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Safety valves - General requirements

安全阀 一般要求

(ISO 4126-1:2013, Safety devices for protection against excessive pressure - Part 1: Safety valves, MOD)

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Safety valves - General requirements

1 Scope

This Standard specifies the terms and definitions of safety valve, design, exit-factory test, type test, determination of safety valve discharge capacity performance, determination of safety valve size, marks and lead seals.

This Standard is applicable to the safety valves of which the diameter of the flow is not less than 4mm, and the set pressure is not less than 0.1MPa.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 1239.2, *Cold coiled helical springs technical specifications - Part 2: Compressions spring*

GB/T 7306 (all parts), *Pipe threads with 55-degree thread angle where pressure-tight joints are made on the threads*

GB/T 9124 (all parts), *Steel pipe flanges*

GB/T 12224, *General requirements for industrial steel valves*

GB/T 12716, *Pipe threads with the thread angle of 60 degrees where pressure-tight joints are made on threads*

GB/T 15530.1, *Cast copper alloy integral flanges*

GB/T 15530.8, *Specifications for copper alloy and composite flanges*

GB/T 17241.6, *Integral cast iron flanges*

GB/T 17241.7, *Specifications for cast iron pipe flanges*

GB/T 23934, *Hot formed helical compression springs - Technical requirement*

GB/T 36588, *Safety devices for protection against excessive pressure - Common data* (GB/T 36588-2018, ISO 4126-7:2013, MOD)

JB/T 2768, *Components of valves - High pressure pipes fittings and end-to-end*

dimensions of valves

JB/T 2769, *Components of valves - High pressure threaded flanges*

3 Terms and definitions

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

3.1 safety valve

an automatic valve that uses the force of its own medium to discharge a certain amount of fluid without any external force, so as to prevent the pressure from exceeding a predetermined safety value

NOTE: When the pressure returns to normal, the valve closes and prevents the medium from continuing to flow out.

3.2 direct loaded safety valve

safety valves that only rely on direct mechanical loading devices such as weights, lever-weighted hammers or springs to overcome the force generated by the pressure of the medium under the disc

3.3 set pressure

the predetermined pressure at which the safety valve begins to open under operating conditions

NOTE: This pressure is the gauge pressure measured at the valve inlet. At this pressure, the force resulting from the medium pressure to open the valve under specified operating conditions is balanced by the force that keeps the disc on the valve seat.

3.4 maximum allowable pressure; p_S

the maximum pressure at which the protected equipment is designed

3.5 over pressure

the pressure increments above the set pressure of the safety valve

NOTE: It is usually expressed as a percentage of set pressure.

3.6 reseating pressure

the inlet static pressure when the valve disc is in contact with the valve seat again after the safety valve is discharged (that is, the lift becomes zero)

3.7 cold differential test pressure

through the valve.

5.2 End connection

5.2.1 End connection type

The end connection type requirements are listed below:

a) Steel flange connection is according to the provisions of GB/T 9124, JB/T 2769. The surface roughness of the sealing surface is according to the regulations of GB/T 9124 and JB/T 2768, respectively. Iron flange connection is according to the provisions of GB/T 17241.6. Surface roughness of the sealing surface is according to the provisions of GB/T 17241.7. Copper flange connection is according to the provisions of GB/T15530.1. Surface roughness of the sealing surface is according to the provisions of GB/T 15530.8.

b) The welding end of the butt-welding connection shall be in accordance with the provisions of GB/T 12224.

c) The threaded connection is in accordance with the provisions of GB/T 7306 and GB/T 12716.

d) Other end connections may also be used by agreement between the manufacturer and the purchaser.

5.2.2 End connection design

No matter what type of safety valve end connection is designed, the internal cross-sectional area of the external pipe or pipe joint connected to the valve inlet shall be at least equal to the internal cross-sectional area of the valve inlet connection [see Figure 1a)].

The internal cross-sectional area of the external nozzle at the outlet of the safety valve shall be at least equal to the internal cross-sectional area of the valve outlet but excluding the valves that the outlet is internal thread connection [see Figure 1b)].

If the valve outlet is of the structure shown in Figure 1b), a suitable pipe shall be fitted when carrying out the tests specified in 7.1.4.

tested according to the technical requirements of the safety valve manufacturer.

The allowable stress shall refer to GB/T 23935 and be determined according to experience. The operating temperature of the spring and its working environment shall be considered.

5.3.1.2 Materials

The material for the manufacture of safety valve springs shall meet the requirements of the corresponding material standards and be compatible with its working conditions.

5.3.1.3 Marks

Spring marks, including stamping or etching, shall be limited to their void ring.

For stock springs, labels or other suitable methods may be used to identify when the above marks are not suitable.

5.3.1.4 Sizes

Size requirements are listed below:

a) Slenderness ratio: that is, the ratio of the free height to the middle diameter, which shall be less than 5.

b) Winding ratio (spring index): that is, the ratio of the middle diameter to the diameter of the steel wire, which shall be in the range of 3 to 12.

c) Coil Spacing: the coil pitch shall be uniform. The compression of the spring (deformation under the maximum working load) shall not be greater than 80% of the nominal (calculated) deformation from the free height to the height of the coil when it is tightened.

d) End ring: the ends of the support rings at both ends of the spring shall be tightened with the working ring, and the ends shall be ground flat. Both ends of the spring shall have a support plane greater than or equal to 3/4 turn and be perpendicular to the axis.

