

## **Standard Procedure to Durability Test for Rubber Fender Units**

### **1. Requirement**

#### **1.1 Scope**

This standard is to stipulate the method of repetitive compression and static compression tests for confirming the durability of the rubber fender unit to be subjected to berthing of vessels.

#### **1.2 Required criteria (for successful completion)**

The rubber fender unit deemed to have passed the durability test if after completing the test as prescribed in "4. Test Protocol", it meets the following criteria.

- i) The units shall have no defects such as cracks etc. to the naked eye.
- ii) After the repetitive compression test, "energy absorption" and "reaction force" shall not be significantly reduced compared to those of before the repetitive compression test results.
- iii) After the repetitive compression test, "residual strain" shall not be significant.

### **2. Test specimens**

#### **2.1 Test specimens**

The test specimens shall have the same basic design and geometry as commercially available products in manufacturer's catalogue.

#### **2.2 Size**

Test specimens comply as follows:

- (1) Products that are commercially available,
- (2) Products that have the same basic design and geometry as similar fenders, and that are the minimum size or larger, and
- (3) Products which Length to Height L/H ratio (L: Length, H: Height) shall be more than the minimum value.

#### **2.3 Hardness of the rubber used for specimens and numbers of specimen**

Two (2) specimens shall be tested. The hardest and softest rubber shall be selected from products that are indicated in the manufacturers' catalogues among having the same basic design and geometry at the time of application.

### **3. Test Apparatus**

#### **3.1 Test Apparatus and Conditions (Environment)**

The compression test apparatus and other apparatus used for testing shall be capable of measuring the parameters listed below.

- a. Number of compression cyclic completed
- b. Displacement or Deflection
- c. Reaction force (Static compression)
- d. Operating status of the testing device (Confirmation of continuous operation)
- e. Room temperature

#### 4. Test Protocol

##### 4.1 Temperature of the specimens and test ambient

###### (1) Temperature of specimen

The temperature of specimens shall be  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$  at the start of the repetitive compression test. The specimens shall not be cooled artificially before or during the test.

###### (2) Temperature of test ambient

The test ambient temperature (air temperature in the same space within 3 m from the surface of the specimen) shall be measured continuously.

- \* The temperature shall be measured continuously, in principle, however if such measurement is not possible, then the temperature shall be measured and recorded at intervals of six to ten hours or shorter.

##### 4.2 Repetitive Compression Test

###### (1) Compression Cycles

The specimens shall be repeatedly compressed at cycle time of less than 150s. An open leg type such as V-type rubber fender shall be fixed to the base plate so that the legs do not open, and no material that changes friction is interposed in the contact face.

- \* Start and finish time of each cycle shall be recorded.

###### (2) Deflection

The specimens shall be compressed to the design deflection specified in the manufacturers' catalogues.

- \* The deflection shall be measured continuously, in principle however, if such measurement is not possible, then the deflections after the first time, 10th, 100th, 1,000th and 3,000th time, shall be recorded.
- \* Design deflection is the maximum design deflection recommended by manufacturer.

###### (3) Number of cycles

The specimens shall be repeatedly compressed a minimum of 3,000 cycles.

- \* The number of compression cycles of the specimens shall be recorded.

###### (4) Compression angle

The specimens shall be compressed along its principal axis. This is based on the fenders normal installation orientation, and taken as being at a right angle (90 degrees) to the normal orientation of a quay, where the angle at which vessels berth is zero degrees (parallel to the normal orientation of the quay).

### 4.3 Static compression test

As part of the durability test, each specimen shall undergo two (2) complete performance measuring by static compressions to determine the performance (Energy Absorption, Reaction Force and Residual Strain) of the fender before and after the repetitive compression. Tests shall be completed at the following stages:

1) Pre repetitive compression test – shall be conducted BEFORE the repetitive compression.

Compress the specimen three times or more to the design deflection or more (Break in compressions). Then, compress once to its design deflection or more after removing load from specimen at least one hour (Static compression). Even if the ambient temperature is difficult to control at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}$ , it is desirable to control at  $23\text{ }^{\circ}\text{C} \pm 15\text{ }^{\circ}$ . In such case, the performance shall be corrected by temperature factor based on the average ambient temperature.

2) Post repetitive compression test – shall be conducted within 24 hours in at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}$  AFTER completion of the repetitive compression test.

The compression rate shall be same within the range of the standard strain rate (0.01 to 0.3% / s) at both Pre and Post repetitive compression tests. If the compression speed is not in the range of above strain rate, the speed of 0.3~1.3 mm/s is also acceptable if the results is corrected by velocity factor of this specimen.

#### Note

This is a translation of the Japanese original standard. The text in Japanese shall prevail in the interpretation of the standard.