

Introduction and Operation of Valve

Content

I . Valve Introduction	2
1. Types of Valves	2
2. Function of Valve	2
3. Main Parameters of Valve	2
4. Inspection of Valve before Use	3
5. Common problems of valves in the use	3
6. Features and precautions of common chemical valves	3
(1) Plug valve (cock)	3
(2) Ball valve	4
(3) Butterfly valve	4
(4) Globe valve	5
(5) Gate valve	6
(6) Throttle valve	7
(7) Check valve	7
(8) Safety valve	8
(9) Fluoroplastic lined valve	8
(10) Steam trap	8
(11) Various sampling valves	9
II . Opening and closing of valve	9
III . Local operation of electric valve	11
IV . Steam valve	11

I . Valve Introduction

Valve is an important accessory for controlling medium flow in chemical pipeline. This handout focuses on the practical application, detailed principle and structural sectional view of valve with reference to relevant data and books.

Valve is composed of valve body, opening and closing mechanism and valve cover. This article mainly introduces the structural characteristics of common valves and the precautions for correct use.

1. Types of Valves

1.1. According to the purpose: cut-off valve, regulating valve, diverter valve, check valve, safety valve;

1.2. According to the acting force: actuated valve and self-acting valve.

2. Function of Valve

2.1. Opening and closing function - cut off or connect the fluid flow in the pipe;

2.2. Regulating function - regulate the flow and flow rate in the pipe;

2.3. Throttling function - a large pressure drop occurs after the fluid passing through the valve;

2.4. Other functions

a. Automatic opening and closing

b. Maintaining a certain pressure

c. Steam trap.

3. Main Parameters of Valve

3.1. PN nominal pressure (the maximum pressure of the fluid allowed to pass through);

3.2. DN nominal diameter;

3.3. TN temperature range (allowable temperature range of fluid).

4. Inspection of Valve before Use

Inspection items include:

- 4.1. Whether there are blisters, cracks and other defects on the inner and outer surfaces of the valve body;
- 4.2. Whether the valve seat is firmly connected with the valve body, whether the valve core is consistent with the valve seat, and whether the sealing surface is intact;
- 4.3. Whether the connection between the valve stem and the valve core is flexible and reliable, whether the valve stem is bent, whether the thread is damaged or corroded;
- 4.4. Whether the packing and gasket are aging and damaged;
- 4.5. Whether the valve is flexible to open;

5. Common problems of valves in the use

- 5.1. Leakage of flange and thread at the connection with the pipeline;
- 5.2. Leakage of stuffing box, leakage of waist pad, and the valve stem could not move;
- 5.3. Internal leakage caused by loose closure between valve core and valve seat.

6. Features and precautions of common chemical valves

(1) Plug valve (cock)

Features: $TN < 150^{\circ}\text{C}$ and $PN < 1.6\text{Mpa}$. It has the advantages of simple structure, rapid opening and closing, convenient operation and small fluid resistance.

Precautions for use:

1. The outer end of the valve stem is square shape, and it is in closed state if the straight line marked on the diagonal line is perpendicular to the direction of the valve body, and it is in open state if the straight line is consistent with the direction of the valve body;
2. Cock special wrench is used for opening and closing the valve generally, to safety accidents caused by slipping with the valve stem; try not to use the adjustable wrench which may cause slipping;

3. Check according to the previous inspection items before opening the valve. After the inspection, slowly open the valve, and avoid to stand in the direction of the sealing surface when opening. Wear an acid-proof mask when encountering acid or alkali fluid.

(2) Ball valve

The ball valve and the plug valve are the same type of valve, and it uses a sphere with a through hole for opening and closing, and the sphere rotates around the center line of the valve stem to achieve the purpose of opening and closing.

Ball valve with jacket insulation, stainless steel ball valve, stainless steel quick-opening ball valve

Features: The valve is simple in structure and reliable in operation. It is applied for pipelines of bidirectional flow medium, with low fluid resistance and good sealing.

Disadvantages: The medium may leak from the valve stem easily.

