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USACE / NAVFAC / AFCEA / NASA            UFGS-35 59 13.19 (April 2006)  
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Preparing Activity: NAVFAC                Replacing without change  
   UFGS-02397 (May 2003)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated January 2009

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### SECTION 35 59 13.19

#### ARCH-TYPE RUBBER MARINE FENDERS 04/06

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NOTE: This guide specification covers the requirements for arch-type rubber marine fenders.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

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NOTE: On the project drawings, show location of fenders and size and spacing of fasteners.

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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 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.

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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.

ASME INTERNATIONAL (ASME)

ASME B18.22.1 (1965; R 2008) Plain Washers

ASME B18.22M (1981; R 2005) Metric Plain Washers

ASTM INTERNATIONAL (ASTM)

ASTM A 479/A 479M (2008) Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

ASTM D 1171 (1999; R 2007) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)

ASTM D 2000 (2008) Standard Classification System for Rubber Products in Automotive Applications

ASTM D 395 (2003; R 2008) Standard Test Methods for Rubber Property - Compression Set

ASTM D 412 (2006ae1e2) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D 471 (2006; R 2008) Standard Test Method for Rubber Property - Effect of Liquids

ASTM D 573 (2004) Standard Test Method for Rubber - Deterioration in an Air Oven

ASTM D 575 (1991; R 2007) Rubber Properties in Compression

ASTM D 624 (2000; R 2007) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

ASTM D 746 (2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM F 593 (2002; R 2008) Stainless Steel Bolts, Hex

Cap Screws, and Studs

ASTM F 594

(2008) Standard Specification for  
Stainless Steel Nuts

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-907

(Rev F) Antiseize Thread Compound, High  
Temperature

## 1.2 SUBMITTALS

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NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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.

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" designation; submittals not having a "G" designation are [for Contractor Quality Control approval.] [for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Fender

Hardware

#### SD-05 Design Data

Reaction--energy--percent compression curve

Dimension

Fender material specifications

Design calculations

#### SD-06 Test Reports

Minimum Tensile Strength

Shore Hardness (Durometer)

Modulus at 400 Percent Elongation

Maximum Compression Set

Tear Resistance

Minimum Elongation

Ozone Resistance

Low Temperature Impact Resistance

Water Absorption

Heat Resistance

Compression Deflection Resistance

Fender Compression Test

Angular Fender Compression Test

Tests shall have been performed on the specified fender within 5 years of submittal of the reports for approval. Test reports shall be accompanied by notarized certificates from the manufacturer certifying that the tested material is of the same type, quality, manufacture and make as that proposed to be supplied.

#### SD-08 Manufacturer's Instructions

Installation Instructions

### 1.3 DELIVERY HANDLING AND STORAGE

Fenders shall be undamaged when delivered and shall be handled and stored so as to prevent damage, such as bending or abrading end fittings, cutting of rubber, or damage to coating of hardware. Protect fenders from exposure to damaging liquids, oils, greases and extended exposure to sunlight.

## PART 2 PRODUCTS

### 2.1 CONFIGURATION

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**NOTE: Coordinate angle with angular compression  
test requirements.**  
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Fender shall be extruded and shall be continuous in the length indicated. The fenders shall have a truncated "A" cross section shape and be attached to the structure at the base, the widest dimension, of the arch. The connecting hardware shall be fully exposed. No encased hardware or molded fenders shall be allowed. The fender and hardware shall be designed and factory tested to the loads per linear meter foot of fender specified in paragraph entitled "PERFORMANCE," for angles of approach of 0 and 0.26 rad 0 and 15 degrees. Fender anchor bolts and method of anchorage shall be of the size and spacing required by the manufacturer's design and testing; however, the size and spacing of anchor bolts indicated on the drawings shall be construed to be the minimum required, unless exceeded by the requirements of the fender manufacturer's design.

### 2.2 ELASTOMER

The elastomer shall be the ethylene propylene dimonomer (EPDM), as specified in ASTM D 2000, with the following properties:

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**NOTE: Coordinate values with calculated design  
requirements.**  
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#### ELASTOMER PROPERTY REQUIREMENTS

Minimum Tensile Strength (ASTM D 412)	[14 MPa] [_____]
Shore Hardness (Durometer) (ASTM D 412)	[70 $\pm$ 5] [_____]
Modulus at 400 Percent Elongation (ASTM D 412)	[6.2 MPa] [_____]
Maximum Compression Set (ASTM D 395 Method B, Maximum Percent 22 Hr. at 70 Degrees C	[25] [_____] Percent
Tear Resistance (ASTM D 624; DIE B Min. 150 lb/in)	[300] [_____] lb/in.
Minimum Elongation (ASTM D 412)	[500] [_____] Percent
Ozone Resistance (ASTM D 1171 Exposure Method B; 70h Bent Loop at 38 Degrees C; 50pphm)	[80] [_____] H $\pm$
Low Temperature Impact Resistance	[0] [_____] Degrees C

ELASTOMER PROPERTY REQUIREMENTS

(ASTM D 746 Procedure B;  
Non-Brittle at -55 Degrees C)

