BS ISO 15364:2016

BSI Standards Publication

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

National foreword

This British Standard is the UK implementation of ISO 15364:2016. It supersedes BS ISO 15364:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee SME/32, Ships and marine technology - Steering committee.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2016

ISBN 978 0 580 80996 5

ICS 47.020.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2016.

Amendments/corrigenda issued since publication

Date	Text affected

BS ISO 15364:2016

INTERNATIONAL STANDARD

ISO 15364

Third edition
2016-04-15

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

Navires et technologie maritime — Soupapes de pression/dépression pour citernes à cargaison

Reference number
ISO 15364:2016(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 on 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 the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 8, *Ships and marine technology*, Subcommittee SC 3, *Piping and machinery*.

This third edition cancels and replaces the second edition (ISO 15364:2007), which has been technically revised.

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

1 Scope

This International Standard is applicable to pressure-vacuum relief valves protecting marine vessel systems, including cargo tanks, which may be subject to gas/vapour pressure or vacuum beyond the design parameters of the system/tank. This International 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 International Standard specifies design and in-service performance criteria, operational testing and maintenance requirements. Design or manufacturing in accordance with this International Standard 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.

This International Standard does not cover all test procedures for devices that prevent the passage of flame, such as flame arresters. Such devices can be used in conjunction with pressure/vacuum valves.

NOTE 1 Additional information for devices to prevent the passage of flame is found in the International Maritime Organization (IMO) "International Convention for the Safety of Life at Sea, 2009" (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.

NOTE 2 In addition to providing pressure relief, high velocity vent valves are devices that prevent the passage of flame. Where high velocity vent valves are installed on the pressure relief system and the vacuum relief valve is protected by a flame arrester, the standards of IMO MSC/Circ. 677, as amended, are applicable. ISO 16852 is also an acceptable test standard for devices to prevent the passage of flame.

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.

International Maritime Organization, Assembly Resolution A.746 (18), *Survey Guidelines under the Harmonized System of Survey and Certification*. International Maritime Organization, *International Convention for the Safety of Life at Sea (SOLAS)*, 2002, Chapter II-2, Regulation 4

International Maritime Organization (IMO), *International Convention for the Safety of Life at Sea (SOLAS)*, 2009

3 Terms and definitions

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

3.1
flame arrester
device to prevent the passage of flame, designed and tested in accordance with a specified performance standard

Note 1 to entry: Its flame-arresting unit is based on the principle of quenching.

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 may be one or more of the types defined below

3.3
full opening valve
design that opens fully at the set pressure

3.4
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)

3.5
maximum experimental safe gap
MESG
maximum clearance of the joint between two parts of the interior chamber of a test apparatus which, when the internal gas mixture is ignited and under specified conditions, prevents ignition of the external gas mixture through a 25 mm (1 in) long joint, for all concentrations of the tested gas or vapour in air

Note 1 to entry: IEC 60079-20-1 standardizes the test apparatus and the test method.

3.6
maximum verified pressure drop
largest pressure drop generated over a valve 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 designed to maintain pressure and/or vacuum in a closed container within preset limits

3.9
standard air
dry air at 21 °C (70 °F) and 1 013,25 hPa (29,92 in Hg) pressure

Note 1 to entry: This is substantially equivalent to a density of 1,2 kg/m^3 (0,075 lb/ft^3). Specific heat of dry air = 1 004,8 J/(kg.K) [0,24 Btu/(lb.°R].

3.10
third party inspection body
organization which is independent from the manufacturer or user and which performs or witnesses the tests and inspections provided for by this International Standard

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

3.12
verified drawings and diagrams
drawings and diagrams certified to be authentic and complete by the test laboratory issuing the test report in accordance with this International Standard

3.13
verified flow chart
pressure versus flow volume presented in a chart certified by the test laboratory issuing the test report in accordance with this International Standard

4 Symbols and abbreviated terms

D	nominal pipe diameter at device connection
D_{min}	minimum 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 test tank and the device for flow testing
L_2	pipe length between test tank and the device during non-oscillation testing
$P_{closing}$	pressure drop over the valve corresponding to the minimum flow required to keep the valve partially open with no contact between the disc and the seat
P_{max}	maximum pressure drop corresponding to the maximum flow volume (Q_3)
P_{set}	set pressure, expressed as the calculated force applied to the disc versus the area on which tank pressure is applied
$P_{1\text{-tpv}}$	pressure at which a transition point valve changes from modulating to full opening
$Q_{1\text{-fov}}$	flow volume needed to open the valve
Q_2	flow volume needed for the valve to remain fully open
$Q_{2\text{-fov}}$	flow volume needed to maintain the valve fully open at P_{set}
$Q_{1\text{-mv}}$	flow volume needed to open the valve
$Q_{2\text{-mv}}$	flow volume needed to maintain the 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 valve
Q_{close}	minimum flow required to keep the valve partially open with no contact between the disc and the seat
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/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 C). 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 Materials for connecting pressure-vacuum valves to their respective piping systems should meet standards for physical characteristics similar to those of the piping systems to which they are connected.

5.4 The possibility of galvanic corrosion shall be considered in the selection of materials (see Annex D for additional considerations).

5.5 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 air that may leak from the valve at 75 % of the nominal setting as determined by the manufacturer. See Annex I for suggested leakage rates.

