

**FABRICATION, INSTALLATION OF NEW PONTOON AND  
REPAIR AND MAINTENANCE OF EXISTING PONTOON FOR  
RORO/ROPAX FACILITY AT GHOGHA- GUJARAT.**

(DPA/RORO/2024, Dated:25/07/2024)

PART 3 – TECHNICAL DOCUMENTS

**TENDER DOCUMENT**

**FOR**

**FABRICATION, INSTALLATION OF NEW  
PONTOON AND REPAIR AND  
MAINTENANCE OF EXISTING PONTOON  
FOR RORO/ROPAX FACILITY AT  
GHOGHA- GUJARAT.**

**VOLUME IV**

**SPECIFICATION FOR FENDERS**




**DEENDAYAL PORT AUTHORITY**

**ADMINISTRATIVE OFFICE BUILDING**

**POST BOX NO. 50**

**GANDHIDHAM (KUTCH)**


**GUJARAT – 370201**

	<p style="text-align: center;"><b>FABRICATION, INSTALLATION OF NEW PONTOON AND REPAIR AND MAINTENANCE OF EXISTING PONTOON FOR RORO/ROPAX FACILITY AT GHOGHA- GUJARAT. SPECIFICATION FOR FENDERS</b></p>	<p>PAGE: 3/ 14</p>
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## **1. SPECIFICATION FOR RUBBER FENDERS**

### **1.1. Scope**

The scope of this section includes the description and the basic engineering parameters and technical specifications for the fender system.

The Contractor shall design, supply, and install rubber fender units in accordance with the Drawings and this Specification. The Contractor should be aware that the Employer requires a long service life together with low maintenance costs for the fender systems. The fender types shall be installed at the positions shown on the Construction Drawings.

### **1.2. Design Life**

The design life of the fender system shall be minimum 25 years with a warranty for 1 years.


### **1.3. Responsibilities**

The Vendor shall be responsible for ensuring correct and safe configuration, functionality and operability of the supplied and installed fender System. The Vendor shall ensure that no omissions from, or compliance with the specifications, data and documentation supplied by others shall prejudice this responsibility.

The Vendor shall ensure that the fender installation complies in all respects with the requirements of the fender system supplied. The scope of Vendor includes but not limited to the following.

- a. Design and Engineering.
- b. Procurement of raw material & bought out components.
- c. Manufacturing and Assembly at works.
- d. Inspection and Testing.
- e. Surface preparation, protective coating and painting shall be done as per Manufacturer's Standard suitable for site condition including supply of paint.
- f. Touch-up/ repair painting at site including supply of paint.
- g. Packing and Supply.
- h. Unloading at site, local handling, transportation from store to work site, storage at work site, assembly at site.
- i. Erection, hook-up, testing, commissioning, and performance Guarantee Test of all systems at job site.
- j. "On-site" training at project site to Owner's personnel for operation and maintenance.



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- k. Necessary assistance to Owner in obtaining the statutory approvals as required/ applicable, by providing drawings & documents as required.

#### **1.4. Objectives**

The objective of the fender system is to provide safe and acceptable berthing support for the Ro-Ro vessel at the jetty. The functions of the fender are.

- To absorb the impact energy due to berthing vessel as specified in section 1.6.3
- To absorb the wind load during berthed condition.

#### **1.5. Scope of Supply**

The scope of supply of fender under this specification includes the following.

- Dual Cone Fender with fender frame and fascia pads or its equivalent for berthing dolphins.
- Arch Fender (ANP) with fascia pads or its equivalent for the guide pin piles and fisher man jetty.
- DAV Arch Fender with fascia pads or its equivalent for the pontoon

Fender assemblies are supplied with anchor bolts suitable for use when mounting to concrete jetty structure. The supply shall include complete fender assembly, tension chains, shear chain, weight chain and its anchorage hardware.


#### **1.6. Design and Performance Requirements**

##### **1.6.1. Fender System**

The fender system proposed is Arch fenders and shall be fully vulcanized and homogeneous, having sufficient resilience, anti-aging weather resistant and wear resistant properties to meet all normal service conditions.

