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**Ships and marine technology —
Methodology for ship launching
utilizing air bags**

*Navires et technologie maritime — Méthodologie pour le lancement
de bateau utilisant des coussins gonflables*



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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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Contents

Page

Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Specification for launching ships	2
5 Requirements for arrangements and equipment	2
5.1 Slipway	2
5.2 Air bags	3
5.3 Towing arrangement	4
6 Ship launching procedure	5
6.1 Document preparation	5
6.2 Planning	5
6.3 Operating procedure	6
7 Safeguard for ship launching	6
Annex A (informative) The arrangements of air bags	8
Annex B (informative) An example of rolling resistance coefficients (μ) for a typical air bag	11

Foreword

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The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 8, *Ship design*.

Ships and marine technology — Methodology for ship launching utilizing air bags

1 Scope

This International Standard specifies general guidelines for ship launching utilizing air bags, including the specification of the ship and facilities such as air bags, slipway, towing arrangements, the launching procedure, and safeguards during the ship launching.

This International Standard is applicable to ships meeting the requirements of 4.1 and utilizing air bags for launching.

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 2408, *Steel wire ropes for general purposes — Minimum requirements*

ISO 14409:2011, *Ships and marine technology — Ship launching air bags*

3 Terms and definitions

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

3.1

ship launching

conveying a ship from a site to water so that the ship becomes buoyant

3.2

ship shifting

moving a ship from one place to another, such as from the building berth to near the water

3.3

slipway

ramp which is used for launching ships, including the part that extends into the water

Note 1 to entry: The shore-side portion, including the berth, is called the main slipway, while the part that extends into the water is called the auxiliary slipway.

3.4

transferring from docking blocks

process that encompasses placing the air bags under the ship, filling the air bags to raise the ship off the building blocks, removing the blocks and letting the ship rest on the air bags

3.5

ground anchor

structure that is in front of the berth and is constructed in the berth, used for mooring the ship, the hemicycle part above the ground is used to fasten the steel wire ropes and tow the ship

3.6

ship length

L_{OA}

longitudinal distance, in metres, measured from the forward extreme to the aft-most part of the ship

4 Specification for launching ships

4.1 A ship shall have a flat bottom and be suitable for putting down, filling and rolling air bags. The bottom acreage of the ship shall be large enough to provide proper contact with the air bags in order to ensure adequate bearing capacity.

4.2 According to the weight and the length of the ship, the ship to be launched is to be classed as follows:

- a) class I: ships of not more than 1 000 tons in weight or not more than 90 m in length (L_{OA});
- b) class II: ships of more than 1 000 tons but less than or equal to 3 000 tons in weight, or more than 90 m but less than or equal to 120 m in length (L_{OA});
- c) class III: ships of more than 3 000 tons but less than or equal to 5 000 tons in weight, or more than 120 m but less than or equal to 150 m in length (L_{OA});
- d) class IV: ships of more than 5 000 tons in weight, or more than 150 m in length (L_{OA}).

4.3 The underwater valves and major equipments are to be installed in position, tested, inspected and approved by shipyard or shipowner.

4.4 All burrs and weld beads on the ship's bottom plates and all appendages shall be ground smooth and inspected.

4.5 In all underwater compartments, all the hot work on the shell plating, blasting and painting and compartment tightness tests shall have been completed and approved by shipowner or classification society. All loose items shall be secured. All mooring equipment and fittings are to be installed.

4.6 The draft marks and the load lines shall be verified and approved by inspection.

4.7 Outer-hull painting shall have been completed as per the approved paint scheme.

5 Requirements for arrangements and equipment

5.1 Slipway

5.1.1 Shipyard QC shall clear the area where each air bag is to be laid and inflated.

5.1.2 The gradient and the length of the slipway shall be determined according to the size of the ship and the hydrological condition of the area water.

5.1.3 The bearing capacity of the slipway shall be at least twice as strong as the working pressure of air bags.

5.1.4 For class III and class IV ships, the slipway shall be constructed with reinforced concrete and the height difference between the right and left sides shall be less than 20 mm. For class II ships, the slipway shall be constructed with cement concrete and the height difference between the right and left sides shall be less than 50 mm. For class I ships, the slipway may be an earthen slope and shall be compacted even by rollers. The height difference between the right and left sides shall be less than 80 mm.

