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Ships and marine technology — Pressure/vacuum valves for cargo tanks

Navires et technologie maritime — Robinets à pression/à vide pour citernes de chargement

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15364 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

Annex A forms a normative part of this International Standard. Annexes B and C are for information only.

Ships and marine technology — Pressure/vacuum valves for cargo tanks

1 Scope

This International Standard applies to pressure/vacuum relief valves protecting marine vessel systems, including cargo tanks, that may be subject to gas/vapour pressure or vacuum outside the design parameters of the system/tank. This standard specifies the minimum requirements for performance and testing of pressure/vacuum relief valves, with emphasis on selection of materials, internal finish and surface requirements for pressure/vacuum valves installed on cargo tanks in tankers (see annex A). This standard specifies design and in-service performance criteria and operational testing and maintenance requirements. This standard does not address devices to prevent the passage of flame. Advice on devices to prevent the passage of flame is found in the International Maritime Organization (IMO) "International Convention on the Safety of Life at Sea, 1997" (SOLAS); Chapter II-2, Regulation 59, and IMO Maritime Safety Committee (MSC) Circular No. 677 (MSC/Circ. 677) "Revised Standards for the Design, Testing and Locating of Devices to Prevent the Passage of Flame into Cargo Tanks in Tankers".

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

International Maritime Organization, Maritime Safety Committee Circular 677 (MSC/Circ. 677), "Revised Standards for the Design, Testing and Locating of Devices to Prevent the Passage of Flame into Cargo Tanks in Tankers".

International Maritime Organization, Assembly Resolution A.746(18), "Survey Guidelines under the Harmonized System of Survey and Certification".

International Maritime Organization, "International Convention on the Safety of Life at Sea, 1997" (SOLAS); Chapter II-2, Regulation 59.

3 Terms and definitions

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

3.1
administration
the government of the state whose flag the ship is entitled to fly

3.2
flame arrester
device to prevent the passage of flame in accordance with a specified performance standard

NOTE Its flame-arresting element is based on the principle of quenching.

3.3
flame screen
device utilizing wire mesh to prevent the passage of unconfined flames in accordance with a specified performance standard

3.4
passive flame stopper
device, such as a flame screen or a flame arrester, that operates passively to prevent the passage of unconfined flames in accordance with a specified performance standard

3.5
high-velocity vent
device to prevent the passage of flame consisting of a mechanical valve which adjusts the opening available for flow in accordance with the pressure at the inlet of the valve in such a way that the efflux velocity cannot be less than 30 m/s (98 ft/sec) under all flow rates and the actual conditions of installation

3.6
pressure/vacuum valve
device to prevent the occurrence of over- or underpressure in a closed container

3.7
standard air
dry air at 21 °C (70 °F) and 1 013,25 hPa (29,92 inHg) pressure

NOTE This is substantially equivalent to air with a density of 1,2 kg/m^3 (0,075 lb/ft^3). The specific heat of dry air is 1 004,8 J/kg·K (0,24 btu/lb/°F).

3.8
third-party inspection body
an organization designated by the administration that is independent of the manufacturer and the user and that performs or witnesses the tests and inspections provided for by this International Standard

4 Ordering information

Orders for devices under this specification shall include the following information, as applicable:

— Nominal pipe size, configuration of pipe, and pipe length.

— Molecular mass and specific heat ratio of each gas or vapour in the tank being protected, and maximum explosive safe gap (MESG) value, if known.

— Inspections and tests other than those specified by this International Standard (see clause 8).

— Set opening points for pressure and vacuum.

— Anticipated ambient air temperature range.

— Materials of construction (see clause 5).

— Maximum flow rate for standard air and the design pressure drop for the piping system at that maximum flow rate, and the maximum allowable tank pressure and tank vacuum.

5 Materials

5.1 The device housing, and other parts or bolting used for pressure retention, shall be constructed of materials suitable for the intended service and listed in a recognized national or international standard.