The berthing energy and the fender reaction should be restricted to the values applicable for the above listed fenders. The fender units, for fendering shall be obtained from approved specialist suppliers and manufacturers and shall be fabricated, assembled, installed, and tested in accordance with manufacturer's instructions and recommendations.



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### 1.6.2. Load Deflection Characteristics

All the fenders supplied shall exhibit load deflection and energy-deflection characteristics as per requirement. Unless otherwise specified all fenders shall exhibit linear load-deflection relationship for deflection of at least 51.5%. Other characteristics shall be as per table 1.1.

**Table 1.1 – Requirements for Arch Fenders (Pontoon)**

1	Berthing condition	Sheltered with difficult berthing condition
2	<b>Design parameters</b>	
	a. Berthing angle	0°
	b. Factor of Safety for abnormal berthing energy	2.0
	c. Berthing energy of fender	@51.5% deflection the minimum energy absorption shall be 32.8Tm.
	d. Reaction force	@51.5% deflection the reaction force shall not exceed 84.4T.
	e. Overall thickness of fender system	1000mm from the face of the base plate
3	Type of fender	DAV 1000H R1 Dipti Arch Fender or its equivalent
4	Accessories	Fender steel frame with fascia pads Anchor bolts (Super Bolt) nuts, washer etc., as required for fixing the fender in position.

### 1.7. Fender Units


The types and locations of fenders to be provided and installed under this Contract are shown on the Construction Drawings.

Prior to procurement or installation of the fenders the Contractor shall provide to the Engineer's Representative for review manufacturer's data to demonstrate general product compliance with this Specification. Details of similar fender units, including fender type, location, and date of installation, which have been successfully installed for similar conditions, shall also be provided.

The Contractor shall supply to the Engineer's Representative the following information:

- Identification marks
- Name of manufacturer
- Place and date of manufacture
- Size and rubber grade of fender unit



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Certificates of origin of each fender bearing the corporate stamp and signature of an authorised person and giving a unique reference to each fender so that it is traceable to its place and date of manufacture.

Design calculations and fully detailed fabrication drawings shall be submitted to the Engineer's Representative for approval prior to manufacture. Responsibility for the design shall remain with the Contractor notwithstanding any approval of the Engineer's Representative.

### **1.8. Rubber Characteristics**

Rubber fender units shall be compression moulded from natural or synthetic or both compounds resistant to ageing, weathering and wearing and shall have the properties stated in the Table 1.2 and 1.3 in compliance with Section 7.3 of Appendix A of the "WG 33 - Guidelines for the Design of Fender Systems: 2002", published by the Permanent International Association for Navigation Congress (PIANC).

The rubber shall be fully vulcanised and homogeneous with no foreign particles and free from defective impurities, pores and cracks, voids, and cuts. Steel plates shall be fully embedded and fully adhered to the rubber during the vulcanizations process to avoid separation between the rubber and steel.

Rubber for fenders shall be natural or synthetic rubber. The material shall be homogeneous and a minimum submerged density of 275 kg/m<sup>3</sup> is required.


The following particulars of the proposed rubber fenders shall be submitted:

- i) Manufacturer's literature, including a list of physical properties of the rubber for the fenders.
- ii) A report on compression load tests and characteristic load-deflection and energy-deflection curves.
- iii) The temperature at which the compression load test was carried out with a graph showing how the buckling load varies with temperature.
- iv) The rate of compression used in the test with a graph showing how the buckling load varies with rate of compression.

The rate of compression curve may be obtained using exact scale models of the fenders provided the models are not less than 100mm high.

The particulars shall be submitted for approval of the source and type of rubber fenders at least 40 days before the first delivery of the rubber fenders to the Site.



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A certificate showing the manufacturer's name, the date and place of manufacture and showing that the rubber fenders, including the rubber used in manufacturing the fenders, comply with the requirements stated in the Contract, shall be submitted for each batch of rubber fenders delivered on the site.