5.3.1.5 Inspection, test and tolerance

Permanent deformation: All springs shall be tested for permanent deformation. That is, measure the original free height of the spring after compressing the spring at least 3 times according to the test load specified by the safety valve manufacturer. Then use the test load to compress the spring at least 3 times. Measure its final free height again. The permanent deformation of the spring shall not exceed 0.5% of its original free height.

Each spring shall be subject to at least the following size inspections:

a) The load and height at the maximum compression the spring will use, or the spring stiffness within a given range (and within a linear range) of less than 80% of the calculated total deflection;

b) Inspection of wire diameter and free height;

c) Inspection of end face verticality: Stand the spring on the plate and lean against a square. Measure the maximum deviation between the upper end ring and the square. The inspection method is in accordance with the provisions of GB/T 23934 and GB/T 1239.2;

d) Inspection of end face parallelism (when applicable): Make the spring stand on the plate. Measure the height difference between the highest point and the lowest point on the upper end face.

When applicable, this measurement shall be repeated with the ends of the spring turned upside down.

Tolerance: The dimensional tolerance of the spring shall be determined according to the provisions of GB/T 23934 and GB/T 1239.2 or determined by the valve and spring manufacturer.

5.3.2 Minimum requirements for disc springs

5.3.2.1 General

The spring manufacturer shall provide a certificate of quality for the disc spring, to indicate that the disc spring is made of the specified material and has completed the test according to the technical requirements of the safety valve manufacturer.

The allowable stress shall be determined by reference to GB/T 1972 and based on experience. The operating temperature of the spring and its working environment shall be considered.

Disc spring packs shall be well guided just like the spring discs.

5.3.2.2 Materials

The material for the manufacture of the safety valve disc spring shall meet the requirements of the corresponding material standards and be compatible with its working conditions.

5.3.2.3 Marks

Disc spring marks, including stencils or etchings, shall be marked in the lowest stress area.

Each set of disc springs shall be marked in such a way that the exact relative position

boosting process.

b) The risk of brittle fracture under test conditions shall be fully assessed at the design stage. The material of the valve to be pneumatically tested is appropriately selected to avoid the risk of brittle fracture during the test. This requires that a sufficient difference be specified between the embrittlement temperature of each component material and the test temperature.

c) Attention shall be paid to the fact that the temperature will drop when the high-pressure gas in the tank is depressurized to the test pressure of the valve.

d) For the valve under the air pressure test, the close inspection can only be carried out after the pressure increase process is completed.

e) No impact load of any kind shall be given to the valve under pneumatic test.

f) Measures shall be taken to prevent the pressure from exceeding the test pressure.

6.5 Adjustment of set pressure or cold differential test pressure

Each safety valve shall be adjusted to its specified set pressure or cold differential test pressure.

Before using air or other gas as the test medium to adjust the set pressure or cold differential test pressure of the safety valve, the safety valve shall undergo the hydraulic test in advance (see 6.3) before adjusting the set pressure or the cold differential test pressure.

6.6 Seal test

The safety valve shall be sealed and tested after adjusting the set pressure or the cold differential test pressure. The test procedure and allowable leakage rate shall be in accordance with the relevant standards or shall be agreed upon between the manufacturer and the purchaser.

7 Type test

7.1 General

7.1.1 Application

The operating performance and discharge capacity performance of the safety valve are to be determined by type testing in accordance with the requirements of this chapter.

7.1.2 Tests

The test to determine the operating performance shall be as specified in 7.2. The test to

determine discharge capacity performance shall be as specified in 7.3.

When these tests are carried out separately, the valve parts that affect the flow of the medium shall be fully installed in the valve.

Test procedures, test benches and equipment shall be capable of determining operating performance and discharge capacity performance at relieving pressure.

7.1.3 Test purpose

The purpose of the test is to determine, under specific test conditions, at least the following characteristics of the valve before opening, during discharge and when reseated:

a) Set pressure;

b) Over pressure;

c) Reseating pressure;

d) Repeatability of valve action;

e) Mechanical characteristics of the valve determined visually or audibly. such as:

1) Good reseating ability;

2) If there is hopping, chattering, jamming, or harmful vibration.

f) Lift at the over pressure;

g) Actual mass flow (actual discharge capacity).

7.1.4 General test requirements

The test shall provide suitable data. From these data, the operating performance and discharge capacity performance of the valve can be determined. For the valve whose outlet is connected with internal thread, its shape is shown in Figure 1b); a pipe with a length of at least 5 times the pipe diameter and an appropriate thickness shall be fitted during the test.

7.1.5 Calculations based on test results

The theoretical discharge capacity is calculated according to GB/T 36588. The coefficient of discharge of the valve is calculated according to GB/T 36588 using the theoretical discharge capacity and the measured discharge capacity under the relieving pressure.

