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Ships and marine technology — Ship launching air bags

Navires et technologie maritime — Boudins pneumatiques pour le lancement des navires

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14409 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 8, *Ship design*.

Ships and marine technology — Ship launching air bags

1 Scope

This International Standard specifies the terms and definitions, classification, materials and dimensions, test items and methods for air bags to be used for launching a vessel. It also specifies issues such as marking, documentation, packaging, transport, storage and so on.

This International Standard is intended for designing, manufacturing, testing and accepting air bags that are made of synthetic-tyre-cord reinforcement layers.

2 Normative references

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

ISO 34-1, *Rubber, vulcanized or thermoplastic — Determination of tear strength — Part 1: Trouser, angle and crescent test pieces*

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

ISO 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

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

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

ISO 7619-1, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*

3 Terms and definitions

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

3.1
bearing capacity of air bag
maximum load carrying capacity of the air bag, while it suffers no permanent deformation or damage

3.2
body of air bag
cylindrical part of the air bag after being fully inflated with compressed air

NOTE See item 3 of Figure 2.

3.3
burst pressure
internal pressure at which the air bag bursts

3.4
diameter of air bag
diameter of the air bag body

NOTE See D in Figure 2.

3.5
head of air bag
conical parts connecting the body and the mouths of the air bag

NOTE See item 2 of Figure 2.

3.6
initial internal pressure
air pressure that fully inflates the air bag, before compression

NOTE See Figure A.1.

3.7
length of air bag
length of the air bag body

NOTE Shown as L in Figure 2.

3.8
mouth of air bag
metal valves mounted on both ends of the air bag for charging air

NOTE Shown in item 1 of Figure 2.

3.9
percentage deformation
ratio of the deformed height to the original diameter of the air bag while the air bag is being compressed

NOTE Shown in Figure 1 and Equation (1).

$$P = (D - H)/D \quad (1)$$

where

P is the percentage deformation (%);

D is the original diameter of the air bag (m);

H is the height of the compressed air bag (m).

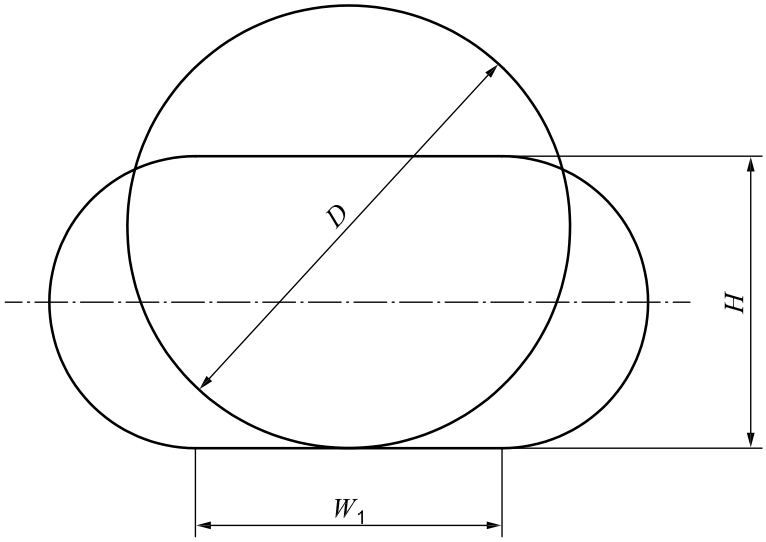


Figure 1 — An air bag being compressed

3.10
rated working pressure
maximum allowable internal pressure of the air bag while supporting a weight or load equal to the rated bearing capacity of the air bag

3.11
synthetic-tyre-cord layer
reinforcement layer of the air bag which is made of rubber coated synthetic-tyre-cord fabrics

3.12
total length of air bag
overall length of the air bag

NOTE Shown as L_{OA} in Figure 2.

4 Classification

4.1 Type and model

4.1.1 Air bags are categorized by the following two types according to the bearing capacity, per metre in length:

a) QP — ordinary air bag;

b) QG — high-bearing capacity air bag.