The rubber characteristics before and after ageing shall meet the following minimum requirements.

**Table 1.2 Rubber Properties – Before Ageing**

Property	Requirement	Testing standard
Tensile Strength	Minimum 15.7MPa	ASTM D412 Die C/BS 903 A.Z.
Elongation	Minimum 300%	ASTM D412 Die C/BS 903 A.Z.
Hardness	Maximum 84 Deg.	ASTM D2240 shore A durometer / BS 903 A.Z

**Table 1.3 Rubber Properties after aging  
(70° C X 96 hrs aging through air heating)**

Change in Tensile Strength	Not less than 80% of original value	ASTM D 573 Die C/BS 903 A.Z.
Change in Elongation	Not less than 80% of original value	ASTM D 573 Die C/BS 903 A.Z.
Hardness	Original value +8° max	ASTM D2240 shore A durometer /BS 903 A.Z
Tear Resistance	Minimum 70 KN/m	ASTM D 624 Die B/BS 903 A.3
Compression set. 70° x 22 hours heat treatment.	Maximum 30%	ASTM D 395/BS 903 A.6A
Abrasion Resistance	Maximum 1.5 CC	BS 903 A9 method C 3000 revolutions
Anchor bolt (Super Bolt) & nuts, Washer, etc.	Stainless steel EN Grades 1.4401	AISI 316/BS970 Gr.316


### **1.9. Documentation**

All fender units shall be permanently marked with a unique reference so that they can be individually identified both during manufacture and once incorporated into the permanent works. For the latter case, the marks are to be clearly legible to someone standing on the quay/berths. For all fenders, full records of manufacture and installation are to be kept on forms to the approval of the Engineer's Representative, including:

- Manufacturer, location of manufacture
- Method of manufacture
- Mould reference where appropriate, supervisor in-charge
- Date(s) of manufacture





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- e) Location of fender unit in Works, and date of installation
- f) Confirmation that the fender has been subjected to a "break in" cycle, including details.
- g) Any other relevant information
- h) Authorised signatures confirming details are correct.

Preliminary forms shall be submitted to the Engineer's Representative prior to delivery of the fender units to Site. Final forms shall be submitted within two weeks of installation of the fenders.

### ***1.10. Anchorage Hardware***

All bolts and fender anchors used for securing components of the fender system shall be designed by the Contractor to suit the specified fender rubber design.

All fixings shall be stainless steel Grade 1.4401 to BS EN 10088 (or AISI grade 316). The bolts shall be well lubricated with a PTFE tape or spray or with a suitable underwater lubricant (Aqua Lube or similar) to prevent galling between the bolt and socket. The positions of the fender anchors shall be determined by the Contractor to suit the fender unit design, whilst still satisfying the geometrical requirements and restrictions shown on the drawings.

All fixings shall be such that they are stronger than the items they are fixing, in order to avoid damage to the fixings in the concrete.


Calculations shall be provided to justify fixings and will be subject to the approval of the Engineer's Representatives or his nominee. Where stainless steel bolts or fender anchors make contact with other dissimilar metals, they shall be electrically insulated to prevent bi-metallic corrosion.

### ***1.11. Assembly and Installation***

Rubber fenders shall be handled and stored in accordance with the manufacturer's instructions. Great care shall be taken to prevent cutting or tearing of the rubber, particularly in the area of any embedded plates and around bolt holes and bolt recesses in the fender base, flanges or fins.

Fenders shall normally be stored in the protection packing in which they have been transported. Fenders shall be handled in such a way as to prevent them from being distorted, overstressed, or damaged in any way. All slings, ropes or chains for handling fenders shall be of rubber or nylon sheathed.



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Final fender alignment shall be such as to provide, within recommended tolerances, a straight line to the berthing face. Fenders shall be installed in accordance with the manufacturer's recommendations/instructions, from the installation of cast-in sockets to the final tensioning of fixing chains. The concrete surface onto which the fender rubber is fixed shall be vertical, flat and continuous and shall provide full bearing for the area of the fender rubber.