7.1.6 Design change

determined. The ratio of valve inlet area to flow area and the ratio of flow area to outlet area shall be considered.

When the size series contains 7 or more sizes, 3 sizes of valves shall be tested. If the size series contains not more than 6 sizes, the number of valve sizes tested may be reduced to 2.

When the scope of a size series is expanded, so that the safety valve previously tested can no longer represent the entire series, the valve size shall be appropriately increased for further tests.

For each size of the test valve, three different springs shall be used for the test. For this purpose, three different springs can be tested on one valve. It is also possible to test three different springs on three valves of the same size. To confirm compliance with the acceptance requirements for performance repeatability, each test shall be carried out at least 3 times. The tests shall be carried out at the minimum design set pressure.

Where only one size valve is manufactured but there are multiple pressure ratings, it shall use 4 different springs that can cover the pressure range of the valve to test.

7.3 Discharge capacity performance test

7.3.1 Test requirements

After determining that the operating performance (see 7.2) is satisfactory, except for valves designed for liquids, use steam, air or other gas with known properties as a medium to carry out the discharge capacity performance test of the valve. Valves for liquids shall be tested with water or other liquids of known properties. When the discharge capacity measurement is performed independently of the operational performance test, the valve disc shall be maintained at the lift determined by the operational performance test.

7.3.2 Selection of valves for discharge capacity test

The valve used for the discharge capacity performance test shall be the valve that has passed the action performance test (see 7.2.3).

7.3.3 Test procedure

7.3.3.1 Test conditions

Test procedures, test benches and equipment shall be approved prior to the test.

Test procedures, test benches and equipment shall be capable of measuring discharge capacity at the over pressure.

The lift limiter can be installed to limit the lift to the value determined according to 7.2.1c).

The test can be carried out with or without springs installed. However, when the spring is in the fluid flow, the test shall be carried out with the spring installed.

If the safety valve has an adjusting ring, it shall be tested at different pressures to confirm that the coefficient of discharge does not change in any way with the relative position of the adjusting ring.

7.3.3.2 Number of test valves

A given valve design shall be tested in 3 sizes, each with 3 different pressures. However, if the size series contains no more than 6 sizes, the number of test sizes can be reduced to 2.

When the number of sizes contained in a size series is expanded from less than 7 to greater than or equal to 7, a total of 9 tests shall be carried out for the valves of 3 sizes.

For newly designed or specially designed valves, when only one size is manufactured and there are multiple pressure ratings, the test shall be carried out at 4 different set pressures. These test pressures shall cover the pressure range for which the valve will be used or be determined by the capabilities of the test facility.

7.3.3.3 Valves that limit the lift

For valves with limited lift, the discharge capacity at the limited lift may be determined immediately after the test to determine the discharge capacity at the full lift. It can also be determined later.

For valves with limited lift, it shall, at all test pressures, use at least 3 lift points to establish a curve of coefficient of discharge corresponding to the valve lift.

7.3.3.4 Test pressure value

For each nominal size safety valve, three tests shall be carried out under the test pressure (these test pressures shall make the ratio of absolute back pressure to absolute relieving pressure less than 0.25).

These tests shall be carried out under atmospheric back pressure.

For compressible media, when the ratio of absolute back pressure to absolute relieving pressure is greater than 0.25, the coefficient of discharge may depend heavily on this pressure ratio. The test shall be carried out at pressure ratios between 0.25 and the required maximum pressure ratio, so as to obtain a curve or table of coefficient of discharge K_d corresponding to the ratio of absolute back pressure to absolute relieving pressure. The curve can also be extended to accommodate the tests with pressure ratios less than 0.25.

The curve shall be used to determine the coefficient of discharge at any set pressure and over pressure. It shall also be used to determine the coefficient of discharge under back

When the relieving pressure is less than the relieving pressure for the discharge capacity performance test (see 7.3), the coefficient of discharge or the certified coefficient of discharge cannot be used to calculate the discharge capacity. But when the relieving pressure is greater than the relieving pressure of the discharge capacity test, they can be used to calculate the discharge capacity.

8 Determination of discharge capacity performance of safety valve

The determination of the discharge capacity performance of the safety valve is in accordance with the provisions of GB/T 36588.

9 Determination of safety valve size

The size of the safety valve is determined according to the provisions of GB/T 36588.

10 Marks and lead seals

10.1 Marks

10.1.1 Marks on safety valve shell

The marks on the safety valve shell can be integrated with the shell. They can also be marked on a sign that is securely fixed to the shell. At least the following shall be marked on the casing of all safety valves:

a) Import size, such as DN×××;

b) Shell material;

c) Manufacturer name or trademark;

d) When the inlet and outlet connection ends have the same size or the same pressure level, the arrow of the flow direction of the medium shall be indicated.

10.1.2 Marks on nameplate

At least the following shall be marked on a nameplate securely fixed to the safety valve:

a) Set pressure (gauge pressure), MPa;

b) Manufacturer's product model;

c) Indicate the certified coefficient of discharge or certified discharge capacity

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