Guideline No. P-06 (202508)

P-06

HIGH-VELOCITY VENT VALVE

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Foreword

China Classification Society (hereinafter referred to as CCS) Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed service@ccs.org.cn.

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Main changes:

1) Full-text proofreading: Updated standard version numbers and unit descriptions;

2) Updated and clarified ISO 15364:2021 as the referenced standard; added IMO MSC.1/Circ.677/Rev.1 and ISO 16852:2016 as referenced standards; removed the note in the original Clause 1.11;

3) Modified the definition of standard conditions in Clause 3.2 (8);

4) Removed the leakage rate requirement at 80% of the set pressure; added standard conditions for converting the maximum allowable leakage rate;

5) Removed the requirement from the old standard in Clause 7.2 (13) for a drain hole on the atmospheric outlet side;

6) Added "satisfying Clause 7.7 (3) for non-metallic diaphragms" to Clause 7.3 (4);

7) Added performance requirement for maximum allowable leakage in Clause 7.4 (8);

8) Added "This manual method shall be applicable to the valve's own components and shall be operable without adding or removing parts." to Clause 7.7 (1); removed references to Appendix C from the old version of ISO 15364;

9) Added in Clause 7.8 (1) the requirements for instructions for use in ISO 15364:2021;

10) Updated the standard name in Clause 7.9 (9);

11) Clarified in Clause 9.3 (1) that the test requirements apply specifically to high-velocity vent valves; other flame arresters may refer to these requirements for implementation;

12) Modified test items in Clause 9.3③; added the undamped oscillation test in Clause 9.3⑩;

13) Modified the test name and description in Clause 9.4 (3);

14) Modified the description of the flow test in Clause 9.4 (4) and removed requirements from the old version of ISO 15364; added a schematic diagram of the flow test setup; removed the requirement for opening/closing pressure differential; added requirements for flow-pressure testing and graphical recording;

15) Updated all schematic diagrams and reference labels;

16) Clarified in Clause 9.4 (5) that flame arresters other than high-velocity vent valves shall meet the test requirements in Appendix C of ISO 15364:2021;

17) Modified Clause 9.4 (6)②(c) to specify that the opening pressure of the vent valve shall be recorded;

18) Added requirements and a schematic diagram for the undamped oscillation test to Clause 9.4 (6)③;

19) Clarified in Clause 9.4 (6)④ that no flashback or flame propagation shall occur during the

relevant tests;

20) Specified that relevant tests for high-velocity vent valves in the Guidelines shall be considered to have satisfied the verification for low-flow flashback and open/close flashback in ISO 16852:2016;

21) Removed the description in Clause 9.4 (6)④ (c) regarding additional tests required to comply with ISO 15364:2021;

22) Modified the test method for the external icing test in Clause 9.4 (8);

23) Removed the description in Clause 9.4 (12) regarding the additional requirement for an undamped oscillation test;

24) Added in Clause 9.6 (3) that the test report shall include the flow curve;

25) Specified the content to be recorded in the type approval certificate;

26) Modified the content of single item/batch survey in Clause 10.3 (3).

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HIGH-VELOCITY VENT VALVE

1 Application

1.1 The Guidelines cover the design, testing, installation, and maintenance requirements for devices preventing the passage of flame into liquid cargo tanks (hereinafter referred to as "the devices"), including high-velocity vent valves, pressure/vacuum valves, and vent covers. They apply to devices intended to be fitted on the liquid cargo tank venting systems of oil tankers and combination carriers classed with CCS, carrying crude oil and petroleum products with a flashpoint of 60°C (closed cup) or less and a Reid vapor pressure below atmospheric pressure, and other cargoes with similar fire hazards. The devices serve a protective function when the gas/vapor pressure or vacuum in a liquid cargo tank exceeds the design parameters of the system/tank.

1.2 Oil tankers and combination carriers fitted with an inert gas system complying with SOLAS Chapter II-2 shall be fitted with devices meeting the requirements of the Guidelines, but need not meet the test requirements of Clauses 9.4(5)③ and 9.4(6) ③ (b) herein. Unless such devices satisfy the test requirements of Clause 9.4(7) herein, they shall only be installed at openings.

1.3 The Guidelines apply to devices protecting cargo tanks carrying crude oil, petroleum products, and flammable chemicals. For chemical cargoes, the test media mentioned in Clause 9 of the Guidelines may be used for cargoes with a maximum experimental safe gap (MESG) (refer to IEC 60079, Electrical apparatus for explosive gas atmospheres) greater than or equal to 0.9 mm. However, for devices intended for dedicated chemical tankers carrying products with an MESG less than 0.9 mm, testing shall be conducted with the following test media based on the equipment group (explosion group) in Column i" of Chapter 17 of the IBC Code:(1) Equipment group (explosion group) IIB – Ethylene (MESG = 0.65 mm);(2) Equipment group (explosion group) IIC – Hydrogen (MESG = 0.28 mm).

For cargoes not assigned a specific grade in Column i" of Chapter 17 of the IBC Code, testing shall be conducted in accordance with the requirements for equipment group (explosion group) IIB.

The concentration of test gas shall be selected as specified in IEC 60079-1-1.

1.4 High-velocity vent valves, pressure/vacuum valves, and other devices shall be tested and installed in accordance with the requirements of the Guidelines.

1.5 High-velocity vent valves, pressure/vacuum valves, and other devices are installed to protect:

(1) Openings intended for relieving pressure or vacuum due to temperature variations;

(2) Openings intended for relieving pressure or vacuum generated during cargo handling and ballast water operations;

(3) Outlets intended for degassing.

1.6 Unless high-velocity vent valves, pressure/vacuum valves, or other devices are tested in their bypass or opening-blocked positions according to the requirements of Clause 9 of the Guidelines, they shall not be capable of being bypassed or having their openings blocked.

1.7 Due to insufficient data used in formulating the technical requirements for high-velocity vent valves, pressure/vacuum valves, and other devices, the Guidelines do not consider ignition sources (e.g., electrical sparks). All cargo handling, tank washing, and ballasting operations shall cease prior to the onset of thunderstorms.

1.8 The Guidelines do not consider the possibility of flame propagation from one liquid cargo tank to another through a common venting system.

1.9 When devices are required to protect the outlet openings of degassing systems on oil tankers not fitted with an inert gas system, they shall comply with the Guidelines, except that the tests specified in Clauses 9.4(5) ③ and 9.4(6) ③ (b) are not required.

1.10 Some tests described in Clause 9 of the Guidelines are potentially hazardous. However, the Guidelines do not specify safety requirements for these tests. Testing organizations shall bear full responsibility for the safety of the tests.

1.11 The latest requirements of the competent authority of the flag state shall be taken into consideration.

1.12 Other types of flame arresters and their applications may also refer to the applicable parts of the Guidelines.

2 Normative References

2.1 The following are the bases for approval and survey adopted in the Guidelines:

(1) International Convention for the Safety of Life at Sea, 1974 and its amendments (hereinafter referred to as SOLAS)

(2) IMO MSC/Circ.1009: Amendments to the Revised Standards for the Design, Testing and Location of Devices to Prevent the Passage of Flame into Cargo Tanks in Tankers (MSC/Circ.677)

(3) IMO MSC/Circ.677: Revised Standards for the Design, Testing and Location of Devices to Prevent the Passage of Flame into Cargo Tanks

(4) ISO 15364:2021: Ships and marine technology — Pressure/vacuum valves for cargo tanks and devices to prevent the passage of flame into cargo tanks

(5) CCS Rules for Classification of Sea-going Steel Ships

(6) CCS Rules for Construction of Inland Waterways Steel Ships

(7) CCS Rules for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk

(8) CCS Rules for Construction and Equipment of Inland Waterways Ships Carrying Dangerous Chemicals in Bulk

(9) IMO MSC.1/Circ.1324: Amendments to the Revised Standards for the Design, Testing and Location of Devices to Prevent the Passage of Flame into Cargo Tanks (MSC/Circ.677, as amended by MSC/Circ.1009)

(10) IMO MSC.1/Circ.677/Rev.1: Revised Standards for the Design, Testing and Location of Devices to Prevent the Passage of Flame into Cargo Tanks

(11) ISO 16852:2016: Flame arresters — Performance requirements, test methods and limits for use.

2.2 The provisions of the above approval and survey bases are incorporated into the Guidelines by reference. For dated references, any subsequent amendments (excluding corrigenda) or revisions are not applicable to the Guidelines. Therefore, the latest version of these documents shall be satisfied in the design, manufacture, and survey of products. For undated references above, the latest edition applies.