5.1.1 Housings, discs, spindles, seats, springs, gaskets, seals, passive flame stoppers (when included in the design) and all other integral parts, including parts with coatings to prevent corrosion, shall be made of materials resistant to attack by seawater and the liquids and vapours contained in the tank being protected (see annex C).

5.1.2 Springs plated with corrosion-resistant material are not acceptable.

5.2 Non-metallic materials, other than gaskets and seals, shall not be used in the construction of pressure-retaining components of the device.

5.2.1 Resilient seals may be installed only if the device is still capable of effectively performing its function when the seals are partially or completely damaged or burned.

5.2.2 Non-metallic gaskets shall be made of non-combustible material suitable for the service intended.

5.3 Materials for connecting pressure/vacuum valves to their respective piping systems shall meet standards for physical characteristics similar to those of the piping systems to which they are connected.

5.4 The materials of all parts not identified above shall be suitable for their intended purpose.

5.5 The possibility of galvanic corrosion shall be considered in the selection of materials.

6 Other requirements

6.1 Device housings shall be gastight in the primary pressure zone upstream of the main valve seat to prevent the escape of vapours.

6.2 Housings, elements and seal gasket materials shall be capable of withstanding the maximum and minimum pressures and temperatures to which the device may be exposed under normal operating conditions, and shall be capable of withstanding the hydrostatic pressure test of 7.2.2.

6.3 Where welded construction is used for pressure-retaining components, welded-joint design details, welding and non-destructive testing shall be in accordance with national or international standards. Welders and weld procedures shall be qualified by a recognized organization to ensure consistent-quality production of weld joints that are sound and of proper strength, in accordance with recognized national/international standards.

6.4 When pressure/vacuum relief valves are designed to allow for inspection, cleaning, repair or removal of internal elements for replacement without removing the entire device from the system, the design shall not allow the valve to be incorrectly reassembled following disassembly for inspection, cleaning or repair.

6.5 Pressure/vacuum valves shall be designed such that condensed vapour drains from the device and does not impair the efficiency of the device. The design shall also prevent the accumulation of water inside the device and subsequent blockage due to freezing.

Where the design does not permit complete drainage of condensed vapours through its connection to the tank, the housing shall be fitted with a plugged drain opening on the side of the atmospheric outlet of not less than 13 mm [1/2 inch nominal pipe size (NPS ½)]. The drain shall not allow vapour to escape unless the drain is equipped with suitable means to prevent the passage of flame and meets all requirements for efflux velocity and direction.

6.6 All fastenings essential to the operation of the device shall be protected against loosening.

6.7 Devices shall be designed and constructed to minimize the effect of fouling under normal operating conditions. The design shall be such that the device can be examined for any build-up of residue due to vapour condensation that might impair the operation of the device. The manufacturer's operating manual shall include instructions on how to determine when cleaning is required and shall specify the method for cleaning (see clause 9). For certain cargoes that crystallize, heating arrangements may be necessary.

6.8 Devices shall be capable of operating over the full range of ambient air temperatures anticipated. Devices shall be capable of operating in freezing conditions (such as may cause blockage by freezing cargo vapours or by icing in bad weather) and when covered by a layer of ice, the allowed thickness of which shall be stated by the manufacturer in the operating manual. Devices shall also be capable of operating at whatever surface temperature is developed by heating arrangements.

6.9 End-of-line devices shall be constructed to direct the efflux vertically upward under all flow rates intended by the manufacturer.

6.10 A manual means shall be provided to verify that any valve lifts easily and cannot remain in the open position, as per manufacturer's instructions. The design shall be such that the device shall not be rendered inoperable due to corrosion, residue build-up or icing, when maintenance is carried out in accordance with the manufacturer's requirements (see annex C).

6.11 Valve discs shall be guided by a suitable means to prevent binding and ensure proper self-closing (seating), taking into account the possible build-up of condensed vapours passing through the valve during loading, when maintenance is carried out in accordance with the manufacturer's requirements.

Valve discs shall normally close against the valve seat by metal-to-metal contact. Resilient-seating seals may be provided if the design is such that the disc closes tight against the seat in case the seals are destroyed, damaged or otherwise carried away.

