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Ships and marine technology — Maritime safety — Gas inflation systems for inflatable life-saving appliances

Navires et technologie maritime — Sécurité maritime — Systèmes de gonflage au gaz pour dispositifs de sauvetage gonflables

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Foreword

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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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 1, *Maritime safety*.

This second edition cancels and replaces the first edition (ISO 15738:2002), which has been technically revised.

The main changes compared to the previous edition are as follows:

— addition of the salt water exposure test for cylinders;

— modifications of the exposure period of the salt water exposure test according to ISO 9227:2017;

— restructuring of clauses of gas cylinder valves and operating heads;

— changes from the absolute values to the relative values in the test pressure of the pressure tests;

— modifications of the test pull loads of operating heads considering the friction in containers of liferafts; and

— additions of the torque test, the valve thread strength test, the plug test, and the valve pull test for necessary valves

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

A gas inflation system for inflatable life-saving appliances is a vital system to inflate life-saving appliances appropriately.

This document addresses the performance and testing of the gas inflation systems for inflatable life-saving appliances including those specified in the 1974 Safety of Life at Sea Convention (SOLAS 74), as amended, and the IMO International Life-Saving Appliance Code (LSA Code), adopted by IMO Resolution MSC.48(66), as amended. In this sense, it supplements the International Maritime Organization (IMO) requirements for inflatable lifesaving appliances.

Ships and marine technology — Maritime safety — Gas inflation systems for inflatable life-saving appliances

1 Scope

This document specifies performance and testing requirements for gas inflation systems for inflatable life-saving appliances.

NOTE It is suitable for inflatable life-saving appliances complying with the requirements of the 1974 Safety of Life at Sea Convention (SOLAS 74), as amended, and the IMO International Life-Saving Appliance Code (LSA Code) as amended, adopted by IMO Resolution MSC.48(66).

This document applies to gas inflation systems which consist of an inflation gas, a gas cylinder valve, a gas cylinder operating head, high-pressure hoses, and pressure-relief/transfer, inflate/deflate and non-return valves. This document addresses only systems in which compressed inflation gas in cylinders is used as the inflation medium.

National requirements for qualification, use, and testing of gas cylinders vary widely. Such requirements for gas cylinders are not addressed in this document, but it is presupposed that gas cylinders meet the requirements of the applicable regulatory bodies. The systems addressed in this document are of the type generally used in life-saving appliances, such as survival craft, marine evacuation systems, and means of rescue. Systems used in personal life-saving appliances, such as inflatable lifejackets, are addressed in ISO 12402-7.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 9227:2017, *Corrosion tests in artificial atmospheres — Salt spray tests*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
approved gas cylinder
gas cylinder which has been approved by a competent authority as complying with an appropriate recognized national or international standard

3.2
gas cylinder valve
closure on a gas cylinder designed to control the transfer of the inflation gas from the cylinder to the inflatable compartments

3.3
siphon tube
device or means to effect the transfer of the liquid phase from the gas cylinder before the gas phase

4 Gas cylinder — Salt water exposure test

Two gas cylinders shall have their ends blanked off and then shall be subjected to a corrosion test in accordance with the neutral salt spray test in ISO 9227:2017, for a period of 168 h at 35 °C ± 2 °C. These cylinders shall then be hydraulically proof tested to their test pressure. No permanent distortion and no leakage are allowed after the test.

5 Inflation gas

5.1 Type and quantity

A non-toxic gas, such as carbon dioxide, shall be used for inflation. The type and quantity shall provide a sufficient rate of inflation to allow the complete system to meet the specified inflation performance requirements for the equipment in which it is installed.

5.2 Dryness

If the gas used is carbon dioxide, the moisture content of the gas used shall be no more than 150 parts of water per 1 million parts of gas by mass.

6 Gas cylinder valve and operating head

6.1 General

If a gas cylinder valve is originally integrated with an operating head, the gas cylinder valve shall meet the requirements of 6.2 and 6.3.