3 Terms and Definitions

3.1 The terms and definitions given in the SOLAS Convention and the CCS Rules for Classification of Sea-Going Steel Ships apply to the Guidelines.

3.2 The following definitions are added for the Guidelines:

(1) Flame arrester

A device that prevents the passage of flames in accordance with specified performance standards. Its flame-arresting element is based on the principle of flame quenching.

(2) Flame screen

A device that uses wire mesh to prevent the passage of free flames and meets specified performance standards.

(3) Flame speed

The speed at which a flame propagates along a pipeline or other systems.

(4) Flashback

The propagation of flames through equipment.

(5) High-velocity vent

A device designed to prevent the passage of flame, consisting of a mechanical valve that adjusts the flow opening in relation to inlet pressure to ensure an exit gas velocity not less than 30 m/s (98 ft/s) to prevent flame passage.

(6) Pressure/vacuum valve

A device used to maintain the pressure or vacuum within predetermined limits in a closed container, and designed and tested according to the requirements of the Guidelines as a device to prevent the passage of flame.

(7) Passive flame stopper

A device which complies with specified performance standards and, when installed, prevents the passage of free flame, such as a flame screen or flame arrester.

(8) Standard conditions

Dry air at a temperature of 288.15 K (15°C, 59°F) and a pressure of 101.325 kPa.

(9) Maximum experimental safe gap (MESG)

The maximum gap between the two parts of the interior chamber of a test apparatus, which, on internal ignition of a combustible mixture and under specified conditions, prevents ignition of an external gas mixture by the burning gases escaping through a 25 mm long gap, and is applicable to all concentrations of the tested gas or vapor in air. The MESG is a characteristic of the gas mixture. (See IEC60079-1-1)

(10) Deflagration

An explosion propagating at subsonic velocity.

(11) Detonation

An explosion propagating at supersonic velocity, characterized by a shock wave.

(12) Pressure setting

The pressure at which the valve disc lifts rapidly from the closed position to the fully open position, unless otherwise specified or indicated.

(13) Rated flow

The standard air flow rate for a pressure valve at 0.021 MPa and for a vacuum valve at -0.007 MPa, unless otherwise specified or indicated.

(14) Dual nozzle valve

A pressure relief valve combining two high-velocity vents with different orifices into a single valve.

4 Drawings and Documentation

4.1 An applicant shall submit the following drawings and technical documents conforming to the design requirements of the Guidelines to CCS for review when initially applying for type approval and drawing review of products such as high-velocity vent valves:

(1) Product main specification and performance parameter table (which may be included in the general assembly drawing), typically including:

① Set pressure of pressure valve (P) (MPa);

② Set pressure of vacuum valve (V) (MPa);

③ Nominal diameter;

④ Rated flow (m^3/h) for pressure valve/vacuum valve, gas freeing cover, and other devices; usually also including maximum rated pressure, design minimum throttling discharge velocity, and maximum gas leakage rate at 75% of the nominal set opening pressure (expressed as volume under standard conditions, m^3/h);

⑤ Product model;

⑥ Intended use and applicable medium of the product;

⑦ Maximum heating temperature of the heating device and heating medium (if equipped), etc.

(2) Product general assembly drawing, typically clearly showing:

① The interrelationship of components, such as the body, disc, seat, seals, flame screen, drain valve, valve core lifting mechanism and counterweights, and deflector;

② Materials of main components, such as body, disc, seat, spindle, bush, seals, flame screen, deflector, and counterweights;

③ Relevant technical requirements for product manufacturing, installation, and survey;

④ Main technical parameters of the product;

⑤ Outline and installation dimensions.

(3) Drawings of the following main components:

Body, disc, seat, spindle/shaft, seals (if manufactured in-house), flame screen assembly, deflector, etc.

(4) Product operation and maintenance manual, typically including the following contents, and meeting the requirements of Clause 7.8 of the Guidelines:

① Specifications and standards the product design complies with, and the product's scope of application;

② Main technical parameters of the product; e.g., allowable ice thickness and material combinations of the product;

③ Working principle of the product (attached with relevant schematic diagram);

④ Installation instructions for the product;

⑤ Operating instructions;

⑥ Maintenance requirements;

⑦ Necessary test reports;

⑧ Flow test data;

⑨ Manufacturer's certificate of conformity;

⑩ Necessary safety warnings;

⑪ Emergency procedures for failures.

(5) Type test/survey outline, clearly stating:

① Test items and acceptance criteria;

② Test methods;

③ Requirements for testing equipment and instruments;

④ Requirements for test environmental conditions;

⑤ Requirements for test gases;

⑥ Safety requirements during the test, etc.

(6) Physical and chemical property (standard) data sheets for main component materials (e.g., if non-standard or non-Chinese standard materials are used for body, disc, seat, spindle/shaft, bush, seals, flame screen, deflector, etc.);

(7) Main process documents (if applicable), etc.;

(8) The manufacturer's relevant information:

① Factory profile: name, address, production history, production capacity, technical and survey personnel, main products, affiliation, product trademarks, etc.;

② Details of products applied for approval;

③ Main production equipment;

④ Main testing equipment;

⑤ Brief production process of the product applied for approval;

⑥ Quality management documents;

⑦ Business registration certificate;

⑧ Qualification certificate and/or production license;

⑨ Sample of product quality certificate;

⑩ Quality control plan, if applicable.

4.2 The manufacturer's relevant information mentioned in the preceding clause and product manufacturing process (casting, welding, heat treatment, testing, etc.) documents (if applicable) shall be submitted directly to the CCS unit responsible for product type approval in the jurisdiction of the manufacturer.

5 Materials and Components

5.1 Components of high-velocity vent valves, pressure/vacuum valves, and vent covers:

(1) Pressure valve (P valve): e.g., valve body, P valve disc, counterweights or similar components (installed as needed), P valve seat, spindle/shaft, bush, seals, manual lifting device, deflector, drain valve;

(2) Vacuum valve (V valve): e.g., body, V valve disc, counterweights (as required), V valve seat, push handle and spindle/shaft, flame screen, seals;

(3) Vent cover (installed as needed): e.g., valve cover, flame screen, seals;

(4) Auxiliary devices (installed as needed): e.g., heating/de-icing, crystallization dissolution, and cleaning devices;

5.2 The following purchased components (if any) shall be accompanied by the manufacturer's quality certificate, meet the requirements of relevant CCS rules and CCS recognized standards, and be suitable for their intended use:

(1) Materials for the body, valve core, and seat;

(2) Information on the flame screen to determine its material, wire diameter, mesh size, and number of layers, etc.

6 Welding Procedure Qualification

6.1 The applicable requirements of Part 1 and Part 3 of the CCS Rules for Materials and Welding shall be met.

7 Technical Requirements

7.1 Principles

(1) High-velocity vent valves, pressure/vacuum valves and other devices shall permit the adequate release of vapor, air, or inert gas mixtures when their set pressure is reached.

(2) The set pressure of high-velocity vent valves and pressure/vacuum valves shall normally be set within the range of positive pressure greater than 0.007 MPa to 0.021 MPa and negative pressure less than -0.0035 MPa to -0.007 MPa. It shall be ensured that the valve disc does not lift at positive pressures below 0.007 MPa and vacuums below 0.0035 MPa. For cargo tanks intended for the carriage of toxic cargoes, the minimum set pressure value for the pressure valve shall be 0.02 MPa.

(3) According to their intended use and installation location, high-velocity vent valves, pressure/vacuum valves and other devices shall be capable of preventing the propagation of the following flames resulting from the ignition of gases due to any cause:

① Traveling flames; and/or

② Stabilized flames from premixed gases.

(4) When flammable gas is ignited at the outlet, the following four situations may occur:

① At low gas flow, the flame may:

(a) Flashback; or

(b) Burn steadily at the outlet like a burner.

② At high gas flow, the flame may:

(a) Burn at a certain height above the outlet;

(b) Be blown out.

(5) To prevent the entry of flame into the cargo tank, high-velocity vent valves and pressure/vacuum valves and other installations must have one or more of the following functions:

① Allow the passage of gas without flashback, and not ignite the gas on the protected side when the device is heated for a specified period;

② Maintain an efflux velocity greater than the flame speed of the gas, and not ignite the gas on the protected side when the device is heated for a specified period, irrespective of the geometry of the device; and

③ Prevent the transmission of flame when a vacuum is created in the cargo tank.

