FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 15364

ISO/TC **8**/SC **3**

Secretariat: ANSI

Voting begins on:
2020-11-13

Voting terminates on:
2021-01-08

Ships and marine technology — Pressure-vacuum valves for cargo tanks and devices to prevent the passage of flame into cargo tanks

Navires et technologie maritime — Soupapes de pression/dépression pour citernes à cargaison et dispositifs pour empêcher le passage des flammes vers les citernes à cargaison

Reference number
ISO/FDIS 15364:2020(E)

Contents

Page

Foreword

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

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

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

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

For an explanation 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 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 3, *Piping and machinery*.

This fourth edition cancels and replaces the third edition (ISO 15364:2016), which has been technically revised.

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

— expansion of the Scope to include devices to prevent the passage of flame into cargo tanks;

— inclusion of requirements for flame transmission tests.

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.

Ships and marine technology — Pressure-vacuum valves for cargo tanks and devices to prevent the passage of flame into cargo tanks

1 Scope

This document is applicable to pressure-vacuum valves and to devices to prevent the passage of flame, both protecting cargo tanks, that can be subject to explosive gas/vapour and/or to gas/vapour pressure or vacuum beyond the design parameters of the system/tank. It specifies the minimum requirements for performance and testing. It also specifies design and in-service performance criteria, operational testing and maintenance requirements. Design or manufacturing in accordance with this document does not imply suitability for any given installation, it indicates that certain minimum requirements have been considered and that information necessary for determination of suitability is provided to the buyer of the equipment.

The flame test procedures of ISO 16852:2016 are incorporated in this document.

NOTE 1 Minimum requirements for devices to prevent the passage of flame are found in the International Maritime Organization (IMO) "International Convention for the Safety of Life at Sea, as amended" (SOLAS), Chapter II-2, Regulation 4, 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", as amended.

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 16852:2016, *Flame arresters — Performance requirements, test methods and limits for use*

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*, as amended by IMO MSC/Circ. 1009 and MSC/Circ. 1324

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
flame arrester
device fitted to the opening of an enclosure, or to the connecting pipe work of a system of enclosures, and whose intended function is to allow flow but to prevent the transmission of flame

3.2
dual nozzle valve
pressure relief valve that features two high velocity vents with different opening settings integrated into one valve, the flow characteristics of which can be of one or more of the designs *full opening valve* (3.3), *modulating valve* (3.7) or *transition point valve* (3.11)

3.3
full opening valve
design that opens fully at maximum 2 % above the set pressure

3.4
high velocity vent valve
pressure relief valve designed always to have efflux velocities that prevent the flame propagation against the flow direction

3.5
maximum experimental safe gap
MESG
maximum gap of a joint of 25 mm in width which prevents any transmission of an explosion during tests

Note 1 to entry: ISO/IEC 80079-20-1 specifies the test apparatus and the test method.

3.6
maximum intended pressure drop
largest pressure drop generated over a device for which the test laboratory verifies the corresponding flow capacity

3.7
modulating valve
design that opens proportionally with rise in pressure

3.8
pressure-vacuum valve
device to relieve the pressure or vacuum formed inside the cargo tanks by opening the valves at the designated setting value to protect the tank from over-pressure or vacuum exceeding the design parameters of the tanks

3.9
standard conditions
dry air at 288,15 K (15,00 °C; 59,00 °F) and 101,325 kPa

3.10
third party inspection body
organization independent from the manufacturer and user, that is qualified to perform or witness the tests and inspections

3.11
transition point valve
design where the valve characteristics change from modulating to full opening at a particular pressure

3.12
verified drawing
drawing certified to be authentic and complete by the *third party inspection body* (3.10) issuing the test report

3.13
verified flow chart
pressure versus flow volume presented in a chart certified by the *third party inspection body* (3.10) issuing the test report

