

Guideline No.P-05 (201510)



P-05

SAFETY VALVE

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Foreword

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 mp@ccs.org.cn.

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SAFETY VALVE

1 Application

1.1 This Guideline applies to the approval and inspection of safety valves for marine steam boilers, pressure vessels and pipelines.

2 Basis for approval and inspection

2.1 *CCS Rules for Classification of Sea-Going Steel Ships (hereinafter referred to as “Sea-going Rules”)*

2.2 *CCS Rules for Materials and Welding*

2.3 *ISO 4126-1 Safety Devices for Protection against Excessive Pressure*

3 Definitions

3.1 For the purpose of this Guideline, the definitions given in CCS Rules for Classification of Sea-going Steel Ships apply.

3.2 Definitions used in this Guideline are as follows:

- (1) Safety valve: valve which automatically, without the assistance of any energy other than that of the fluid concerned, discharges a quantity of the fluid so as to prevent a predetermined safe pressure being exceeded, and which is designed to re-close and prevent further flow of fluid after normal pressure conditions of service have been restored.
- (2) Set pressure: predetermined pressure at which a safety valve under operating conditions commences to open;
- (3) Reseating pressure: value of the inlet static pressure at which the disc re-establishes contact with the seat or at which the lift becomes zero;
- (4) Blowdown: Difference between set and reseating pressures, normally stated as a percentage of set pressure;
- (5) Lift: actual travel of the valve disc away from the closed position;
- (6) Flow area: minimum cross-sectional flow area between inlet and seat.

4 Plans and documents

4.1 For application for works approval, the following plans and documents are to be submitted to CCS for approval:

- (1) Main product performance specification table, including the nominal pressure, operating

pressure, design temperature, applicable media, nominal diameter and other parameters of the product to be approved;

- (2) General assembly plan;
- (3) Plans of main components such as the valve body and connecting flange, valve disc and stem, valve seat, spring;
- (4) List of chemical compositions and mechanical properties of materials for main components;
- (5) Type test program.

4.2 Plans and documents for information:

- (1) Main process documents: Welding process, heat treatment, surfacing and spray welding (if applicable);
- (2) List of qualified supplier for main components;
- (3) Product operation instructions, nameplate and certificate of inspection (in both Chinese and English for international navigation ships).

4.3 Other required information:

- (1) Documents as specified in Article 3.2.1, Part One “General” of *CCS Guidelines for Product Inspection*.

5 Materials and components

5.1 Materials and components are to be controlled according to relevant requirements of the CCS Rules currently in effect.

5.2 Materials and components mainly include the valve body and connecting flange, valve disc, plate, stem and seat, spring, etc.

5.2 Valves and other pressed components are to be subject to the 100% hydraulic strength test, and then 100% tightness test after being assembled with the valve disc, plate and spring. The Surveyor is required to audit and confirm the test report or witness the test process.

5.3 Applicants must provide a well-established method for controlling the sub-contractor quality to ensure quality, and materials for main components listed in Article 5.2 are to be compliant with relevant requirements of CCS Rules for Materials and Welding. Special note: Materials for main components of safety valves used in cargo systems of low-temperature liquefied gas carriers or chemical tankers are to be tested according to relevant requirements of Chapter 6, Part One of *CCS Rules for Materials and Welding*.

6 Welding procedures qualification

6.1 Valves of welding structure are to be qualified and approved for welding procedures according to relevant requirements of CCS Rules for Materials and Welding.

7 Design and technical requirements

7.1 General technical requirements

- (1) Means are to be provided to lock and/or seal all external adjustments in such a manner so as to prevent or reveal unauthorized adjustments of the safety valve;
- (2) Unless additional discharge actions are taken, a relief connector is required at the lowest position in the safety valve where liquids may accumulate;
- (3) The design of valve end connections, whatever their type, shall be such that the internal area of the connecting piping or stub connection at the safety valve inlet is at least equal to that of the valve inlet connection.

7.2 Safety valves for boilers and superheaters are to meet the following requirements:

- (1) Any safety valve is to have a diameter of no greater than 100 mm but at least 25 mm;
- (2) After being regulated and locked up, the safety valve is not to be modified or overloaded, and the valve disc is not to run out of the valve seat when the spring is broken;
- (3) The safety valve is not to directly exhaust to the spring;
- (4) The safety valve body is to be equipped with a drain pipe to the bottom of the tank, on which no valve or cock is allowed;
- (5) The safety valve is to be equipped with a manual opening device which could be operated at a safe location on the bottom layer of the stoke hold or the engine room;
- (6) The spring case of the superheater safety valve is to be protected from excessive temperatures through ventilation or other means;
- (7) Two safety valves may be installed in a valve body.