(6) Vent outlets for cargo handling and ballasting operations shall:

① Allow free flow of vapor mixtures; or

② Maintain a throttled discharge velocity of vapor mixtures of not less than 30 m/s.

7.2 Mechanical Design Standards

(1) High-velocity vent valves, pressure/vacuum valves, and other devices shall be designed to facilitate inspection and removal of internal components for replacement, cleaning, or repair.

(2) If the valve design allows inspection, cleaning, repair, or removal of internal parts for replacement without removing the entire valve from the system, the design shall prevent incorrect reassembly after disassembly for inspection, cleaning, or repair.

(3) All mating surfaces of the body shall be machined and provide appropriate metal-to-metal contact.

(4) Flame arresting elements shall be fitted within the body in such a way that flame cannot pass through the gap between the element and the body.

(5) High-velocity vent valves, pressure/vacuum valves, and other devices shall effectively drain moisture without impairing their effectiveness in preventing the passage of flame.

(6) Pipe-end devices shall direct the gas discharge vertically upwards at all flow rates anticipated by the manufacturer.

(7) All fasteners associated with the valve operation shall be secured against loosening. The pressure setting adjustment device shall be permanently secured by lock wire, lock nuts, or other suitable means to prevent maladjustment due to handling, installation, or vibration.

(8) Means shall be provided to readily check the valve's open condition without requiring it to be held in the open position.

(9) When the flame arrestment of high-velocity vent valves, pressure/vacuum valves, and other devices is achieved by the action of the valve itself, without incorporating a flame arresting element, the width of the seat contact face shall be at least 5 mm.

(10) In-line devices (pipeline flame arresters) shall be capable of withstanding internal pressure generated by deflagration without damage or permanent deformation when tested in accordance with Clause 9.4(7) of the Guidelines.

(11) The design of flame arrester elements shall ensure that manufacturing quality control maintains the type test characteristics required by the Guidelines.

(12) Venting devices shall be capable of automatically draining any condensed liquid within the device to the cargo tank under all normal trim and heel conditions of the ship. Internal components, passages, and walls shall normally be sloped to facilitate drainage. If an automatic drainage line cannot be installed, then permanent devices shall be provided. If it is necessary to drain the venting system connected to any pressure/vacuum valve, capped or sealed drain cocks shall be provided to discharge liquids from the vent piping into the cargo tank.

(13) High-velocity vent valves and pressure/vacuum valves shall be designed to drain vapor condensate from the valve to the liguid cargo tank without reducing the valve's efficiency. The design shall also prevent water accumulation inside the valve that could freeze and cause blockage.

(14) For high-velocity vent valves, pressure/vacuum valves intended for cargo tanks of inland waterway chemical tankers carrying products with a flashpoint not exceeding 60°C (closed cup test), indicators showing the proper operation of the pressure and vacuum valves shall be provided.

(15) The body of the valve, in the main upstream pressure zone of the main seat, shall be gastight to prevent vapor escape.

(16) High-velocity vent valves, pressure/vacuum valves, vent covers, and other devices intended for chemical tankers shall be designed to prevent water from entering the cargo tank.

7.3 Materials

(1) When placing an order, a purchaser shall specify the material requirements for relevant components, or select the materials for main components based on the product material list provided by the manufacturer, ensuring the implementation of the requirements in Clauses 7.3(2), 7.3(3), and 7.3(5) below.

(2) The housings and bodies of high-velocity vent valves, pressure/vacuum valves, and other devices shall meet standards for strength (including ductility), heat resistance, and corrosion resistance similar to the piping to which they are connected. The wall thickness of bodies of

high-velocity vent valves and pressure/vacuum valves shall normally be not less than 6 mm (corrosion allowance may be deducted for stainless steel bodies depending on the medium).

(3) The valve bodies and other components or threaded connections used to retain pressure shall be made of materials listed in recognized national or international standards, suitable for the intended use.

① Bodies, discs, shafts, seats, springs, gaskets, sealing devices, passive flame stoppers (when included in the design), and all other integral components, including parts coated with anti-corrosion coatings, shall be made of materials resistant to corrosion by seawater and by the liquid and vapor of the protected tank.

② The use of springs plated with anti-corrosion materials is not permitted.

(4) Apart from gaskets, sealing devices, and non-metallic diaphragms satisfying Clause 7.7(3), the pressure-retaining structural parts of the valve shall not be made of non-metallic materials.

① Elastic sealing devices may only be installed if they can effectively prevent flame passage even when partially or completely damaged or burned.

② Non-metallic gaskets shall be made of non-combustible materials suitable for the intended use.

③ The use of materials containing asbestos is prohibited.

(5) The materials of the body, elements, and gaskets shall be capable of withstanding the pressures and temperatures that may occur under both normal conditions and the specified fire test conditions for the device.

(6) Materials for all components not mentioned above shall be suitable for the intended use.

(7) The possibility of galvanic corrosion shall be considered when selecting materials.

(8) If the main components of valves are made of stainless steel, they shall be solution annealed.

7.4 Performance Standards

(1) High-velocity vent valves, pressure/vacuum valves, and other devices shall be tested in

accordance with the requirements of Clause 9 of the Guidelines and shall meet the applicable test requirements of Clauses 9.4(5) to 9.4(7).

(2) The performance characteristics of high-velocity vent valves, pressure/vacuum valves, and other devices, such as flow capacity, operating sensitivity, flow resistance, and flow velocity under positive and negative pressures, shall be demonstrated by appropriate tests. Unless the gas discharge velocity exceeds 30 m/s for high-velocity vent valves, the flow capacity test shall include the flame screen.

(3) The design and construction of the devices shall minimize contamination effects under normal operating conditions. The design shall allow for the detection of all internal deposits, caused by vapor condensation, that could affect the normal operation of the devices. The manufacturer's operating manual shall include information on how to determine when cleaning is necessary and a detailed description of the cleaning method (see Clause 7.8 of the Guidelines). For certain cargoes prone to crystallization, a heating device may be required.

(4) Valves shall be capable of operating within the full range of anticipated ambient temperatures. The valves shall be capable of operating under icy conditions (e.g., blockage caused by freezing of cargo vapors or icing from severe weather), and the operating manual shall specify the permissible ice thickness when the valves are covered with ice. If the valves are fitted with a heating device that raises the surface temperature above 85°C, they shall be tested at the maximum operating temperature.

(5) High-velocity vent valves operating on the principle of maintaining a minimum velocity shall open by immediately establishing a velocity of 30 m/s and maintain an efflux velocity of at least 30 m/s under all flow conditions. When the gas flow is blocked, the valve shall close by maintaining the aforementioned minimum velocity until it is fully closed.

(6) For high-velocity vents, the possibility of damage and/or failure due to unexpected harmful water hammer shall be considered and eliminated.

Note: Water hammer is a phenomenon of rapid full-stroke opening/closing that the manufacturer does not anticipate during normal operation.

(7) The materials of the valve body, parts, and gaskets shall be capable of withstanding the maximum and minimum pressures and temperatures that may occur under normal operating conditions of the valve, and shall be capable of withstanding the hydrostatic pressure test

required by Clause 9.4(2) below.

(8) Newly manufactured pressure/vacuum valves and high-velocity vent valves shall meet the maximum allowable gas leakage rate. When tested and verified under standard conditions with air conversion, at 75% of the manufacturer-confirmed nominal opening pressure, they shall comply with the requirements specified in the table below.

Maximum allowable leakage

Nominal diameter mm(in)	Maximum allowable leakage m^3/h (CFH)
≤150 (6)	0.0142 (0.5)
200-400 (8-16)	0.1416 (5.0)
＞400 (16)	0.5663 (20.0)

7.5 Flame screens

(1) Flame screens shall:

① Be designed so that they cannot be incorrectly inserted into the opening;

② Be securely fitted into the opening so that flame cannot bypass the screen;

③ Be capable of meeting the requirements of the Guidelines. Flame screens fitted at the inlet of a vacuum valve which does not release vapor to atmosphere need not meet the test requirements of Clause 9.4(5)③ of the Guidelines; and

④ Be protected from mechanical damage.

7.6 Specifications, Location and Installation of Devices

(1) To determine the size of valves and avoid unacceptable pressure or vacuum in cargo tanks during cargo handling, the ship designer/selector shall perform pressure loss calculations, taking into account the following parameters:

① Loading/unloading rates;

② Gas evolution;

③ Pressure loss across the device (considering resistance coefficients);

④ Pressure loss in the vent piping system;

⑤ The set pressure of the valve when using a high-velocity vent valve;

⑥ The density of the saturated vapor/air mixture; and

⑦ Use of 70% of the rated performance of the device in the pressure drop calculation for installation, to compensate for possible fouling of flame arresters.