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.

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. 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/International Standards may be used.

6.4 End-of-line 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. Devices shall be capable of operating in freezing conditions (such as may cause blockage by freezing cargo vapours or by icing in bad weather). Devices shall also be capable of operating at whatever surface temperature is developed by heating arrangements.

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 should contain appropriate information to ensure continued operation.

6.8 End-of-line devices are required to direct the efflux vertically upward (see SOLAS 2009, Ch. II-2 Regulation 4, 5.3.4.1.1.2) and the minimum average velocity of air 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 cannot remain in the open position. 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 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 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 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. 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.

7 Type tests

7.1 Type tests shall be conducted by a laboratory acceptable to a third party inspection body. The laboratory should be qualified 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 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 who can certify that the tests are conducted in accordance with this International Standard.

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 should be submitted for type testing. 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.

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 3 450 hPa 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.

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

7.2.4 An external ice test shall be conducted to verify the allowable accumulation of an external layer of ice at which the valve 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).

7.3 A test report with documentation for each prototype test shall be prepared by the laboratory. Further to the requirements given in ISO/IEC 17025:2005, 5.10.3, 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;

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

— an instruction manual provided.

8 Flow and velocity tests

8.1 Determination of capacity

The capacity of pressure and/or 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 8.2 to 8.4.

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

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 nominal diameter of the test pipe shall be of the same or larger size as 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 normal conditions;

e) all measuring instruments shall be calibrated.

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

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 $5 \cdot D$ and a length no less than $1{,}5 \cdot D$ 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 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 and/or 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 need not be taken into consideration.

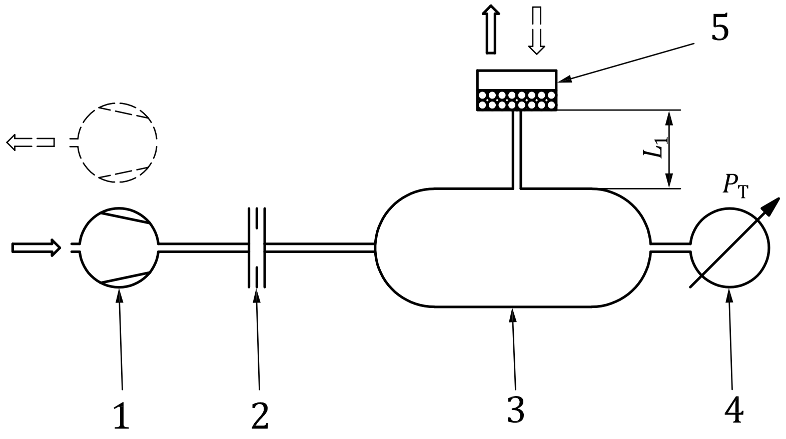
8.4.2 The pressure at which the valve opens shall be established using a flow rate resulting in a pressure rise no greater than 0,01 N/mm^2/min (10 kPa/min or 0,2953 in Hg). The set-pressure is designated as P_{set}, which shall be within ±3 % of the calculated set-pressure expressed as the correlation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

8.4.3 Depending on valve type, the flow measurement shall consist of the steps described in Annex B. See Annex F 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 may 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 described by Annex B, and in the appropriate format given in Annex F.

8.4.5 Flow testing shall be conducted adhering to the test rig provided in Figure 1. All instrumentation shall be calibrated and have an uncertainty of no more than ±5 %.



Key

1 blower or fan
2 flow meter
3 tank
4 pressure measurement
5 pressure/vacuum valve
L_1 length of connection pipe

NOTE Blower or fan flow is reversible depending on pressure or vacuum test.

Figure 1 — Flow test rig

9 Undamped oscillation tests

High velocity vents shall be tested for undamped oscillations. The test apparatus is shown in Figure 2. All instrumentation shall be calibrated.

This test shall be carried out with the lowest and the highest opening setting available for the particular model without a change of setting constituting a modification as defined in the note in 8.4.1.

If a closing pressure value is established to be satisfactory, valves of the same model with higher set pressure but the same closing pressure need not be tested.

The length and diameter of the pipe, L_2, and the volume of the tank shall be requested by the manufacturer.

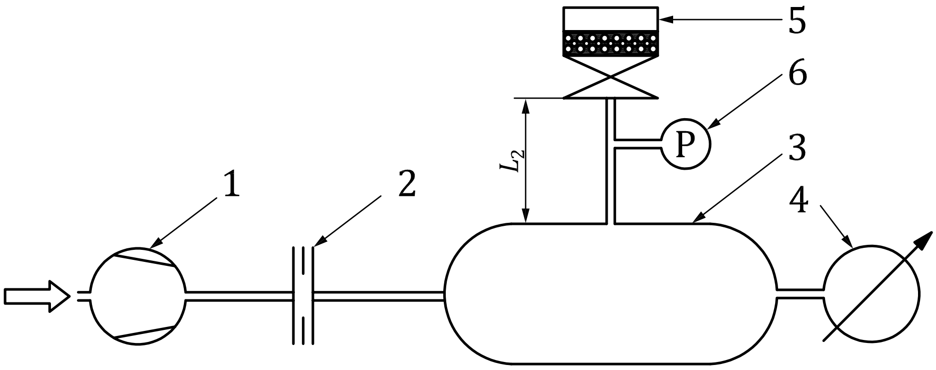
The tests shall be carried out for 3 min each at ten about-equally spaced flow rates starting at $0{,}2 \cdot Q_{close}$ and using this rate as the step width (maximum flow in this test: $2 \cdot Q_{close}$).