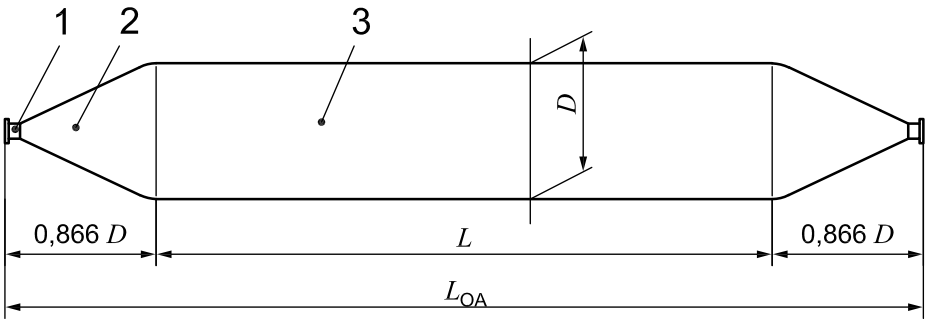
4.1.2 The types and models of air bags are specified in Table 1.

Table 1 — Type and model of air bags

Type	Type No.	Model
QP	QP3	ordinary air bag with 3 layers of cord fabric
	QP4	ordinary air bag with 4 layers of cord fabric
	QP5	ordinary air bag with 5 layers of cord fabric
QG	QG6	high-bearing capacity air bag with 6 layers of cord fabric

4.2 Structure

As shown in Figure 2, an air bag has a cylindrical body and two conical heads, one at each end.



Key

1 mouth
2 head
3 body

Figure 2 — Structure of a typical air bag

4.3 Size

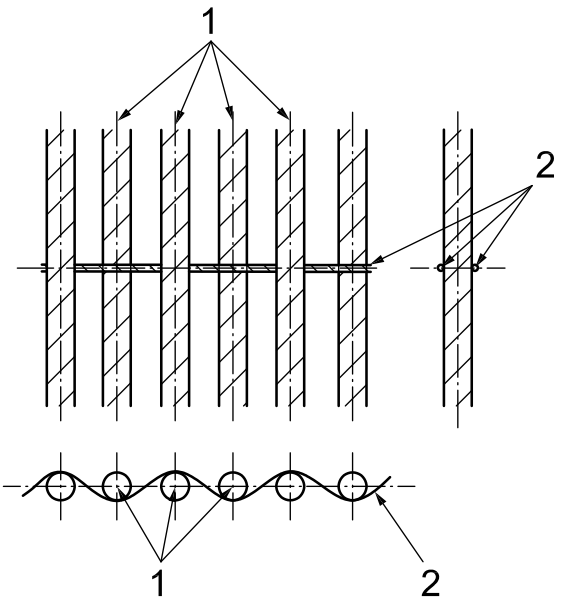
4.3.1 Diameter of air bag (D) varies such as 0,8 m, 1,0 m, 1,2 m, 1,5 m, 1,8 m, etc.

4.3.2 Length of air bag (L) is to be specified by the user.

5 Materials and dimensions

5.1 Materials

5.1.1 An air bag is to be constructed of an outer rubber layer, one or more synthetic-tyre-cord layers, and an inner rubber layer. The arrangement of synthetic-tyre-cord reinforcement layers is shown in Figure 3. All materials shall be vulcanized firmly.



Key

1 warp
2 weft

Figure 3 — Tyre cord

5.1.2 Prior to the air bag production, the outer and inner rubber layers shall be tested to meet the criteria in Table 2 in accordance with the test methods given in the International Standards listed in Table 2. While only one satisfactory sample per batch is required for test numbers 1 through 3, all others must be tested for test numbers 4 through 9 annually. If the first sample fails, two additional samples shall be tested. If the additional samples pass the test requirements, the materials will be deemed to have passed the test. Otherwise, the materials will be deemed to have failed the test and another batch of materials shall be selected.

Table 2 — Rubber material requirements

No.	Test item		Required value	Test method
1	Tensile strength, MPa		≥ 18	ISO 37
2	Elongation at break, %		≥ 400	ISO 37
3	Hardness, ° (Shore A)		60 ± 10	ISO 7619-1
4	Tear strength, N/cm		≥ 400	ISO 34-1
5	Compression set, % (70 °C ± 1 °C, 22 h)		≤ 30	ISO 815-1
6	After thermal ageing at 70 °C ± 1 °C, 96 h	Holding of pull lengthening, %	≥ 80	ISO 188
7		Holding of elongation at break, %	≥ 80	ISO 188
8		Change of hardness, ° (Shore A)	≤ 8	ISO 7619-1
9	Static ozone ageing at 40 °C × 96 h [ozone concentration (50 ± 5) × 10^{-8}], extension 20 %		No crack	ISO 1431-1

5.1.3 As a reinforcing material, the warp should be (90 ± 5) cords per 100 mm in width, and the breaking strength shall be more than 205 N per cord.