Valve discs may be solid or made hollow so that weight material may be added to vary the lifting pressure. If hollow discs are employed, a watertight bolted cover shall be fitted to encase the weight material. The lifting pressure shall not be varied by personnel other than the manufacturer without prior approval by the administration. A clear indication, visible from the outside of the valve, shall be employed to indicate the position of the valve. If the lifting pressure is varied, the marking required by clause 10 shall be updated.

6.12 Valves may be actuated by non-metallic diaphragms except where failure would result in unrestricted flow of tank vapours to the atmosphere or in an increase in the pressure or vacuum at which the valve normally releases.

6.13 Relief pressure adjusting mechanisms shall be permanently secured by lockwire, locknuts or other suitable means to prevent devices from becoming misadjusted due to handling, installation or vibration.

7 Approval tests

7.1 Type approval tests shall be conducted by a laboratory acceptable to the administration. The manufacturer, in choosing a laboratory, shall ensure that the laboratory is qualified (by the administration or by a certifying entity designated by the administration) to conduct the tests provided for by this International Standard and that the laboratory has (or has access to) the apparatus, facilities, personnel and calibrated instruments that are necessary for the tests. Alternatively, the tests provided for by this International Standard may be conducted by the manufacturer when the tests are witnessed by a third-party inspection body designated by the administration who can certify that the tests are conducted properly.

7.2 One device of each model and each size shall be tested. A change of design, material or construction that affects the corrosion resistance, or any change that alters the flow characteristics of the device, shall be considered a change of model for the purpose of this subclause.

7.2.1 A corrosion test shall be conducted. In this test, a complete device, including a section of pipe similar to that to which the device will be fitted, shall be exposed to a 5 % sodium chloride solution spray at a temperature of 25 °C (41 °F) for a period of 240 h, and allowed to dry for 48 h. Following this exposure, all movable parts shall operate properly and there shall be no corrosion deposits that cannot be washed off.

7.2.2 The pressure-retaining boundary of the device shall be subjected to a hydrostatic-pressure test of at least 150 % of maximum rated pressure (MRP) or a minimum pressure of 3 450 hPa gauge (50 psig), whichever is greater, for ten minutes without rupturing, leaking or showing permanent distortion. For the purposes of this test, the disc may be gagged or blocked.

7.2.3 Performance characteristics as declared by the manufacturer, such as flow rates under both positive and negative pressures, operating sensitivity, flow resistance and velocity, shall be demonstrated by appropriate tests. Flow testing shall be conducted in accordance with clause 12.

7.3 Each finished device shall be pneumatically tested at 70 kPa (10 psi) either using a submersion test or a soap test for a duration of three minutes to ensure there is no leakage.

7.4 A test report for each prototype and each finished device shall be prepared by the laboratory. This shall include:

— detailed drawings of the device and its components;

— the types of test conducted and the results obtained, with all recorded data;

— specific advice on approved attachments;

— drawings of the test rig, to include a description of the inlet and outlet piping attached;

— a record of all markings found on the device tested;

— a report number.

8 Inspection

8.1 The manufacturer shall afford the purchaser's representative all reasonable facilities necessary to satisfy him that the material is being furnished in accordance with this International Standard. Inspection by the purchaser shall not interfere unnecessarily with the manufacturer's operations. All examinations and inspections shall be made at the place of manufacture, unless otherwise agreed upon.

8.2 Each finished device shall be visually and dimensionally checked to ensure that the device complies with this International Standard, including the ordering information in clause 4, certification in clause 9 and marking in clause 10. Special attention shall be given to the adequacy of welds and the proper fit-up of joints.

9 Certification

9.1 The manufacturer shall provide an instruction manual for each device. The instruction manual shall include the items described in 9.2 to 9.7.

9.2 Installation instructions.

9.3 Operating instructions, including information on the lowest MESG (in accordance with MSC/Circ. 677) that the device is suitable for, if fitted with a flame screen or with a high-velocity vent. The instructions shall also include any service restrictions imposed for safe functioning of the device, including requirements imposed for the proper installation of the device.

