H100-022 Balance Multi-Layer Cage Low Temperature Control Valve

I. Description and Working Principle

1-1 Application Scope

The H100-022 Balance Multi-Layer Cage Low Temperature Control Valve is primarily used for precise regulation of ultra-low temperature media, with temperatures as low as -196°C. It is suitable for low-temperature applications such as ethylene, LNG (liquefied natural gas), air separation, and pressure swing adsorption (PSA) oxygen production units.

1-2 Main Technical Parameters

- **Body**

Form	Balanced multi-layer sleeve type cast ball valve
Nominal diameter	15/20/25, 32, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350mm
Nominal pressure	Class 150, 300, 600, 900, 1500
Connection type	Flange type: FF, RF, RJ, TG, MFM Welding type: SW(40~50mm); BW(65~200mm) Flange standards: JIS B2201, JB/T79. 1-94(PN1.6MPa), JB/T79.2-94(PN4.0, 6.4MPa), ANSI B16.5-2009, HG20592-2009, HG20615-2009
Dimensions	See Table 5
Material of valve body and bonnet	CF3, CF3M, CF8, CF8M See Table 1 and Table 2 for the operating temperature and pressure ranges of various materials
Bonnet type	Elongation type III (EIII): -196~+200°C
Gland type	Bolt compression type
Packing	V-type PTFE packing, graphite packing. See Fig. 2
Gasket	Zigzag type (316, 316L)
Surface coating	Dark gray (epoxy resin). However, when the valve body is made of stainless steel, no coating will be applied to the valve body.

- **Trim**

Plug Type	**Single-seat plunger type**
Flow Characteristics	High-Capacity Flow Characteristics ● Equal Percentage Characteristics (%F) and Linear Characteristics (LF) High-Precision Flow Characteristics ● Equal Percentage Characteristics (%) and Linear Characteristics (L)

- **Actuator**

Model Specification	**Pneumatic Diaphragm Type**	**Cylinder Piston Type**	**Electronic Type**	**Intelligent type**

	HA	HV	EIL	M8 Series
	Multi-spring type	Single/double acting piston type		
Purpose	Modulation	Modulation	Modulation	
Air supply pressure/ Service voltage	Air supply (spring range) 500kPa	Air supply pressure 500kPa	Voltage: 220/380V50HZ Input signal: 4~20mADC	Voltage: 220/380V50HZ Input signal: 4~20mADC
Connection	Air piping: NPT1/4 (HA11~HA41); NPT1/2（HA51）	Air piping: NPT1/4（HV21~31）; NPT3/8（HV41~51）; NPT1/2（HV61~71）; NPT3/4（HV81）	Wiring: 2-PF3/4	Wiring: PG13.5
Direct Action	Air to valve shut	Air to valve shut	Signal increase to valve shut	Signal increase to valve shut
Reverse Action	Air to valve open	Air to valve open	Signal increase to valve open	Signal increase to valve open
Hysteresis Error	≤1%FS (with positioner) ≤3%FS (without positioner) ≤5%FS (equipped with type HA1)	≤1%FS (with positioner) ≤3%FS (without positioner)	≤1%FS	≤1%FS
Intrinsic Error	≤1%FS (with positioner) ≤5%FS (without positioner) ≤2%FS (equipped with type HA1)	≤1%FS (with positioner) ≤5%FS (without positioner)	≤1%FS	≤1%FS
Ambient temperature	Standard type -30 ~ +70℃ High Temp. service -15 ~ +120℃ Low Temp. service -40 ~ +70℃	Standard type -20 ~ +80℃ High Temp. service -15 ~ +120℃ Low Temp. service -40 ~ +80℃	-20 ~ +70℃	-25 ~ +70℃
Painting	Water blue (color RAL5021)	Water blue (color RAL5021)		
Attachments	Positioner, air-set, lock-up valve, position transmitter, handwheel, etc.	Positioner, air-set, lock-up valve, position transmitter, handwheel, etc.	EIL actuator handwheel	M8 actuator handwheel

1-3 Structure and Working Principle

Structure: It mainly consists of a bonnet, valve body, valve seat, plug assembly, packing, packing gland, guide ring and other components. Plug assembly: The plug assembly is composed of a plug and a valve stem, fixed with a cylindrical pin. There is a packing chamber on the bonnet, filled with PTFE V-shaped packing or graphite packing, as shown in Figure 1.