6.2 Gas cylinder valve

6.2.1 General

6.2.1.1 The gas cylinder valve shall be fitted with a safety relief device that vents gas prior to damage to the gas cylinder due to over-pressurization.

6.2.1.2 Means shall be provided to protect the threads on the gas cylinder valve for attachment of the high-pressure hoses and an operating head from damage during storage and transit. If the gas cylinder valve is originally integrated with the operating head, the means may be provided only for the high-pressure hoses.

6.2.1.3 A gas cylinder valve constructed from aluminum alloy shall be anodized and may only be used with an aluminum cylinder, unless it is galvanically isolated from the cylinder.

6.2.1.4 Each combination of a gas cylinder valve and a gas cylinder that differ in materials, or any aluminum alloy cylinder valve used with an aluminum gas cylinder, shall be subjected to the salt water exposure test as described in 6.2.2.9.

6.2.1.5 If the gas cylinder valve is used with an inflation gas producing a liquid phase within the certified value of pressure and temperature, the design of the gas cylinder valve shall prevent the transfer of the gas phase until the liquid phase is transferred. A siphon tube or similar arrangements may be used, in which it shall be ensured that, in all operational positions of the cylinder, the siphon tube's open end remains submerged in the liquid phase.

6.2.2 Testing

6.2.2.1 Safety relief test

It shall be demonstrated that the safety relief device on the gas cylinders valve, when fitted to an approved gas cylinder in accordance with the instructions of the cylinder valve manufacturer, operates at a pressure not greater than the highest cylinder test pressure for which it is rated.

6.2.2.2 Proof-load test

The bodies of six gas cylinder valves shall be subjected to an internal hydraulic pressure 1,5 times the test pressure for which the valve is rated. The pressure shall be held for a period of 2 min.

On completion of the test, there shall not be any signs of leakage or damage.

6.2.2.3 Temperature cycling test

Two gas cylinder valves fitted to approved gas cylinders, with a gas capacity of not less than 5 l, shall be charged with 3,17 kg of CO_2/N_2 gas in the ratio 96 %/4 % by mass, weighed and then alternately subjected to surrounding temperatures of −30 °C and +65 °C. These alternating exposures need not follow immediately after each other and the following procedure is acceptable.

a) Complete an 8 h half-cycle exposure at +65 °C in one day.

b) Remove the specimens from the hot chamber and leave them exposed to ordinary room temperature until the following day.

c) Complete an 8 h half-cycle exposure at −30 °C the next day.

d) Remove the specimens from the cold chamber and leave them exposed to ordinary room temperature until the following day.

e) Repeat the above procedure a further nine times.

f) On completion of the test, the gas cylinders shall be subjected to the leak test as per clause 6.2.2.6.

6.2.2.4 Cold inflation test

Gas cylinder valves fitted to two approved gas cylinders, with a gas capacity of not less than 5 l, one charged with 3,17 kg of CO_2 and the other charged with 3,17 kg of CO_2/N_2 in the ratio 96 %/4 % by mass, shall be placed in a cold chamber at a temperature of −30 °C for a period of 3 h.

On completion, the gas shall be capable of being completely and continuously discharged within 20 s through a nozzle containing four holes of diameter 3,3 mm. There shall be no interruptions of flow by ice formation.

Where a siphon tube is fitted, the cylinder shall be rotated through 180° at least every 5 s during the discharge to demonstrate the efficacy of the siphon tube.

6.2.2.5 Fatigue test

Two gas cylinder valve bodies shall be hydraulically pressure-cycled internally in a laboratory from 0 MPa to 20 MPa for 33 000 cycles.

On completion of the test, they shall be subjected to a hydraulic pressure 1,5 times the test pressure for which the valve is rated. The pressure shall be held for a period of 2 min. There shall be no damage to the valve bodies after this test.

6.2.2.6 Long-term leak test

Two gas cylinders assembled with the valves used in the temperature cycling test in 6.2.2.3 shall be tested to ensure that they shall not lose more than 2 % of the original mass of the gas over an 18 month period.