8 Type test

8.1 Selection of typical sample

- (1) For the first approval, generally three models are to be selected from each series to be approved. These samples are to be the most representative, covering the production level, processing and test capacities of the manufacturer and providing the maximum, the minimum and the median values in terms of the structure, purpose, design pressure and

design temperature.

8.2 Test items

- (1) Test of physicochemical properties of raw materials for main components;
- (2) Inspection of structural dimension and appearance of main components;
- (3) Overall visual inspection;
- (4) Spring performance test;
- (4) Valve body strength test;
- (5) Tightness test;
- (6) Set pressure test;
- (7) Relieving pressure test;
- (8) Reseating pressure test;
- (9) Mechanical characteristic test;
- (10) Lift test;
- (11) Relieving capacity test.

8.3 Test conditions

Any manufacturer's site to be serving as the type test site is to allow the test items specified in the program to be performed, and inspected and considered satisfactory by the CCS in terms of the testing capability, measures and personnel. Otherwise, a site considered qualified by CCS is to be used.

8.4 Test method and technical requirements

8.4.1 Test of physicochemical properties of raw materials for main components

All castings and forgings must have their technical conditions conforming to related recognized material standards, with the grade and surface quality indicated in the plan. The casting method and size of the test coupon, the machined shape, size, chemical composition, mechanical properties and heat treatment of the specimen are to be compliant with the relevant provisions of CCS Rules for Materials and Welding. Materials not covered in this Rules may be in accordance with other recognized relevant standards.

8.4.2 Inspection of structural dimension and appearance of main components

The structural dimension and appearance are to be as specified in the plans approved by CCS.

8.4.3 Overall visual inspection

The valve body is to have a clean and smooth surface free of such casting defects as harmful cavity, shrinkage, cold shut, and adhesive sand.

8.4.4 Spring performance test

A spring is to be given prestressing or hot prestressing treatment, and 10% (at least two) springs of the same specification are to be taken per heat treatment furnace to determine the permanent deformation under the specified load. The permanent deformation is to be within a 10% deviation and obtained from the difference between the original free height of the spring compressed under the specified test load for at least three times and the final free height obtained after further compression in the same way. A purchased spring is to be accompanied by a warranty certificate, and randomly taken for re-test.

8.4.5 Valve body strength test

Seal the valve seat sealing face, with a pressure 1.5 times the nominal pressure of the valve applied to the chamber at the inlet side for at least 3 min, and then the pressed part is to exhibit no leakage and noticeable residual deformation.

8.4.6 Tightness test

(1) The test pressure is to be:

- ① 90% of set pressure or the reseating pressure, whichever is the lesser, for steam safety valves.
- ② 0.03 MPa lower than the set pressure (< 0.3 MPa) or 90% of set pressure (≥ 0.3 MPa) in case of safety valves for air, other gases, water or other liquids.

Tightness test media

Table 8.4.6(1)

Media for safety valve	Tightness test media
Steam	Saturated steam
Air or other gases	Air
Water or other liquids	Water

(2) The tightness test is to meet the following requirements:

- ① For steam safety valves, no steam leakage is found at the outlet through visual or audible inspection;

- ② For safety valves with metallic sealing face for air or other gases, the bubble leakage rate per minute is to be as specified below:

Allowable bubble leakage rate for tightness test Table 8.4.6 (2)

Flow diameter, mm	Operating pressure, MPa	
	≤ 10.0	> 10.0
	Maximum allowable leakage rate, bubble/min.	
≤ 15	10 ~ 12	10 ~ 15
> 20	8 ~ 10	10

- ③ For safety valves with non-metallic sealing face for air or other gases, no leakage is allowed;
- ④ For safety valves for water or other liquids, no drop of water is allowed on the sealing face with the valve maintained at the operating pressure for 2 min.