Principle: The control valve is in direct contact with the regulated medium. As the upward and downward movement of the valve element changes the flow area between the valve core and the valve seat, thus changing the resistance coefficient of the valve and achieving the regulation effect on the medium flow.

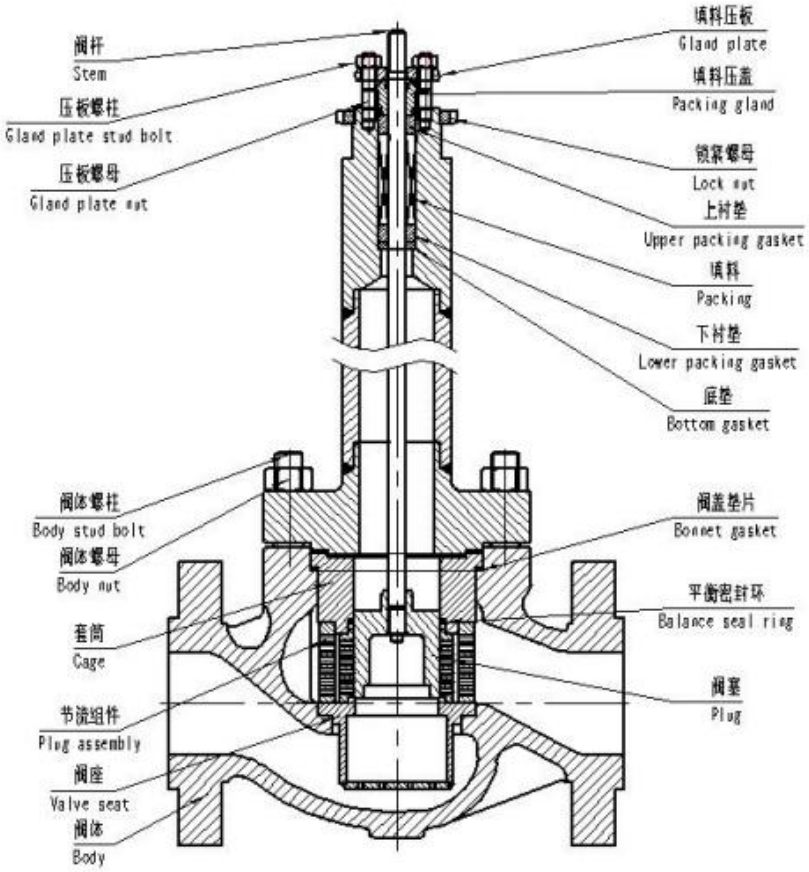


Figure 1 Structural Diagram of H100-022 Valve Body Assembly

II. Instructions for Installation, Commissioning and Use

2-1 Installation Preparation

⚠ Warning

Due to the heavy weight of control valves, attention must be paid to the following points to avoid causing significant personal injuries due to improper operation:

- Use appropriate lifting equipment that meets the requirements of labor safety and health laws for the connection of control valves with pipelines. Do not stand or operate lifting machinery under lifted objects.
- Personnel making any adjustments or installations to valves should use equipment and clothing commonly used for valve installation.
- Before installing the valve, the pipeline must be depressurized, drained, and ventilated.
- Handling and installation of all valves and actuators must be carried out by personnel trained in all aspects of installation and manual/mechanical handling techniques.
- Packing leakage may cause personal injury. The valve packing has been tightened before leaving the factory; however, it may need to be readjusted to meet specific application conditions.
- Please thoroughly clean the inside of the pipes and remove debris, welding slags and water rust before installing the control valve. Any residual foreign objects will cause leakage between the valve plug and the valve seat. In addition, if these foreign matters enter the guiding part of the valve plug, it will cause malfunctions.
- For purpose if installing the control valve onto the pipeline, please do not subject it to severe impacts such as collisions or drops. Otherwise, it will cause malfunctions and require recalibration.
- Please ensure that there is sufficient space available for the disassembly and maintenance of the control valve.
- Do not install the control valve in areas with severe vibration or excessive loads on the control valve.
- Control valves must be installed in directions that allow the media to flow in the directions indicated by the arrows on valve bodies.