5.1.5 The main slipway shall enable the ship to glide automatically when the ship is off the tow. The auxiliary slipway shall be determined according to the ship type, the water level at time of launching, the diameter of the air bags, and the safety requirements.

5.2 Air bags

5.2.1 Air bags shall meet the requirements of ISO 14409.

5.2.2 For class III and class IV ships, air bags with bearing capacity of at least 200 kN/m shall be used.

5.2.3 Prior to using any air bag for ship launching, all air bags shall be tested for any potential leakage. Without applying any external load, an air bag shall be filled to 1,25 times of the rated working pressure, as shown in Table 3 of ISO 14409:2011, and the pressure shall be maintained for at least one hour.

5.2.4 According to the weight of the ship being launched, the quantity of the air bags needed for this operation shall be calculated in accordance with Formula (1):

$$N = K_1 \frac{Qg}{C_b \cdot R \cdot L_d} \quad (1)$$

where

N is the quantity of air bags used for ship launching;

K_1 is a coefficient, in general, $K_1 \geq 1,2$;

Q is the weight of the ship (ton);

g is acceleration of gravity (m/s^2), $g = 9,8$;

C_b is the block coefficient of the ship being launched;

R is the allowable unit bearing capacity of the air bags (kN/m), see Table 3 of ISO 14409:2011;

L_d is the contact length between the bottom of the ship and the body of the air bag at the midship section (m).

5.2.5 For ship shifting, 2 to 4 additional air bags shall be made ready and available.

5.2.6 For class IV ships, prior to launching, calculations shall be made for transferring from docking blocks. The product of the bearing load of an air bag times the distance between the air bag and the ship's longitudinal centre of gravity shall be less than 1 % of the product of ship's launching weight times the distance between the perpendiculars.

5.2.7 The centre to centre distance between two neighbouring air bags shall be less than or equals to that found in Formula (2) and equals to or be greater than that found in Formula (3).

$$L/(N - 1) \leq 6k \quad (2)$$

$$L/(N - 1) \geq \pi D/2 + 0,3 \quad (3)$$

where

L is the actual length of the ship bottom that can make contact with the air bags (m);

N is the quantity of air bags used for ship launching;

k is a coefficient, $k = 1$ for steel ships, $k = 0,8$ for wooden, aluminium and glass-fibre-reinforced ships;

D is the nominal diameter of air bags (m).

5.2.8 In general, the long axes of the air bags shall be arranged perpendicular to the direction of ship's movement. When it is necessary to move a ship in a curved manner, the long axes of the air bags shall be arranged perpendicular to the direction of tangent line to the curve.

5.2.9 See Annex A for air bags arrangement.

5.3 Towing arrangement

5.3.1 A windlass shall be used to control the movement of the ship. Tow system that comprises windlass, steel wire rope and pulley set shall be securely fastened to the ground anchor in front of the berth.

5.3.2 In general, a slow windlass shall be selected for ship launching. The veering speed of the windlass shall be 9 m/min to 13 m/min.

5.3.3 The forces of the windlass and the steel wire rope are shown in Figure 1 when the ship is being launched and before gaining any floatation. The maximum tensile force of the steel wire rope shall be calculated in accordance with Formula (4). The hauling force of windlass's steel wire shall be checked in accordance with Formula (5).