Tolerances on fender installations shall be compatible with tolerances on concrete structures to which they are affixed but shall in no circumstances be installed to dimensions that exceed the tolerances stated herein.

### **1.12. Permitted Tolerances**

Tolerances on fender performance and physical dimensions shall not exceed the following.

- i) Performance:
  - Energy absorption (E) = +/- 10%
  - Reaction force (R) = +/- 10%
- ii) Physical Dimensions:
  - Height of fender (H) = +4/- 2%

The rated reaction and energy absorption specified in this specification excludes the tolerances and shall be selected while selecting the suitable fender.


### **1.13. Fender Inspection Requirements**

The testing, with the exception of fatigue testing, shall be carried out in accordance with the latest revision of Supplement to Bulletin No 45 "Report of the International Commission for Improving the Design of Fenders" by PIANC.

All fenders shall be inspected at the manufacturer's Works and shall be duly certified by a third-party inspection agency as fully meeting this specification. The third-party inspection agency shall be Lloyd's or IRS or other agency approved by the Employer. The cost of Third-Party Inspection shall be borne by the contractor.

The Contractor shall supply in-house laboratory material testing reports giving results of all tests performed on each batch of material actually used for the fender manufacture, duly certified by the third-party inspection agency, at the time of supply of fender units.



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#### ***1.14. Compression Fender Testing Requirements***

Verification testing to determine compliance with the specified energy and reaction requirements shall be carried out in accordance with Section 6 of Appendix A of the “WG 33 - Guidelines for the Design of Fendering Systems: 2002”, published by the Permanent International Navigation Association (PIANC).

CONTRACTOR shall submit Factory Acceptance Test (FAT) procedure for approval prior to testing. Quality Control Agency shall be present at FAT in order to approve and verify proper test methods are being applied. Warranty letters for fenders and material certificates shall be provided.

At least 10% of total fender units shall be tested with a minimum of 2 units. These tests shall be witnessed by Engineer’s Representative or his representative.

All rubber fenders shall be subject to at least a single "break in" compression cycle to rated deflection at the factory prior to shipment. Original copies of test certificates shall be sent to the Engineer’s Representative.


Samples for verification testing shall be actual fender elements selected at random. One fender unit shall be selected from each batch of ten units produced of a particular size, grade, and specification. Where different moulds are used or the manufacturing process is altered, this shall be treated as a new batch of fenders for the purpose of this Clause. Where there are less than ten fenders in a batch, then one fender shall be tested from that batch.

The Engineer’s Representative shall be given at least four weeks’ notice of when and where the fenders are to be tested. The Contractor shall furnish in-house laboratory testing report for the deflection-load and deflection-energy absorption tests carried out on the selected fender duly witnessed and certified by the third-party inspection agency specified herein at the time of supply of the fender units. The Contractor shall provide facilities to permit the Engineer’s Representative or his nominee to witness the tests to be conducted in India if he so desires and the cost of visiting test will be borne by the Port (Employer).

Where the test is not carried out at the conditions specified for the Rated Performance Data, then tests to establish the Temperature Factor and Velocity Factor shall be carried out in accordance with Appendix A of the “WG 33 - Guidelines for the Design of Fendering Systems: 2002”. These tests shall be considered as part of the verification testing, and the requirements of the previous paragraph shall apply.

Full details of the tests shall be provided, including certification of the test equipment used.



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### ***1.15. Drooping Testing Requirements***

Fender drooping is a phenomenon that often happens due to the heavy steel frame that is supported by the fender due to slackness of weight chain. The shear and bending capacity of the rubber fenders shall be sufficient enough to support such weight.

Drooping test for each fender shall be carried out with the weight of the fender frame assembly and the load shall be maintained for at least 1 week to determine the maximum deflection of the fender. The maximum deflection shall not exceed 25mm or L/100 whichever is lower.

Full details of the tests shall be provided, including certification of the test equipment used.