2-2 Installation Position

The standard installation method for a control valve assembly is to mount the actuator vertically above the valve. Installation on other positions may lead to uneven wear of valve trim, affecting valve performance. Installation within the range shown in Figure 2 is permissible when necessary. If the control valve may be subjected to vibration or external forces, please use the attached yoke or piping support for the control valve.

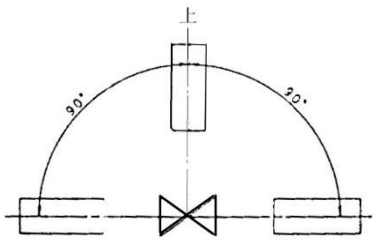


Figure 2

2-3 Installation Orientation and Support Requirements for Actuator on Pipeline

The normal installation method for a control valve assembly is to mount the actuator vertically above the

valve. For some valves, when the actuator is not vertical, it may also need to be supported with a brace.

Recommended installation orientations for various actuator types:

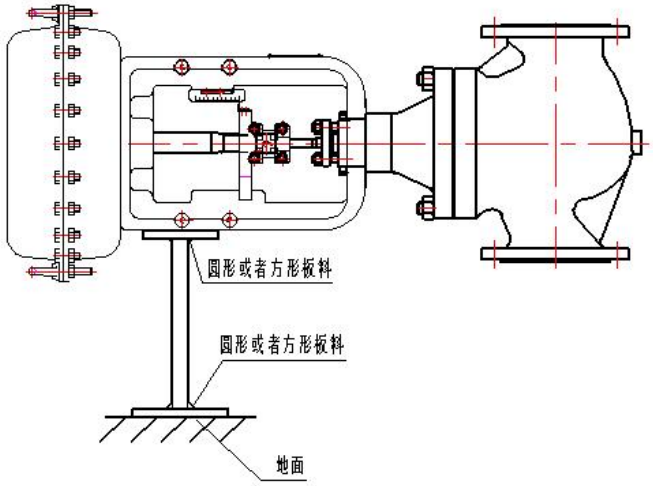
(1) HA Series: Vertical installation is recommended. Field usage data shows no issues with horizontal installation for some HA2~4 models. However, theoretical analysis indicates a higher probability of issues with horizontal installation for HA4X2 or HA5Y actuators.

● When a HA4X2 or HA5Y actuator is placed horizontally, the diaphragm assembly of the diaphragm type actuator has no support inside the chamber and is entirely supported at the guide sleeve position of the rod. This position is mainly for guiding and if used for support, the gravity of the diaphragm assembly (including the tray, etc.) will all press on the edge of the rod guide, causing significant friction. Moreover, the rod material (304) is not wear-resistant, which can easily lead to scratching of the rod, abnormal noise, seizing, and scratching of sealing parts, which cause leakage.

● The HA actuator has a multi-spring structure with only one-sided guidance, which is short and weak. Horizontal placement can easily cause spring tilting, which may lead to overall failure of the actuator.

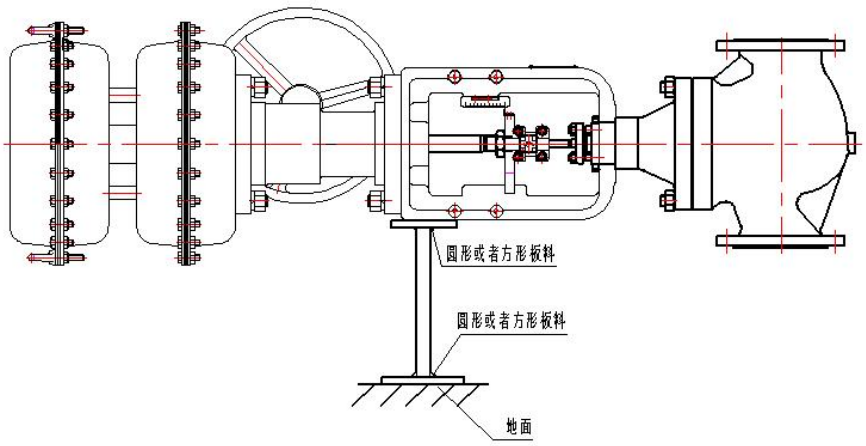
(2) HV Series: Any orientation

● When the actuator is installed horizontally, it needs to be supported as shown in the diagrams.