5.2 Appearance

The appearance of an air bag shall be smooth, glossy and without blemish such as crack, blister, delamination, pits or impurities.

5.3 Dimensional tolerances

The length and diameter of an air bag shall be measured with the rated working pressure and be within ± 3 %.

6 Test

6.1 General

All products must meet the following test criteria.

6.2 Test condition

6.2.1 Unless otherwise specified, tests shall be performed under the following conditions:

a) ambient temperature: 10 °C ~ 35 °C;

b) media: (1) dry clean compressed air, and (2) clean fresh water for bursting test.

6.2.2 Testing instruments, including pressure gauges and testing machine, shall be calibrated.

6.2.3 The test should be performed using a full-sized air bag. If the air bag is too large to be mounted on the test machine, the test may be performed on a scaled-down air bag. In order to maintain a proper representation of the full-sized sample air bag, the diameter of the scaled-down air bag shall be no less than 1/2 of the full-sized sample air bag diameter, while the length (L) shall be no less than 3 times the diameter of the scaled-down air bag.

6.3 Gastightness test

Without carrying any load, fill the air bag till the internal pressure of the air bag reaches P_e in Table 3. The internal pressure should be recorded and compared with P_e after 1 hour. The pressure loss should be less than 5 % of P_e.

Table 3 — Performance parameters of air bags

Type No.	**Diameter**	**Initial internal pressure for test**	**Rated working pressure,** P_e	**Bearing capacity per meter in length,** P_h (when compress deformation reaches 70 %, and the inner pressure reaches the rated working pressure, P_e)	**Minimum burst pressure**
	m	kPa	kPa	kN/m	kPa
QP3	0,8	25	130	114	390
	1,0	18	100	110	300
	1,2	15	85	112	260
	1,5	13	70	115	210
	1,8	11	60	118	180
QP4	0,8	35	170	149	510
	1,0	25	130	143	390
	1,2	20	110	145	330
	1,5	16	90	148	270
	1,8	14	80	158	240
QP5	0,8	48	210	184	630
	1,0	35	170	186	510
	1,2	28	140	185	420
	1,5	20	110	181	330
	1,8	16	90	178	270
QG6	0,8	56	245	215	740
	1,0	45	200	219	600
	1,2	32	165	217	490
	1,5	25	130	215	390
	1,8	20	110	218	330
Rated working pressure may deviate ± 5 %. Compress deformation may deviate ± 2 %.					
NOTE Initial internal pressure is the reference value.					

6.4 Compression test

6.4.1 Compression test under the initial internal pressure specified in Table 3 should be carried out after the tests of 5.1, 5.2, 5.3 and 6.3.

6.4.2 The air bag is to be put on a press with large enough width and length to ensure that all parts of the compressed air bag are within the press. The test should be conducted as follows:

a) fill the air bag to the initial pressure in Table 3, start the test machine and press the air bag perpendicularly till the percentage deformation reaches 70 %. Observe to see if the air bag is functioning properly;

b) gradually reduce the compressive force on the air bag until the air bag, by its own flexibility, returns to the height of its original state. Record the internal pressure;

c) apply a compressive force perpendicularly to the air bag again, till the percentage deformation reaches 70 %.

During the course of compressing and releasing, the reaction forces, internal pressures and deformation rate should be recorded at every 10 % deformation interval.

6.4.3 The compression performance curve of a QG6 air bag is shown in Figure A.1. The rated working pressure of the air bag is as specified in Table 3.

6.5 Bearing capacity test

6.5.1 When the internal pressure reaches the rated working pressure, P_e, and the percentage deformation reaches 70 %, the carrying capacity per metre in length of an air bag shall be equal to or greater than the values specified in Table 3. The curve of the bearing capacity per metre in length of a QG6 air bag is shown in Figure A.2.

6.5.2 In order to carry out the bearing capacity test, mark two parallel lines circumferentially somewhere along the body of the air bag that has been filled to the initial pressure listed in Table 3. The distance between the parallel lines should be 1 000 mm $\pm$ 5 mm. The marking lines should be made far away from the joint lines between heads and body of the air bag. This distance shall be no less than 1/4 of the air bag's diameter. The test shall be conducted as follows.

a) Fill the air bag to the initial pressure stated in Table 3. Start the test machine, and compress the air bag perpendicularly until the deformation reaches 70 %. The air bag shall be kept in this compressed state for a minimum of five minutes. After 5 minutes, record the internal pressure, P_1, of the air bag. Measure and record the contact area width, W_1, between the air bag and the press table, in a direction perpendicular to the length of the air bag. Take three measurements at three locations within the two parallel lines, and calculate the arithmetic mean value of the width. The bearing capacity per unit length, P_h, shall be calculated in accordance with Equation (2):

$$P_h = W_1 \times P_1 \tag{2}$$

where

P_h is the bearing capacity per unit length (kN/m);

