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USACE / NAVFAC / AFCEC / NASA **UFGS-35 59 13.18 (November 2021)**

Preparing Activity: NAVFAC **New**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2022
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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 59 13.18

PNEUMATIC AND HYDRO-PNEUMATIC MARINE FENDERS

11/21

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SECTION 35 59 13.18

PNEUMATIC AND HYDRO-PNEUMATIC MARINE FENDERS
11/21

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NOTE: This guide specification covers the requirements for pneumatic and hydro-pneumatic marine fenders.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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NOTE: Fender type should be selected based on the following considerations:

1. Performance, including energy, berthing angle, reaction, and hull pressure.

2. Geometry, including stand-off, dock configuration, vessel configuration, and tidal variation.

3. Configuration and construction, including corrosion resistance, netted vs not netted, magnetic permeability, buoyancy and portability.

The following information shall be shown on the project drawings:

1. Location, size,and mounting elevation (if applicable) of each fender type.

2. Connection details to the waterfront structure. Include connection sizes, material type, embedment, plate sizes and hole sizes and locations, as applicable.

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PART 1 GENERAL

1.1 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN BUREAU OF SHIPPING (ABS)

ABS 2	(2019) Rules for Building and Classing Steel Vessels

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020; Errata 1 2021) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D624	(2000; R 2020) Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 34-1	(2015) Rubber, Vulcanized rr Thermoplastic -- Determination of Tear Strength -- Part 1: Trouser, Angle and Crescent Test Pieces
ISO 37	(2017) Rubber, Vulcanized or Thermoplastic -- Determination of Tensile Stress-Strain Properties
ISO 815-1	(2019) Rubber, Vulcanized or Thermoplastic -- Determination of Compression Set -- Part 1: At Ambient or Elevated Temperatures
ISO 1431-1	(2012) Rubber, Vulcanized or Thermoplastic - Resistance to ozone cracking - Part 1: Static and dynamic strain testing
ISO 7619-1	(2010) Rubber, Vulcanized or Thermoplastic - Determination of indentation hardness - Part 1: Duromater method (Shore hardness)
ISO 17357-1	(2014) Ships and Marine Technology - Floating Pneumatic Rubber Fenders - Part 1: High Pressure

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-C-271	(Rev H) Chains and Attachments, Carbon And Alloy Steel

1.2 SYSTEM DESCRIPTION

1.2.1 Pneumatic and Hydro-pneumatic Fenders

****
NOTE: Pneumatic fenders are inflated with air and float on the surface of the water to serve as a protective buffer for ships. Hydro-pneumatic fenders are similar, but contain water in addition to the pressurized air, with a counterweight at one end so the fender is partially submerged and are specifically designed for the berthing of submarines.
****

Pneumatic and hydro-pneumatic fenders are constructed of an inner rubber layer, reinforcing cord layers and an outer rubber layer that form a synthetic-cord-rubber sheet, which forms a cylindrical air-bag with

hemispherical heads at each end,which can be inflated with air. These fenders can be used as stand-alone fenders, fendering between ships, or between a ship and a berthing structure. In hydro-pneumatic fenders, the upper hemispherical head has a top plate that allows internal placement of water and air into the bag, and the lower hemispherical head has a bottom plate that provides a connection location for the counterweight. The air-bag typically has a long cylindrical shape and is counter-weighted to float vertically. Hydro-pneumatic fenders are typically used as fenders for submarines, acting as buffers between submarines and berthing structures and as separators between submarines. Hydro-pneumatic fenders can be used in combination with foam-filled fenders or pneumatic fenders to support both ships and submarines at the same berth, if designed appropriately.

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G". Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Pneumatic Fenders Manufacturer's Data; G[, [_____]]

Hydro-Pneumatic Fenders Manufacturer's Data; G[, [_____]]

SD-05 Design Data

****

NOTE: Performance requirements: the rated energy of the fender shall be no less than the calculated berthing energy and the rated fender reaction shall not exceed the allowable load on the structure supporting it.

The maximum reaction divided by the corresponding contact area, shall be less than or equal to the maximum specified hull pressure for fender panels.

Deflected standoff at specified energy must be greater than or equal to minimum specified standoff. The undeflected standoff, including nets if any, shall not be greater than any specified undeflected standoff.

Fender design load shall be less than the rated reaction of the fender. Static shear force shall use the minimum static coefficient of friction. Dynamic shear force for pneumatic and hydro-pneumatic shall be the rated reaction times the difference between the coefficient of friction between the structure and fender and the coefficient between the fender and vessel times a factor of safety of 1.5. Dynamic shear force for rubber fenders for slicing surfaces shall be twice the maximum published dynamic coefficient of friction. For UHMW against steel, use 0.20 or the maximum published for the coefficient of friction.

