RULES

PUBLICATION 68/P

TYPE TESTING PROCEDURE FOR CRANKCASE EXPLOSION RELIEF VALVES

July
2022

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków complete or extend the Rules and are mandatory where applicable.

GDAŃSK

Publication 68/P – Type Testing Procedure for Crankcase Explosion Relief Valves – July 2022 was approved by the PRS Board on 6 June 2022 and enters into force on 1 July 2022.

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CONTENTS

Page

1 GENERAL

1.1 Applicatiom

1.1.1 The present *Publication* specifies type tests and standard test conditions using methane and air mixture for crankcase explosion relief valves intended to be fitted to engines and gear cases.

1.1.2 The present *Publication* is only applicable to explosion relief valves fitted with flame arresters.

Note:
Where internal oil wetting of a flame arrester is a design feature of an explosion relief valve, alternative type testing arrangements that demonstrate compliance with the requirements of the present *Publication* may be proposed by the manufacturer. The alternative type testing arrangements are to be agreed with PRS.

1.1.3 Diesel engines are to be fitted with explosion relief valves complying with the requirements of the present *Publication* when:

.1 a request for certification of an engine is dated on/after 1 July 2022, or
.2 installed in a new ship for which the date of contract for construction is on or after 1 July 2022.

2 RELATED STANDARDS AND IMO REQUIREMENTS

2.1 Standards

2.1.1 ISO 16852:2016 Performance requirements, test methods and limits for use.

2.1.2 ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories.

2.1.3 VDI 3673-1:2002 Pressure Venting of Dust Explosions.

2.2 IMO Requirements

2.2.1 IMO MSC/Circ.677 as amended by MSC/Circ.1009 and MSC.1/Circ.1324 – Revised Standards for the Design, Testing and Locating of Devices to Prevent the Passage of Flame into Cargo Tanks in Tankers.

3 PURPOSE

3.1 The purpose of type testing crankcase explosion relief valves is:

.1 to verify the effectiveness of the flame arrester;
.2 to verify that the valve closes after an explosion;
.3 to verify that the valve is gas/air tight after an explosion;
.4 to establish the level of over pressure protection after an explosion.

4 TEST HOUSE

4.1 Test houses carrying out type testing of crankcase explosion relief valves are to meet the below-given requirements.

4.1.1 The test houses are to be accredited to Polish or International Standards, e.g. ISO/IEC 17025:2017 and are to hold PRS Approval Certificates.

4.1.2 The test houses are to be equipped so that they can perform and record explosion testing in accordance with the present *Publication*.

4.1.3 The test houses are be provided with equipment for controlling and measuring a methane gas in air concentration within a test vessel to an accuracy of ±0.1%.

4.1.4 The test houses are to be capable of effective point-located ignition of a methane gas in air mixture.

4.1.5 The pressure measuring equipment is to be capable of measuring the pressure in the test vessel in at least two positions: at the valve and at the test vessel centre. The measuring arrangements are to be capable of measuring and recording the pressure changes throughout an explosion test at a frequency recognizing the speed of events during an explosion. The result of each test is to be documented by video recording and, if necessary, by recording with a heat sensitive camera.

4.1.6 The test vessel for explosion testing is to have documented dimensions. The dimensions are to be such that the distance between the dished ends is between 2 and 2.5 times the vessel diameter. The internal volume of the test vessel is to include any standpipe arrangements.

4.1.7 The test vessel is to be provided with a flange, located at approximately one third from the end, for mounting the explosion relief valve consistent with the valve orientation in service, i.e. in the vertical or horizontal plane.

4.1.8 A circular plate is to be provided for fitting between the test vessel flange and the valve to be tested, with the following dimensions:

- outside diameter 2 times the outer diameter of the valve top cover;
- internal bore having the same internal diameter as the valve to be tested.

4.1.9 The test vessel is to have connections for measuring the methane in air mixture at the top and bottom.

4.1.10 The test vessel is to be provided with a means of fitting an ignition source in accordance with paragraph 5.3.

4.1.11 The test vessel volume is to be, as far as practicable, related to the size and capability of the relief valve to be tested. In general, the volume is to correspond to the requirements of paragraph 2.2.5, *Part VII – Machinery, Boilers and Pressure Vessels* of the *Rules for the Classification and Construction of Sea-going Ships* for the free area of explosion relief valve which should be not less than 115 cm^2/m^3 of the crankcase gross volume.

Notes:
1. This means that the testing of a valve having 1150 cm^2 of free area would require a test vessel with a volume of 10 m^3.
2. Where the free area of relief valves is greater than 115 cm^2/m^3 of the crankcase gross volume, the volume of the test vessel is to be consistent with the design ratio.
3. In no case is the volume of the test vessel to vary by more than +15% to –10% from the design cm^2/m^3 volume ratio.