(2) Unless tested and approved for installation in series, devices shall be installed at the outlet to atmosphere. In-line devices shall not be installed at the outlet to atmosphere unless the device has also been tested and approved for that location.

(3) The pipe end device dedicated to the opening of the inerted liquid cargo tank does not need to be subjected to fire resistance test as required by Clause 9.4 (5) ③ of these guidelines.

(4) When a pipe-end device is fitted with accessories such as vent cowls, weather hoods, and deflectors, these accessories shall be installed for tests as described in Clause 9 of the Guidelines.

(5) Like in-line devices venting to atmosphere, detonation flame arresters shall be located at a sufficient distance from the open end of the pipe to prevent the possibility of a stabilized flame resting on the arrester.

(6) When venting to atmosphere through pipe-end devices as described in Clause 7.6(4) above or detonation flame arresters as described in Clause 7.6(5) above is not practicable, in-line devices (including any piping, tees, elbows, cowls, weather hoods, etc., that may be installed between the device and atmosphere) must be tested as required. The tests shall include the flashback test described in Clause 9.4(5)② of the Guidelines and, if the installation could result in a stabilized flame resting on the device, also the fire resistance test described in Clause 9.4(5)③ of the Guidelines.

7.7 Other Requirements

(1) A manual method shall be provided according to the manufacturer's instruction manual to check that each valve can be easily opened and will not remain in the open position. This

manual method shall use the valve's own components and shall be operable without adding or removing any components. The design shall ensure that the valve will not become inoperable due to corrosion deposits or icing when maintained in accordance with the manufacturer's requirements.

(2) When maintenance is performed according to the manufacturer's requirements, consideration shall be given to possible accumulation due to condensate passing through the valve during loading. The valve disc shall be fitted with suitable guides to prevent jamming and to ensure proper self-closing function (seat).

The valve disc shall normally close against the seat with metal-to-metal contact. An elastic seat seal may be used, provided the design ensures that the disc closes against the seat even if the seal is damaged, destroyed, or removed.

The valve disc may be solid or constructed hollow to allow the addition of ballast material to adjust the opening pressure. If a hollow disc is used, a bolted watertight cover shall be fitted to enclose the ballast material. The set pressure shall not be alterable by anyone other than the manufacturer without the approval of the competent authority or CCS. The valve shall be externally marked with a clearly visible indication of the disc position, which shall typically be visible from below and beside the valve on deck. If the set pressure is changed, the marking required by Clause 7.9 of the Guidelines shall be updated accordingly.

(3) Non-metallic diaphragms may be used in valves, except when failure would allow free flow of tank vapor to atmosphere, or when tank pressure or vacuum increases while the valve is in its normal open condition.

(4) If welded construction is used for pressure-retaining structural parts, the details of the weld design, welding, and non-destructive testing shall comply with applicable requirements of national or international standards. To ensure consistent quality of product welds, the welds shall be sound and of adequate strength. Welders and welding procedures shall be approved by CCS in accordance with recognized national or international standards.

(5) The text in the instruction manual mentioned in Clause 7.8 below and the permanent marking mentioned in Clause 7.9 shall be in both Chinese and English. If the product is not for use by a Chinese shipowner, English alone may be used.

7.8 Manufacturer's Instruction Manual

(1) The manufacturer shall ensure that an instruction manual is supplied with each device. The manual shall include items listed in 7.8(2) to 7.8(9), relevant requirements of Clauses 11.1, 11.2, and Appendix F of ISO 15364:2021, and/or requirements of ISO 16852:2016.

(2) Installation instructions.

(3) Operating instructions. If a flame screen or high-velocity vent is fitted, the minimum MESG value and explosion group for which the device is suitable shall be included. The instructions shall also include any mandatory usage restrictions relating to the safety performance of the device and mandatory requirements for correct installation.

(4) Maintenance requirements, including maintenance information for each corrosion protection system.

① Instructions on how to determine when the device requires cleaning and the method of cleaning.

If the manufacturer permits overhaul of the device by the user, the manufacturer shall provide the necessary procedures, instructions, and diagrams to allow the device to be restored to its original state as purchased regarding set pressure and flow capacity.

② Instructions on the frequency of cleaning the device to remove vapor condensate. The frequency for cleaning deposits from condensation will vary depending on the cargo carried. The number of times the condensate residue is cleaned from the device will vary depending on the cargo loaded.

③ A clear description of the method for setting the pressure, including information for disassembly/assembly of the device, numbering methods, ordering, and diagrams for correct assembly of components.

④ Instructions on inspecting the opening and closing status of the device by the user prior to each loading and unloading operation.

⑤ Instructions on guiding the comprehensive overhaul of the device and the recommended inspection frequency.

(5) Test report as described in clause 9.5(3) of the Guidelines. As an option, the manual may include provisions for copies of test reports that are available at the purchaser's request.

(6) Flow test data, including flow at positive and negative pressures, operational sensitivity, flow resistance, flow rate and maximum pipe length on the inlet side.

(7) Manufacturer's certificate of conformity that the device has been manufactured and tested in accordance with the Guidelines.

(8) Necessary safety warnings;

(9) Emergency treatment of faults.

The manual text shall usually be in both Chinese and English. If the product is not for use by a Chinese ship owner, English alone may be used.

7.9 Marking

Each device shall be permanently marked or have a permanently fixed plate made of stainless steel or other corrosion-resistant materials, indicating:

(1) Name and trademark of the manufacturer;

(2) Type, pattern, model number or other markings of the device by the manufacturer shall form the unique identification of the device;

(3) Inlet size (and outlet size, if any);

(4) Product No.;

(5) The approved installation location, including the maximum or minimum length of pipe between the device and the atmosphere (if any), and the classification of equipment for testing the device (explosion-proof category);

(6) Flow direction of fluid through the device;

(7) Laboratory and test report number;

(8) Set pressure and vacuum degree;

(9) Comply with the requirements of MSC circular MSC.1/Circ.677/Rev.1.

The label text shall usually be in both Chinese and English. If the product is not for use by a Chinese ship owner, English alone may be used.

7.10 Ordering Information

Valve orders shall include the following relevant information as required by the Guidelines:

(1) Nominal diameter, type and length of pipes;

(2) For each gas or vapor in protected cargo tanks, the molecular weight and specific heat, as well as the maximum experimental safe gap (MESG) value (if known);

(3) Inspections and tests other than those specified in these guidelines (see Clause 10 of the Guidelines);

(4) Set pressure and vacuum opening value;

(5) The expected ambient air temperature range;

(6) Manufacturing materials (see Clause 7.2 of the Guidelines and Appendix B of ISO15364 standard);

(7) The maximum flow rate of standard air and the design pressure drop of the piping system at this maximum flow rate, as well as the maximum allowable pressure and vacuum degree of cargo tank.

8 Selection of Typical Samples

8.1 When the manufacturer applies for type approval of a single specification product, 1 unit shall be randomly selected for type test.

8.2 When the manufacturer applies for series type approval of products with the same model/drawing number, different specifications and different models/drawing numbers, 1 unit shall be sampled from each type and size of device for testing. Any changes in design, materials or manufacturing that affect corrosion resistance, or any changes to the flow characteristics of the device, are considered changes of type as described in this clause. However, the flame arrester fire resistance test may be limited to the smallest and largest sizes of each type and an intermediate size selected by CCS. The devices shall have the same size and the most unfavorable clearance in this type of product. If the tested high-velocity vent valves and pressure/vacuum valve devices are

modified during the test procedure, they shall be retested.

8.3 The inspection and testing of products after approval shall be carried out in accordance with the requirements of Clause 10 of the Guidelines for single item/batch survey.

9 Type Test

9.1 The type approval test shall be carried out by the laboratory approved by CCS. When selecting a laboratory, the manufacturer shall ensure that it has the qualifications to conduct tests (approved by the competent authority or certified by the laboratory of CCS) to perform the tests specified in the Guidelines, and that the laboratory has (or has access to) the necessary instruments, tools, personnel and calibration equipment for the experiment. When CCS proves that the manufacturer may correctly carry out the tests specified in the Guidelines, the tests (or some test items) specified in the Guidelines may be carried out by the manufacturer under the on-site witness of CCS's surveyors.