Precautions for use: the same as plug valve;

The valve with handle, it is closed when the handle is perpendicular to the medium flow direction, and is open when the handle is consistent with the medium flow direction;

For ball valve with jacket insulation, pay attention to the following matters:

The steam supply of jacket insulation shall be opened to melt the easy-to-crystallize medium in the valve before opening and closing the valve. Do not forcibly open or close the valve before the medium is completely melted;

When the valve cannot be opened, it could not be opened with the method of lengthening the force arm, which will make the valve stem falling off with the valve core due to large resistance, causing damage to the valve or the wrench, and resulting in unsafe factors.

(3) Butterfly valve

Butterfly valve uses a disc rotating around the shaft to control the opening and closing of the pipeline. The angle of rotation reflects the opening degree of the valve.

According to different transmission modes, there are 3 types of butterfly valves: manual, pneumatic and electric. And manual type is the most commonly used one, the valve is opened and closed by the valve stem which is driven by the gear with the rotating handle.

Features: Butterfly valve has the advantages of simple structure, quick opening and closing,

small fluid resistance, convenient maintenance, etc., but it couldnot be used in high temperature and high pressure occasions, and the large-diameter pipeline of water, steam, air, oil, and etc. with PN < 1.6Mpa and TN< 120 degrees.

Precautions for use:

1. The valve core can rotate 90 degree only. Generally, the arrow direction of CLOSE and OPEN are indicated on the valve body, and it is close clockwise rotating, and is open anti-clockwise rotating.
2. If there was a certain resistance when opening and closing, the valve can be open and close with a special F wrench, but couldnot by force, otherwise the valve stem and gear would be damaged;
3. It is forbidden to remove the handwheel and use an adjustable wrench to move the valve stem; (the same goes for the valves below)
4. Open and close gradually, and observe whether any abnormal situation, to prevent leakage.

(4) Globe valve

Globe valve is the most widely used cut-off valve in chemical production. Compared with the above three types cut-off valves, the valve is opened and closed by changing the distance between the valve disc and the valve seat through lifting of the valve stem which is connected with the valve disc, rather than by rotating the opening and closing parts.

Streamline type globe valve American standard globe valve

Features: The upper part of the globe valve has a handwheel and a valve stem, and the middle part has a thread and a stuffing box sealing section. If a small valve, the thread on the valve stem is in the valve body, is compact in structure. But more part of valve stem is contacted with the medium, the threaded part is easily corroded especially. It can be judged from the height of the valve stem out of the valve cover.

The structure of the globe valve is complex, and the operation is simple and effortless. The flow and the cutoff channel can be adjusted easily, and no water hammer phenomenon during slow opening and closing, so it is widely used.

When installing the globe valve, pay attention to the fluid direction. Make the pipeline fluid flow through the valve seat port from bottom to top, that is, the so-called "low in and high out". The

purpose is to reduce the fluid resistance to save effort in opening, and make the valve stem and packing culvert not in contact with the medium in the closing state to ensure that the valve stem and packing culvert will not be damaged and leaked.

The globe valve is mainly applied to the pipeline of water, steam, compressed air and various materials. It can accurately adjust the flow and strictly cut off the channel, and it couldnot be used for materials with high viscosity and easy crystallization.

Precautions for use:

1. Before opening, check whether the valve is intact, especially whether there is leakage at the stuffing box;
2. When the valve stem cannot be rotated directly by hand, a special F wrench can be used. If it still cannot be opened and closed, please do not lengthen the force arm of the wrench to forcibly open and close, otherwise the valve would be damaged and lead to safety accidents;
3. when it is applied in medium-pressure steam pipeline, drain the condensate in the pipeline firstly before opening, and then slowly open the valve till 0.2~0.3Mpa for preheating the pipeline, so as to prevent the sealing surface from being damaged by sudden pressure rise . When it is normal after checking, adjust the pressure to the required state.

(5) Gate valve

Gate valve is also called gate plate valve, it is opened and closed by lifting the gate plate. The gate plate is perpendicular to the fluid direction, the channel size can be changed by changing the relative position between the gate plate and the valve seat.

Rising stem gate valve Non-rising stem gate valve

According to the different movement of the valve stem when opening and closing, the gate valve is divided into two types: rising stem type and non-rising stem type.

The rising-stem gate valve, the stem thread is exposed outside the valve body. When the valve is opened, the stem extends from the handwheel. The advantage is that the opening degree of the valve can be judged according to the extension length of the stem, and the thread part is basically unaffected by medium corrosion because of the small contact length between the stem and the medium. And the disadvantage is the large height of the overhanging space.