The procedure of measuring mass loss is as follows.

a) The gas cylinder valves shall be fitted to two approved gas cylinders, with a gas capacity of not less than 5 l, charged with not less than 3,17 kg of CO_2/N_2 gas in the ratio 96 %/4 % by mass.

b) The cylinders shall be weighed carefully and then stowed in a secure stowage place for a period of 18 months at an ambient temperature of 18 °C to 20° C.

c) On completion of the 18 month period, the cylinders shall be reweighed and the loss of gas charge on each cylinder shall not exceed 2 % of the original mass of the gas.

6.2.2.7 Impact test

One of the gas cylinders and gas cylinder valves used in the long-term leak test, after being fully discharged of gas, shall be dropped 9 times from a height of 300 mm at an angle of 45° onto a concrete floor covered with hardboard so that the valve receives the full force of the impact.

The test shall be repeated with the cylinder angled in a plane at 90° to the original test.

After the above test, the cylinder shall be stood vertically on its base, and pushed over so that, as it falls, the gas cylinder valve strikes a steel stop secured to the floor. The height of the steel stop shall be not less than half the diameter of the cylinder used for the test. The test shall be repeated 12 times.

On completion of the above test, the valve shall be carefully examined using appropriate means. There shall not be any signs of flaw or fracture other than superficial surface damage.

An approved gas cylinder, with a mass of at least 8,165 kg, fitted with the gas cylinder valve shall be dropped three times from a height of 1,5 m onto an aluminum sheet so that the valve takes the full force of the impact at an angle of 60° to the sheet.

The aluminum sheet shall be removed and the test shall be repeated with a single drop onto a concrete floor.

On completion of the tests, the valve shall be removed from the cylinder and carefully examined. There shall not be any signs of flaw or fracture other than superficial surface damage.

6.2.2.8 Torque test

An approved gas cylinder shall be valved and devalved in accordance with the instructions of the valve manufacturer. The test shall be repeated six cycles.

On completion of the test, carefully examine the valve threads. There shall not be any signs of damage.

6.2.2.9 Salt water exposure test

6.2.2.9.1 Application

This test is applicable to combinations of gas cylinder valve and approved gas cylinder that are of differing in materials, or any aluminum-alloy gas cylinder valve used with an approved aluminum gas cylinder.

6.2.2.9.2 Test procedure

Two gas cylinder valve operating head assemblies shall be assembled to approved gas cylinders filled with a typical gas charge. The assemblies shall be subjected to a corrosion test in accordance with the neutral salt spray test in ISO 9227:2017 for a period of 168 h at 35 °C ± 2 °C.

On completion of this test, the assemblies shall be checked to ensure that no more than 2% of the gas charge has been lost.

The system shall demonstrate that it functions correctly at an ambient temperature of 18 °C to 20 °C and the pull load does not exceed 125 N.

NOTE This test can be performed simultaneously with the test specified in 6.3.2.4.

6.3 Gas cylinder operating head

6.3.1 General

The operating head fitted to a charged gas cylinder shall be able to fully open the gas cylinder valve with a pull load less than 125 N and a pull distance of less than 200 mm at the temperature range of −30 °C to +65 °C.

The operating head shall be made from corrosion-resistant materials.

An operating head constructed from aluminum alloy shall be anodized and shall comply with 6.2.1.4.

Means shall be provided, as necessary, to prevent kinking of the cable and abrasive damage to the fabric of an inflatable survival craft.

The operating head shall be sealed against the ingress of water.

The operating head shall be of a design that prevents any chafing of the fabric of an inflatable survival craft.

NOTE The 125 N pull load is a component performance requirement, whereas the maximum activation force of 150 N in LSA Code and MSC.81(70) Part 2 is for fully assembled liferafts where some additional friction should be expected.