5 EXPLOSION TEST PROCEDURE

5.1 Explosion tests to verify the functionality of crankcase explosion relief valves are to be carried out using an air and methane mixture with a methane concentration of 9.5% ± 0.5%. The pressure in the test vessel is to be not less than atmospheric and is not to exceed the opening pressure of the relief valve.

5.2 The concentration of methane in the vessel is to be measured at the top and bottom of the vessel and these concentrations are not to differ by more than 0.5%.

5.3 The ignition of the methane and air mixture is to be made at a position approximately one third of the height or length of the test vessel opposite to where the valve is mounted.

5.4 The ignition is to be made using a 100 joule explosive charge.

6 VALVES TO BE TESTED

6.1 The valves used for type testing (including testing specified in paragraph 6.3) are to be selected from the manufacturer's normal production line for such valves by PRS' Surveyor witnessing the tests.

6.2 For approval of a specific valve size, three valves are to be tested in accordance with paragraphs 6.3 and 7. For a series of valves, the requirements of Chapter 9 apply.

6.3 The valves selected for type testing are to be previously tested at the manufacturer's works to demonstrate that the opening pressure is in accordance with the specification within a tolerance of ± 20% and that the valve is air tight at the pressure below the opening pressure for at least 30 seconds.

Note:
The test is to verify that the valves are air tight following assembly at the manufacturer's works and that the valves begin to open at the required pressure.

6.4 The type testing of valves is to take into account the orientation in which they are intended to be installed on the engine or gear case. Three valves of each size are to be tested for each intended installation orientation, i.e. in the vertical and/or horizontal positions.

7 TESTS

7.1 The requirements, stated below, are to be satisfied at explosion testing.

7.1.1 Where type testing approval is required by PRS, the explosion testing is to be witnessed by PRS' Surveyor.

7.1.2 Where valves are to be installed on an engine or gear case with shielding arrangements to deflect the emission of explosion combustion products, the valves are to be tested with the shielding arrangements fitted.

7.1.3 Successive explosion testing to establish a valve's functionality is to be carried out as quickly as possible during stable weather conditions.

7.1.4 The pressure rise and decay during all explosion tests is to be recorded.

7.1.5 The external condition of the valves is to be monitored during each test for indication of any flame release.

7.2 The explosion testing is to be carried out in three stages for each valve that is required to be approved as being type tested.

7.2.1 Stage I

7.2.1.1 Two explosion tests are to be carried out in the test vessel fitted with a circular plate (see paragraph 4.1.8). The opening in the plate is to be covered by a 0.05 mm thick polythene film. The purpose of the test is to establish a reference pressure level for determination of the capability of a relief valve in terms of pressure rise in the test vessel – see 8.1.6.

7.2.2 Stage II

7.2.2.1 Two explosion tests are to be carried out on three different valves of the same size. Each valve is to be mounted in the orientation for which approval is sought, i.e. in the vertical or horizontal position with the circular plate, described in paragraph 4.1.8, located between the valve and the test vessel mounting flange.

7.2.2.2 The first of the two tests on each explosion valve is to be carried out with a 0.05 mm thick polythene bag having a minimum diameter of three times the diameter of the circular plate, referred to in 4.1.9. The volume of the bag is to be not less than 30% of the test vessel, enclosing the valve and circular plate. Before carrying out the explosion test the polythene bag is to be empty of air. The polythene bag is required to provide a readily visible means of assessing whether there is flame transmission through the relief valve following an explosion consistent with the requirements of the standards referred to in Chapter 2 and IMO requirements.

Note:
During the test, the explosion pressure will open the valve and some unburned methane/air mixture will be collected in the polythene bag. When the flame reaches the flame arrester and if there is flame transmission through the flame arrester, the methane/air mixture in the bag will be ignited and will be visible.

7.2.2.3 If the first explosion test successfully demonstrated that there was no ignition of combustion outside the flame arrester and there are no visible signs of damage to the flame arrester or valve, a second explosion test without the polythene bag arrangements is to be carried out as quickly as possible after the first test. During the second explosion test, the valve is to be visually monitored for any indication of combustion outside the flame arrester and video records are to be kept for subsequent analysis. The second test is required to demonstrate that the valve can still function in the event of a secondary crankcase explosion.

7.2.2.4 After each explosion, the test vessel is to be maintained in the closed condition for at least 10 seconds to enable the tightness of the valve to be ascertained. The tightness of the valve can be verified during the test from the pressure/time records or by a separate test after completing the second explosion test.

7.2.3 Stage III

7.2.3.1 Two further explosion tests, as described in Stage I, are to be carried out. These further tests are required to provide an average baseline value for the assessment of pressure rise recognizing that the test vessel ambient conditions may have changed during the testing of the explosion relief valves in Stage II.

8 ASSESSMENT AND RECORDS OF THE VALVES AFTER EXPLOSIONS

8.1 The assessment and records of the valves used for explosion testing is to address the following:

8.1.1 The valves to be tested are to have evidence of design appraisal/approval by the Classification Society witnessing the tests.