W_1 is contact width between the body of the air bag, within the 2 parallel lines, and the platform of the test machine shown as W_1 in Figure 1 (m);

P_1 is the internal pressure of the air bag (kPa).

b) Inspect the air bag to see if it is functioning properly. If it is, continue to increase the pressure until the internal pressure reaches 125 % of the rated working pressure stated in Table 3 and hold it there for five minutes. Again, inspect the air bag for any damage or defect such as cracks.

c) Gradually lessen the compressive force on the air bag until the force of the test machine returns to zero. The air bag should return to the original height of the free state.

Both compressed height and internal pressure of the air bag shall be recorded. W_1 shall be measured and recorded at every 5 % deformation interval.

6.6 Bursting test

6.6.1 Air bags shall be tested to the minimum burst pressures as specified in Table 3.

6.6.2 Fill the air bag with water until the air bag bursts. The water pressure at the time of bursting shall equal or be more than the value specified in Table 3.

6.7 Compression–recovery test

6.7.1 To test the recoverability of an air bag, the air bag is to be repeatedly and rapidly compressed and released over a very short period of time.

6.7.2 Fill the air bag with air until reaching the initial pressure stated in Table 3, and then compress the air bag perpendicularly till the percentage deformation reaches 75 %. The air bag shall be kept in this compressed state for 1 minute. Afterward, release the air bag and it shall recover more than 97 % of its original diameter within 5 minutes.

7 Type approval test

7.1 General

The type approval test shall be carried out under one of the following situations:

a) initial production;

b) whenever the elastomer formulation is changed significantly;

c) whenever the structure or type of products is changed;

d) whenever the manufacturing technique which could affect the functionality of the air bag or one of its components is changed significantly;

e) upon reproduction or re-manufacturing, after having being suspended from production for one year or more; or

f) upon authority request.

7.2 Test items

The following tests for type approval shall be carried out, in addition to the items required in 5.1, 5.2 and 5.3:

a) gastightness test, see 6.3;

b) compression test, see 6.4;

c) bearing capacity test, see 6.5;

d) bursting test, see 6.6; and

e) compression–recovery test, see 6.7.

7.3 Acceptance criteria

Only one sample of each type of air bag is necessary for the type test. If the sample meets all test requirements, the air bag will be deemed to have passed the type test. However, if the sample fails to meet any of the test requirements, two additional samples shall be tested. If the additional samples pass all test requirements, the air bag will be deemed to have passed the type test. Otherwise, the air bag will be deemed to have failed the type test.

8 Acceptance test

8.1 Test items

Prior to delivery of the air bags, the manufacturer shall test every air bag for the following items:

a) appearance, see 5.2;

b) dimensional tolerances, see 5.3; and

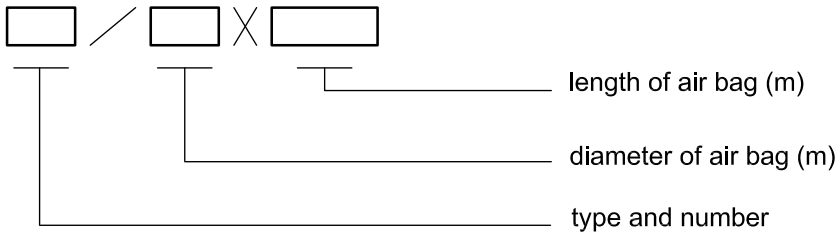
c) gastightness, see 6.3.

8.2 Acceptance criteria

If the air bag meets the requirements specified in 8.1, the product will be deemed to have passed the acceptance test. However, if the air bag fails to meet any of the test requirements, repair may be allowed only one time for re-tests. If the repaired air bag passes the test requirements in 8.1, the air bag will be deemed to have passed the acceptance test. Otherwise, the air bag will be deemed to have failed the acceptance test.

9 Marking

9.1 An accepted air bag is to be marked on one of its heads as follows:



For example, an air bag with three layers of cord fabric has a diameter of 1,5 m, and the length of 15 m is to be marked as:

Air bag ISO 14409:2011 QP3/1.5 × 15

9.2 Markings should have the following information:

a) product name;

b) type;

c) size (diameter and length);

d) individual serial number;

e) rated working pressure;

f) weight;

g) full or abbreviated name of the manufacturer; and

h) date of manufacture or its abbreviation.