9.2 Test Principles

(1) For all devices such as high-velocity vent valves and pressure/vacuum valves protecting cargo tanks containing the flammable atmosphere of cargoes described in Clause 1.1 of the Guidelines, as applicable and in accordance with the provisions of the Guidelines, the tests described in the Guidelines may use gasoline vapor (the main components of which are unleaded petroleum fractions of chain hydrocarbons with a boiling point of about 65°C to 75°C), industrial hexane vapor or industrial propane. This shall not exclude the use of gasoline vapor or industrial hexane vapor for all tests described in this section.

(2) After the relevant tests, devices such as high-velocity vent valves and pressure/vacuum valves shall not have mechanical damage that affects their original performance.

(3) Before conducting the test, the following equipment (if applicable) shall be properly calibrated:

① Gas concentration meter;

② Thermometer;

③ Flowmeter;

④ Pressure gauge;

⑤ Time recorder.

(4) The samples shall be inspected as follows:

① Appearance and size inspection: The product structure dimensions, material use, casting quality, processing quality, assembly quality, marking and labeling, main component dimensions, dimensions and gaps that affect fire resistance performance meet the applicable requirements of the approved drawings and the Guidelines.

② Structural inspection: The high-velocity vent valve, pressure/vacuum valve and other devices shall be disassembled and assembled in accordance with the requirements of the instruction manual to assess whether their design meets the requirements of Clauses 7.2 (1), 7.2 (2), 7.5 (1) and 7.7 (1) of the Guidelines.

9.3 Test Item:

(1) The product samples of high-velocity vent valves, pressure/vacuum valves and other devices extracted in accordance with Section 8 of the Guidelines shall be subjected to the following applicable project product type tests. Other flame arresters may refer to the implementation:

① Corrosion test. (Applicable to different material combinations allowed in product design, see Clause 9.4(1) of the Guidelines)

② Hydraulic test. (See Clause 9.4(2) of the Guidelines)

③ Maximum allowable leakage test. (See Clause 9.4(3) of the Guidelines)

④ Test verification of product performance characteristics marked by the manufacturer. For example, flow, operational sensitivity, flow resistance and flow rate under positive and negative pressures shall be verified by appropriate tests. The flow test shall be carried out in accordance with Clause 9.4 (4) of the Guidelines.

⑤ Pressure test of pressure valve opening and closing. (See Clauses 9.4 (4) and 9.4 (6) of the Guidelines)

⑥ Flow rate test. (See Clauses 9.4 (4) and 9.4 (6) of the Guidelines)

⑦ Vacuum valve opening and closing pressure test. (See Clauses 9.4 (4) and 9.4 (6) of the Guidelines)

⑧ Flashback test of pressure valve. (See Clause 9.4 (5) to (6) of the Guidelines)

⑨ Fire resistance test of pressure valve. (See Clause 9.4 (5) ③of the Guidelines)

⑩ Flashback test of vacuum valve. (See Clause 9.4 (5) to (6) of the Guidelines)

⑪ Running test at a 10° tilt. (See Clause 9.4(6) of the Guidelines)

⑫ Freezing test and high temperature test. (See Clause 9.4 (8) of the Guidelines)

⑬ Other design function checks. (See Clause 9.4 (9) of the Guidelines)

⑭ Auxiliary devices (if applicable). (See Clause 9.4(10) of the Guidelines)

⑮ Working stability test of duplex valve group (if applicable). (See Clause 9.4(11) of the Guidelines)

⑯ Undamped oscillation test. (See Clause 9.4(6) ③of the Guidelines)

⑰ Type test items specified in the product design standards selected by the manufacturer and explicitly stated to the public (if applicable);

Among them, the above-mentioned tests ④to ⑧and ⑩shall be carried out under the maximum and minimum set pressure values allowed by the design of high-velocity vent valves and pressure/vacuum valves respectively.

9.4 Test Procedures and Methods

(1) Corrosion test. In this test, the entire device including the connected pipe section, shall be placed in a spray of 5% sodium chloride solution at a temperature of 25°C for 240 hours and then dried for 48 hours. An equivalent test satisfactory to CCS may be adopted. After the test, all movable parts shall function accurately without any corrosive deposits that cannot be washed away.

(2) Hydraulic Test. The pressure-bearing interface of the device shall be subjected to a hydrostatic pressure test, and the test pressure shall be at least 150% of the maximum rated

pressure or the minimum gauge pressure 345kPa gauge pressure (50psig), whichever is greater. There shall be no rupture, leakage or permanent deformation within 10 minutes. For test purposes, the valve disc may be closed or blocked.

(3) Maximum allowable leakage test.

In accordance with ISO 15364: 2021, each finished device shall undergo a leakage test at 75% of the nominal set opening pressure, and the maximum allowable leakage shall be verified by converting it into air leakage under standard conditions (4) Flow Test

① Determination of flowThe flow rate of pressure/vacuum valves and flame arresters shall be determined based on flow tests. At least one product sample of each type and size of vent device shall be tested under the conditions listed in Clauses②③④below. If pressure or vacuum valves are used with flame arresters, the entire assembly shall be flow tested.

② Flow dataThe establishment of flow data must meet the following requirements:

(a) Pipes and connections between pipes and equipment shall be free of obstructions to avoid additional turbulence;

(b) The inner diameter of the test pipeline shall not be less than the inner diameter of the flange of the device under test;

(c) All pressure measuring points shall be arranged in the vertical direction of the pipeline axis and shall not affect the airflow;

(d) The test medium is air under ambient conditions, and the ambient pressure and temperature shall be recorded for conversion of flow rate under standard conditions;

(e) All measuring equipment shall be calibrated;

③ Installation of flow test deviceThe test device is shown in Fig. 9.4 (1) (refer to ISO 15364:2021):

(a) The container 3 shall be of sufficient dimensions so that the average flow rate therein is less than 0.5m/s, and the pressure data in the container shall be recorded under this condition;

(b) The length of the straight pipe joint L1 shall be 1.5 to 5 times the diameter of the test

sample. The pipe joint shall enter from a flat position in the container, and the fillet of the penetration shall meet recognized national or international standards to reduce the impact of pressure drop;

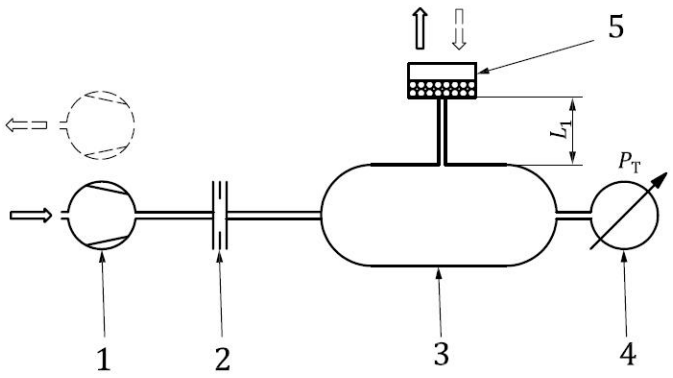
(c) The flow direction of the vacuum valve is opposite to that mentioned above;

(d) The occurrence of system oscillation caused by imbalance or damage to the fan or blower blades shall be avoided;

(e) The accuracy error of the testing instruments shall not exceed ±5%;

(f) The pressure rise rate in the test container shall not be greater than 0.01 N/mm2/min;

(g) It shall be possible to record the pressure at the initial opening point and final closing point of the vent device.



1. Fan; 2. Flow meter; 3. Test container; 4. Pressure measuring device; 5. Test sample;

Figure 9.4 (1) Test device for flow test

④ Relevant requirements:

(a) The measured rated flow rate shall not be less than the design value of the drawing promised by the manufacturer;

(b) When the internal air pressure reaches 70% of the set pressure, there shall be no continuous bubbles or audible leakage sound on the valve disc sealing surface;

(c) When the internal air pressure reaches 75% of the set pressure, the maximum standard

air volumetric leakage rate shall be detected and recorded to meet the product design requirements;

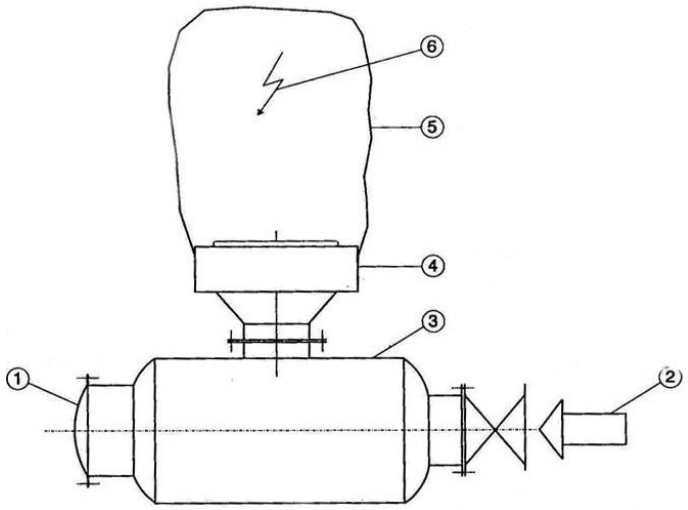
(d) The pressure/vacuum valve shall open at the set pressure (error ±3%);

(e) The valve disc opens and closes rapidly, works smoothly, and has no abnormal phenomena such as vibration and hammering.