Some valve designs will perform open/close cycles that will cause periodic changes on the flowmeter reading (Figure 2). In these cases, the average flow recorded in the 3 min span shall reflect the step-value in question.

If the disc location sensor indicates contact with either seat or upper stops with a frequency of more than 0,5 Hz, the pipe length, L_2, shall be shortened until this value is not exceeded. That length shall be recorded as L_{max} and the diameter of the piping as D_{min} while the tank volume is recorded as V_{min}.

The use shall be limited to pipe length on the protected side not exceeding L_{max} and the diameter shall not be less than D_{min}, while the minimum pre-volume available at any time in the tank protected (ullage space) shall not be less than V_{min}.

For modulating valves, where there is no flow volume at the closing pressure, the first step shall start at 10 % of the flow volume, at which the valve is fully open.



Key

1 blower or fan

2 flow meter

3 tank

4 pressure measuring device

5 high velocity vent valve

6 pressure sensor

L_2 length of vent pipe

Figure 2 — Test rig for undamped oscillations

10 Production control and inspections

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.

Each finished device shall be visually and dimensionally checked to ensure that the device complies with this International Standard, including the specification information in Annex E and the markings in Clause 12. Special attention shall be given to the adequacy of welds and the proper fit-up of joints.

Each finished device shall be tested using air to verify that the leakage is below the maximum leakage rate specified according to 6.1.

The set pressure(s) of each finished device shall be tested with air and recorded.

11 Documentation

11.1 General

An instruction manual shall be provided. The instruction manual shall include the items described in Table 1 and 11.2.

Table 1 — Product data relevant for the specification information according to Annex E to be included in the instruction manual

Specification information	Purpose	A. Data location B. Description of test data/application note
1. Nominal pipe size, configuration of piping, and pipe length	Compliance with design parameters for tank pressure limits, and for high velocity vents, compliance with non-hammering conditions.	A: Type testing certificate. B: For high velocity vents: test records indicating piping limitations for safe, non-hammering performance [D_{min}, L_{max}, V_{min}]
2. Maximum gas density considered	Compliance with design parameters for tank pressure limits.	B: Convert to standard air.
3. Lowest MESG	Suitability for the application.	A: Type testing certificate. B: The lowest MESG
4. Set opening points for pressure and vacuum	Suitability for the application.	A: Type testing certificate. B: The upper and lower values applied during flow testing shall not be exceeded.
5. Maximum pressure drop	Compliance with design parameters for tank pressure limits and the selected opening setting of the device. In the case of transition point valves, the minimum pressure drop value to be used for pressure drop calculations is P1 according to Annex F, while the value relevant for a full-opening valve is $P_{closing}$ or higher depending on the required flow rate according to Annex E	A: Certified flow charts. B: The flow chart format shall show the maximum pressure drop over the valve for any flow volume. This value is essential for pressure drop calculations.
5a. Pressure drop at maximum flow	Compliance with design parameters for tank pressure limits and the selected opening setting of the device.	A: Certified flow charts. B: The flow chart shall show the pressure drop over the valve at the maximum required flow rate to be established.
6. Minimum reseating pressure	Suitability for the application with regard to minimizing the loss of cargo vapour.	A: Certified flow charts. B: The flow chart format shall indicate the reseating pressure
7. Maximum and minimum ambient temperature	Suitability for the application.	A: Instruction manual. B: The manufacturer's recommendations shall not be exceeded.
8. Materials of construction	Suitability for the application.	A: Verified drawing. B: The combination of materials chosen may not have lower corrosion resistance than the version tested. The drawing shall include a bill of materials in accordance with Clause 5.
9. Surface treatment and coating	Suitability for the application.	A: Instruction manual. B: The surface treatment and coating, if any, shall be decided by the buyer with due consideration to Annex D.
10. Maximum gas flow in standard air, pressure drop of the piping system, and maximum tank pressure	Suitability for the application and compliance with design parameters for tank pressure limits, alarms, liquid-filled breakers, filling limitations for high density cargoes	A: Certified flow chart. B: The maximum tank pressure allowed in normal operations less an appropriate fouling factor and margin for alarm and breaker settings, etc., shall not be exceeded when calculating the combined pressure caused by the valve and the pressure drop over the piping system.