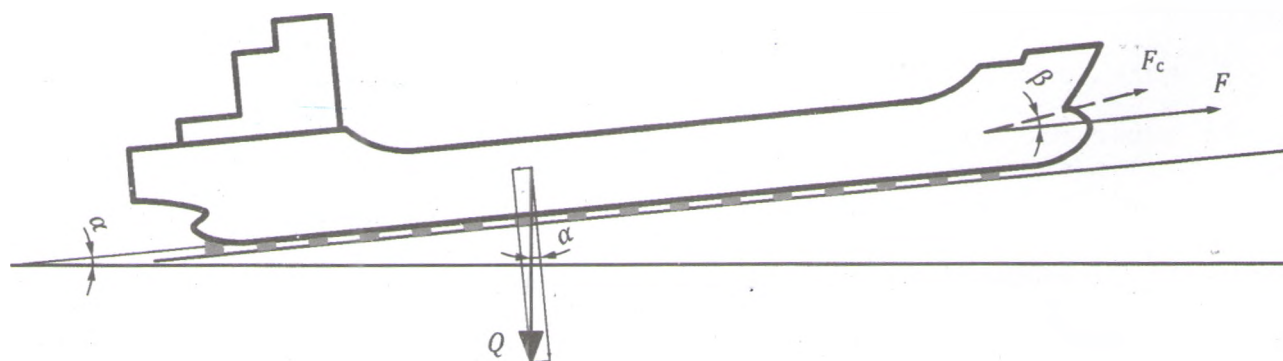


Figure 1 — Force components of a ship being launched

$$F = Qg \cdot \sin\alpha - \mu Qg \cdot \cos\alpha + Q \frac{v}{t} \quad (4)$$

$$F_c \geq \frac{KF}{N_c \cos\beta} \quad (5)$$

where

F is the maximum pulling force of the steel wire rope when the ship is being launched (kN);

α is the angle between the ship, which is borne by air bags, and the horizon (degree);

μ is a friction coefficient of the rolling air bags on the slipway. It shall be determined according to many factors such as gradient of the slipway, condition of the ground, configuration and internal pressure and arrangement of air bags (see Table B.1 of Annex B for an example);

v is the speed of the ship in motion (m/s);

t is the time for the windlass to brake the ship motion (s);

F_c is the tensile force of the steel wire rope of the windlass (N);

K is the safety coefficient, in general, $K = 1,2\sim 1,5$;

N_c is the number of the hauling wire ropes on the moving tackle;

β is the angle between the direction of maximum pull force (F) and the steel wire rope (degree).
In general, it is not to be greater than 6° .

5.3.4 Windlass shall be securely fixed to the ground anchor. The design load of ground anchor shall meet the requirement of the calculated pulling force (F).

5.3.5 The steel wire ropes shall meet the requirements of ISO 2408, with capacity of the calculated maximum pull force (F) or the calculated tensile force (F_c). The allowable load of pulley set, shackle, steel wire rope and rope clip shall meet the calculated pulling force.

5.3.6 Windlass shall be checked and maintained on a regular basis. Steel wire ropes shall be inspected and, according to the manufacturer's specification, be replaced on a regular basis.

6 Ship launching procedure

6.1 Document preparation

The following documents shall be prepared before ship launching:

- a) general arrangement and the lines plan;
- b) weight and centre of gravity of the ship;
- c) light ship distribution curve including ballast if any;
- d) hydrostatic curves or data and Bonjean curves or data;
- e) principal data of berth and the ship launching slipway;
- f) docking block arrangement plan;
- g) bearing force report of the slipway; and
- h) hydrological data such as water depth, tide table and current speed.

6.2 Planning

6.2.1 Planning including the following items shall be prepared before ship launching.

- a) ship's main dimension, weight and centre of gravity, slipway and hydrological conditions;
- b) launching calculations, including specifications, quantities, bearing capacities and arrangements of air bags;
- c) calculations of hauling force, arrangements of the hauling bat, arrangement of windlass and steel wire ropes; and
- d) planning for transferring from docking blocks.

6.2.2 For class IV ships, calculations indicating variations in the internal pressures of the air bags shall be made for the entire ship launching operation. The location of the ship when the maximum air bag internal pressure will occur and the maximum internal pressure attained shall be made available for feasibility study and safety procedure preparation.

6.3 Operating procedure

6.3.1 All obstacles shall be cleared along the way of the air bags, including the ship bottom.

6.3.2 The bow of the ship shall be tied to the windlass with mooring steel wire ropes. One end of the steel wire rope shall be tied to the strength member of the ship such as a bollard or a special horn, the other end shall be tied to the pulley set of the towing system.

6.3.3 According to the planning of 6.2, air bags shall be placed underneath the ship.

6.3.4 The air bags are to be filled from the stern to the bow. Initially, the air bags are not to be fully inflated. Having inflated all air bags and ensured that they made contact with the ship's bottom, the air bags shall be filled to the specified pressure.