The ultimate elastomeric elongation shall be at least three times the maximum elongation anticipated at maximum design conditions. The bond strength of the elastomer to its substrate shall be greater than the elastomer's tensile strength at the ultimate elongation.

Structural components shall be sized with a design load that does not exceed 80 percent of yield. Panel loads shall be based on the greater of:

1. Horizontal line contact applied at any elevation over the flat height of the panel.

2. Simultaneous horizontal line contacts at top and bottom edge of the front face of the panel.

Design factor for attachment points, restraints and nets shall be based on 1.5 times the dynamic shear.

The end attachment load shall not exceed 80 percent of yield. Restraints shall be sized such that the load applied to the weakest component does not exceed 50 percent of its breaking strength.

A weak link, preferably a shackle, swivel or other readily replaceable, cost effective component shall be designed to fail first. Concrete embedments shall have a break out capacity of at least 1.5 times the characteristic load of the weakest link.

Mechanical hardware, such as fasteners shall be sized with a design working load that does not exceed 60 percent of the lower of the yield or breaking load.

Pneumatic and hydro-pneumatic fenders should have at least 50 percent of the contact dimension in bearing on the supporting structure, or as recommended by the manufacturer. The contact surface for all floating fenders when not under load, should have low abrasion characteristics. Typically UHMWPE or plastic is used to face concrete or composite elements in the wear area.
****

Pneumatic Fenders Performance Characteristics; G[, [_____]]

Hydro-Pneumatic Fenders Performance Characteristics; G[, [_____]]

Pneumatic Fenders Design Data; G[, [_____]]

Hydro-Pneumatic Fenders Design Data; G[, [_____]]

SD-06 Test Reports

Prototype Fender Performance Confirmation; G[, [_____]]

****
NOTE: Prototype fender performance confirmation includes the following tests: (1) performance; (2) angular compression; (3) durability; (4) compression recovery; and (5) puncture resistance.
****

Dimensional Inspection; G[, [_____]]

Air-leakage Test; G[, [_____]]

Hydrostatic-pressure Test; G[, [_____]]

Pressure Relief Valve Test

Design Proof; G[, [_____]]

Rubber Material Test; G[, [_____]]

Submit copies of reports of tests specified herein. Also, submit reports for tests specified in referenced documents which

are applicable to the particular material furnished for use.

SD-07 Certificates

Hydro-Pneumatic Certificates; G[, [_____]]

Pneumatic Certificates; G[, [_____]]

SD-08 Manufacturer's Instructions

Installation Instructions

SD-10 Operation and Maintenance Data

Fender Manual

SD-11 Closeout Submittals

Pneumatic and Hydro-Pneumatic Fenders - Warranty; G

1.4 DELIVERY, HANDLING AND STORAGE

Deliver fenders undamaged. Handle and store fenders as to prevent damage, such as bending or abrading end fittings, cutting of rubber, or damage to coating of hardware. Protect folded fender corners from forklift and/or maintenance while tires that could possibly damage the outer rubber and reinforced layers of the fender. Protect fenders from exposure to damaging liquids, oils, greases and extended exposure to sunlight.

1.4.1 Rejection

Fenders that are delivered to the site in a damaged condition or that are not in conformance with this specification are subject to rejection. Replace any rejected materials with suitable materials, at no additional cost to the Government.

1.4.2 Fender Marking

Unless otherwise specified, identify all fenders in readable characters at least 25 mm 1 inch high, either directly or on corrosion- and sunlight resistant permanently attached tags. For fenders 2500 mm 8 feet in diameter, the letter heights must be a minimum of 100 mm 4 in. The markings must include the following:

a. International Standard number and applicable year, i.e. ISO 17357-1:2014.

b. size (Diameter and Length),

c. initial internal pressure,

d. date of manufacture or its abbreviation,

e. full or abbreviated name of manufacturer

f. individual serial number,

g. type of reinforcement layer,

h. other information as the purchase specification or contact requires.

1.4.3 Fender Instructions and Manual

Provide installation instructions and a fender manual describing maintenance requirements for each fender type.

1.4.4 Handling Coated Material

Store, handle, and place coated material in a manner that will minimize damage to the coating and will not reduce its effective protective value. Repair damaged surfaces as directed and per the Manufacturer's recommendations. Handle coated work which is flexible in a manner that will prevent flexing sufficient to crack coating, especially when temperature is below 4 degrees C 40 degrees F. Do not place coated surfaces on strips or skids until coating has hardened thoroughly. Wide fabric slings used for lifting, and strips, slings, blocks, skids, cradles, and other supports must provide ample bearing areas. In transporting, fasten and protect coated materials in a manner that will prevent movement and preclude chafing and rubbing, and when unloading, do not dump or drop. Place coated material in position carefully on suitably prepared beds and with a minimum of handling.