4 Symbols and abbreviated terms

D	pipe inner diameter at device connection
D_{min}	minimum inner diameter of the piping between the device and the tank allowed for non-oscillating performance
L_{max}	maximum length of the piping between the device and the tank allowed for non-oscillating performance
L_1	pipe length between the test tank and the device for flow testing
L_2	pipe length between the test tank and the device during non-oscillation testing
$P_{closing}$	value of inlet pressure at which the valve disk re-establishes contact with the seat or at which lift becomes zero, when the valve is closing and pressure is decreasing
$P_{closing1}$	value of inlet pressure at which the valve disk re-establishes contact with the seat or at which lift becomes zero, when the main valve is closing and pressure is decreasing
$P_{closing2}$	value of inlet pressure at which the valve disk re-establishes contact with the seat or at which lift becomes zero, when the extra valve is closing and pressure is decreasing
P_{max}	maximum pressure corresponding to the maximum flow volume (Q_3)
P_{set}	gauge pressure at the device inlet at which the valve is designed to start opening
P_{set1}	gauge pressure at the device inlet at which the main valve is designed to start opening
P_{set2}	gauge pressure at the device inlet at which the extra valve is designed to start opening
$P_{1\text{-}tpv}$	pressure at which a transition point valve changes from modulating to full opening
$Q_{1\text{-}fov}$	flow volume needed to open a full opening valve
Q_1	flow volume needed to open the second nozzle
Q_2	flow volume needed for a valve to remain fully open
$Q_{2\text{-}fov}$	flow volume needed to maintain a full opening valve fully open at P_{set}
$Q_{1\text{-}mv}$	flow volume needed to open a modulating valve
$Q_{2\text{-}mv}$	flow volume needed to maintain a modulating valve fully open
$Q_{1\text{-}tpv}$	flow volume at which a transition point valve changes from modulating to full opening
$Q_{2\text{-}tpv}$	flow volume needed to maintain a transition point valve fully open at $P_{1\text{-}tpv}$
Q_3	flow volume corresponding to the maximum intended pressure drop over the device
Q_{close}	minimum flow required to keep the valve partially open with no contact between the disc and the seat
$Q_{2\ total}$	flow volume needed to maintain the main and extra valves fully open at P_{set1}
$Q_{3\ total}$	flow volume corresponding to the maximum intended pressure drop over the dual nozzle valve
V_{min}	minimum volume of the tank allowed for non-oscillating performance

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 standard or International Standard. Housings, discs, spindles, seats, springs, gaskets, seals, flame arresters (when included in the design) and all other integral parts, including parts with coatings to prevent corrosion, shall be resistant to attack by sea water and the liquids and vapours contained in the tank being protected (see Annex D for guidance on the material selection). Springs plated with corrosion resistant material are not acceptable.

5.2 Non-metallic materials, other than gaskets, seals and diaphragms as allowed by 6.11, shall not be used in the construction of pressure retaining components of the device. Resilient seals may be installed only if the device is still capable of effectively performing its flame arresting function when the seals are worn down, partially or completely damaged or burned. Non-metallic gaskets shall be made of non-combustible material and suitable for the service intended.

5.3 The possibility of galvanic corrosion shall be considered in the selection of materials (see Annex E for additional considerations on corrosion protection).

5.4 The verified drawings shall include a complete bill of materials showing conformity with this subclause and any other material requirements listed in Clause 6.

6 Other requirements

6.1 The maximum gas leakage rate shall be provided and expressed as the volume in standard conditions that can leak from the valve at 75 % of the nominal setting as determined by the manufacturer. Maximum leakage rates are given in Annex J.

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. Flat surfaces of flanges shall be machined to provide for adequate joint integrity.

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 standards or International Standards. Welding procedures should be in accordance with the ISO 15607 series. Welders should be qualified according to the ISO 9606 series. Non-destructive testing should comply with ISO 5817.

Alternative equivalent national standards or International Standards may be used.

6.4 Pressure-vacuum valves shall be designed, such that condensed vapour and water in the pressure-retaining zone drain from the device into the tank and do 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. The design shall prevent pockets of water or product from accumulating.

6.5 All fasteners essential to the operation of the device shall be protected against loosening.

6.6 Devices shall be designed and constructed to minimize the effect of fouling under normal operating conditions.

6.7 Devices shall be capable of operating over the full range of ambient air temperatures anticipated and in freezing conditions, provided that the check-lift is operated to break the ice layer. If a heating arrangement is applied, the surface temperature developed may not exceed the maximum design temperature.

Where a valve is intended to be fitted in a ship that will be operated in climate conditions that might hamper its operation, e.g. seawater icing, the instruction manual shall contain appropriate information to ensure continued operation.

6.8 End-of-line devices are required to direct the efflux vertically upward. Further, for high velocity vent valves, the minimum average velocity of efflux through a cross section of the valve's outlet to atmosphere shall not be less than 30 m/s for all flow rates.

6.9 A manual means (e.g. check-lift) shall be provided to verify that any valve disc and other moving elements lift freely and fully and do not remain in the open position. The manual means shall be part of the valve assembly and be operated without the need to add or remove parts. The design shall be such that the device is verified not to be inoperable due to corrosion, residue build-up or icing, when the aforementioned manual means is used in combination with the manufacturer's requirements for visual inspection.

