KN	KNM	KN	Kg
0.45 x 0.70	12.0	32.7	17.1	46.5	30
1.0 x 1.5	33.2	120.6	47.5	172.6	157
1.0 x 2.0	47.0	177.5	67.6	253.9	210
1.2 x 2.0	65.5	198.2	91.2	279.4	305
1.35 x 2.5	106.8	292.2	152.0	417.7	430
1.5 x 3.0	165.7	409.9	237.3	586.4	661
1.7 x 3.0	197.1	432.4	281.4	617.8	754
2.0 x 3.5	316.7	590.3	453.0	844.3	1175
2.5 x 4.0	559.9	837.4	800.2	1196.4	1930
2.5 x 5.5	839.4	1251.3	1199.3	1787.7	3068
3.3 x 4.5	1049.3	1183.6	1497.4	1689.6	3545
3.3 x 6.5	1694.5	1911.3	2420.2	2730.1	5500

Note: Foam fenders are also available with various performance characteristics depending on the foam grades. Weight of the foam fenders vary as per the foam grades. The performance and weight values mentioned are subject to change without notice.

(Performance Tolerance ± 10%)



# DONUT FENDERS

Donut Fenders are ideal for turning structures, lead-in jetties, berthing dolphins, and guiding support. The Fender is equipped with low friction bearings and offers a frictionless rotation. It provides smooth berthing along with aligning to the ships. The foam is unsinkable and thus having no maintenance.

The Donut Fender being light in weight, self adjust itself during tidal variation. The Fender skin is a durable polyurethane material that enhances the life of the Donut fender.

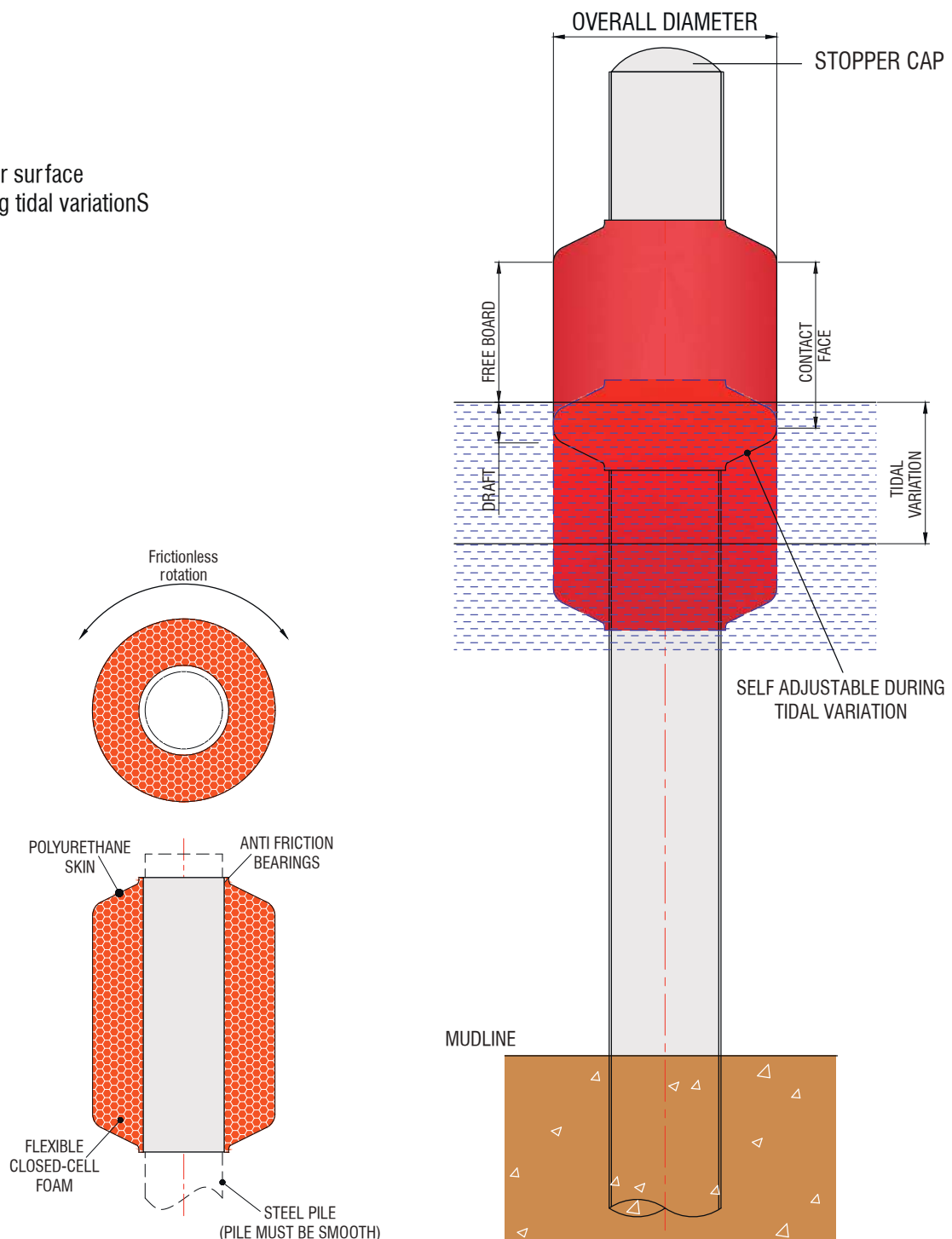
Donut Fender can be custom designed for any application. Different colours can be chosen to have better visibility and safety.