Table 1 *(continued)*

Specification information	Purpose	A. Data location B. Description of test data/application note
11. Maximum outer ice layer thickness for check-lift operation	Suitability for the application.	A. Type testing certificate. B. Due consideration shall be given to vessel service conditions and facilities available for on-deck de-icing before cargo operations and during voyage.
12. For high velocity vents: the minimum average velocity required for cross section of the valve's outlet to atmosphere	Suitability for the application.	A: Recorded in test report. B: The ability to disperse gas above deck relates to the velocity through the cross section of the valve's outlet to atmosphere.
13. Maximum air leakage rate	Suitability for the application.	A: Instruction manual. B: The verified product data shall state the maximum leakage rate expressed in air of a new valve at 75 % of the nominal setting. The leakage rate is expected to increase over time.
14. Warning regarding accumulation of ice	Suitability for the application.	A warning to the operator shall be in the instruction manual, noting that significant ice accumulation may prevent proper operation of the valve.
15. Use of resilient seals, where employed	Suitability for the application	A: Instruction manual B: Inspection and maintenance of installed resilient seals

11.2 Installation instructions

a.) Operating instructions, including any service restrictions imposed for safe functioning of the device.

b) Maintenance requirements, including information on maintenance of any corrosion prevention system (see Annex D).

c) Instructions on when cleaning is required due to the inside build-up of residue. The instruction manual shall also describe the method for cleaning using a diagram.

d) Verified exploded view drawings with indication for each component as to the order of disassembling and re- assembling for inspection, cleaning, repair or removal of internal elements for replacement. The design shall not allow the valve to be incorrectly reassembled following inspection, cleaning or repair, be it due to wrong order of parts or missing parts. Information on sizes for all components shall be included on the drawings to ensure that the specified gas-tightness is achieved, and for the valve to be restored to the original, as-purchased condition with regard to set pressure and flow rate.

e) Full work descriptions, including drawings, on how replacement of wearing parts is achieved in-service without removing the valve.

f) Instructions for the user to check valve lift prior to each cargo loading and cargo unloading operation in order to

   1) verify unobstructed movement of the moving parts, and

   2) ensure that fouling conditions are controlled to establish safe operation and full capacity.

   A diagram shall be included which shows the parts either moved or cleared when the check-lift is operated.

g) The test reports.

12 Marking

Each device shall be permanently marked indicating the following:

a) manufacturer's name or trademark;

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

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

d) serial number;

e) direction of flow through the device;

f) test laboratory and report number(s);

g) pressure and vacuum setting;

h) ISO designation of this International Standard, i.e. ISO 15364.

If the set-pressure is changed, the marking shall be updated accordingly.

13 Quality assurance

a) 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. No changes or modifications are allowed without adhering to 7.2.

b) 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 delivered with this International Standard designation that does not meet the requirements herein.

Annex A
(normative)

Installation requirements for ships subject to the International Convention for the Safety of Life at Sea, 2009 (SOLAS)

A.1 General

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, 2009 (SOLAS), Chapter II-2, Regulation 4, 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), 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, should be fitted when necessary, with provisions allowing for inspection of inside accumulation of cargo residue and parts replacement. The instruction manual for the device shall include diagrams showing the weight of all parts over 10 kg (22 lb) that need be dismounted for inspection, cleaning and replacement of wearing parts, so that precautions for crane support can be allocated, if necessary, and appropriate working schedules are prepared.

Annex B
(normative)

Flow test measurements

B.1 General

Depending on valve type, the flow measurement shall consist of the following steps (see Annex F for corresponding diagrams).

B.2 Transition point valves

a) The opening phase from shut to the transition point where the valve characteristics change from modulating to full open.

b) The flow rate, for which the pressure does not rise above the minimum level required for the valve to remain fully open.

c) The maximum intended pressure drop over the valve.

d) The closing phase from fully open at the maximum intended pressure drop to shut.

Step 1:

The flow measurement is made to establish the maximum pressure drop of the valve and the corresponding flow rate, at which the valve characteristics change from modulating to full open (transition point). This intersection is designated as $P_{1\text{-tpv}}$ and $Q_{1\text{-tpv}}$. Ten equally spaced pressure measurements between zero capacity and $Q_{1\text{-tpv}}$ shall be recorded. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

Step 2:

The flow measurement is made to establish the flow rate needed for the valve to remain fully open at $P_{1\text{-tpv}}$. This intersection is designated $Q_{2\text{-tpv}}$. On the flow chart representation a horizontal line shall be drawn from $Q_{1\text{-tpv}}$ to $Q_{2\text{-tpv}}$.

Step 3:

The flow measurement is made to establish the flow rate corresponding to the maximum intended pressure drop over the valve. This is designated P_{max} and Q_3. Ten equally spaced flow measurements between $Q_{2\text{-tpv}}$ and Q_3 shall be recorded. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

Step 4:

The flow measurement is made to establish the closing pressure of the device, P_{closing}. The flow range between Q_3 and the flow value corresponding to P_{closing} shall be divided into ten equally spaced flow rates. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

B.3 Full opening valves

a) The opening phase from shut to where the valve is constantly fully open.

b) The maximum intended pressure drop over the valve.

c) The closing phase from fully open at the maximum intended pressure drop to shut.

Step 1:

The flow rate needed to open the valve, $Q_{1\text{-fov}}$, shall be ignored for the purpose of the flow chart. The flow measurement is done to establish the flow rate needed for the valve to remain fully open at P_{set}. This intersection is designated $Q_{2\text{-fov}}$. On the flow chart representation a horizontal line shall be drawn from $Q_{1\text{-fov}}$ to $Q_{2\text{-fov}}$ horizontally from P_{set}.