Water Absorption [10.0] [\_\_\_\_\_] Percent  
(ASTM D 471 Method B;  
70h at 100 Degrees C.;  
Volume Change +5 Percent

Heat Resistance Shall exceed  
(ASTM D 573; 70h at 100 Degrees C requirements  
Ch Tensile, Elong. -25 Percent,  
Hardness +10

Compression Deflection Resistance Shall exceed  
(ASTM D 575 Method B; requirements  
3 S Dwell at 23 Degrees C

ELASTOMER PROPERTY REQUIREMENTS

Minimum Tensile Strength [2000 psi] [\_\_\_\_\_]   
(ASTM D 412)

Shore Hardness (Durometer) [70 ± 5] [\_\_\_\_\_]   
(ASTM D 412)

Modulus at 400 Percent Elongation [900 psi] [\_\_\_\_\_]   
(ASTM D 412)

Maximum Compression Set [25] [\_\_\_\_\_] Percent  
(ASTM D 395 Method B,  
Maximum Percent 22 Hr. at 158 Degrees F

Tear Resistance [300] [\_\_\_\_\_] lb/in.  
(ASTM D 624; DIE B Min. 150 lb/in)

Minimum Elongation [500] [\_\_\_\_\_] Percent  
(ASTM D 412)

Ozone Resistance [80] [\_\_\_\_\_] H ±  
(ASTM D 1171 Exposure Method B;  
70h Bent Loop at 100 Degrees F; 50pphm)

Low Temperature Impact Resistance [-40] [\_\_\_\_\_] Degrees F  
(ASTM D 746 Procedure B;  
Non-Brittle at -67 Degrees F)

Water Absorption [10.0] [\_\_\_\_\_] Percent  
(ASTM D 471 Method B;  
70h at 212 Degrees F.;  
Volume Change +5 Percent

Heat Resistance Shall exceed  
(ASTM D 573; 70h at 212 Degrees F requirements  
Ch Tensile, Elong. -25 Percent,  
Hardness +10

Compression Deflection Resistance Shall exceed

## ELASTOMER PROPERTY REQUIREMENTS

(ASTM D 575 Method B; requirements  
3 S Dwell at 73 Degrees F

### 2.3 HARDWARE

#### 2.3.1 Plates and Angles

ASTM A 479/A 479M, Type 316L stainless steel for plates, angles, and miscellaneous hardware required to attach the fenders to the structure.

#### 2.3.2 Nuts, Bolts, and Washers

ASTM F 593 or ASTM F 594, Group 2 (316 alloy) stainless steel for nuts and bolts. ASME B18.22M ASME B18.22.1 for washers, except fabricate washers of 316 alloy stainless steel.

#### 2.3.3 Antiseize Compound

MIL-PRF-907.

### 2.4 PERFORMANCE

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NOTE: Coordinate values with calculated design requirements.  
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When vertically compressed by a plate extending the full length and width of a 0.30 m one foot section of the fender, the fender shall absorb [8950] [\_\_\_\_\_] joules [6,600] [\_\_\_\_\_] foot pounds of energy  $\pm 10$  percent when [48] [\_\_\_\_\_] percent compressed (i.e., to a dimension of [52] [\_\_\_\_\_] percent of its original height) with a corresponding load of not more than [85,402] [\_\_\_\_\_] N [19,200] [\_\_\_\_\_] pounds  $\pm 10$  percent.

#### 2.4.1 FENDER COMPRESSION TEST

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NOTE: Coordinate values with calculated design requirements.  
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Compress fender along its longitudinal axis between two parallel flat plate surfaces to a compressed dimension of [48] [\_\_\_\_\_] percent of its original height. Record load and the corresponding deflection at 6 mm 1/4 inch increments and plot as a graph of load versus deflection. The Load-Deflection curve shall then be integrated to generate an Energy-Deflection curve for the fender. After compression of the fender to [48] [\_\_\_\_\_] percent of its original height, the fender shall be rebound to 98 percent of its original height within [ten] [\_\_\_\_\_] minutes after the load is removed.

#### 2.4.2 ANGULAR FENDER COMPRESSION TEST

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NOTE: Coordinate values with calculated design requirements.  
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Compress fender along its longitudinal axis between two flat plate surfaces, at an angle of [0.26] [\_\_\_\_\_] rad [15] [\_\_\_\_\_] degrees to each other, to a compressed dimension of [48] [\_\_\_\_\_] percent of its original height. Record load and the corresponding deflection at 6 mm 1/4 inch increments and plot as a graph of load versus deflection. The Load-Deflection curve shall then be integrated to generate an Energy-Deflection curve for the fender. After compression of the fender to [48] [\_\_\_\_\_] percent of its original height, the fender shall rebound to 98 percent of its original height within [10] [\_\_\_\_\_] minutes after the load is removed.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install fenders with the fender longitudinal axis vertical. Install the fenders in the position and at the spacing indicated on the drawings.

#### 3.1.1 Antiseize Compound

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

-- End of Section --