6.3.5 When the ship bottom is lifted higher than the docking blocks and the air bags are bearing the weight of the ship, the docking blocks shall be removed. After all the docking blocks are removed, adjust the internal pressure of the air bags to make the force balance.

6.3.6 After the workers and other personnel who are going to stay onboard during the launching have boarded the ship, remove the ladders and gangways and so on.

6.3.7 Depending on the conditions of slipway and area water, one of the following launching methods may be used:

- a) if the area water is wide enough, one can launch the ship by moving the ship to the water's edge, disengage the windlass, remove or cut the tow line and let the ship slides into the water by itself;
- b) if the area water is not wide enough, use the windlass to control the launching speed and let the ship glide into the water slowly;
- c) if the stern of the ship is built directly over the water and no windlass is available, the ship shall be secured to the ground anchor by the rope before filling the air bags. The minimum water depth needed for launching is to be calculated. The ship may be launched by herself into the water by cutting off the rope or letting off the ground anchor when there is enough water depth.

6.3.8 After the ship is afloat, tow and secure the ship to the wharf, measure the bow and stern drafts; inspect each compartment for leakage.

6.3.9 All air bags shall be retrieved.

6.3.10 All data of launching operation shall be recorded.

7 Safeguard for ship launching

7.1 The launching team shall develop all details to safeguard the launching process taking into account the ship characteristics, the geography of the launching site, and the hydrological condition of the area water. They shall also ensure that any emergency can be dealt with immediately.

7.2 Each operator shall receive technical training and knowledge of the ship launching skills. During the launching, personnel filling the air bags shall stand to the side of the nozzle of each air bag.

7.3 To avoid potential accidents such as the steel wire rope coming apart or the air bag bursts, a danger zone shall be identified and marked during the ship launching process.

Annex A (informative)

The arrangements of air bags

A.1 Launching type

Based on the ship shapes, the ship may be launched, using air bags, by either end launching type (see A.2) or side launching type (see A.3).

A.2 End launching type

A.2.1 There are three ways to arrange air bags when using the end launching type. They are (1) linear arrangement (see [Figure A.1](#)), (2) staggered arrangement (see [Figure A.2](#)), and (3) two-lines arrangement (see [Figure A.3](#)). As for which arrangement to use, it will depend on the ship's width and the length of the air bags.

A.2.2 When the ship's width is not greater than the effective length of the air bags, the linear arrangement shall be selected.

A.2.3 When the ship's width is greater than the effective length of an air bag and less than the effective length of two air bags, the staggered arrangement shall be selected.

A.2.4 When the ship's width is greater than the combined effective length of two air bags, or for special ship such as catamaran HSC or split hopper barge, the two lines arrangement shall be selected. The distance between the near ends of two air bags is greater than 0,2 m.