6.10 Valve discs and other moving parts shall be guided by a suitable means to prevent binding and to ensure proper self-closing (seating), taking into account the possible build-up of condensed vapours.

NOTE Maintenance in accordance with the manufacturer's requirements is normally necessary to ensure proper valve operation.

Valve discs and other moving parts shall close against the valve seat by metal to metal contact. Where the valve closes against a metal seat and a resilient seal is added to reduce gas leakage, the valve's performance in terms of flow shall not be affected if the seal is destroyed, damaged or is otherwise carried away.

Valve discs may be solid or made hollow so that weight material can be added to vary the lifting pressure. If hollow discs are employed, a watertight bolted cover shall be fitted to encase the weight material. A clear indication, visible from the outside of the valve, shall be employed to indicate the position of the valve disc(s). The indicator shall be visible from below and from the side of the valve at deck level.

6.11 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.

6.12 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.

6.13 The design shall be such that the device can be examined for any build-up of residue due to vapour condensation. For certain cargoes that solidify, heating arrangements may be necessary.

6.14 Devices shall not be bypassed or blocked open unless they are tested in the bypassed or blocked open position in accordance with Annex C.

6.15 Flame arrester elements shall fit in the housing in such a way that flame cannot pass between the element and the housing.

6.16 Resilient seals shall be installed only if their design is such that if the seals are partially or completely damaged or burned, the device is still capable of effectively preventing the passage of flame.

6.17 Devices shall allow for efficient drainage of moisture without impairing their efficiency to prevent the passage of flame.

6.18 The casing and element and gasket materials shall be capable of withstanding the highest pressure and temperature to which the device may be exposed under both normal and specified fire test conditions.

6.19 Detonation arresters shall be able to withstand, without damage or permanent deformation, the internal pressure resulting from detonation when tested in accordance with Annex C.

6.20 Flame arresting elements shall be:

1) designed in such a manner that they cannot be inserted improperly in the opening;

2) securely fitted in openings so that flames cannot circumvent the screen;

3) protected against mechanical damage.

6.21 Means to offset the opening of a pressure or vacuum valve beyond the set pressure shall be designed in a failsafe manner and shall not prevent any required inspection procedures to be carried out. The offset opening pressure shall be verified and clearly marked.

7 Type tests

7.1 Type tests shall be conducted by a laboratory acceptable to a third party inspection body. The laboratory shall be qualified to conduct the tests provided for by this document and shall have (or shall have access to) the apparatus, facilities, personnel and calibrated instruments necessary for the tests. Alternatively, the tests provided for by this document may be conducted by the manufacturer when the tests are witnessed by a third party inspection body who can certify that the tests are conducted in accordance with this document.

Note For certain tankers, the Laboratory must be acceptable to the Administration under whose authority the ship operates and/or a valve is intended to be fitted.

7.2 One of each model device and each size shall be tested in accordance with Clauses 7, 8 and 9. A change of material or coating system that negatively affects the corrosion resistance shall be considered a change of model for the purpose of this paragraph. A change of design or construction shall be considered a change of model for the purpose of this paragraph. Each size of each model shall be submitted for type testing. For end-of-line deflagration flame arresters of the same design series, testing may be limited to the smallest and the largest sizes. Devices should have the same dimensions and most unfavourable clearances expected in the production model. If a device is modified during the test programme, or at a later date, such that the functions of the valve or its performance characteristics are affected, the third party inspection body shall be informed. An appropriate test related to the modified part may be required by the third party inspection body.

Devices shall be tested in accordance with 7.2.1 and 7.2.2 and thereafter shown to meet the test requirements of Annex C, as appropriate.

7.2.1 A corrosion test shall be conducted. In this test, a complete device shall be exposed to a 5 % sodium chloride solution spray at a temperature of 25 °C (77 °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 or a minimum pressure of 345 kPa gauge (50 psig[1)]), whichever is greater, for 10 min without rupturing, leaking, or showing permanent distortion. For the purposes of this test, the disc may be gagged or blocked.

1) 1 psig = 1 lbf/in^2 gauge.

7.2.3 Performance characteristics as declared by the manufacturer, such as flow rates under both positive and negative pressure, operating sensitivity, working stability for dual nozzle valve, leakage, flow resistance and velocity, shall be verified by laboratory tests.