6.3.2 Testing

6.3.2.1 Hot actuation-force test

Two operating heads fitted to approved gas cylinders, with a gas capacity of not less than 5 l, charged with 3,17 kg of CO_2, shall be placed in a hot chamber at a temperature of +65 °C for a period of 2 h. On removal from the hot chamber, the force required to activate the heads shall be measured.

The force shall not exceed 125 N.

6.3.2.2 Cold actuation-force test

Two operating heads fitted to approved gas cylinders, with a gas capacity of not less than 5 l, charged with 3,17kg of CO_2, shall be placed in a cold chamber at a temperature of −30 °C for a period of 2 h. On removal from the chamber, the force required to activate the heads shall be measured.

The force shall not exceed 125 N.

6.3.2.3 Ambient actuation-force test

Two operating heads fitted to approved gas cylinders, with a gas capacity of not less than 5 l, charged with 3,17 kg of CO_2, shall be placed at a temperature of 20 °C ± 3 °C for a period of 2 h. After this period, the force required to activate the heads shall be measured.

The force shall not exceed 125 N.

6.3.2.4 Salt water exposure test

The salt water exposure test for gas cylinder operating heads shall be carried out in accordance with 6.2.2.9.2.

This test can be combined with 6.2.2.9

6.3.2.5 Impact test

An operating head assembly shall be fitted to an approved type of gas cylinder valve and placed in a cold chamber for a period of 2 h at −30 °C. The assembly shall be picked up from the cold chamber and dropped, within 10 s, from a height of 2 m onto a solid floor covered with a sheet of hardboard so that the operating head receives the full impact on

— the top of the head, and

— the side of the head.

The test shall be repeated three times, replacing the assembly in the cold chamber between each test to ensure that a temperature of −30 °C is maintained.

There shall be no visible signs of damage to the operating head.

The assembly shall demonstrate that it functions correctly and the pull load does not exceed 125 N.

6.3.2.6 Water ingress test

Two operating head assemblies, each fitted to an approved type of gas cylinder valve and gas cylinder, shall be weighed and then submerged in water to a depth of 4 m for a period of 30 min.

On removal from the water, each assembly shall be weighed. There shall be no increase in mass due to water ingress.

Each operating head shall then be activated, and the contents of the cylinder shall be completely discharged. The actuation force shall not exceed 125 N.

After discharge, each operating head shall then be disassembled for inspection. There shall be no ingress of water or signs of water ingress into the system.

7 High-pressure hose assembly

7.1 General

A high-pressure hose shall be used to connect the gas cylinder to the inlet manifold on the inflatable chambers.

The hose shall have a smooth bore.

The hose shall have adequate corrosion resistance.

It shall be fitted with end connectors of sufficient strength to withstand moderate overtightening.

Brass end connectors with a mass fraction of zinc of more than 33 %, if cold pressed without annealing, can be subject to “season cracking” and shall not be used.

Where nipples are inserted into the ends of the hose, they shall be suitably shaped to prevent damage or abrasion to the inner lining and to provide a smooth gas flow.

The outer casing of the hose shall be suitably protected against damage or abrasion.

The hose shall have a minimum burst pressure exceeding 1,5 times the maximum pressure rating of the valve.

The hose shall operate in a satisfactory manner throughout an air temperature range of −45 °C to +65 °C.

The hose shall be capable of being bent through 180° over a former of 50 mm radius, at a temperature of −45 °C, without cracking or damage.

The hose shall be subjected to a hydraulic pressure equal to the maximum pressure rating of the valve to be used on. There shall be no permanent distortion or damage.

Every hose shall be carefully inspected and marked by the manufacturer's quality inspector.

To enable traceability, the hose shall be marked externally with

— the name of the manufacturer, and

— the lot or batch number.

7.2 Testing

7.2.1 Pressure test

Three hoses, at an ambient temperature of 18 °C to 20 °C, shall be subjected to a pressure of 1,5 times the maximum rated pressure of the gas cylinder on which they are used. The criterion is whether they burst or not.