## FEATURES :

- Frictionless rotation
- Good visibility
- Easy to install
- Low maintenance
- High performance
- Low hull pressure
- Non-marking Fender surface
- Self-adjusting during tidal variations

## APPLICATIONS :

- Lead-in Jettis
- Dolphins
- Turning Structures
- Corner protection
- Bridge protection
- Encroached areas

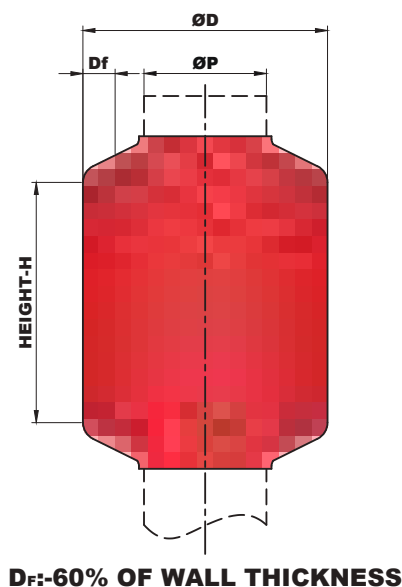


# DONUT FENDERS

## DIMENSIONS AND PERFORMANCE OF STANDARD SIZES

Donut Size- $\varnothing D$ (mm)	Deflection 60% of wall thickness		
	Max Pile Dia. (mm)	Energy (Knm)	Reaction (Kn)
1280	610	6.8	117.7
1460	710	8.8	128.5
1530	762	10.7	142.2
1770	914	14.7	161.8
1900	995	16.6	184.4
2040	1067	18.6	187.3
2220	1185	22.5	204.0
2300	1219	24.5	210.9
2550	1345	28.4	230.5
2530	1372	30.4	237.4
2800	1524	35.3	256.0
2980	1636	40.2	273.6
3050	1676	42.1	283.5
3290	1829	50.0	303.1
3440	1933	54.9	319.8
3540	1981	57.8	328.6
3810	2134	66.7	351.1
3970	2241	73.5	362.9
4050	2286	75.5	374.7
4200	2388	81.4	389.4

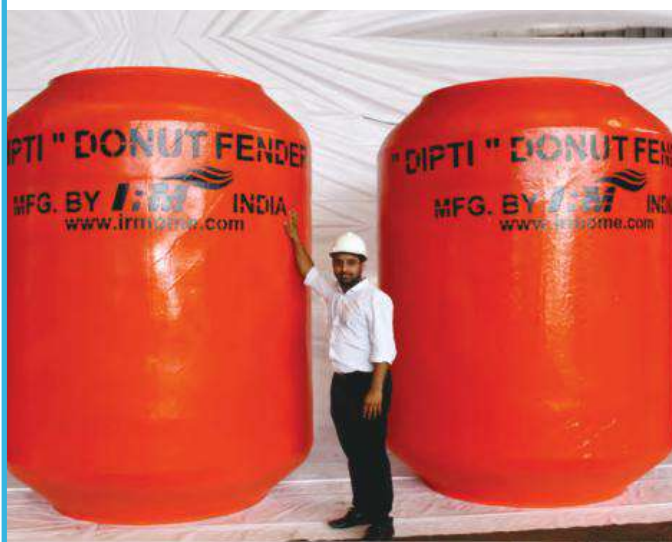
Notes :  
 1. Performances are based on standard foam grades. Performance can be altered by modifying the foam grade of the Donut fenders.  
 2. The above values are for 1m height. In case if the height is increased the performance will increase proportionately.  
 (Performance Tolerance  $\pm 10\%$ )