7.2.4 An external ice test shall be conducted for pressure-vacuum valves to verify the allowable accumulation of an external layer of ice at which the valve check-lift will still operate. In this test, a complete device shall be exposed to a temperature of -10 °C (14 °F) for a period of 24 h. Following this initial exposure, 1 l (1,7 pints) of water at no more than 2 °C (35,6 °F) shall be sprayed every 10 min on to the outside of the valve until the specified ice thickness is achieved. After achieving the specified thickness, proper operation of the valve check-lift shall be verified. The maximum ice thickness at which the valve check-lift will operate properly shall be noted in the instruction manual (see Clause 11).

7.2.5 Devices to prevent the passage of flame shall also be tested for flame transmission according to ISO 16852:2016 (see Annex C).

7.3 A test report with documentation for each prototype test shall be prepared by the laboratory. Further to the requirements given in ISO/IEC 17025:2017, 7.8, the test report shall as a minimum, include:

— types of test conducted, and results obtained with such recorded data to allow verification of the tests. Where detonation arresters are tested, this information shall include the maximum pressures and velocities observed in the test;

— assessment of the mechanical design requirements in accordance with Clause 5 and 6;

— drawings of the test rig, including a description of the inlet and outlet piping attachments;

— an instruction manual;

— detailed drawings of the device;

— specific advice on approved attachments;

— types of cargo for which the device is approved;

— in the case of high velocity vents, the pressures at which the device opens and closes and the efflux velocity;

— all the information marked on the device in accordance with Clause 12.

8 Flow and velocity tests

8.1 Determination of capacity

The capacity of the device shall be established by flow testing of at least one production model of every type and size of venting device, under the conditions specified in 8.2 to 8.4.

Where a pressure or vacuum valve is used with a flame arrester, the capacity of the overall assembly is different than the capacity of a standalone valve. The capacity test shall be conducted on the combined assembly.

Capacity measurements for flame arresters in accordance with ISO 16852 is also acceptable.

8.2 Capacity data

The following requirements shall be met when establishing capacity data:

a) the pipes, as well as the connections between the pipes and the device, shall be without obstructions causing additional turbulence;

b) the inner diameter of the test pipe shall be of the same or larger diameter than the connection flange of the device being tested;

c) all pressure measuring points shall be arranged normal to the pipe axis and shall not influence the flow;

d) the test medium shall be air at ambient conditions; ambient pressure and temperature shall be recorded to convert flow rate to standard conditions;

e) all measuring instruments shall be calibrated.

8.3 Test apparatus

The test apparatus is shown in Figure 1. The dimensions of the tank (key 3) shall be sufficient to allow a mean flow velocity of less than 0,5 m/s in the tank. All tank pressure data shall be recorded under these conditions.

The test pipe L_1 shall have a length of no more than 5D and a length no less than 1,5D of the test specimen. The tank penetration should be at a location of the tank where it is essentially flat and the rounding of the penetration shall be in accordance with a recognized national standard or International Standard to provide uniform pressure drop influence.

Vacuum valves shall have the flow direction reversed.

CAUTION — It should be observed that the blower or fan may cause oscillation in the system if the fan wings are not aligned or damaged. This should be avoided.

8.4 Flow measurements

8.4.1 Flow measurements for pressure-vacuum valves shall be made using the lowest and highest setting for the specific model. Flow charts for in-between settings may be interpolated.

NOTE If the setting can be changed without making any changes to the form and shape of the valve housing and the physical appearance of any component (e.g. by changing the magnet power, spring compression, etc.), this does not constitute a change of model. The spring wire diameter needs not be taken into consideration.

8.4.2 The pressure at which the valve opens shall be established using a flow rate resulting in a pressure rise no greater than 0,01 $N/mm^2/min$ (10 kPa/min or 0,2953 in Hg). The set-pressure is designated as P_{set} and shall be within ±3 % of the calculated set-pressure expressed as the correlation between the closing force and the area of the disc against which tank pressure is projected.

Note For certain tankers, there can be a specified minimum opening pressure that does not allow for negative tolerances in operation.

8.4.3 Depending on the device type, the flow measurement shall consist of the steps described in Annex B. See Annex G for corresponding examples of flow diagrams. For high velocity vents, during each of the measuring periods in accordance with Annex B, the average velocity of air through a cross section of the valve's outlet to atmosphere shall be recorded.

NOTE Manufacturers can choose to provide information regarding the dispersion of the discharged gas.

8.4.4 Flow graphs shall be drawn showing the readings from the steps specified in Annex B. Annex G provides examples of appropriate formats of flow graphs.