Step 2:

The flow measurement is made to establish the flow rate corresponding to the maximum intended pressure drop over the valve. This is designated P_{max} and Q_3. Ten equally spaced flow measurements between $Q_{2\text{-fov}}$ and Q_3 shall be recorded. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

Step 3:

The flow measurement is made to establish the closing pressure of the device, $P_{closing}$. The flow range between Q_3 and the flow value corresponding to $P_{closing}$ shall be divided into ten equally spaced flow rates. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

B.4 Modulating valves

a) The opening phase from shut to the maximum intended pressure drop over the valve.

b) The closing phase from fully open at the maximum intended pressure drop to shut.

Step 1:

The flow rate needed to open the valve, $Q_{1\text{-mv}}$, and the flow rate needed for the valve to remain fully open, $Q_{2\text{-mv}}$, shall be ignored for the purpose of the flow chart. The flow measurement is made to establish the flow rate corresponding to the maximum intended pressure drop over the valve. This is designated P_{max} and Q_3. Ten equally spaced flow measurements between zero capacity and Q_3 shall be recorded. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

Step 2:

The flow measurement is made to establish the closing pressure of the device, $P_{closing}$. The flow range between Q_3 and the flow value corresponding to $P_{closing}$ shall be divided into ten equally spaced flow rates. Each flow increment shall be maintained under stabilized conditions for at least 5 s with logged flow and corresponding pressure readings at least 10 times per second.

B.5 Dual nozzle valves

To be carried out in accordance with the appropriate valve characteristics as specified above in B.1 to B.4.

Annex C
(informative)

Materials selection guidelines

C.1 General

The purpose of these guidelines is to recommend general criteria for the selection, application and maintenance of materials used in the 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 selection of equipment is based on the specification information provided by the buyer in accordance with Annex D. The manufacturer shall provide details to the buyer on the necessary system to ensure an adequate level of corrosion protection of the pressure/vacuum valves.

C.2 Selection of materials

The materials chosen for the construction of pressure/vacuum valves shall 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 cargoes), cast iron, ductile iron, bronze and different grades of stainless steel may be used. Refer to Clause 5 for allowed use of non-metallic parts. 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.

The working conditions can negatively influence the lifetime of the wearing parts as a consequence of frequent seat and disc contact due to the following:

a) oversizing, which prevents the valve from opening fully during normal operation;

b) excessive maximum pressure drop over the valve, which keeps the lift of the disc reduced at low filling rates;

c) inadvertent relation between the venting rate during normal operations and the valve’s transition point, where it becomes fully open.

Annex D
(informative)

Corrosion protection guidelines

D.1 Corrosion protection systems

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

Available methods 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 carried out with the same coating system originally used, provided the surface treatment and working conditions required for a satisfactorily result are obtainable. The valve manufacturer shall furnish, with the instruction manual, instructions for carrying out repair works on the corrosion protection system including details on surface treatment, procedures, and type of coatings allowed.

D.2 Selection of corrosion protection system

In selecting the corrosion protection system, the parties involved should consider the current situation, foreseeable service conditions and planned maintenance programme. The following aspects should be considered:

— current 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 temperatures;

— aspired durability;

— maintenance features.

D.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

a) epoxy formulations for high surface protection, and

b) combinations of natural or synthetic oils and grease formulations containing corrosion inhibitors.

Observing the coating process and in-service inspection is best served by using a light-coloured coating.

The provided technical product data sheet and job specification should be carefully followed, including required ambient and working conditions.

A record of the ambient and working conditions during the coating application process should be entered.

D.4 Surface preparation

The performance of a coating system is highly affected by the condition of the treated surface. Over time, the grade of surface preparation has a direct influence on the selection of protective coatings and their performance.

Recognized National or International Standards for good practice concerning methods for surface preparation should be observed along with the manufacturer's recommendations.

Possible surface preparation methods include the following:

— blast cleaning;

— hand and power tool cleaning;

— flame cleaning;

— high pressure water blasting;

— electrolytic cleaning.

The method chosen should take into consideration the necessary requirements for cleanliness, humidity and grade of surface preparation.

Remaining particles such as blasting abrasives, dust, rust flakes and water should be removed as appropriate. A record of the result of the surface preparation should be entered.

D.5 Application

The application of a coating should be carried out in accordance with the manufacturer's recommendations.

Coatings, liquid or powders may be applied by spraying under documented working conditions. Additional repair work, if required, should be applied by brush or roller.

Each coating layer should have the maximum/minimum thickness required in accordance with the job specification. Eighty percent of all measurements should be higher than or equal to the nominal coat thickness, and none of the balance should be below 80 % of the required nominal thickness.

Depending on the type of coating, the thickness may be measured either on wet or dry surfaces.

Instructions should indicate the dry-to-recoat periods and limits of ambient conditions during the application process.

D.6 Testing

Destructive testing should be avoided.

Coat thickness testing should be carried out after each coat layer is applied, by means of appropriate thickness gauges.

D.7 Inspection

Surface preparation and coating application should be inspected as relevant in accordance with prior agreement between the parties involved. Inspections should be logged in an agreed format to be signed at the conclusion of each stage of the process. Items to be inspected may include the following:

— working conditions;

— ambient conditions, i.e. temperature and humidity;

— surface preparation processes;

— coating application equipment;

— thickness of layers drying period for the different layers;

— final drying time;

— coating repairs.

During inspection, defective areas should be marked and appropriately repaired.

