
**Ships and marine technology —
Floating pneumatic rubber fenders —
Part 2:
Low pressure**

*Navires et technologie maritime — Éperons pneumatiques
flottants —*

Partie 2: Basse pression

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 4, *Outfitting and deck machinery*.

ISO 17357-1 together with ISO 17357-2 cancels and replaces ISO 17357:2002.

ISO 17357 consists of the following parts, under the general title *Ships and marine technology — Floating pneumatic rubber fenders*:

- Part 1: *High pressure*
- Part 2: *Low pressure*

Introduction

This International Standard has been developed to provide guidelines on the quality and performance of all floating pneumatic rubber fenders. Floating pneumatic rubber fenders can play an important role in a ships safe berthing operation and this International Standard is seen as a technical reference to ensure necessary product standards.

Essentially there are two main types of floating pneumatic rubber fender, defined as either high- or low-pressure fenders. Although manufactured using different techniques, both high and low-pressure fenders work by the same principle. The resistance to berthing vessel momentum is provided by a reaction pressure due to compression of the air inside the fender when deformed by the vessels hull. The kinetic energy of the berthing vessel is absorbed during the work done to compress the air inside the fender. Fenders are sized according to the expected duty of the fender in terms of the energy absorption (EA) requirements which will be at the most basic level, a function of the vessel mass and velocity.

Throughout this International Standard, the minimum essential criteria are identified by the use of the key word “shall”. Recommended criteria are identified by the use of the key word “should”, and while not mandatory are considered to be of primary importance in providing serviceable, economical and practical connectors. Deviation from the recommended criteria should occur only after careful consideration, extensive testing and thorough service evaluation have shown alternative methods to be satisfactory.

The documents in the Bibliography provide information on the usage of the fenders.

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Ships and marine technology — Floating pneumatic rubber fenders —

Part 2: Low pressure

1 Scope

This part of ISO 17357 specifies the material, performance, and dimensions of low-pressure floating pneumatic rubber fenders, which are intended to be used for the berthing, and mooring of a ship to another ship or berthing structure. It also specifies the minimum test and inspection procedures for floating low-pressure pneumatic rubber fenders.

This part of ISO 17357 does not address the methods for selecting the correct fender type or any safety hazards associated with its use. It is the user's responsibility to establish appropriate safety and health practices and determine the applicability of regulatory limitations before using this part of ISO 17357.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

ISO 815-1, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*

ISO 1421, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break*

ISO 1431-1, *Rubber, vulcanized or thermoplastic — Resistance to ozone cracking — Part 1: Static and dynamic strain testing*

ISO 2411, *Rubber- or plastics-coated fabrics — Determination of coating adhesion*

BS 3424-5, *Testing coated fabrics. Methods 7A, 7B and 7C. Methods for determination of tear strength*

FED-STD-191A 1978, *Textile test methods*

ASTM D751, *Standard test method for Coated Fabrics*

ISO 4674-1, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE The following definitions are specifically applicable to low pressure floating pneumatic rubber fenders.

3.1

bead ring

ring of several layers of high-tensile steel wire which is an integral part of moulded ends, reinforcing the end around which the end closure plate assembly is clamped

3.2

clamped end fitting

metal assembly comprising of end link plates and mooring plates, fitted to the ends of the clamped end fenders to seal the ends of the fender and also to provide mooring points

3.3

clamped end type

low-pressure fenders up to and including 2,3 m diameter, manufactured from a number of longitudinal panels of coated textile and sealed by means of clamped end fittings

Note 1 to entry: Typically the longitudinal panels are tapered at the ends to form a parabolic shape, though for smaller fenders the ends can be folded to form a "parcel end" design.

3.4

coated textile

vulcanized-synthetic-rubber-covered high-tenacity continuous filament woven nylon textile

Note 1 to entry: The outer coating is designed to give a high level of resistance to abrasion and other external forces. The combination of the inner and outer synthetic rubber coating provides the required resistance of permeability to the escape of the compressed air essential for the demands of the product.