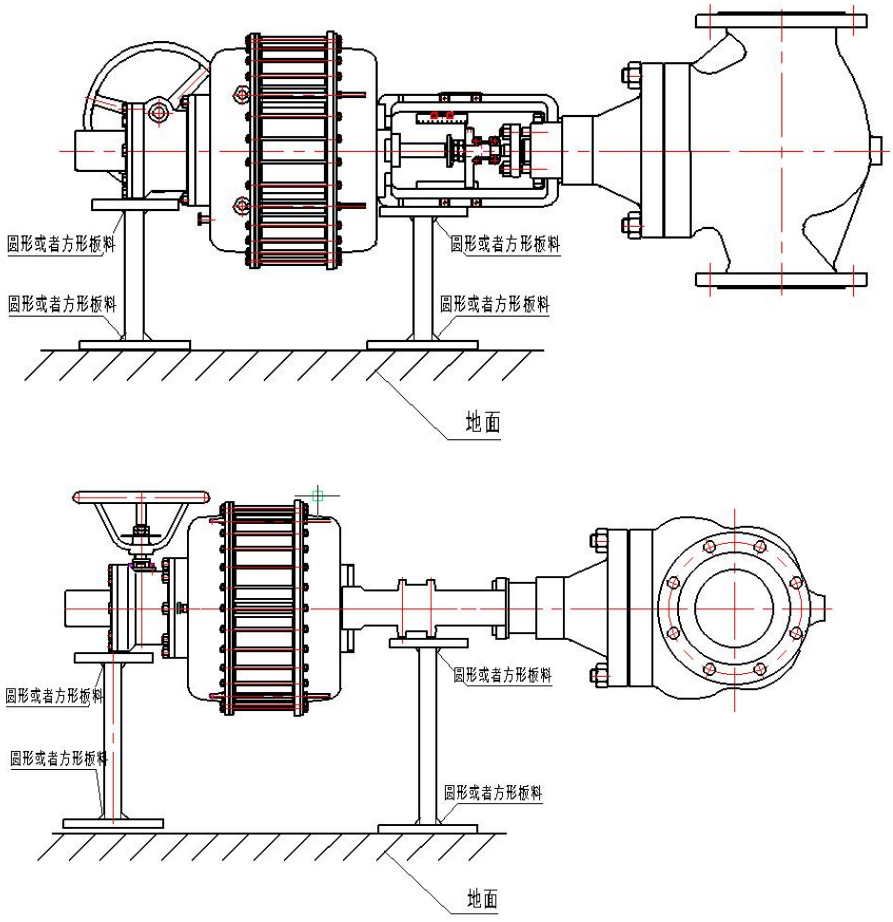
圆形或者方形板料	Circular or square sheet metal
地面	Floor

Support Diagram for HA1~4 Horizontal Installation



圆形或者方形板料	Circular or square sheet metal
地面	Floor

Support Diagram for HA4X2 Horizontal Installation



圆形或者方形板料	Circular or square sheet metal
地面	Floor

Support Diagram for HA5 Horizontal Installation

Figure3　Support Diagrams for HA Series Actuator Horizontal Installation

2-4 Commissioning

All control valves produced by our factory have been debugged before leaving the factory. However, if they have been disassembled for inspection, when assembling the actuator and valve body components, it is necessary to adjust the actuator stem stroke (to obtain the rated stroke). At this time, please follow the following sequence (stroke adjustment is only limited to the actuator HA and HV produced by Chuanyi Control Valve, and refer to the corresponding manufacturer's actuator instructions for stroke adjustment of actuators of other manufacturers):

1. Reverse action actuator

(1) Apply the rated air source pressure to the lower air chamber to move the actuator stem upward. Then place a metallic transition block between the actuator stem and the valve stem. Disconnect the air source, allowing the actuator stem to reset and press the transition block downward, thereby making the valve core and seat come into forced contact;

(2) Reapply the rated air source pressure into the lower air chamber to move the actuator stem upward to fully open the actuator position (actuator stem halted at maximum upward state) and then remove the transition block;

(3) Mount the indicating tool onto the actuator stem, ensuring the tool indicator aligns with the travel plate's highest scale mark (fully open "O" position);

(4) Lower the intake pressure of the precision pressure-reducing valve, allowing the spring to slowly reset and move the actuator stem downward. When the tool indicator aligns with the lowest scale mark on the travel plate (fully closed "S position"), remove the "indicating tool", secure the valve stem and actuator stem threads with slit nuts, tighten them, and disconnect the input air source;

(5) Adjust the stroke plate up and down to align the indicator of the slit nut with the lowest scale mark ("S position") on the stroke plate. Secure the stroke plate to complete the operation.