(f) The flow-pressure test steps and diagram recording requirements for various valve types specified in Clause 8.4, Appendixes B and G of ISO 15364:2021 shall be met.

(5) Test procedure for flame arresters located at openings to atmosphere

① The test equipment shall consist of a device for generating an explosive mixture, a small container with a diaphragm, a flanged flame arrester sample, and a plastic bag (Note: The size of the plastic bag depends on the size of the flame arrester, but for flame arresters commonly used in oil tankers, the plastic bag may be: circumference 2m, length 2.5m, wall thickness 0.05mm) and fire sources located at 3 locations (see Figure 9.4 (2) Test device for flashback test) (Note: In order to prevent the residue of the plastic bag from falling back onto the test device after the fuel/air mixture is ignited, it may be useful to set a thick wire rack across the device in the plastic bag. However, the construction of the bracket shall not affect the test results.) Other test equipment may also be used, but the tests described in the Guidelines shall be carried out to the satisfaction of CCS.



1. Rupture disc; 2. Explosive mixed gas inlet; 3. Gas holder; 4. Flame arrester device; 5. Plastic bag; 6.

Ignition source

Figure 9.4 (2) Test device for flashback test

② The flashback test shall be carried out according to the following steps:

(a) The space between the container, flame arrester assembly and plastic bag covering the flame arrester sample shall be filled with the most ignitable propane/air mixture (see IEC 60079 electrical equipment for explosive gas atmospheres). The concentration of the mixed gas shall be verified by appropriate testing of the gas composition in the plastic bag, which shall be installed at the outlet to the atmosphere when the device described in Clause 7.6(6) of the Guidelines is tested. Three ignition sources shall be installed along the axis of the bag, one close to the flame arrester and the other as far away as possible, with the third located midway between the two above ignition sources. The above three ignition sources shall be ignited continuously, and each ignition source shall be ignited twice. The temperature of the test gas shall be between 15°C and 40°C;

(b) If flashback occurs, the bursting diaphragm of the container in Figure 9.4(2) will rupture, and this will be audible and visible to the operator due to the radiation of the flame. Flame, heat and pressure sensors may also be used instead of the bursting diaphragm.

③ When it is expected that there may be explosive airflow at the outlet of the flame arrester, in addition to the flashback test, the flame arrester shall also undergo a fire resistance test:

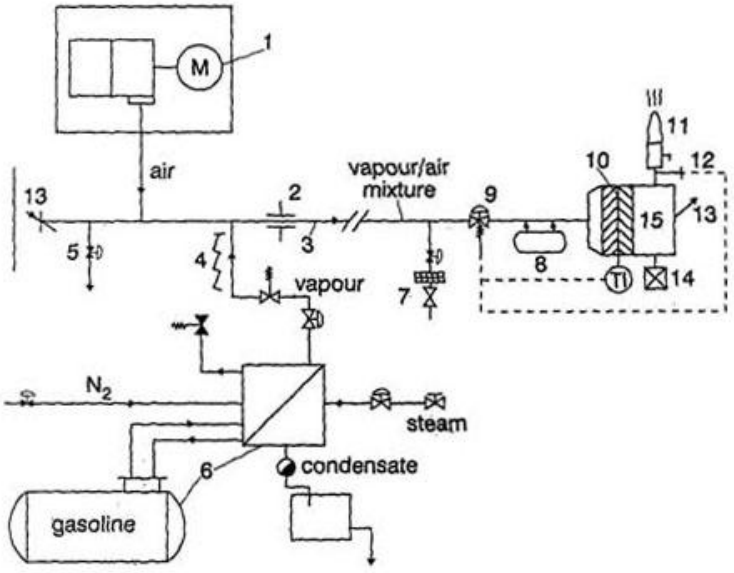
(a) The test equipment described in Clause 9.4 (5) ①above may be used instead of plastic bags. The flame arrester shall be installed with the mixed gas jet flow directed vertically. Ignite the mixture at this position. When the device described in Clause 7.6(6) of the Guidelines is tested, the flame arrester shall be installed in the final position determined;

(b) The fire-resistance test shall be conducted using highly flammable gasoline vapor/air mixtures or highly flammable industrial hexane vapor/air mixtures, with a continuously operating pilot flame or a continuously operating spark igniter provided at the outlet. The test gas shall be introduced upstream of the vessel as shown in Figure 9.4 (3). The concentration of the above mixture shall be maintained by changing the flow rate until the cargo tank side of the flame arrester shall be heated to the maximum achievable

temperature. Temperature measurements shall be made, such as the temperature of the extinguishing substrate protection side of the flame arrester (or the temperature of the valve seat during the high-velocity vent test required by Clause 9.4 (6) of the Guidelines). When the temperature rise rate does not exceed 0.5°C/min for a period of more than 10 minutes, it may be considered that the maximum achievable temperature has been reached.The above temperature shall be maintained for 10 minutes, then the airflow shall be stopped and the test situation is checked. The temperature of the test gas shall be between 15°C and 40°C.

If there is no temperature rise: check that the flame arrester temperature sensor is properly located and note the visually recorded position of the stable flame during the first test procedure. Consideration must also be given to the locations where small holes need to be drilled in the flame arrester fixings. If none of the above measures are effective, add a temperature sensor on the non-protected side of the flame arrester close to the stable flame.

If it is difficult to establish a stable temperature condition (at high temperatures), the following criteria shall be adopted: use the flow rate that produced the highest temperature during the above test, continue the fire resistance test for another 2 hours from reaching the above flow rate, then shut off the airflow and check the test conditions. No flashback shall occur during the above tests.



1. Variable-speed fan; 2. Volumetric flow meter; 3. Pipe (500 mm diameter) length approx. 30 m; 4. Hot steam pipe; 5. Air bypass valve; 6. Evaporator and liquid storage cabinet; 7. Steam/air

mixture bypass device; 8. Extinguishing agent; 9. Emergency shut-off valve; 10. Explosion-proof corrugated band with temperature control for test device safety; 11. Tested high-velocity valve; 12. Flame detector; 13. Rupture diaphragm; 14. Concentration indicator; 15. Gas holder

Figure 9.4(3) Schematic Diagram of the High-Velocity Valve Test Device (Fire Resistance Test Only)

④ When the flame arrester is equipped with a pressure and/or vacuum valve, the flashback test must be conducted with the pressure and/or vacuum valve open. If the pressure valve is not fitted with an additional flame arrester element, it shall be regarded as a high-velocity vent valve and tested in accordance with the requirements of Clause 9.4(6) of this guideline.

⑤ Except for high-velocity vent valves, other flame arresters shall be tested according to the test items listed in Table C.1 of Appendix C of ISO 15364:2021, and the test requirements shall comply with ISO 16852:2016.

(6) Test procedure for high-velocity vents

① The test device shall be capable of generating the required volumetric flow rate. Sample diagrams of applicable test device are shown in Figures 9.4(3) and 9.4(4). Other test devices may also be used, but the tests must be acceptable to CCS.

② Compressed air or other gases shall be used to perform flow condition tests, including for high-velocity vents, at an agreed flow rate. The following items shall be recorded:

(a) Flow rate. When air or other gases are used in the test instead of the cargo vapour for which the vent is intended, the effect of the cargo vapour density shall be taken into account and the achieved flow rate shall be corrected accordingly.

(b) Pressure prior to opening of the vent. The rate of pressure rise within the test chamber in which the vent is installed shall not exceed 0.01 N/mm² per minute;

(c) Vent opening pressure;

(d) Vent closing pressure;

(e) After the valve is opened, the airflow velocity at the ejection port shall not be less than 30 m/s at any time.

The test shall comply with the requirements of Clause 9.4 (4) ④of the Guidelines. Measure the flow rate and the airflow velocity at the ejection port with the high-velocity vent valve in various opening positions (corresponding to different flow rates). The airflow velocity at the ejection port shall not be less than 30 m/s at any time; the flow rate shall meet the design requirements specified in the drawings.