### ***1.16. Documentation***

#### **1.16.1. Calculation Notes**

Following notes shall be included, as a minimum:


- Fender rubber strength against drooping in vertical direction due to self-weight of fender and frontal frame.
- Fender System Justification (front panels and fender) according to performance requirement including manufacturer tolerances.
- Panel structural justification
- Chains and accessories structural justification
- Anchor bolt calculations for fenders and chains

#### **1.16.2. Drawings**

Including, at least, following drawings:

- Fendering system plans (plan view, front and side elevations)
- Anchor bolt layout
- Insert details.
- Panel details
- Chain padeye details
- Bolts, nuts and washers' details
- UHMW panel details
- Chain assemblies
- Chain turnbuckles
- Bill of material



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#### 1.16.3. Fabrication related Procedures

- Fitting justification
- PE-UHMW pads technical data sheets.
- Fender performances curves
- FAT procedure and PIANC procedure
- Handling, transportation, and storage procedure
- Installation and maintenance procedure
- Painting procedure
- Inspection and tests plan


#### 1.16.4. Certificates and Test Reports

- PIANC Material certificates for rubber, including material traceability sheet.
- Material certificates type 3.1 for accessories or, at least, Certificate of compliance with the purchase order type 2.1, including material traceability sheet.
- FAT report
- PIANC test report
- Painting report

#### **1.17. Special Points of Consideration**

- i) All metal parts including bolts, washers head, plate, etc., are to be of stainless steel only.
- ii) The system should preferably be designed to facilitate easy removal of old bolts and reinserting of new bolts in case of bolts connecting the fender to the wharf fail.
- iii) Suitable arrangements to prevent the bolt working loose while in operation due to berthing force and frequent tightening of the bolts is to be avoided.
- iv) The connection between the front bearing plate and the fender rubber should be carefully designed to avoid the bolts shearing often.
- v) Full specifications with illustrations and necessary drawings, spare parts lists, complete set of all necessary tools and spanners shall be supplied along with the fenders together with detailed instructions and all other information needed for guidance and any further clarification that may be sought later to enable proper installation of the fenders.
- vi) All materials and workmanship and duty shall be corresponding to Indian Standard Specifications and ratings. In case the materials and ratings are as per standard specifications and ratings other than I.S.S. or I.S. ratings the supplier shall enclose two copies of such standard specification or ratings along with his tender.
- vii) Compression test shall be performed on fender extracted from a lot of shipment at random to confirm that the fender meets with the specifications, viz., energy, absorption, reaction load and deflection including tolerance, it any. (To compress



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the sample fender vertically, with the compression tester to measure the reaction load, one rubber fender will be tested at a time).

- viii) The recovery in height of the rubber fender at one minute after the fender is released from the load should be more than 95% of its original height.
- ix) All materials used shall be new and no material shall be used on the work without the prior approval of the Engineer's Representative or his representative.
- x) The decision of the Engineer's Representative or his representative regarding the quality of any materials used on the work will be final and binding on the contractor. He shall remove from the site of work any material rejected as unfit for use on the work at his own cost as soon as he is ordered to do so, failing which the Engineer's Representative or his representatives shall remove such materials from the site of work and shall deduct the cost incurred by such removal by the Board from the site of work from any moneys due to the contractor.
- xi) All the work shall be carried out as per relevant specifications and to the satisfaction of the Engineer's Representative.
- xii) The specification of all other materials shall be as per the relevant Indian Standard specifications as applicable. All BIS specification referred to in this schedule shall be the latest version.

### ***1.18. Defect Liability Period for Fenders***

The Contractor shall warranty the complete fender system for a period of 12 months from the date of completion of work, for any kind of manufacturing defects or deviations from specified performance. An amount of 10% of the value of the marine fender work will be held towards the satisfactory performance of the fenders until expiry of defect liability period. However, the Contractor may also submit a Bank guarantee for an equivalent amount (as stated above) issued from any Nationalized Bank having its branch in Gandhidham or enforceable and encash-able at Gandhidham. The rates entered shall be inclusive of inspection, testing as above.