10 Documentation, packaging, transport and storage

10.1 Documentation

Per batch of the air bags, the manufacturer should provide the purchaser with a certificate indicating that the air bags have been tested and inspected in accordance with this International Standard and that all the requirements have been met. In addition, the manufacturer must supply the purchaser with a user guide as well as maintenance manuals.

10.2 Packaging

The air bags may be folded and then bundled up.

10.3 Transport

For a short distance move, the air bags may be relocated by being (1) lifted vertically from one end with a crane or some other machinery, (2) carried over shoulders, or (3) rolled on the ground, if the air bags are filled with air.

For a long distance move, drain out the air, properly prepare the air bags (see 10.4), and pack them into shipping/storage crates/containers. The sides and bottoms of the containers/crates should be padded to protect and secure the air bags.

10.4 Storage

10.4.1 When the air bags are not to be used for a long period of time, they should be drained, cleaned, dried, filled with talc powder, and the exterior surfaces should be coated with talc powder. The air bags should be maintained in a dry, ventilated room and be protected from light. The air bags should be stored in a relaxed condition free from tension, compression or other deformation.

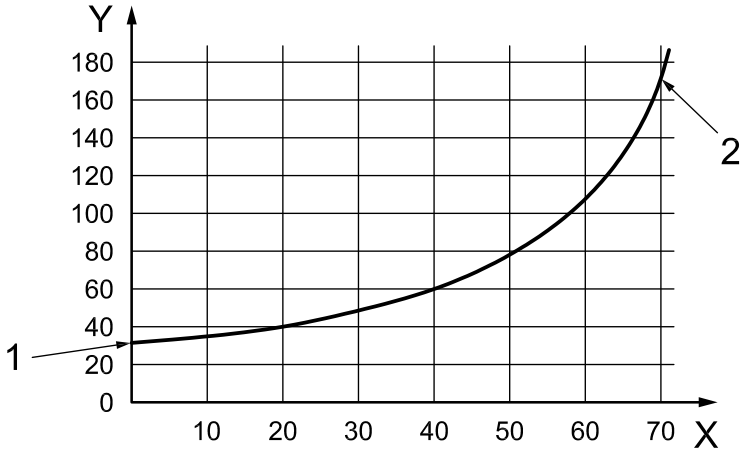
10.4.2 The air bags should be kept away from any heat source.

10.4.3 The air bags should be protected from acids, alkalis, oils or organic solvents.

Annex A
(informative)

The compression performance curve for a QG6 (Φ1,2 m) air bag

A.1 The compression performance curve of a QG6 air bag (Φ1,2 m) is shown in Figure A.1.

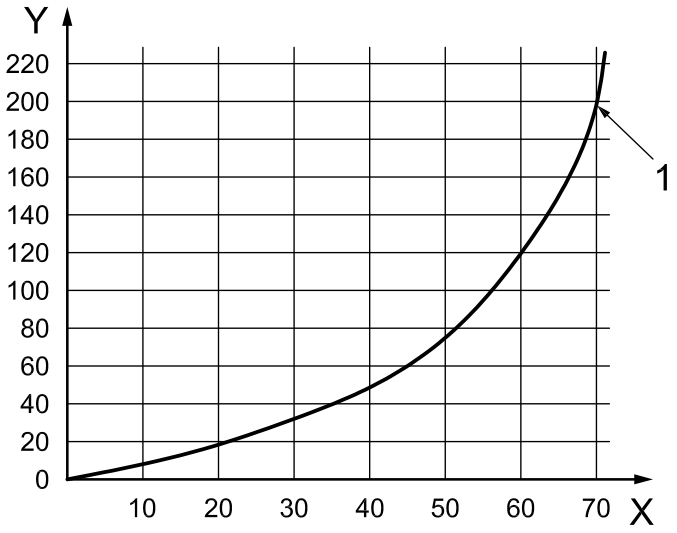


Key

X compress deformation (%)
Y internal compress (kPa)
1 initial pressure
2 rated working pressure

Figure A.1 — The compression performance curve for a QG6 (Φ1,2 m) air bag

A.2 The bearing capacity per metre in length for a QG6 air bag (Φ1,2 m) is shown in Figure A.2.



Key

X compress deformation (%)
Y bearing capacity per metre (kN/m)
1 bearing capacity

Figure A.2 — The bearing capacity per metre in length for a QG6 (Φ1,2 m) air bag

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