D.8 Maintenance

D.8.1 A corrosion protection system should be maintained throughout the lifetime of the valves. Maintenance should be in accordance with the manufacturer’s recommendations for the most effective way to preserve the efficiency of the corrosion protection system.

D.8.2 The type of cargo carried should be taken into consideration when deciding for the appropriate maintenance schedule. Factors that may influence the frequency of maintenance are the following:

— chemical aggressiveness of the cargoes and tendency of cargo vapour to crystallize;

— valve design features allowing condensate to accumulate;

— valve designs sensitive to seizing if free passage is hindered at certain narrow passages;

— valve designs where the proper function depends on the free through-passage of ingress water (rain or sea water) and vapour condensate through drains or drain valves;

— valve designs where the condition of the gas passage way cannot be examined visually without dismantling;

— valve designs where the gas passage way cannot be cleaned without dismantling.

D.9 General inspections of in-service equipment

The lasting effectiveness of the corrosion protection system and the function of the valves in general shall be monitored throughout the service life of the valves.

Assessment of the condition of the valves should be carried out regularly reflecting the items and conditions listed in 8.2.

Hard coatings shall be assessed by monitoring any localized breakdown that should indicate accelerated corrosion.

Annex E
(informative)

Specification information

In order to allow manufacturers to provide the end-user with a suitable pressure/vacuum valve, the manufacturer shall be provided with sufficient information. This Annex contains typical elements of such information. Specifications for devices under this International Standard should include the following information:

a) nominal pipe size, configuration of piping and pipe length;

b) maximum gas density;

c) maximum gas evolution factor;

d) lowest maximum experimental safe gap (MESG);

e) set opening points for pressure and vacuum;

f) maximum pressure drop allowed over the device at any flow rate;

g) reseating pressure;

h) maximum and minimum ambient air temperature;

i) materials of construction, in particular the wearing parts mentioned in Annex C, and information on the anticipated pH-value of the environment anticipated and the desired service lifetime of the wearing parts;

j) surface treatment and coating considerations (from Annex D);

k) maximum gas flow converted into standard air, the design pressure drop of the piping system and the maximum allowed operating tank pressure range;

l) maximum allowed contribution of pressure drop generated over the valve at the larger of either full flow or the maximum pressure drop;

m) maximum outer ice-layer thickness permitted for proper operation;

n) whether heating is required to prevent crystallization of certain cargoes;

o) for high velocity vents, the minimum average velocity required for a cross section of the valve's outlet to atmosphere.

The information provided shall include the specifications by reference to a recognized National or International Standards on materials of construction for the following components (see Clause 5 for additional details):

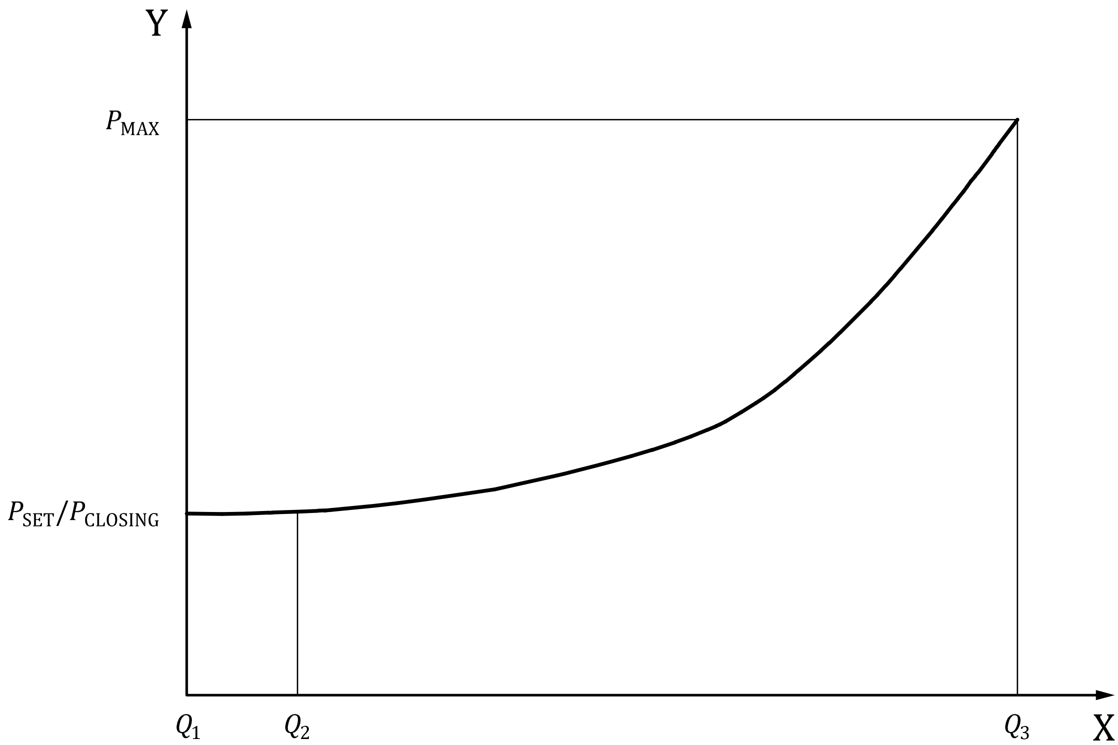
— housing and bolting;

— discs, spindles, seats, springs, gaskets, seals, flame arresting components.