3.5

end closure plate assembly

metal assembly fitted to the low-pressure moulded end fenders to close off both ends of the fender and, in addition, at one end, the inflation air valve and pressure gauge valve are fitted

Note 1 to entry: The mooring fittings are attached to this assembly.

3.6

guaranteed energy absorption

energy the fender can absorb without permanent deformation or failure

3.7

initial internal pressure

air pressure at which an uncompressed fender operates, i.e. the initial pressure to which a fender is inflated

3.8

low-pressure floating pneumatic rubber fender

fender which is manufactured essentially from a textile reinforced rubber material with compressed air inside, at a typical initial pressure of 7 kPa, to enable it to float on the water and act as a shock absorber between ship and ship or between ship and berthing structures when they are coming alongside each other on the water

3.9

moulded end type

low-pressure fenders of 2,8 m diameter and above, which are manufactured with a cylindrical body fabricated from a number of longitudinal panels of coated textile, onto which are attached hemispherical-shaped moulded sections at each end

3.10

reaction force

force produced by a fender reacting to a compressive force

Note 1 to entry: Reaction force is equal to the force of the air pressure of the fender multiplied by the contact area of the fender to the ship or berthing structure.

4 Classification

4.1 Low-pressure fender types

Low-pressure fender types are defined as follows:

- a) clamped end type;
- b) moulded end type.

4.2 Initial internal pressure

Unless specified otherwise, the initial internal pressure for low-pressure pneumatic rubber fenders is 7 kPa.

5 Ordering information

5.1 Information to the manufacturer

The fender order, contract, or enquiry should state the following information:

- a) the International Standard number and applicable year, i.e. ISO 17357-2;
- b) fender type (see 4.1);
- c) initial internal pressure (see 4.2);
- d) fender size: nominal fender diameter and length (see Tables 1, 2, or 3);

NOTE If the purchaser requests other sizes, they shall satisfy the requirements of 6.3.

- e) fender colour (if not specified, the colour shall be black);
- f) if inspection/evaluation by a major classification is required, see Clause 12.

5.2 Information from the manufacturer

In order to confirm that the products meet the requirements of this part of ISO 17357, the purchaser can request the manufacturer to provide the following information prior to order placement.

- a) Prototype fender test certificate

This certificate confirms successful results of the tests in Clause 8, which are evaluated by a major classification society and are conducted no more than 10 years prior to inquiry date.

- b) Commercial fender inspection and test certificate

This certificate confirms successful results of the inspections and the tests in Clause 9, which shall be performed on fenders which have a diameter equal to or larger than the inquired fender with the same or higher internal pressure, and are evaluated by a major classification society and are conducted no more than 10 years prior to inquiry date.

6 Low-pressure fender requirements

6.1 Clamped end fender requirements

6.1.1 Floating low-pressure pneumatic rubber fenders with clamped ends shall consist of a cylindrical body mainly parallel over its central section, either tapering into integral paraboloid shaped ends, or

folded into a “parcel end” design. The whole construction forms an airbag, which shall be filled with compressed air.

6.1.2 The fender body shall be manufactured from a number of longitudinal panels of a vulcanized-synthetic-rubber-coated textile.

6.1.3 The inner and outer rubber coatings shall satisfy the values in [Table 2](#).

6.1.4 The coated textile panel material shall satisfy the values in [Table 3](#).

6.1.5 The panels of coated textile shall be bonded together so that the seam strength is sufficient to contain the air pressure developed during compression of the fender.

6.1.6 The fender is sealed at the extreme ends by means of the clamped end fittings comprising a number of interlocking metal links and mooring plates bolted together through the material.

6.1.7 For 1,8 m to 2,3 m diameter clamped end fenders, the inflation fitting assembly shall be fitted onto the sloping section of one end of the fender in such a position that it will not inhibit the fender from compressing to 60 %. The inflation fitting assembly shall be comprised of a recessed clamping flange into which two individual valves for air inflation and for gauging the air pressure shall be fitted.