(6) Supply rated air source pressure to the lower air chamber and verify whether the slit nut indicator aligns with the highest and lowest scale marks on the stroke plate when the actuator stem reaches its highest point and resets when the air is disconnected. If correct, the operation is completed.

2. Direct action actuator

(1) Similarly to the reaction, place a metal transition block between the actuator stem and the valve stem. Introduce the rated air source pressure into the upper air chamber of the actuator, and move the actuator stem downward to press the transition block, ensuring forceful contact between the valve core and the valve seat.

(2) Disconnect the input air source, allowing the actuator stem to reset upward to the fully open position of the actuator (initial state), and remove the transition block.

(3) Attach the indicating tool to the actuator stem to align its indicator with the highest scale mark of the stroke plate (fully open "O" position);

(4) Gradually increase the air source pressure to the upper air chamber using the precision pressure-reducing valve, causing the actuator stem to move downward. When the tooling indicator aligns with the lowest scale mark on the stroke plate (fully closed "S position"), remove the "indicating tooling" and secure the valve stem and actuator stem thread with a slit nut from both ends, then disconnect the input air source;

(5) Adjust the stroke plate vertically to align the indicator of the slit nut with the lowest scale mark ("S position") on the stroke plate, and then secure the stroke plate;

(6) Apply the rated air source pressure into the upper air chamber and verify alignment of the slit nut indicator with the lowest and highest scale marks of the stroke plate when the actuator stem reaches the bottom point and resets upon air cutoff. If correct, the operation is complete.

3. Double-acting Actuator

(1) Apply the rated air source pressure to the lower air chamber to move the actuator stem upward, then insert a metal transition block between the actuator stem and valve stem;

(2) Disconnect the input air source of the lower air chamber, introduce the rated air pressure source into the upper air chamber, and move the actuator stem downward to compress the transition block, ensuring the valve core

contacts the valve seat under force;
(3) Disconnect the input air source of the upper air chamber, introduce the rated air pressure source into the lower air chamber, allowing the actuator stem to move upward to the fully open position of the actuator (where the actuator stem moves up and halts). Remove the transition block.
(4) Attach the indicating tool to the actuator stem, aligning the tool indicator with the highest scale mark on the travel plate (fully open "O" position);
(5) Disconnect the input air source for the lower air chamber. Gradually introduce a small amount of air pressure into the upper air chamber with the precision pressure-reducing valve to move the actuator stem downward. Align the tooling indicator with the lowest scale mark of the stroke plate (fully closed 'S position'). If the indicator moves below the scale mark, slightly increase the pressure in the lower air chamber and repeat the process until alignment is achieved. Then, remove the "indicator tooling". Use a slit nut to securely clamp the valve stem and actuator stem threads together. Tighten appropriately and disconnect the input air sources for both the upper and lower air chambers.
(6) Adjust the stroke plate vertically to ensure the slit nut indicator aligns with the lowest scale mark ('S position') on the stroke plate. Secure the stroke plate tightly in place;
(7) Introduce the rated air source pressure into both the lower and upper air chambers separately. Check whether the actuator stem reaches the extremities of its movement and whether the slit nut indicator aligns with the highest and lowest scale marks on the stroke plate. If everything is correct, the operation is complete.
(Note: The rated supply pressure refers to the size of the air source stated in the air source pressure column on the valve nameplate.)

III. Maintenance

3-1 Maintenance Instructions

3-1-1 Routine Inspection
(1) Verify whether the valve operates smoothly.
(2) Ensure the normal operation of the control components (including actuators, positioners, pressure-reducing valves, etc.).
(3) Examine for any medium leakage at the valve body, bonnet, stem packing box, flange connections, and actuator joints.
(4) Check the valve's exterior for corrosion, paint removal, mechanical damage, or excessive dirt accumulation.
(5) Inspect the stability of valve supports and hangers, and confirm no bolts are loose.
3-1-2 Routine Inspections
(1) Clean the valve surface and moving parts (e.g., exposed sections of the valve stem) every six months of dust, oil residue, process media remnants, and debris to prevent corrosion and operational hindrance.
(2) Lubricate components such as bearings and gears within the actuator following the manual's specified intervals and prescribed grease brand.
(3) Every six months, check the tightness of the packing gland bolts to ensure adequate compression.
(4) Regularly inspect and securely tighten key connecting pieces, including valve body-to-valve cover bolts, flange connection bolts, and actuator mounting bolts.
(5) Regularly verify whether the full stroke of the valve operates smoothly.