The non-rising stem gate valve, the stem thread is inside the valve stem and is fit into the internal thread on the gate plate. When the valve is opened, the stem only rotates without lifting up and down, and the gate rises along the stem thread. The advantage is small extension space, and the disadvantage is that the opening degree of the valve can not be judged according to the valve stem, and the valve stem thread is easy to be corroded due to long-term contact with the medium.

The gate valve has the advantages: small fluid resistance, constant medium flow direction, free of water hammer phenomenon because of slow opening, easy to regulate the flowrate, etc. The disadvantages are complex structure, large size, long opening and closing time, difficult maintenance of sealing surface, etc.

Precautions for use:

1. When the valve stem is opened and closed in place, do not force again, otherwise the internal thread or bolt screw would be broken, causing damage to the valve;
2. F wrench is allowed to be used to open and close the valve when it cannot be directly opened and closed by hand;
3. When opening and closing the valve, pay attention to the sealing surface of the valve, especially the packing gland to prevent leakage.

(6) Throttle valve

Throttle valve, also known as needle valve, the appearance is similar to the globe valve, the shape of spool is different, conical or parabolic. It is commonly used as chemical instruments, and is threaded connection commonly.

Precautions for use:

1. Because of the threaded connection, check whether the threaded connection is loose and leaking firstly when opening and closing;
2. Open and close the valve slowly, because the flow area is small and the flow rate is large, which may cause corrosion on the sealing surface. Pay attention to the change of pressure.

(7) Check valve

The check valve is a valve that automatically opens and closes by the pressure difference of the medium before and after the valve, controlling the medium flowing in the one-way, also known as a check valve or one-way valve.

According to different structures, check valves are divided into lifting type and swing type.

Precautions for the use: pay attention to the direction of the valve, the arrow is consistent with the flow of the medium. If the medium is easy to crystallize, the valve disc may be blocked and could not be pressed down, and the valve could not work.

(8) Safety valve

Safety valve is a kind of valve that can automatically open and close according to the medium pressure. When the medium pressure exceeds the setting value, the valve can open automatically for discharge and pressure relief, to prevent the equipment and pipeline from being damaged, and can automatically close after the pressure returning to normal.

According to different ways of balancing internal pressure, safety valves are divided into lever weight type and spring type.

Precautions for use:

1. The safety valve must be used within the valid calibration period;
2. the control valve of the safety valve installed on the pipeline or equipment is the globe valve generally, which must be open to ensure that the safety valve can work effectively;
3. The valve disc shall be lifted slightly and regularly, to purge the impurities in the valve with medium;
4. Re-calibrate or replace the the safety valve if it cannot work within the set pressure.

(9) Fluoroplastic lined valve

Fluoroplastic lined valve is mainly applied to corrosive media such as acid and alkali, the structure and principle are similar to non-fluoroplastic one, excepting all the valve stem, valve core and valve seat are lined with fluoroplastic, and the use method is similar .

(10) Steam trap

Steam trap valve is a kind of valve that can automatically discharge condensate intermittently in steam pipelines, heaters and other equipment systems, and can also prevent steam from leaking. And the commonly used type are bell float type, thermodynamic type and pulse type.

Precautions for use:

1. Before use, discharge the condensate with the pipeline bypass valve. When there is steam

supply, close the bypass and use the steam trap of the main pass, otherwise the water in the valve would be locked and could not be drained;

2. Be careful not to be scalded by steam when opening and closing the valve.

(11) Various sampling valves

The sampling valve is used for obtaining medium samples for chemical analysis, it is generally installed on equipment or pipelines, and can be roughly divided into the following types: double opening valve, flange clip valve and sampling valve with insulation jacket;

Precautions for use:

1. The double opening valve is generally composed of two ball valves, to achieve the purpose of sampling safety and sampling through linkage in the negative pressure device; When sampling, close the valve second close to the equipment and pipeline, open the first valve to let the medium flowing into the space between the two valves; Then close the first valve, open the second valve, and place the sampling vessel at the sampling port to collect the medium;

2. The flange clip valve is generally sealed by the cone at the top of the valve stem and the bore-hole of the valve seat. When sampling, rotate the handwheel to separate the valve stem from the bore-hole, so that the medium can flow from the bore-hole to the external sampling vessel;

3. For the sampling valve with jacket insulation, pay attention to the following matters:

- ① The valve can be opened and closed after the easy-to-crystallize medium is melted by the steam in insulation jacket, and is not allowed to be opened and closed until the medium was completely melted;

- ② When the valve couldnot be opened, it is not allowed to be opened forcibly with the method of lengthening the force arm, otherwise the valve stem may fall off with the valve core due to large resistance, and cause the damage of the valve or the wrench, and lead to unsafe factors.