6.1.8 For clamped end fenders less than 1,8 m diameter, the inflation fitting with separate inflation and pressure test valves is not required and shall be replaced by a single dual-purpose inflation and pressure gauge valve fitted direct to the coated textile.

6.2 Moulded end fender requirements

6.2.1 Floating low-pressure pneumatic rubber fenders with moulded ends shall consist of a cylindrical body largely parallel over its central section onto which hemispherical moulded ends are attached. For very large diameter moulded end fenders, the cylindrical section can have tapered ends onto which the hemispherical shaped end mouldings are attached. The whole construction forms an air bag, which shall be filled with compressed air.

6.2.2 The cylindrical body shall be manufactured from a number of longitudinal panels of a vulcanized-synthetic-rubber-coated textile.

6.2.3 The inner and outer rubber coatings shall satisfy the values in [Table 2](#).

6.2.4 The coated textile panel material shall satisfy the values in [Table 3](#).

6.2.5 The panels of coated textile shall be bonded together so that the seam strength is sufficient to contain the air pressure developed during compression of the fender.

6.2.6 The hemispherical moulded ends shall consist of a reinforcement of high-tenacity weftless nylon cord sandwiched between inner and outer layers of rubber, all vulcanized firmly together. The rubber strapping shall satisfy the values specified in [Table 2](#). The reinforcement cord layers shall be strong enough to hold the internal pressure in both the compressed and non-compressed situations.

6.2.7 The reinforcement shall wrap around the integral bead ring where appropriate.

6.2.8 The moulded end shall be attached to the body of the fender by means of a circumferential seam so that the seam strength is sufficient to contain the air pressure developed during compression of the fender.

6.2.9 There shall be a flange opening at both ends into which the end closure assembly is clamped to close off the end of the fender and to provide attachment for the mooring fittings. At one end, the end closure assembly shall incorporate two individual valves: one for air inflation and one to gauging air pressure.

6.3 Size requirements

Sizes not listed in [Table 1](#) shall satisfy all the requirements in this subclause, using the pressure requirements of the next-larger-diameter size.

EXAMPLE A 2,5-m-diameter low-pressure fender shall satisfy the pressure requirements of a 2,75 m diameter low-pressure fender.

7 Performance

7.1 Specification of performance

The performance of low-pressure floating pneumatic rubber fenders shall be specified in terms of guaranteed energy absorption (GEA), reaction force at GEA deflection, and hull pressure at GEA deflection.

7.2 Performance curves

The relationship between the deflection percentage, reaction force, inner pressure (which is equal to the hull pressure), and energy absorption is shown in [Figure 1](#). The reaction force, the inner pressure, and the energy absorption of the fender increase as the deflection percentage increases. From the GEA value, point A is determined on the energy absorption curve and the corresponding deflection percentage is read as GEA deflection. The reaction force and the hull pressure are then obtained at that deflection percentage value.

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7.3 Fender performance

7.3.1 The moulded and clamped end low-pressure fenders shall satisfy the values specified in [Table 1](#).

7.3.2 GEA values shown in [Tables 1, 2, and 3](#) shall be obtained at $(60 \pm 5) \%$ deflection.

7.3.3 The tolerance of the reaction force at GEA deflection shall be $\pm 10 \%$

7.3.4 Fender performance can be calculated by the formula, which shall be established based on the performance test described in [8.1](#).

8 Performance confirmation of prototype fender test

8.1 General

Each fender, involving different methods of basic construction and/or design, shall require a prototype test.

Fenders of lesser diameter than a prototype confirmed fender, incorporating the same basic design, construction, and fabrication methods, but satisfying all requirements of this part of ISO 17357, do not require a prototype test.

The manufacturer shall provide the certificate confirming the successful results of the tests, which are evaluated by a major classification society, and the performance confirmation of prototype fender test shall be done every 10 years.