⚠ Warning

Accidents causing personal injury or property damage due to sudden release of process pressure or rupture of parts should be avoided. Before performance of any maintenance operations, the following steps should be taken:

● Always wear protective gloves, clothing, and goggles when performing any maintenance operations to prevent personal injury.

● Disconnect all operational lines supplying pneumatic pressure, power, or control signals to the actuator. Ensure that the actuator will not suddenly open or close the valve.

● Isolate the process pressure from the valve by bypassing or completely shutting down the process. Fully release the process pressure on both sides of the valve. Drain the process media from both sides of the valve.

● Vent the pneumatic actuator loading pressure and release any pre-compression force in the actuator springs.

● Use locking mechanisms to ensure that the above measures remain effective while you are working on the equipment.

● Even if the valve has been removed from the pipeline, the valve's stuffing box may contain pressurized process fluid. Therefore, when removing the packing hardware or packing rings, the process fluid may eject under pressure.

3-2 Packing Maintenance and Replacement

(1) Maintenance of packing

If the packing is not spring-loaded and unexpected leakage occurs, first attempt to limit the leakage by adding a bit of pure PTFE or graphite packing and then tightening the packing flange nuts to enhance the valve stem seal.

If the packing is relatively new and tightly adheres to the valve stem, and if tightening the packing flange nuts does not stop the leakage, the valve stem may be worn or scored, preventing a seal from forming. The surface finish of a new valve stem is crucial for achieving a good packing seal. If the leakage originates from the outer diameter of the packing, it may be caused by nicks or scratches on the stuffing box wall.

When control valves are used in high-temperature media such as steam, it is recommended to lubricate the graphite packing every six months. To lubricate, fully open the valve, slightly loosen the packing gland nuts, drip non-freezing lubricating oil into the gap between the valve stem and the packing, and move the valve stem back and forth a few times to achieve lubrication.

（2）Packing Replacement

1. Isolate the control valve from the pipeline pressure, release the pressure on both sides of the valve body, drain the process media from both sides of the valve, and use locking mechanisms to ensure that the above measures remain effective while you are working on the equipment.
2. Apply a certain amount of air pressure to the actuator so that the pointer indicates 80% to 90% of the fully closed position.
3. Loosen the hex bolts on the split nuts connecting the valve stem and the push rod, remove the split nuts, and separate the actuator's push rod from the valve stem.
4. Loosen the bracket locking nuts and lift them off.
5. Lift the actuator to separate it from the valve body.
6. Loosen the packing gland nuts so that the packing does not tightly adhere to the valve stem, and remove all travel indicator parts and split nuts from the valve stem threads.

Warning

To prevent personal injury or property damage due to uncontrolled movement of the valve bonnet, loosen the bonnet according to the instructions provided in the next step. Do not use tools that can extend, retract, or store energy in any way to forcibly pull open or remove a tightly fitted valve bonnet, as sudden release of stored energy can cause uncontrolled movement of the valve bonnet.

Caution

To avoid damaging the seating surface due to the valve plug and stem assembly falling out of the valve bonnet after it has been partially lifted.

7. The valve bonnet is secured to the valve body with hex nuts. Loosen these nuts by approximately 3mm, then shake the valve bonnet or pry between the valve bonnet and the valve to loosen the joint surface of the valve body and the bonnet gasket. Use a pry bar to pry the valve bonnet around its perimeter until it is loose. If no liquid leaks from the joint surface, completely remove the nuts or hex head screws and carefully lift the valve bonnet away from the valve body.
8. Remove the locking nuts and separate the valve spool and valve stem from the valve bonnet, placing the parts on a protective material surface to prevent damage to the sealing rings or seating surfaces.
9. Remove the bonnet gasket and cover the valve opening to protect the sealing ring surface and prevent foreign objects from entering the valve body cavity.
10. Remove the packing flange nuts, packing gland, and packing retainer. Use a round bar or other tool that will not scratch the stuffing box wall to carefully push all remaining packing parts out from the valve side of the valve bonnet, and clean the stuffing box and metal packing parts.
11. Inspect the valve stem threads and stuffing box surface for sharp edges that may cut the packing. Scratches or burrs can cause stuffing box leakage or damage to new packing. If surface conditions cannot be improved by lightly sanding, replace the damaged parts.
12. Remove the cover protecting the valve body cavity and install a new serrated gasket for the valve bonnet, ensuring that the gasket seating surface is clean and smooth. Then slide the valve bonnet along the valve stem and onto the double-ended threaded studs.