7.2.2 Cold pressure test

Three hoses, after being placed in a cold chamber at a temperature of −45 °C for a period of 72 h, shall immediately be subjected to a pressure of 1,5 times the maximum rated pressure of the gas cylinder on which they are used. The criterion is whether they burst or not.

7.2.3 Salt water exposure test

Three hoses shall have their ends blanked off and then shall be subjected to a corrosion test in accordance with the neutral salt spray test in ISO 9227:2017 for a period of 168 h at 35 °C ± 2 °C.

7.2.4 Hydraulic pressure test

The three hoses used in the salt water exposure test shall be subjected to an internal hydraulic pressure equal to the maximum rated pressure of the valve they are to be used on, for a period of 60 s. During the test, the hose and end fittings shall be carefully examined and there shall not be any signs of leakage, damage or distortion.

7.2.5 Cold bend test

The three hoses used in the hydraulic pressure test, after being thoroughly dried out, shall be placed in a cold chamber for a period of 2 h at a temperature of −45 °C. Immediately upon removal from the cold chamber, the hoses shall be bent through 180° around a former 50 mm in diameter, without any signs of cracking or damage. On completion of this test, the hoses shall be allowed to warm up to room

temperature before being subjected again to the hydraulic pressure test specified in 7.2.4 to confirm that the hoses are still in a serviceable condition.

7.2.6 Joint-securing test

The joint between the hose and the end connections shall be subjected to an in-line loading of 180 kg, i.e. 1 765 N, for a period of 60 s, at an ambient temperature of 18 °C to 20 °C. On completion, the hose shall be carefully examined and shall not show any signs of damage or detachment from the end connections.

7.2.7 Flow test

A hose placed on a solid base shall be subjected to a loading of 45 kg, i.e. 441 N, applied on a bar 25 mm square section resting on the hose at right angles to the bore, for a period of 60 s at an ambient temperature of 18 °C to 20 °C. Using a flow meter, flow rates shall be taken before and after the test, without the bar and the load, to confirm that there has been no loss of cross-sectional area in the bore of the hose.

8 Valves — Pressure-relief/transfer, inflate/deflate, non-return

8.1 Pressure-relief/transfer valve

8.1.1 Torque test

This test shall be carried out if plastic threads are used under constant load to clamp the valve into the fabric.

A torque test in a typical installation shall demonstrate that the design shall withstand a minimum of 2,5 times the recommended assembly torque.

8.1.2 Valve thread strength test

This test shall be carried out if plastic threads are used under constant load to clamp the valve into the fabric.

Six valves shall be assembled into a typical liferaft fabric and they shall be tightened to a torque of 2,5 times the recommended tightening torque. The valves shall hold this torque for a period of 3 min without breaking.

8.1.3 Plug test

This test is applicable to pressure relief valves.

Six valves shall have the manufacturer's production plugs fitted; the plugs shall be wet. They shall have pressure applied through the valve. The pressure shall be the highest reseat pressure that the valve is manufactured with. The test shall last for a period of 60 s. The plugs shall remain in place and have a leak rate of less than 0,01 l/h.

8.1.4 Salt water exposure test

This test shall be carried out if the valve has external metallic parts.

Two valves shall be subjected to the corrosion test in accordance with the neutral salt spray test in ISO 9227:2017 for a period of 168 h at 35 °C ± 2 °C.

8.1.5 Pressure test

A minimum of six valves used in the salt water exposure test shall be subjected to this test. Each valve shall be placed in a suitable test rig and air pressure applied slowly until the valve opens. The pressure shall then be gradually reduced until the valve re-seats. The valve shall be considered to have re-seated when its leak rate is less than 0,01 l/h.

The pressures at which the valve opens and re-seats shall be recorded and shall fall within the design parameters specified by the manufacturer.

8.1.6 Drop test

A minimum of six valves shall be subjected to this test. A valve shall be dropped 12 times from a height of 2 m onto a solid concrete floor. On completion of the drops, the valve shall be carefully examined and then activated on a suitable test rig. There shall be no signs of any damage other than superficial surface damage, and the valve shall continue to function in a satisfactory manner.