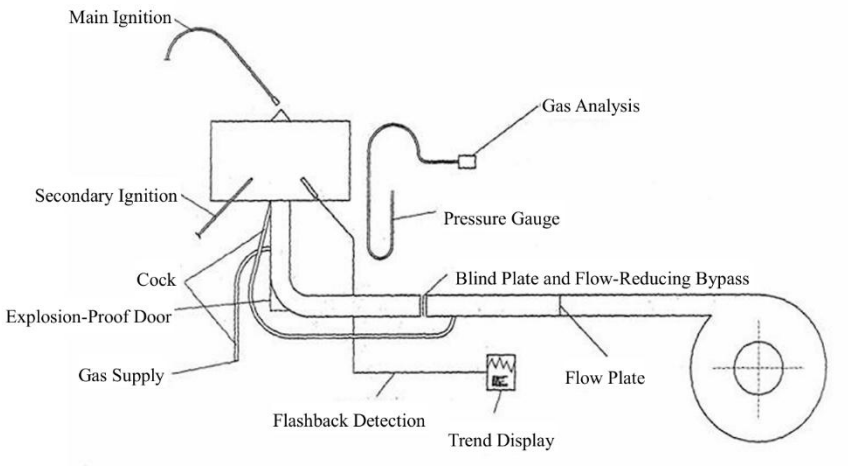


Figure 9.4 (4) Test Device for High-Velocity Vent Valve

③ Undamped oscillation test

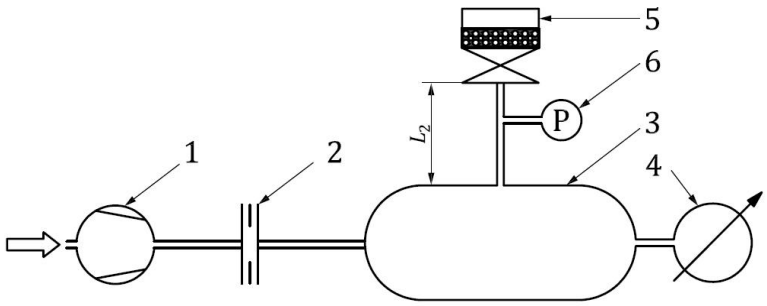
High-velocity vent valves, including dual (twin) valves, shall undergo undamped oscillation test. The test device is shown in Figure 9.4 (5). This test shall be carried out at the minimum and maximum opening set pressures of the specific valve. If there are no changes as described in Clause 8.2 of the Guidelines and the maximum set opening pressure does not exceed 130% of the minimum set opening pressure, the maximum setting pressure test may be omitted. Valves of the same specification with higher set pressures but the same closing pressure may also be exempted from testing if they have been verified as qualified at a particular closing pressure.

The pipeline length, inner diameter, and tank volume involved shall be initially provided by the manufacturer.

During the test, the flow shall start at 0.2 times the minimum closing flow and shall be increased in the same increment in 10 steps up to a maximum of 2 times the minimum closing flow, with each step maintained for 3 minutes. For valves designed for periodic opening and closing cycles, the 3-minute average flow shall be taken as the reference value. During the test, if the sensor at the valve disc indicates that the contact frequency

with the valve seat or upper stop point exceeds 0.5 Hz, resulting in undamped oscillation, the L2 length shall be reduced until the frequency drops below 0.5 Hz. At the same time, record the pipeline length as the maximum pipeline length on the protected side, the corresponding pipeline diameter as the minimum diameter, and the tank volume as the minimum volume. In actual use or other test items specified in the Guidelines, these limits must not be exceeded.

For valves with no actual flow at closing pressure, 10% of the valve's fully open flow rate shall be selected as the test start point.



1. Fan; 2. Flow meter; 3. Test container; 4. Pressure measuring device; 5. Test sample; 6. Pressure sensor

Figure 9.4(5) Undamped Oscillation Test Device

④ Under the operating conditions described in Clause 7.4(6) of the Guidelines and when using a gasoline vapor-air mixture or industrial hexane vapor-air mixture that is highly flammable at the ignition point, the following fire safety tests shall be conducted. Flashback or flame propagation must not occur. The above mixture shall be ignited at the outlet with the assistance of the permanent pilot flame or spark igniter:

(a) When propane is permitted as a substitute for gasoline or hexane in flashback tests, the vent shall be tested in the vertical position and at a 10° inclination from the vertical. For certain vents, additional tests may be required with the vent inclined in more than one direction. In each of the tests above, the flow rate shall be reduced until the vent closes and the flame is extinguished. Each test shall be repeated at least 50 times. This takes into account compliance with the verification requirements for low-flow flashback and open/close flashback of high-velocity vent valves in ISO 16852:2016. To test the effectiveness of the required devices, the vacuum side of the combination valve shall be tested during the test in accordance with Clause 9.4(5) ②, with the vacuum valve maintained in the open position;

(b) The fire resistance test specified in Clause 9.4(5) ③shall be performed. After the test, the main flame shall be extinguished, while the pilot flame is kept burning or the spark igniter continues operating. A small amount of flammable mixture shall be allowed to escape, maintaining a pressure below 90% of the valve's set pressure for 10 minutes. During this period, no flashback shall occur. For this purpose, soft seals or soft valve seats shall be removed during this test.

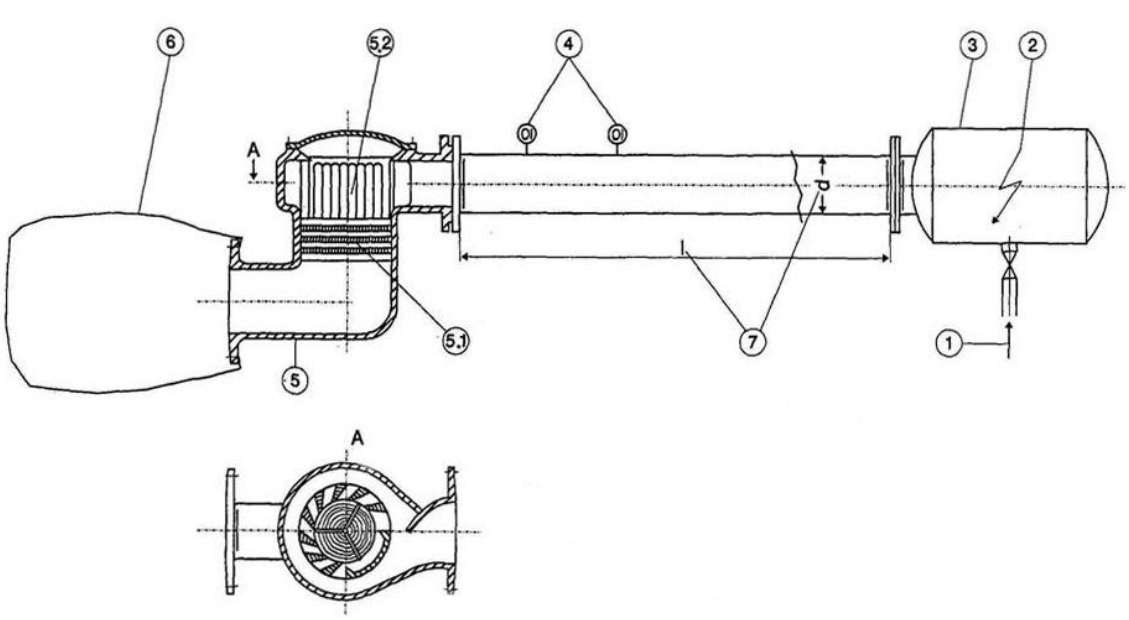
(7) Test device and procedure for series deflagration flame arresters

① The flame arrester shall be installed at one end of a pipe of suitable length, with the pipe flange diameter matching that of the flame arrester. At the other end, a length of pipe equivalent to 10 times the pipe diameter shall be attached to the flange and sealed with a plastic bag (Note: The plastic bag shall have a minimum circumference of 4m, length 4m, and material thickness of 0.05mm) or a diaphragm. The pipe shall be filled with a mixture of flammable propane and air, and then ignited. The flame speed near the flame arrester shall be measured, and a stable deflagration value shall be obtained.

② Three deflagration tests shall be conducted. During the tests, there must be no flashback in the device, and the flame arrester components must remain undamaged and free from permanent deformation.

③ The diagram of the test device is shown in Figure 9.4(6). Other test devices may also be used, but the tests must satisfy the requirements of CCS.