Caution

Proper execution of the bolt tightening method can compress the serrated washer, thereby fully sealing the joint surface between the valve body and the valve bonnet.

The correct bolt tightening method includes, but is not limited to, ensuring that the bolt threads are clean and tightening the nuts on the hex head screws or stud bolts evenly in a crisscross pattern. Tightening one hex head screw or nut may loosen an adjacent one. Repeat the crisscross tightening method several times until each hex head screw or nut is tightened and the valve body is sealed against the valve bonnet. When the operating temperature is reached, perform this torque tightening method once again.

13. Install the bolts and, depending on the configuration, install new packing or metal stuffing box parts. When the packing is PTFE, place a smooth-edged tube over the valve stem and gently tap each soft packing part into the

stuffing box. Slide the packing gland and packing retainer into place and install the packing gland nuts. When the packing is V-shaped graphite, place it in the stuffing box first, then install the packing gland, packing retainer, packing bolts, and nuts. Tighten the packing nuts to compress the packing.

3-3 Maintenance of Valve Trim

(1) If the disassembled parts need to be cleaned, they can be cleaned with organic solvents or high-temperature steam.
(2) For the valve produced by our company, in non-oil-prohibited operating conditions, we have applied rust-preventive oil to the non-coated surfaces of carbon steel products to achieve rust prevention. The coated areas include but are not limited to the valve body flow path, flange sealing surfaces, etc.
Note: Rust-preventive oil is a rust prevention product based on mineral oil. If cleaning is required, it can be done using an organic solvent or high-temperature steam. After cleaning, the product will lose its rust prevention ability.

IV. Repair

4-1 Service Life and Wear Parts Handling

4-1-1 Specified Service Life

The service life of the valve is specified as 20 years.

4-1-2 Wear Parts

The non-metallic parts of the control valve undergo normal wear during valve operation and must therefore be inspected and replaced as needed. The frequency of inspections and maintenance depends on the severity of the process conditions. If ordering and replacement of valve wear parts are required, please contact Chongqing Chuanyi Control Valve Co., Ltd. for consultation. If users need to perform on-site disassembly, please do so under the guidance of our factory's maintenance or technical personnel to avoid affecting the performance of the actuator and to prevent safety accidents. If the valve is kept closed for a long time, it should be opened and closed several times every 12 months to check whether all components of the valve are functioning normally. If any abnormality is found, timely valve maintenance is required.

Table 1: Non-metallic Wear Parts of Control Valve

Name	Location	Replacement Interval
O-ring	Packing gland	5 years or based on operating conditions
Packing assembly	Stuffing box	5 years or based on operating conditions
Soft valve seat	Valve seat position	Replace upon damage or as needed based on usage
Seat sealing gasket	Valve seat position	Require replacement for each valve disassembly and reassembly
Metal spiral wound gasket	Upper bonnet, sleeve	Require replacement for each valve disassembly and reassembly
Sintbain seal ring	Sleeve	5 years or based on operating conditions

4-2 List of Key Faults

See Table 2 for possible faults that may occur and the troubleshooting methods to eliminate such faults.

