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Standard Procedure to Durability Test for Rubber Fender Units
– Implementation Details –

For the items not specified in the Standard Procedures for Durability Test for Rubber Fender Units stipulated by the SCOPE, the following particulars specified in this Implementation Details shall be applied:

1. Test Specimens

Test Specimens shall be selected as stipulated in "Clause 2. Test Specimens" of the Standard Procedures for Durability Test for Rubber Fender Units. Sizes of the test specimen specified in clause 2.2, shall be within the range of cross hatched area in Fig.1

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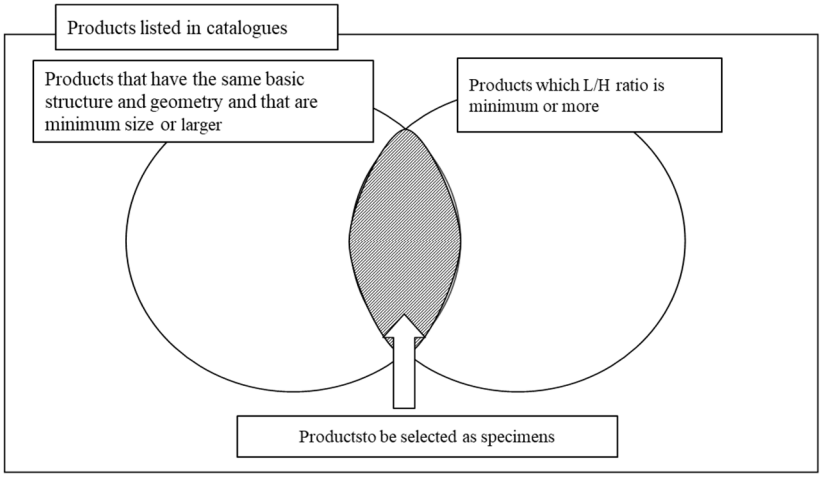

Fig. 1 Conceptual diagram for selecting specimens

2. Performance tests

(1) Residual deflection

For the post repetitive compression performance, the residual strain of the specimens caused by the repetitive compression, shall be included in the amount of compression and the repetitive compression starts from the same point as the compression started. Total deflection applied for this test shall be the same before and after the repetitive test as shown in Fig. 2.

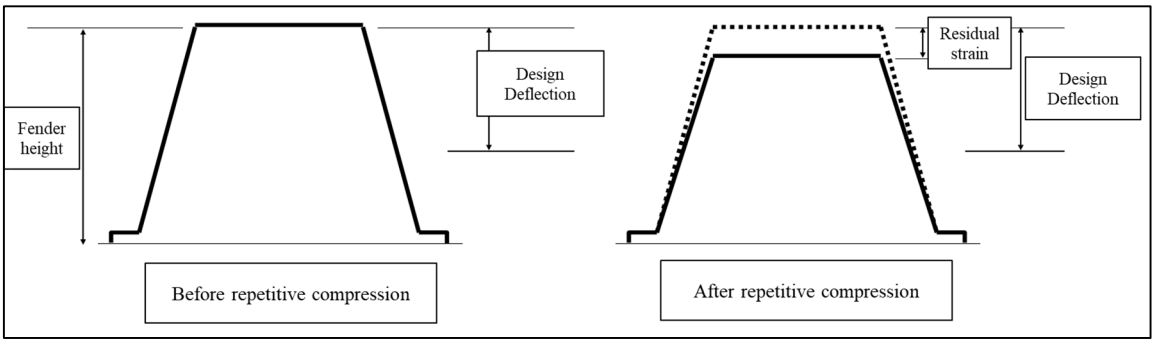

Fig. 2 Conceptual diagram of performance test protocol

The reaction force and absorbed energy are explained in Fig. 3.

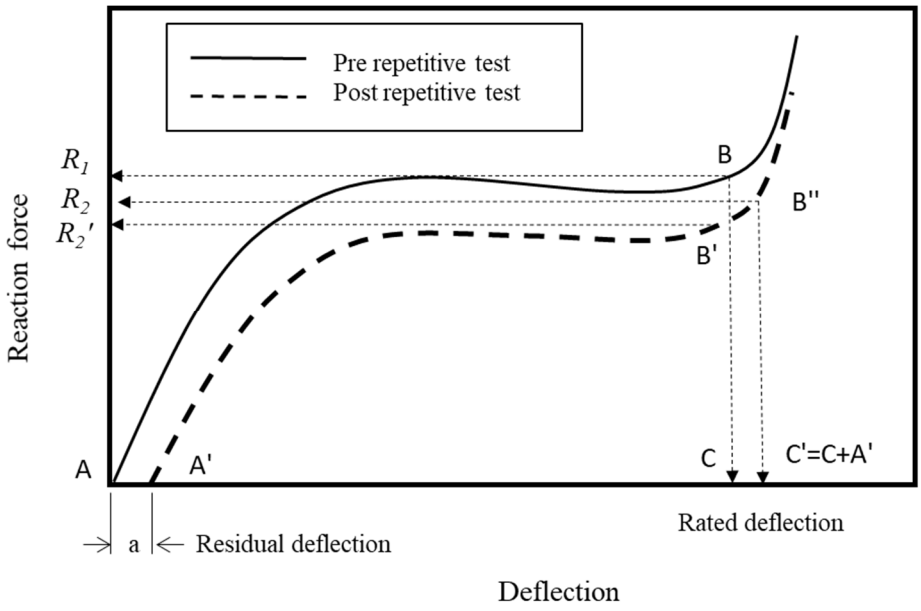

Fig. 3 Example figure of reaction force curves before and after repetitive test

*Energy absorption (Fig. 3)

The absorbed energy E_1 before the repetitive compression test is obtained from the area of the portion surrounded by ABC. The reaction force is R_1. Note that the absorbed energy E_2' after repetitive compression is the area surrounded by A' B' C and not A' B "C'. Therefore, the reaction force of Post repetitive compression is R_2'

The Appendix Table-A (1) Durability, in "Rubber Fender Durability Certification Examination Criteria" requests to check whether "energy absorption" and "reaction force" significantly reduced after the repetitive compression. In carrying out the above test method, the durability should be confirmed through the following steps I to IV. If all of them can be confirmed as having no problem, it is judged to be acceptable.