④ If the flame arrester is designed according to ISO15364:2021, deflagration and fire resistance tests shall also be performed. The test setup and technical requirements shall meet the requirements of ISO16852:2016.



1. Explosive mixture inlet; 2. Ignition source for igniting non-flowing mixture; 3. Gas holder; 4. Flame speed measurement system for stable detonation; 5. Series flame arrester; 5.1. Flame arrester element; 5.2. Shock wave absorber; 6. Plastic bag; 7.$l/d \approx 100$

Figure 9.4 (6) Test Device for Series Flame Arresters

(8) Freezing test and high temperature test.

① Place high-velocity vent valves, pressure/vacuum valves, and other devices in an environment at -30°C or a lower temperature as specified by the product design for 24 hours. After removal, immediately inspect all components to ensure proper operation. The valve stem shall be able to manually open and close the valve disc smoothly and reliably.

② External icing test: Place the entire device in an environment at -10°C for 24 hours. Subsequently, spray 1L of water at a temperature not exceeding 2°C onto the exterior of the valve shell every ten minutes until the maximum permissible ice thickness is reached. Under this ice thickness, verify that the valve lifts and operates normally.

③ Internal icing test: For products without heating devices that are suitable for cargo vapor freezing environments, artificial simulation of cargo vapor freezing at -10°C shall be used to create internal ice formation. The frozen areas shall include at least the interface between the bush and the shaft, as well as between the valve disc and the valve seat. After manually breaking the ice, the device must be able to operate normally.

④ Place high-velocity vent valves, pressure/vacuum valves, and other devices in an environment at 65°C, or at a higher temperature as specified by the product design, for 24 hours. After removal, immediately check that all components function properly, and verify that manual operation of the valve stem enables the valve disc to open and close smoothly and reliably.

(9) Inspection of other functions.

① Inspection of manual lifting devices. Manually operate the pressure/vacuum valve stem as specified in the product manual. The valve disc should open and close smoothly and reliably, and valve position detection shall comply with the requirements of Clause 7.2 (8) of the Guidelines.

② Use simulation methods to verify the drainage performance of the device and the discharge of cargo condensate. The results shall comply with the requirements of Clauses 7.2(12) and 7.2(13) of the Guidelines.

③ A water jet test shall be conducted on the device (refer to the test method for the second digit “5” of the IP protection rating in IEC 60529). The results shall comply with the requirements of Clause 7.2(16) of the Guidelines.

(10) Auxiliary devices (if applicable).

① If the device is equipped with heating, de-icing, or crystallization melting units, the following necessary tests shall be carried out:

(a) The pressure shell shall undergo a hydraulic test at 1.5 times the maximum allowable working pressure (but not less than 3 bar), with the test medium at the maximum allowable heating temperature and maintained for 5 minutes. No abnormalities shall be observed;

(b) After completing the hydraulic test, maintain the pressure at the maximum allowable working pressure. Manually check the opening and closing of the valve disc to ensure it is flexible and reliable, and verify the temperature distribution meets the requirements specified in the design drawings.

② If a cleaning device is installed, a simulation test shall be conducted to verify that the cleaning performance meets the requirements specified in the design drawings.

(11) Stability test for dual-valve assembly operation.

The operational stability of dual-valve assembly products shall be verified through testing:

① Set the opening pressures of the two valves respectively so that the difference between their settings is the minimum allowable value specified in the product manual. Perform the flow test in accordance with Clause 9.4 (4). The valves must operate steadily within the rated flow range specified in the product design, with no hammering or other unstable phenomena occurring. If the product's opening pressure is set as a range, the test shall include at least the verification of the operation of the valves at the minimum and maximum pressure set points.

② The operational stability test should include both pressure valves and vacuum valves.

(12) Type test items specified in the product design standards selected by the manufacturer and explicitly stated to the public (if applicable);

Any tests in the selected standard that exceed the requirements of this chapter shall be conducted in accordance with the selected standard.

9.6 Laboratory records and reports

(1) The following characteristic parameters shall be recorded throughout the entire test period, as applicable:

① Concentration of mixed gas fuel;

② Temperature of the test gas mixture upon entering the device, and flow rate of the test gas mixture (where applicable).

(2) On the protected side of the device, flame propagation shall be recorded and monitored. This may be conducted using suitable sensors to measure temperature, pressure, or light radiation; video recordings may also be used.

(3) Test report

The laboratory shall prepare a test report for each sample and each finished valve, which shall include:

(a) Detailed drawings of the verified device and its components;

(b) The type of test conducted and the results obtained, including records of verifiable test data; for tests on series-connected devices, the data shall include the maximum pressure and maximum velocity observed during the test;

(c) Special notes for the approved accessories;

(d) The types of goods for which the device is approved for use;

(e) Diagram of the test device, including a description of the connected inlet and outlet pipelines;

(f) For high-velocity vent devices, the pressure, flow rate, and relevant curves when the device opens and closes at jet velocity;

(g) Complete records of all markings made on the device as required by Clause 7.9 of the Guidelines;

(h) User manual (provided by the manufacturer);

(i) Report number.

(4) Items to be recorded in the type approval certificate

① Pipeline limit values for the undamped oscillation test of the high-velocity vent valve, including maximum pipe length L_{max}, minimum pipe diameter D_{min}, and minimum tank volume V_{min};

② Minimum MESG of the applicable medium;

③ Set opening pressures of the pressure valve and vacuum valve;

④ Maximum external ice thickness allowed for lifting operation;

10 Unit/batch inspection

10.1 Quality assurance

(1) The manufacturer shall ensure that the design, manufacturing, and testing of the device meet the characteristics of the sample tested and approved by CCS.

(2) The manufacturer shall maintain the quality of devices designed, tested, and marked in accordance with the Guidelines, and ensure and commit to compliance with its requirements. Devices that do not meet the requirements of the Guidelines shall not be marked, promoted, or sold using any marks related to the inspection requirements of CCS.

10.2 Inspection

(1) The manufacturer shall provide the CCS's attending surveyor with all necessary and appropriate conditions and documentation to confirm that the supplied materials comply with the provisions of the Guidelines. This generally includes:

① Material certification documents for the valve body, valve core, and valve seat;

② Documentation of the flame arrester;

③ Factory survey and test reports (survey and test items shall comply with the requirements of 10.2(2) to 10.4);

④ Declaration of product conformity or certificate of compliance. (For details, see Clause 10.1 of the Guidelines)

(2) Each finished device shall undergo visual and dimensional inspection to ensure compliance with the Guidelines, including the ordering information specified in Clause 7.10, the user manual required by Clause 7.8, and the marking requirements of Clause 7.9. Special attention shall be given to inspecting the adequacy of welds and the proper assembly of joints.

10.3 Typically, single item/batch survey after approval should include the following:

(1) Appearance inspection: The product's structure, material usage, casting quality, machining quality, and assembly quality shall conform to the requirements of the approved drawings.

(2) Hydraulic test of pressure shell: Conduct the test in accordance with Clause 9.3 (1) ② of the Guidelines; there shall be no rupture, leakage, or permanent deformation.

(3) Maximum allowable leakage test: Conduct the test in accordance with Clause 9.3 (1) ③ of

the Guidelines.

(4) Pressure valve opening/closing pressure test: Conduct the test in accordance with Clause 9.3 (1) ⑤ of the Guidelines. Verify that the set pressure meets the requirements of the approved drawings and purchase order.

(5) Flow rate test: Conduct the test in accordance with Clause 9.3 (1) ⑥ of the Guidelines. When the valve opens at the set pressure, measure the outlet flow rate. For high-velocity vent valves, the air velocity shall be no less than 30 m/s.

(6) Vacuum valve opening/closing pressure test: Conduct the test in accordance with Clause 9.3 (1) ⑦ of the Guidelines. Open at the designated opening pressure (this pressure shall meet the requirements of the approved drawings and purchase order, and is generally not less than -0.007 MPa). The valve shall open, close, and operate smoothly. After opening the vacuum valve, measure the rated flow and ensure it meets the design requirements.

10.4 The manufacturer shall also ensure completion of the following product survey items:

(1) Factory survey and test items stipulated by the product design standards selected and publicly declared by the manufacturer;

(2) Special test items added by the technical terms of the order contract (if applicable).

10.5 The manufacturer shall carry out surveys and tests on each device intended for submission in accordance with the above survey and test items, and only upon passing shall the device be submitted for CCS’s inspection. The on-site sampling ratio by our surveyors, as well as the specific items for sampling inspection and tests, shall be carried out in accordance with the "Survey Plan" issued together with the approval certificate by CCS.