8.1.2 The designation, dimensions and characteristics of the valves to be tested are to be recorded. This is to include the free area of the valve and of the flame arrester, as well as the amount of valve lift at 0.02 MPa.

8.1.3 The test vessel volume is to be determined and recorded.

8.1.4 For acceptance of the functioning of the flame arrester there is not to be any indication of flame or combustion outside the valve during an explosion test.

8.1.5 The pressure rise and decay during an explosion is to be recorded, with indication of the pressure variation showing the maximum overpressure and steady under-pressure in the test vessel during testing. The pressure variation is to be recorded at two points in the test vessel.

8.1.6 The effect of an explosion relief valve in terms of pressure rise following an explosion is ascertained from maximum pressures recorded at the centre of the test vessel during the three stages. The pressure rise within the test vessel due to the installation of a relief valve is the difference between average pressure of the four explosions from Stages I and III and the average of the first tests on three valves in Stage II. The pressure rise is not to exceed the limit specified by the manufacturer.

8.1.7 The valve tightness is to be ascertained by verifying from the records at the time of testing that an under-pressure of at least 0.03 MPa is held by the test vessel for at least 10 seconds following an explosion. This test is to verify that the valve has effectively closed and is reasonably gas-tight following dynamic operation during an explosion.

8.1.8 After each explosion test in Stage II, the external condition of the flame arrester is to be examined for signs of serious damage and/or deformation that may affect the operation of the valve.

8.1.9 After completing the explosion tests, the valves are to be dismantled and the condition of all components ascertained and documented. In particular, any indication of valve sticking or uneven opening that may affect operation of the valve is to be noted. Photographic records of the valve condition are to be taken and included in the report.

9 TYPE APPROVAL OF VALVES

9.1 The qualification of quenching devices to prevent the passage of flame can be evaluated for other similar devices of identical type if one such device has been tested and found satisfactory.

9.2 The quenching ability of a flame arrester depends on the total mass of quenching lamellas/mesh. Provided the materials, thickness of material, depth of lamellas/thickness of mesh layer and the quenching gaps are the same, then the same quenching ability can be qualified for different sizes of flame arresters, subject to compliance with (a) and (b):

a) $\frac{n_1}{n_2} = \sqrt{\frac{S_1}{S_2}}$

b) $\frac{A_1}{A_2} = \sqrt{\frac{S_1}{S_2}}$,

where:

n_1 = number of lamellas of size 1 quenching device for a valve with a relief area equal to S_1
n_2 = number of lamellas of size 2 quenching device for a valve with a relief area equal to S_2
A_1 = free area of quenching device for a valve with a relief area equal to S_1
A_2 = free area of quenching device for a valve with a relief area equal to S_2.

9.3 The qualification of explosion relief valves of larger sizes than that which has been previously satisfactory tested in accordance with paragraphs 7 and 8 can be evaluated where valves are of identical type and have identical features of construction subject to the following:

9.3.1 The free area of a larger valve does not exceed three times that of the valve that has been satisfactorily tested.

9.3.2 One valve of each larger size requiring qualification is subject to satisfactory testing required by 6.3 and 7.2.2, except that a single valve will be accepted to 7.2.2.1 and the volume of the test vessel is not to be less than one third of the volume required by 4.1.11.

9.3.3 The assessment and records relating to valves after explosion are to be in accordance with Chapter 8 noting that 8.1.6 will only be applicable to Stage II for a single valve.

9.4 The qualification of explosion relief valves of smaller sizes than that which has been previously satisfactory tested in accordance with paragraphs 7 and 8 can be evaluated where valves are of identical type and have identical features of construction subject to the following:

9.4.1 The free area of a smaller valve is not less than one third of the valve that has been satisfactorily tested.

9.4.2 One valve of each smaller size requiring qualification is subject to satisfactory testing required by paragraphs 6.3 and 7.2.2, except that a single valve will be accepted to 7.2.2.1 and the volume of the test vessel is not to be greater than the volume required by 4.1.11.

9.4.3 The assessment and records relating to valves after explosion are to be in accordance with Chapter 8 noting that 8.1.6 will only be applicable to Stage II for a single valve.

10 TEST REPORT

10.1 The test house is to deliver a full report that includes the following information and documents:

.1 Test specifications.
.2 Details of the test vessel and the valves tested.
.3 The orientation in which the valve was tested (vertical or horizontal position).
.4 Methane concentration in air for each test.
.5 Ignition source.
.6 Pressure curves for each valve test.
.7 Video recordings of each valve test.
.8 The assessment and records, in accordance with Chapter 8.

11 APPROVAL

11.1 The approval of an explosion relief valve is granted at the discretion of PRS, based on the approved documentation and the test house report of the type testing results.

List of amendments effective as of 1 July 2022

Item	*Title*	*Source*
1.1.3	Date of application changed	PRS
2.1 2.2.1 4.1.1	Date of standards' issue added	IACS UR M66 Rev.4 Corr.1