8.4.7 Test of set pressure, relieving pressure and reseating pressure

- (1) After success of the tightness test, test the set pressure, relieving pressure and reseating pressure on the test bench, and record and regulate these pressures to the design value, then repeat the test at least three times during which the valve is to operate stably.
- (2) The set pressure is to be within a deviation of:
- ① ±0.14 MPa where it is below the limit deviation under 0.5 MPa;
 - ② ± 3% where it is ≥ 0.5 MPa.
- (3) The relieving pressure is to be:
- ① not greater than 103% of the set pressure for steam safety valves;
 - ② not greater than 110% of the set pressure for safety valves for air or other gases;
 - ③ not greater than 120% of the set pressure for safety valves for water or other liquids.
- (4) The blowdown of a safety valve is to be as follows:

Blowdown of a steam safety valve

Table 8.4.7 (1)

Set pressure	Blowdown	
	For pipelines	For pressure vessels
≤ 0.3	≤ 0.05	≤ 0.04
> 0.3	≤ 20% set pressure	≤ 10% set pressure

Blowdown of safety valves for air or other gases

Table 8.4.7 (2)

Set pressure	Blowdown	
	For pipelines	For pressure vessels
≤ 0.3	≤ 0.05	≤ 0.04
> 0.3	≤ 15% set pressure	≤ 10% set pressure

Blowdown of safety valves for water or other liquids

Table 8.4.7 (3)

Set pressure	Blowdown
≤ 0.3	≤ 0.06
> 0.3	≤ 20% set pressure

8.4.8 Lift test

When the relieving pressure is reached, measure the lift on the test bench with a lift measuring device. The lift is to be:

- (1) For full lift safety valves, $\geq 1/4$ of the flow diameter, with the deviation being $\pm 5\%$ of the average;
- (2) For low lift safety valves, $\geq 1/20$ or $1/40$ of the flow diameter, and up to the design value before the medium pressure reaches the upper limit of relieving pressure specified in this standard.

8.4.9 Mechanical characteristic test

The safety valve is to work stably without chatter, flutter, sticking, etc.

8.4.10 Relieving capacity test

Mount the safety valve to the test device and open the flow control valve; when the medium pressure reaches the set pressure, the safety valve will begin relieving continuously; when the pressure rises to the rated relieving pressure, measure the relieving capacity and record the values.

The coefficient of discharge is to be given by:

Coefficient of discharge = Actual discharge capacity/theoretical discharge capacity

The theoretical discharge capacity is to be calculated according to ISO4126.

8.5 Exemption of the type test items

8.5.1 First approval

All applicable test items described in Article 8.2 are to be conducted for the first approval. If the following conditions are met, the manufacturer may submit a written application on exemption of part of test items to CCS, and the Surveyor is to give his/her comments based on the production situation and the product history and usage records of the factory and fax such comments along with the written application of the manufacturer to the Construction Classification Division of the Headquarters. Only after being approved can the test items be exempted:

- (1) The manufacturer applying for approval is to provide the test reports of relevant test items recently issued by an authoritative testing agency (such as the General Administration of Quality Supervision, Inspection and Quarantine or the Defense Science and Technology Laboratory);
- (2) The test approval applicant is to provide the test reports of relevant test items recently signed by IACS members.
- (3) Where the product is produced by the applicant based on technology transfer or licensing from another manufacturer, and has been approved by CCS, it may be exempted from some test items as described in the above Article 5.8.2 after assessment of the manufacturing capacity and processing/assembling level of the applicant.

9 Unit/batch inspection

9.1 The inspection providing a certificate of marine product is to be carried out where the manufacturer has passed the specified inspection/test and its products have proven to be deliverable.

9.2 Unit/batch inspection of products from manufacturers approved by CCS

- (1) The inspection items are to be in accordance with the inspection plan (related content in quality control plan) ratified at the time of approval, but generally inclusive of the overall visual inspection, valve body strength test, tightness test, test of set pressure and reseating pressure (for air reservoir safety valve if applicable);

- (2) The above tests may be carried out independently by the manufacturer, with a complete test report to be submitted to the Surveyor for approval;
- (3) The Surveyor is required to randomly take at least 5% (or 1 unit) of valves per batch/specification for re-test of the above inspection and test items, or for onsite witness during the test at the manufacturer;
- (4) In each application for unit/batch inspection, the *Quality Proof Documents of Materials for Components* of the batch together with related test records are to be provided at the same time to the Surveyor for approval.

9.3 The unit/batch inspection of products from manufacturers not approved by CCS is to meet the following requirements:

- (1) The manufacturer is to prepare and submit plans/documents as specified in Articles 5.4.1 and 5.4.2 of this Guideline to the CCS for approval/information;
- (2) At least one of safety valves for product inspection is to be randomly taken per model to the type test for all items specified in Article 5.8.2 of this Guideline;
- (3) Marine safety valves not selected are to be inspected and tested at least for items as set forth in Article 5.8.2 of this Guideline.