1.5 QUALITY ASSURANCE

1.5.1 Certificates

Submit pneumatic certificates of compliance and hydro-pneumatic certificates of compliance certifying that materials meet the requirements specified herein.

1.5.2 Elastomer Skin

The elastomer skin of the fender must be free from cracks, burrs, warpage, checks, chipped or blistered surfaces, and must have a smooth surface.

1.5.3 Steel Fabrication

The steel used in fabrication must be free from kinks, sharp bends, and other conditions which would be detrimental to the finished product. Manufacturing processes must not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes must be done neatly and accurately. Make bends by controlled means to insure uniformity of size and shape.

1.5.4 Welding

AWS D1.1/D1.1M. Provide welds of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds must transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

1.6 PNEUMATIC AND HYDRO-PNEUMATIC FENDERS - WARRANTY

****

NOTE: The warranty requirements in this guide specification have been approved by a Level I Contracting Officer in accordance with the requirements of Naval Facilities Acquisition

Supplement (NFAS).

NFAS can be found at the following link:
https://www.navfac.navy.mil/

The paragraphs in this guide specification may be used without further approval.

****

Furnish the manufacturer's warranty. Issue the warranty directly to the Government. It must not be limited in dollar value. The warranty period must be not less than 1 year from the date of Government acceptance of the work.

PART 2 PRODUCTS

2.1 PNEUMATIC AND HYDRO-PNEUMATIC FENDERS

2.1.1 Manufacturer's Data

2.1.1.1 Pneumatic Fenders Manufacturer's Data

Prior to fabrication, submit copies of the manufacturer's catalog data, performance curves per ISO 17357-1, dimensions, material specifications, and method of manufacture.

2.1.1.2 Hydro-Pneumatic Fenders Manufacturer's Data

Prior to fabrication, submit copies of the manufacturer's catalog data, performance curves per ISO 17357-1, dimensions, material specifications, and method of manufacture.

2.1.2 Design Data

2.1.2.1 Pneumatic Fenders Design Data

Submit rated performance data (RPD) and published performance curves per ISO 17357-1.

2.1.2.2 Hydro-Pneumatic Fenders Design Data

Submit rated performance data (RPD) and published performance curves per ISO 17357-1.

2.1.3 Configuration

Manufacture fenders in accordance with ISO 17357-1. Fenders must have cylindrical mid-bodies with hemispherical shaped ends terminating in an end fitting on the cylinder's centerline at each end. Size the flange opening fittings (not to exceed 12 percent of fender diameter) so as not to contact loading surfaces when the fender is compressed to 20 percent of its original diameter (80 percent compression). Incorporate a safety valve for Pneumatic and Hydro-Pneumatic fenders 2500 mm 8 feet diameter or larger and pressure monitoring system in their manufacture.

2.1.4 Dimensions

Diameter and length as indicated on the drawings.

2.1.5 Fender Skin

The fender skin must have a minimum strength in accordance with ISO 17357-1. When designing the skin thickness, consider skin strength and the stress induced by the internal operating and berthing pressure, and the abrasion and impact loads caused by handling and berthing operations. Ensure an adequate margin of safety is incorporated for the fender's intended use. Design the connection of the skin to the end fittings to resist the specified minimum endurable pressure at 60 percent compression in ISO 17357-1 for the respective operating pressure. For hydro-pneumatic fenders, the Minimum Endurable Pressure value in Table 5 of ISO 17357-1 (Pneumatic 80 fender pressure requirements) must be used.

2.1.5.1 Elastomer

Provide rubber material test proving the elastomer meets the requirements of ISO 17357-1, material test of rubber.

****

NOTE: After aging refers to air oven aging at 70 degrees C 158 degrees F plus/minus 1 degree C 33.8 degrees F, 96 hours.