II . Opening and closing of valve

1. A suitable wrench shall be used in case of manual valve operation. It is strictly forbidden to use a large wrench for small valves and a small wrench for large valves. And it is strictly forbidden

to operate with lengthening the strength stem of the wrench.

2. When operate the valve, the operator shall stand at the side of the valve handwheel, and do not stand in the direction facing the valve stem, to prevent the operator from being hurt by medium leaking from the pipeline .

3. When operate the manual valve with a wrench, the wrench must be clipped with the handwheel of the valve firmly, to prevent the operator from being injured caused by slipping. (especially if you are standing on ground where might slip)

4. Use arm strength to operate, it is strictly forbidden to rely on body gravity to prevent falling injury caused by wrench slipping.

5. When operate the valves of acid or alkali pipelines, if there is a possibility of leakage in system or the valve direct contacting with acid or alkali is operated, wear labor protection articles which are acid and alkali resistant, assign special personnel to monitor, and take preventive measures.

6. The sampling valve of various vapor and liquid pipeline must be operated manually, wrenches are strictly prohibited. And the operators shall wear gloves during operation to prevent scalding, and shall wear fireproof clothes in case of any leakage.

7. The dual valves of the boiler water pump must be operated by hand, and the two handwheels must be operated alternately.

8. During operation of valve, if it feels heavy, return it firstly and then continue, and operate alternately in this way until the valve is opened or closed completely.

9. The drain valve of the reheater and the primary valve of the drum differential pressure water level gauge shall be operated by hand. If a wrench is necessary, the wrench should not longer than 25cm.

10. Whether opening or closing the manual valve, turn it in the opposite direction (about 1/4 to 1/5 circle) after in place, so as to ensure that the operation direction can be judged in next operation, and it is conducive to the valve core a certain expansion margin. .

11. When there is internal leakage in the valve, manually open it sightly to flush for 1 to 2 minutes, and then close it. Repeat flushing 2 to 3 times to confirm the internal leakage, and then report the defect.

12. In order to prevent hydrogen explosion caused by sparks during valve operation in hydrogen-oil-water system, copper wrench must be used for valve operation in hydrogen oil-water system.

III. Local operation of electric valve

1. The local operation of electric valve must be agreed by the supervisor. Contact the supervisor to monitor the action of the electric valve before operation.

2. It is strictly forbidden to tighten the electric valve with a wrench. If necessary, make a record, and loose the valve before the next electric operation.

3. If the electric valve is operated electrically on the local electric actuator, set the remote control of the valve to "no operation", then turn the valve control mode switch to "local" on the local electric actuator, and then operate the electric switch of the valve.

4. When the electric valve needs to be operated locally with a mechanical handwheel, in addition to set the valve to "no operation", power off the valve before operation.

IV. Steam valve

Slowly and slightly open the valve, wait until the temperature of the pipeline after the valve reached to the steam temperature, the condensate in the pipeline was basically discharged, and the pressure at both sides of the valve was basically the same, then slowly and completely open the valve. Be careful not to face the valve when opening the valve to avoid accidents. The opening method of steam pipeline valve has a huge impact on the pipeline. When the steam supply of the steam pipeline has stopped for a long time and the temperature of the pipeline has dropped to room temperature, if the steam valve was opened quickly, a large amount of high-temperature steam rapidly entered the pipeline, and then a large amount of condensate would be generated in the steam pipeline due to the low temperature of the pipeline. And the condensate was mixed with high-velocity steam, flowing at

high speed in the pipeline, which impact valves, elbows, etc., and water hammer was produced, which would damage the pipe fittings and endanger the personal safety of operators.

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