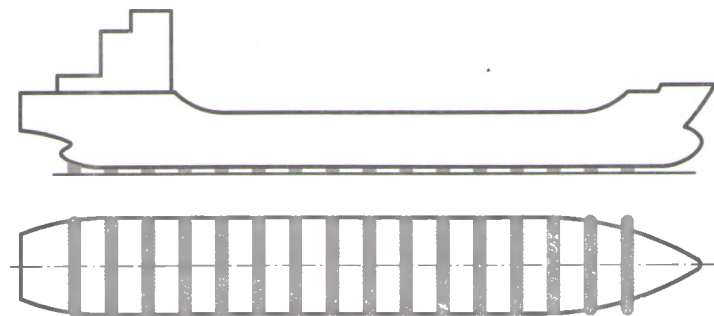


Figure A.1 — Linear arrangement

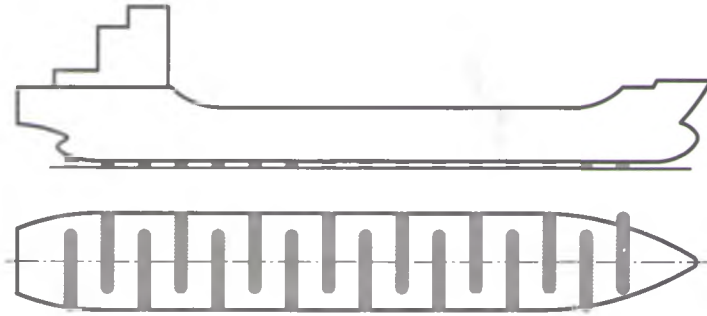


Figure A.2 — Staggered arrangement

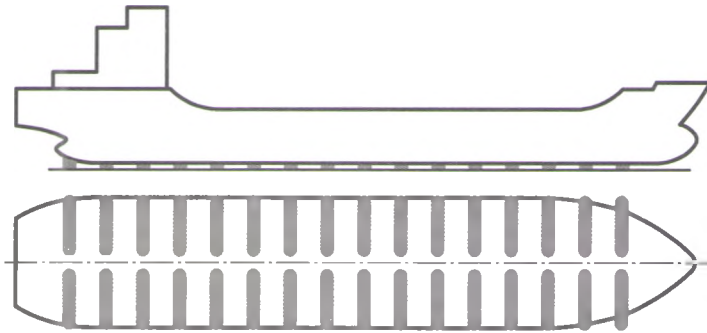
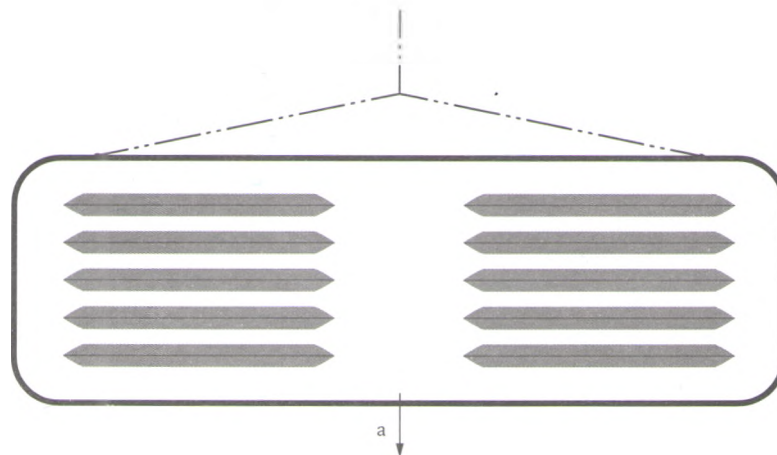


Figure A.3 — Two-lines arrangement

A.3 Side launching type

A.3.1 For small flat-bottom ships, side launching method may be utilized (see [Figure A.4](#)). In this case, the air bags of same specification, same diameter and same length shall be used.



Key

^a direction of ship launching

Figure A.4 — Side launching

A.3.2 The air bags shall be divided into two groups, and be evenly arranged under the bow and the stern ends of the ship. The distance between two air bags shall be made equal. The distance between the ends of two groups shall be greater than 1 m but not greater than 10 percent of the ship's length.

A.3.3 The hauling rope shall be fixed at the middle of the two air bag groups and be perpendicular to the hull of the ship.

Annex B (informative)

An example of rolling resistance coefficients (μ) for a typical air bag

An example of the reference values of rolling resistance coefficient (μ) of the typical air bag with diameter of 1,5 m and the compression deformation rate of 45 % is listed in [Table B.1](#).

NOTE The values of rolling resistance coefficient (μ) of the typical air bag are empirical.

Table B.1 — An example of rolling resistance coefficients (μ)

Ground condition	Initial internal pressure MPa	Value (μ)
sand soil ground	0,01	0,060 ~ 0,070
	0,02	0,050 ~ 0,055
	0,03	0,040 ~ 0,045
	0,04	0,030 ~ 0,035
firm soil ground	0,05	0,026 ~ 0,028
	0,06	0,023 ~ 0,025
	0,07	0,020 ~ 0,022
	0,08	0,017 ~ 0,019
	0,09	0,014 ~ 0,016
cement concrete ground	0,10	0,011 ~ 0,012
	0,11	0,010 ~ 0,011
	0,12	0,009 ~ 0,010
	0,13	0,008 ~ 0,009
	0,14	0,007 ~ 0,008
	0,15	0,006 ~ 0,007
	0,16	0,005 ~ 0,006