****

Per ISO 17357-1, the elastomer used in the outer skin must be rubber, with the following unreinforced properties:

a. Durometer Hardness, Shore A	
(ASTM D2240 or ISO 7619-1)	
Before Aging	[50 to 70] [_____]
After Aging	Not to exceed the original property by more than 8

b. Minimum Tensile strength	
(ASTM D412 or ISO 37)	
Before Aging	[18] [_____] MPa [2600] [_____] psi
After Aging	Not less than 80 percent of original property

c. Minimum Elongation (ultimate)	
(ASTM D412 or ISO 37)	
Before Aging	[400 percent] [_____]
After Aging	Not less than 80 percent of original property

d. Minimum Tear strength	[400] [_____] N per cm [228] [_____] lbs/inch

(ASTM D624 or ISO 34-1)	
e. Compression set	30 percent(70 degrees C 158 degrees F plus/minus 1 degree C 33.8 degrees F, 22 hours) or less
(ISO 815-1)	

f. Static ozone aging test (ISO 1431-1)	No cracks after elongation by 20 percent and exposure to 50 pphm (parts of ozone per hundred million of air by volume) at 40 degrees C 104 degrees F for 96 hours

The elastomer used in the inner skin must be rubber, with the following unreinforced properties:

a. Durometer Hardness, Shore A	
(ASTM D2240 or ISO 7619-1)	
Before Aging	[40 to 60] [_____]
After Aging	Not to exceed the original property by more than 8

b. Minimum Tensile strength	
(ASTM D412 or ISO 37)	
Before Aging	[10] [_____] MPa [1450] [_____] psi
After Aging	Not less than 80 percent of original property

c. Minimum Elongation (ultimate)	
(ASTM D412 or ISO 37)	
Before Aging	[400 percent] [_____]
After Aging	Not less than 80 percent of original property

2.1.5.2 Color

Fender skin color must be black throughout the entire thickness. Galvanized hardware must be unpainted.

2.1.5.3 Repairability

The fender casing must be repairable in the event of tears or punctures in the elastomer skin. The repaired area must have not less than 90 percent of the properties as specified in paragraph ELASTOMER. Required repair materials must be readily available. Each fender must include a detailed repair procedure from the manufacturer that outlines a step by step

process for mending tears, punctures or severe abrasions to fender casings.

2.1.6 Test Reports

Perform tests on the specified fender within 5 years of submittal of the reports for approval. Test reports must be accompanied by notarized certificates from the manufacturer certifying that the tested material is of the same type, size, quality, manufacture and make as that proposed to be supplied. Perform the following tests:

2.1.6.1 Performance Requirements

The performance of each fender must be meet the requirements of ISO 17357-1. Confirm the performance of the fender with a prototype fender performance confirmation per ISO 17357-1. The tests must include a parallel performance, angular compression, durability, compression-recovery, and puncture-resistance test.

2.1.6.1.1 Design Proof

Design proof must document minimum endurable pressure based on at least 30 test samples that cover entire range of compression from 0 percent to 60 percent plus or minus 5 percent deflection.

2.1.6.1.2 Pneumatic Fenders Performance Characteristics

****
NOTE: Refer to ISO 17357-1 for guaranteed energy absorption and reaction force values for nominal size of fender under consideration.
****

Provide the performance characteristics of each pneumatic fender ensuring they meet the following:

SIZE	GUARANTEED ENERGY ABSORPTION (GEA)	REACTION FORCE (R)
	at 60 +/- 5 percent deflection	at GEA deflection (+/- 10 percent)
[_____]mm x [_____]mm [_____]ft x [_____]ft	[_____] kN-m [_____] ft-kips	[_____] kN [_____] kips

2.1.6.1.3 Hydro-pneumatic Fenders Performance Characteristics

****
NOTE: The performance of the hydro-pneumatic fenders vary according to the size, water/air ratio and internal pressure. The Manufacturer should be consulted in the selection of the desired performance characteristics.
****

****
NOTE: Refer to ISO 17357-1 for guaranteed energy absorption and reaction force values for nominal size of fender under consideration.

****

Provide the performance characteristics of each hydro-pneumatic fender ensuring they meet the following:

SIZE	GUARANTEED ENERGY ABSORPTION (GEA)	REACTION FORCE (R)
	at 60 +/- 5 percent deflection	at GEA deflection (+/- 10 percent)
[_____]mm x [_____]mm [_____]ft x [_____]ft	[_____] kN-m [_____] ft-kips	[_____] kN [_____] kips

2.1.6.2 Dimensional Inspection

Perform and submit the dimensional inspection results proving the dimensions of all fenders meet the requirements of ISO 17357-1.

****

NOTE: The dimensional tolerances per ISO 17357-1 are as follows:
- length: plus 10 percent, minus 5 percent
- diameter: plus 10 percent, minus 5 percent

The diameter shall be obtained from the average of at least two different measurements taken at the middle of the cylindrical section of the fender.

The diameters of bead ring or other steel material around the flange opening shall be inspected, and the results shall be less than 0.20 fender diameters.