9.4 Maintenance requirements, including information on maintenance of any corrosion protection system (see annex C).

9.4.1 Instructions on how to determine when device cleaning is required and the method of cleaning.

Where the manufacturer allows valve overhauls to be performed by the user, the manufacturer shall provide the necessary procedures, instructions and diagrams for the valve to be restored to original, as-purchased condition with regard to set pressure and flow rate.

9.4.2 Instructions on the frequency of cleaning of the device to remove vapour condensate. The frequency of cleaning condensate residue from the valve will vary depending on the cargo.

9.4.3 Instructions clearly defining the method of setting the pressure, including information such as dismantling and reassembling the valve, numbering and ordering information, and diagrams for proper assembly of items.

9.4.4 Instructions to check valve lift by the user prior to each cargo loading and cargo unloading operation.

9.4.5 Instructions to conduct a complete inspection of the valve and the recommended frequency.

9.5 The test report described in 7.4. Alternatively, the instruction manual may include a clause stating that a copy of the test report will be made available to the purchaser upon request.

9.6 Flow test data, including flow rates under both positive and negative pressures, operating sensitivity, flow resistance, velocity and maximum pipe length on the inlet side.

9.7 The manufacturer's certification that the device has been constructed and tested in accordance with this International Standard.

10 Marking

Each device shall be permanently marked indicating:

— manufacturer's name or trademark;

— style, type, model or other manufacturer's designation for the device, which shall form a unique identification of the device;

— size of the inlet (and outlet, if applicable);

— serial number;

— direction of flow through the device;

— test laboratory and report number;

— pressure and vacuum setting;

— the reference number of this International Standard.

11 Quality assurance

11.1 Devices shall be designed, manufactured and tested in a manner that ensures they meet the characteristics of the prototype tested in accordance with this International Standard.

11.2 The device manufacturer shall maintain the quality of the devices that are designed, tested and marked in accordance with this International Standard. At no time shall a device be sold marked with the reference number of this International Standard that does not meet the requirements herein.

12 Flow tests

12.1 Determination of capacity

The capacity of pressure/vacuum valves shall be established by flow testing at least one production model of every type and size of venting device under the conditions listed in 12.2.

12.2 Capacity data

12.2.1 The capacity data shall be presented in the form of curves or tables that give the volume of flow through both vacuum and pressure ports and that cover the full range between the opening pressure (or vacuum) and the pressure (or vacuum) at which the ports are fully open and the valve is flowing at its maximum anticipated rate. The capacity data for pilot-operated vents or devices that open fully at a set pressure (or vacuum) may be expressed as a flow coefficient that is the ratio of the flow through the vent to the flow through a theoretically perfect nozzle of the same diameter. Sufficient measurements shall be made at pressures in the vicinity of the opening points, particularly at 1,1, 1,2 and 1,5 times the opening pressure and at 1,5 and 2,0 times the opening point on vacuum, to establish clearly the flow capacity at these points.

12.2.2 The capacity data shall indicate the points of initial opening and final closing of the venting device.

12.2.3 The capacity data shall be expressed in terms of cubic metres of air per hour at a temperature of 0 °C (32 °F) and a pressure of 1 015 hPa (14,7 psia).

12.2.4 Pressures shall be expressed in hectopascals; however, auxiliary scales shall be expressed in millimetres of water, and other units of measurement may also be included if desired.

12.2.5 The capacity data shall include a statement of the manner in which the valves were mounted and tested, along with a description of the inlet and outlet piping attached. If any medium other than air is used in the test, this fact (together with the temperature of the medium actually used and its specific gravity at standard conditions) shall be noted on the test report.