# LOAD DEFLECTION TESTING



# PHOTO GALLERY



# PHOTO GALLERY



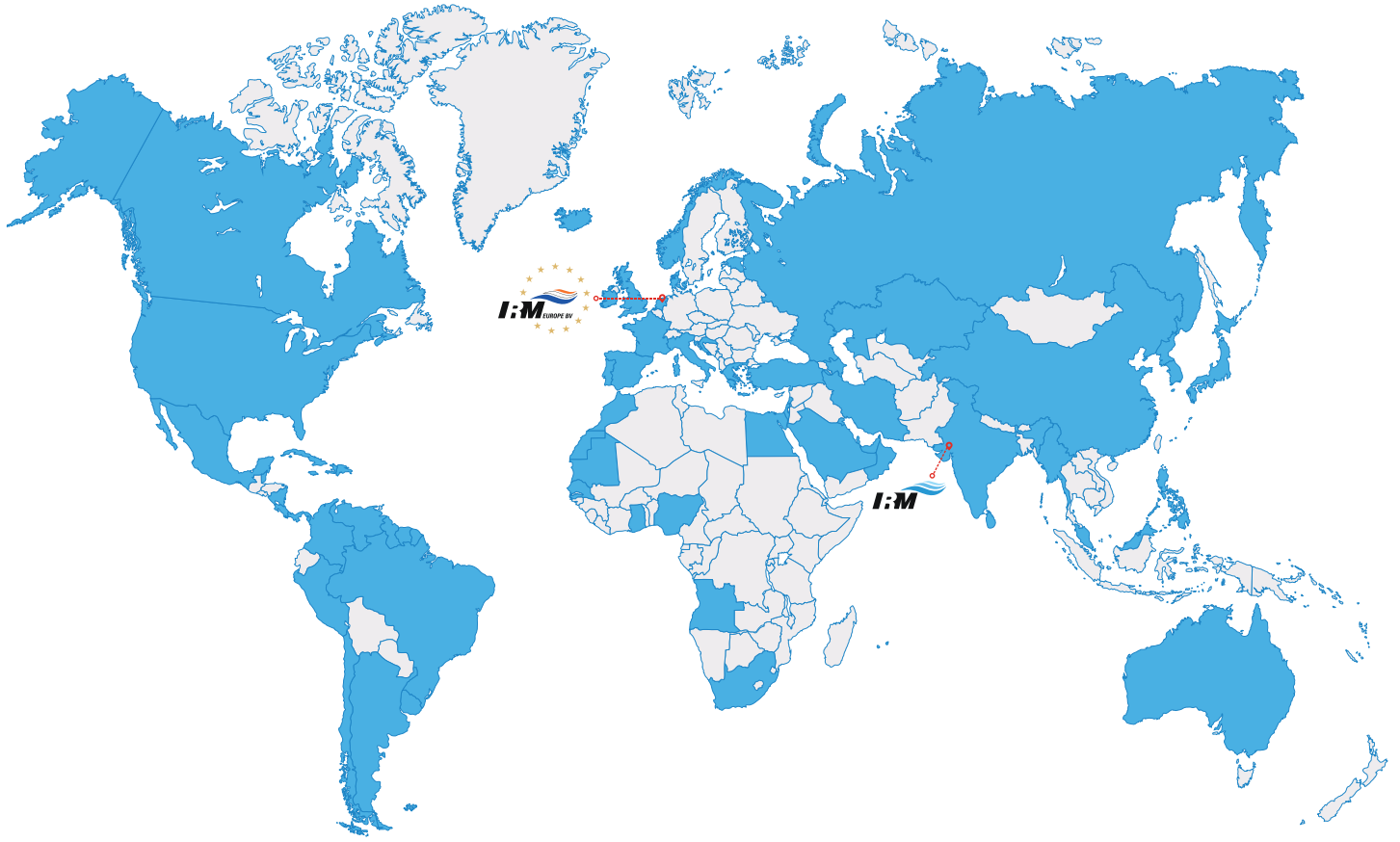


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