****

2.1.6.3 Air-leakage Test

Perform and submit the results of the air leakage test per ISO 17357-1. The test must confirm that there is no air leakage when the initial pressure is held for more than 30 minutes.

2.1.6.4 Hydrostatic-pressure Test

Perform and submit the Hydrostatic-pressure test results per ISO 17357-1. Perform the test for 10 minutes at the hydrostatic pressure shown as "Testing pressure at 0 percent deflection" in Tables 4 and 5 in ISO 17357-1. There must be no leakage of water and no defects during the test.

****

NOTE: The frequency of the test shall be one per 20 fenders of each size and pressure. If the customer so requests, one per order of each size and pressure if the quantity is less than 20.

Circumferential and longitudinal lengths shall be measured at 10 kPa pressure and at the test pressure shown in Table 4 or Table 5 in ISO 17357-1. The temporary elongation shall be as follows:

a) maximum circumferential temporary elongation:10

percent;
b) maximum longitudinal temporary elongation:10 percent.

The increase in diameter and length shall be obtained by measuring the distance of two points marked circumferentially and longitudinally, at 10 kPa 1.45 psi pressure, on the middle of the fender's body.

The distance between the two points shall be larger than one-fifth of the fender's diameter.

****

2.1.6.5 Pressure Relief Valve Test

Mount the pressure relief valve to a test chamber for a pressure relief test. After mounting, the chamber internal pressure must be slowly increased until the specified relief pressure is attained. Set the pressure relief valve to relieve pressure according to the manufacturers recommendations. If the pressure relief valve opens at a higher or lower pressure than allowed, it must be adjusted as required and tested again until within the specified limits. Maintain a written test procedure and records pertaining to this test.

2.1.7 Connecting Hardware

Galvanize the connecting chain, swivel, and shackles in accordance with ASTM A123/A123M or ASTM A153/A153M, as appropriate. The hardware must be as follows:

Item	Type
Chain	ABS 2, Grade 2, Stud Link or Open Link
Shackle	FS RR-C-271, Type IVA, Class 3, Grade A
Swivel	FS RR-C-271, Type VII, Class 2

All connecting bolts and pins must be of mild steel, matching the properties of the shackle bow. For Class 3 shackles, secure the bolt or pins in place with stainless steel (Type 316) cotter pins or locking pins.

2.1.7.1 Hydro-pneumatic Guy Chain

Provide guy chains for attachment from the upper fender end fitting assembly to the pier. Cover the portion of the chain extending from the fender itself with protective rubber sleeves to a point beyond which the fender will be contacted for fender body protection.

2.1.7.2 Hydro-pneumatic Hanging Chain

Provide hanging chains for attachment from the counterweight to the pier.

2.1.7.3 Hydro-pneumatic Lower End Fitting Assembly

Fabricate the lower end fitting from steel and provide connecting points for the connecting chain and the hanging chain.

2.1.7.4 Hydro-pneumatic Upper End Fitting Assembly

Fabricate the upper end fitting from steel and design to house all necessary valves and fitting necessary to charge and discharge the fender body with air and water necessary for proper installation and operation of the deployed fender. Include the air charging assembly, the water charging assembly, the pressure safety relief valve assembly and lifting eyes adequately sized for guy chain attachment. Attach all valves and related hardware to the inner assembly plate. Include an outer assembly blind flange plate to provide protection during handling and operations. The pressure relief valve must be bronze, adjustable to ensure maintenance of the proper setting, and capable of adequate flow (volume of air released per second) to maintain a safe internal pressure. Make certain a changeable rubber gasket is installed between the top flange and plate to prohibit moisture from collecting inside the upper end fitting assembly that could possibly corrode valve handles and cause debris that could foul the pressure relief valve assembly.

2.1.7.5 Hydro-pneumatic Counterweight

Provide a steel counterweight for attachment to the fender's lower flange assembly by two shackles. Include an upper eye for shackle attachment of the hanging chain and coat with a marine coating system. The counterweight must be sized in accordance with the Manufacturer's recommendation.

PART 3 EXECUTION

3.1 PNEUMATIC AND HYDRO-PNEUMATIC FENDERS

Install the fendering system in accordance with the manufacturer's specifications and shop drawings. Tighten bolts an additional 1/3 turn of the nut, from the snug tight condition, and secured with cotter pins or screw lock.

3.2 WELDING

Perform welding in accordance with AWS D1.1/D1.1M.

3.3 CONNECTIONS

3.3.1 Antiseize Compound

Coat threads of bolts prior to applying washers and nuts. Recoat bolt thread projection beyond nut after tightening.

-- End of Section --