Annex F
(informative)

Flow graph examples

Flow graphs issued in accordance with Clause 9 should appear as shown in Figures F.1 to F.4, indicated for each type.

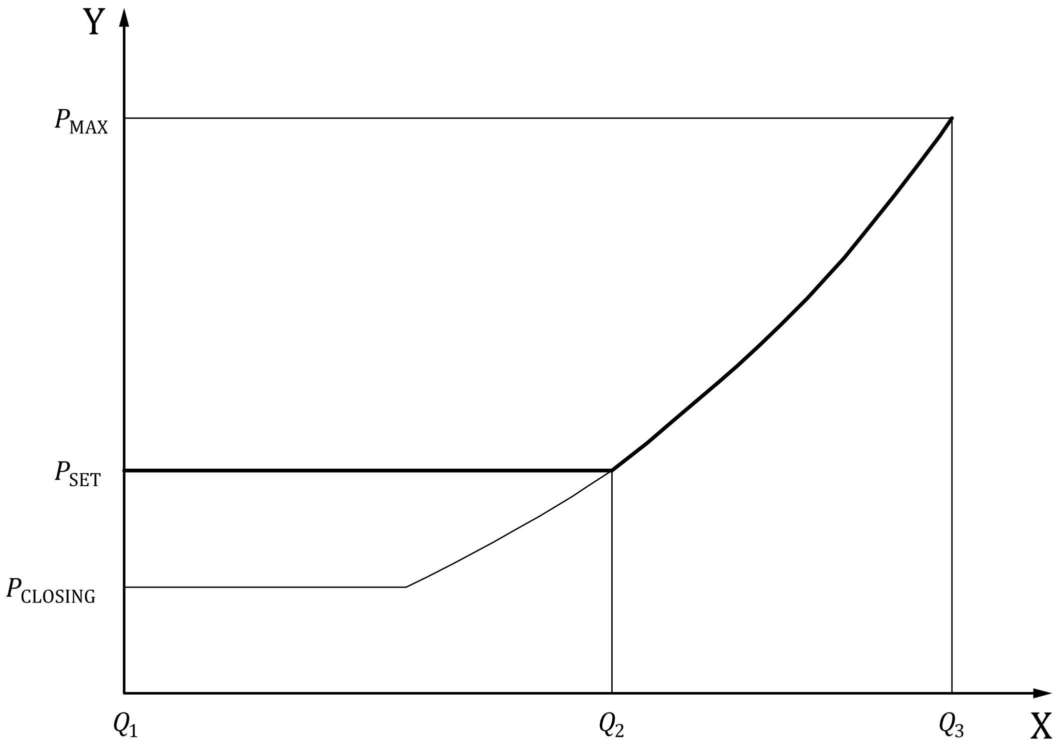


Key

X volume flow

Y pressure

Figure F.1 — Flow for modulating valves

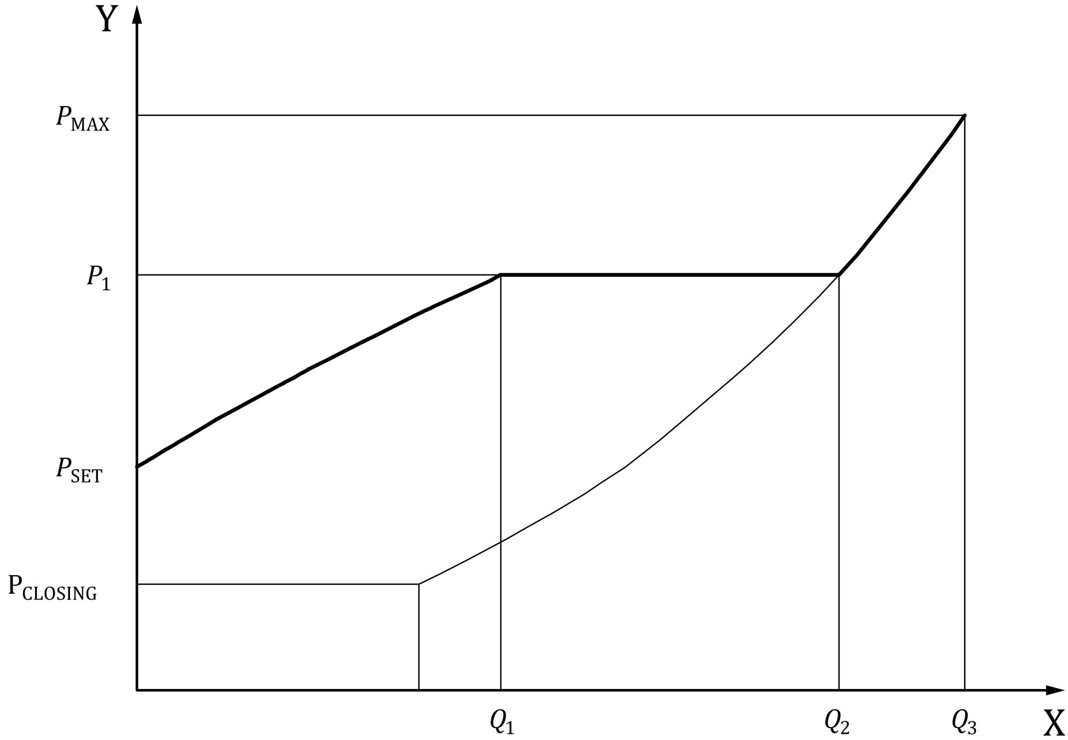


Key

X volume flow

Y pressure

Figure F.2 — Flow for full opening valves

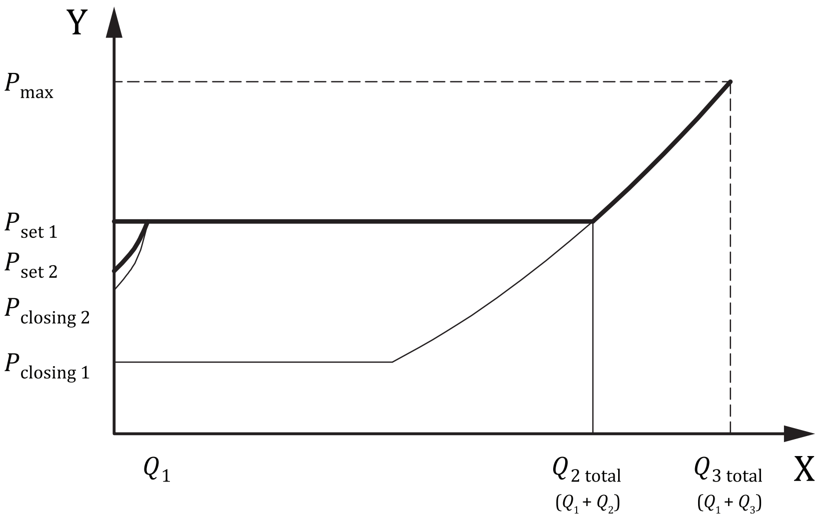


Key

X volume flow

Y pressure

Figure F.3 — Flow for transition point valves



Key

X volume flow

Y pressure

Figure F.4 — Flow for dual nozzle valves

Annex G
(informative)

Relevant issues for reduction of volatile organic compound (VOC) losses during cargo handling

G.1 General

The purpose of these guidelines is to recommend general criteria for the selection and application of valves with a view to minimize loss of tank vapour during normal cargo handling, in particular during voyage.

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.

G.2 Beneficial valve characteristics to minimize VOC loss and Inert Gas topping-up

In order to achieve as high a tank pressure as safely possible, IMO MSC/Circ. 680 section 1.4.2 and 1.4.3, reads:

Section 1.4.2: the ship should define a target operating pressure for the cargo tanks, which should be as high as safely possible and the ship should aim to maintain tanks at this level during the loading and carriage of relevant cargo

Section 1.4.3: when venting to reduce tank pressure is required, the decrease in the pressure in the tanks should be as small as possible to maintain the tank pressure as high as possible

The following issues should be considered when valve designs are considered for selection:

Set-pressure: As high as safely possible with due consideration for any pressure increase required for the valve to attain a stable, full-open position during normal operations.

Closing pressure: As high as possible to minimize the gas volume vented in each venting cycle.

Vent line arrangement: With a minimum of pressure drop in order to facilitate a higher closing pressure (non- oscillation considered) and thereby reduced VOC loss in each venting cycle.

Annex H