I. Visually confirm that no defects such as cracks etc. have occurred.
II. Confirm the degradation in “energy absorption” before/ after the repetitive compression.
*For a guideline for buckling type fenders, the degradation of energy absorption should be less than 20%
III. Confirm that there is no significant degradation in the reaction force curve before/ after the repetitive compression.
*For a guideline for buckling type fenders, the degradation of reaction force should be less than 20% and keep the buckling curve with a peak.
IV. Confirm that the residual strain is not large.
*For a guideline for buckling type fenders, residual strain should be less than 5%.

(2) Performance test after the repetitive compression test

The post cyclic compression performance test shall be completed within 24 hours after the final compression test.

(3) Check items

Table 1. Items to be checked in the static compression tests

Timing of measurement		Measurement items	Criteria etc.
Pre (Before) repetitive compression	Before the test	Date and time of the test	
		Specimen temperature	
		Height of specimen	At the size inspection
Post (After) repetitive compression	Before the test	Date and time of the test	
		Height of specimen	Measuring residual strain
	On completion of the test	Date and time of the test	Within 24 hours after the completion of repetitive compression test.

3. Repetitive Compression Test

Check items

Table 2 Items to be checked in the repetitive compression test

Timing of measurement		Measurement items	Criteria etc.
Test run without specimen * 1		Compression cycle	Within 150s per one cycle
		Deflection (stroke)	To the design deflection
When specimens are put in place		Compression angle	At the angle (90°) to the surfaces of specimens to be subjected to pressure (rubber fender units) * 2
Repetitive Compression Test	Before starting test	Date and time when tests begin	
		Temperature of specimen	23℃±5℃
	During the test * 3	Compression cycle Deflection (stroke) Number of cycle	Within 150s per one cycle To the design deflection 3,000 times or more
		Ambient temperature	Within 3m from specimen in same space without partition.
	On test completion	Date and time	
		Temperature of specimen	
	Visual inspection	Examination of cracks	There are no defects such as cracks etc. to the naked eyes.

*** 1** Check if the measured cycle and stroke of the tester are consistent with the measured values.

*** 2** Check visually.

*** 3** For items measured during the test, it shall be possible to confirm that they have complied with their respective standard values.

4. Test results

Test results shall be recorded in accordance with the form attached separately.

5. Photographic records

(1) Common items

A blackboard or other similar item shall be used to describe the recorded items, when photographs are taken. The items to be recorded shall refer to “Examples of recorded items “as below.

Examples of recorded items

- Test item
- Date of test
- Dates and times of tests (at commencing and completion of the repetitive compression test, as well as the date and time of static compression test)

- Specimen numbers and types, hardness of the rubber, and sizes (L × H)
- Inspection company name (for witnessing, refer to Table 3 Items to be included in photographic records)

(2) Items for individual inspection and test

Table 3. Items to be included in photographic records

Test and inspection	Timing of photographing	Items to be included in photographs
Appearance and size inspection	During appearance inspection (for each specimen)	Actual inspection operations, witnessing inspector(s), and blackboard
	During size inspection (for each specimen)	Actual inspection operations, witnessing inspector(s), and blackboard
Static compression test (before and after repetitive compression test)	During compression test (for each specimen)	Actual test operations, witnessing inspector(s), and blackboard
	During temperature measuring on specimen	Actual test operations, witnessing inspector(s), and blackboard
	During measurement of residual deflection (for each specimen)	Actual measurement operations, witnessing inspector(s), and blackboard
Repetitive compression test	During check of operation (for each specimen)	Actual checking operations, (witnessing inspector(s)), and blackboard
	During measurement of the temperature on the specimens (for each specimen) before and after the test	Actual measurement operations, (witnessing inspector(s)), and blackboard
	During repetitive compression test (for each specimen)*1	Actual test operations, (witnessing inspector(s)), and blackboard*2
	Installation of thermometer for measuring the ambient temperature (for each specimen)	Actual measurement of the distance between the surfaces of the specimens and the thermometer, (witnessing inspector(s)), and blackboard
	During visual inspection of appearance (for each specimen)	Actual checking operations, witnessing inspector(s), and blackboard
Rubber physical test	During checking of the specimens (for each specimen)	Actual checking operations, witnessing inspector(s), and blackboard
	During tensile, elongation, and hardness tests (before and after heat aging) (for each specimen)	Actual test operations and blackboard
	During heat aging test (for each specimen)	Actual heat aging operations and blackboard
	During ozone resistance test (for each specimen)	Ozone exposure tester and blackboard
	During checking of crack (for each specimen)	Actual checking operations, witnessing inspector(s), and blackboard

***1** Take photographs at the start and completion of the repetitive compression test.

***2** The witnessing inspector is not required to stay throughout the repetitive compression test. However, it is necessary to take photograph(s) that show an inspector is actually witnessing the test.

***3** Items marked in parentheses by the attending inspector in the above table do not necessarily require the attending of the inspector.

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