8.1.7 Valve securing test (where applicable)

This test shall be carried out if the valve screws into a flange that is welded or bonded into the raft fabric.

A minimum of six valves used in the salt water exposure test shall be subjected to this test. Each valve shall be placed in a suitable test rig and subjected for a period of 3 min to a tensile test force of 1 800 N across the flange in an attempt to separate it from the valve. The valve shall be turned through 90° and the test repeated.

On completion of the test, the valve shall be examined and shall not show any signs of distortion or detachment of the flange from the valve.

8.1.8 Pulsating load test

A minimum of six valves shall be subjected to this test. A valve shall be fitted to a single inflatable buoyancy tube of an approved six-person liferaft. The tube shall be inflated until the valve opens, and the pressures at which the valve opens and re-seats shall be recorded. A person weighing not less than 82,5 kg shall then step up onto the tube 25 times and, on completion of the test, the pressure in the tube shall be recorded. The pressure drop in the tube shall not be greater than 10 % of the pressure at which the valve re-seated.

8.1.9 Overpressure test

A minimum of six valves used in the salt water exposure test shall be subjected to this test. The valve, fitted to the tube used in 8.1.8, shall be plugged, and the tube inflated to a pressure at least three times the pressure at which the valve opens (blow-off pressure). This pressure shall be maintained for a period of 5 min and the valve shall be carefully examined.

There shall be no visible signs of damage to the valve detached from the tube.

8.1.10 Flow test

A minimum of six valves used in the salt water exposure test shall be subjected to this test. Where there are a number of different pressure settings available for the valve there shall be three valves from the lowest pressure setting and three from the highest pressure setting. Using a flow meter or suitable flow measuring equipment, the flow rate shall be shown to be within the manufacturer's specification from opening to twice the opening pressure at an ambient temperature of 18 °C to 20 °C.

8.2 Inflate/deflate valve

8.2.1 Torque test

This test shall be carried out if plastic threads are used under constant load to clamp the valve into the fabric.

The torque test for inflate/deflate valves shall be carried out in accordance with 8.1.1.

8.2.2 Valve thread strength test

This test shall be carried out if plastic threads are used under constant load to clamp the valve into the fabric

The valve thread strength test for inflate/deflate valves shall be carried out in accordance with 8.1.2.

8.2.3 Plug test

This test is applicable to pressure relief valves.

Six valves shall have the manufacturer's production plugs fitted; the plugs shall be wet. They shall have pressure applied through the valve. The pressure shall be the manufacturer's maximum recommended installation pressure. The test shall last for a period of 60 s. The plugs shall remain in place and have a leak rate of less than 0,01 l/h.

8.2.4 Salt water exposure test

This test shall be carried out if the valve has external metallic parts.

The salt water exposure test for inflate/deflate valves shall be carried out in accordance with 8.1.4.

8.2.5 Leak test

A minimum of six valves used in the salt water exposure test shall be subjected to this test. Each valve shall be placed in a suitable test rig and air pressure shall be slowly applied until the valve opens. The valve shall be allowed to re-seat and an air pressure of 0,014 MPa shall be applied to the back of the valve. The leak rate through the valve shall be less than 0,01 l/h.

8.2.6 Valve-securing test (Where applicable)

This test shall be carried out if the valve screws into a flange that is welded or bonded into the raft fabric.

The valve-securing test for the inflate/deflate valve used in the salt water exposure test shall be carried out in accordance with 8.1.7.

8.2.7 Drop test

The drop test for inflate/deflate valves shall be carried out in accordance with 8.1.6.2.

8.2.8 Flow test

A minimum of six valves used in the salt water exposure test shall be subjected to this test using a flow meter or a suitable flow measuring equipment. It shall be demonstrated, at an ambient temperature of 18 °C to 20 °C, that the opening pressure and flow rate are within the manufacturer's specification.