12.3 Mounting of the device for flow testing

Mounting of the venting device shall be in accordance with a recognized national or international standard. In addition to complying with a recognized national or international standard, the venting device shall also comply with the following requirements:

a) To minimize the effect of entrance losses, the venting device shall be mounted on the top of the test tank at a location near the centre of an area that is essentially flat. The flat area shall have a diameter at least five times greater than the nominal diameter of the valve tested.

b) The valve shall be mounted for test on a straight-pipe nipple that has the same nominal diameter as the valve and is of sufficient length (but not less than 1,5 times the nominal diameter) to enable the intended flow measurement in accordance with the recognized national or international standard used. The pipe nipple shall squarely enter the top of the test tank near the centre of the flat portion, with the end of the nipple machined to an angle of 90° with the axis and flush with the inside of the tank. Rounding of the entrance in excess of an 80 mm (3,1 inch) radius is not permitted.

Annex A
(normative)

Installation requirements for ships subject to the International Convention for the Safety of Life at Sea, 1997 (SOLAS)

A.1 Cargo tank venting

For the purpose of arrangement and installation of cargo tank venting systems on board ships, the "International Convention for the Safety of Life at Sea, 1997" (SOLAS), Chapter II-2, Regulation 59 shall be applied.

A.2 Examination of cargo tank pressure/vacuum valves on board ships

For the purpose of examination of cargo tank pressure/vacuum relief valves on ships, the International Maritime Organization Assembly Resolution A.746(18), “Survey Guidelines under the Harmonized System of Survey and Certification,” paragraph 6.2.3.3, shall be applied.

A.3 Access arrangements for examining pressure/vacuum valves

For the purpose of ensuring that any pressure/vacuum relief valve lifts easily and cannot remain in the open position (as per manufacturer’s instructions), appropriate access arrangements to the valve to facilitate this operation, such as a stand or platform at deck level, shall be fitted when necessary (see 6.10).

Annex B
(informative)

Materials selection guidelines

B.1 General

The purpose of these guidelines is to recommend general criteria for the selection, application, and maintenance of materials used in pressure/vacuum relief valves within the scope of this International Standard.

These guidelines are not intended to replace the technical aspects of any specific design or type of equipment that is under the responsibility of ship owners, manufacturers and shipyards.

The owner should select and maintain a system to ensure an adequate level of corrosion protection of the pressure/vacuum valves.

B.2 Selection of materials

The materials chosen for the construction of pressure/vacuum valves should reflect the expected working conditions and environment in terms of being subjected to various cargoes and their vapours. Depending on application (e.g. end-of-line or in-line installation and type of cargo), cast iron, ductile iron, bronze and different grades of stainless steel may be used.

For wearing parts, such as seats and discs, material selection should reflect the expected working conditions associated with the predicted functional characteristics of the particular valve design.

Materials for seals and packings, including soft seats, should be selected to obtain the same operational lifetime as for the particular component selected in accordance with the previous paragraph.

Annex C
(informative)

Corrosion protection guidelines

C.1 Corrosion protection systems

The surface preparation grade, design features, expected working conditions, maintenance scheme and desired protection time should be taken into account in the selection of suitable corrosion protection systems.

Available for corrosion protection are hard coatings, soft coatings with optional corrosion inhibitors, and powder treatments.

When repairs are necessary due to corrosion, maintenance coatings should be applied using the same coating system originally used, provided the surface treatment and working conditions required for a satisfactorily result are obtainable. The valve manufacturer should furnish, with the operating-instructions manual, instructions for carrying out repair work on the corrosion protection system, including details of the surface treatment, procedures and types of coating allowed.

C.2 Selection of corrosion protection system

In selecting the corrosion protection system, the parties involved should consider the present situation, the foreseeable service conditions and the planned maintenance programme.

The following aspects should be considered:

— present surface condition;

— possible surface preparation;

— valve design and intended service;

— required surface cleanliness and dryness;

— required ambient conditions during preparation;

— frequency of loading operations causing the valve to be subjected to aggressive compounds and their temperature;

— desired durability;

— maintenance features.

C.3 Coatings

The durability of coatings applied for corrosion protection is influenced by factors such as surface conditions, surface penetration, coating selection, application and maintenance.

Common types of coating used for surface protection are:

— epoxy formulations for high surface preparation;