(informative)

Sizing guidelines

Working conditions may negatively influence the lifetime of the wearing parts as a consequence of frequent seat and disc contact due to the following:

Over-sizing:

If the venting capacity of the valve exceeds the true venting requirements based on the loading rate, gas growth rate, and the appropriate density compensation, increased open/shut cycles will occur and the valve will be prevented from assuming a stable, full-open position during normal operation.

Excessive maximum pressure drop of the valve:

In the case of transition point valves, the flow rate necessary to bring the valve to be full-open during normal operation may be too large and cause excessive open/shut cycles, especially under the influence of long and/or narrow diameter vent lines.

Excessive pressure drop over the vent line:

Save for modulating valves, the pressure drop over the vent line should be lower than the valve's blow-down in order to ascertain that the valve can assume a stable, full-open position during normal operation.

NOTE Blow-down refers to the difference between the valve's set pressure, $P_{set,}$ and closing pressure, $P_{closing}$.

Annex I
(informative)

Suggested guidelines for valve leakage

Table I.1 is provided as guidance on limiting leakage from newly manufactured valves

Table I.1 — Maximum allowable leakage rates (according to API 2000/ISO 28300)

Vent size mm (in)	**Maximum allowable leak rate** m3/h (CFH)
≤150 (6)	0,0142 (0,5)
200 to 400 (8 to 12)	0,1416 (5,0)
>400 (12)	0,5663 (20,0)

NOTE 1 Vent size refers to the rated diameter (inner diameter) of the connecting flange.

NOTE 2 Leakage rates established by ISO 4126-4 may also be acceptable.

If greater seat tightness is required, the purchaser shall specify this in the purchase order.

Bibliography

[1] ISO 4126-4, *Safety devices for protection against excessive pressure — Part 4: Pilot operated safety valves*

[2] IEC 60079-1, *Explosive atmospheres — Part 1: Equipment protection by flameproof enclosures 'd'*

[3] 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

ICS 47.020.30
Price based on 27 pages

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.