Table 2

Common Faults	Causes	Troubleshooting Methods
Valve Does Not Actuate or Actuates Slowly	1. Low supply pressure. 2. Blockage or leakage in air piping. 3. Actuator failure, such as diaphragm rupture causing leakage. 4. Adhesion on the guide part of the valve spool, or bending or breaking of the valve stem. 5. Abnormal accessories: positioner, solenoid valve, etc. 6. Deformation of the sleeve.	1. Supply the specified air pressure. 2. Clean and reinforce connections, then repipe. 3. Replace the diaphragm. 4. Clean and replace parts. 5. Without connecting accessories, apply the specified air pressure to the actuator's air supply port. If no abnormalities are found, adjust the positioner or inspect and replace other accessories. 6. Replace the sleeve.
Unstable Actuation	1. The actuator stiffness is too low, resulting in insufficient thrust due to changes in medium pressure. 2. Fluctuations in the positioner signal. 3. Variations in supply pressure. 4. Malfunction of the pressure reducing valve.	1. Use an actuator with greater stiffness. 2. Adjust various settings of the positioner and inspect the signal system. 3. Verify or replace the diameter of the air supply piping. 4. Repair or replace the pressure reducing valve.
Excessive Valve Leakage	1. Corrosion or damage to the sealing surfaces between the valve spool and valve seat, and between the valve seat and valve body. 2. Damage to the valve seat sealing ring. 3. Excessively high differential pressure of the medium, resulting in insufficient output force of the actuator. 4. Foreign objects inside the valve body. 5. Insufficient full stroke.	1. Repair or replace components. 2. Replace the sealing ring. 3. Install a positioner or replace the actuator. 4. Remove foreign objects. 5. Adjust the full stroke.

Leakage at the Packing and Valve Body Connection	1. The packing gland is not tightly compressed. 2. The packing assembly is aged, degraded, or twisted. 3. Wear on the valve stem sealing surface. 4. Loose flange connecting nuts or packing gland connecting nuts. 5. Corrosion or damage to the sealing surfaces of other parts in contact with the sealing gasket. 6. Damage to the sealing gasket at the valve body connection. 7. Wear on the valve stem sealing surface (repeated). 8. Damage to the bellows. 9. External leakage from the valve body. 10. Jacket leakage (only applicable to jacketed valves).	1. Tighten the packing. 2. Replace the packing assembly. 3. Replace the valve stem. 4. Tighten the nuts. 5. Repair or replace related parts. 6. Replace the sealing gasket. 7. Repair or replace related parts (repeated). 8. Replace the bellows. 9. Repair by welding or replace the valve body. 10. Repair by welding (for jacketed valves).

4-3 Working Staff Requirements

Staff should:

— Be familiar with the structural principles and processes of valves, and master the procedures for assembly and disassembly;

— Possess appropriate qualifications for the position and tasks they are to perform;

— Have received training in explosion protection and understand methods for emergency troubleshooting;

— Strictly adhere to operating procedures and national laws.

V. Test

5-1 Actuator Air Tightness Test

The air chamber of pneumatic actuator should be airtight. For the HA series actuator operating under a 500kPa air supply pressure, the pressure drop in the diaphragm chamber must not exceed 2.5 kPa within 5 minutes. For the HV series actuator operating under a 700kPa air supply pressure, the pressure drop in each cylinder chamber must not exceed 5 kPa within 5 minutes. In actuator air chambers without potential internal leakage, the HA series actuator introduces air at a pressure of 500kPa into the sealed air chamber, while the HV series actuator introduces air at 700kPa. After cutting off the air supply, soapy water is applied to the air chamber seals, ensuring no leakage occurs within 5 minutes.

5-2 Pressure Withstand Strength Test

5-2-1 Hydrostatic test

The test pressure is 1.5 times the nominal pressure, and refer to Table 4 for the ANSI standard test pressure. Use room temperature water with a specified test pressure and introduce it into the valve body of the control valve in the specified inlet direction, and close the other end so that all valve cavities under pressure during operation are subjected to pressure resistance tests simultaneously. Observe whether there is visible leakage in the pressure-bearing part of the control valve. Refer to Table 2 for the duration. During the test, the control valve must remain in the fully open position, and the testing apparatus should not impose external stresses on the control

valve that could influence the test results. There shall be no visible leakage during the test (this test is not required for oil-free and water-free valves).

Table 4 Test Pressure of ANSI Standard

Nominal pressure	Test pressure MPa	Nominal pressure	Test pressure MPa
Class 150	3.0	Class 900	23.3
Class 300	7.8	Class 1500	38.9
Class 600	16.5	-	-

Table 5 Duration of Pressure Withstand Strength Test

Nominal diameter	Test duration		
	PN16	PN100	PN260
	Class150	Class600	Class1500
≤DN50（NPS2）	2 min	2 min	2 min
DN100（NPS4）	2 min	2 min	4 min
DN200（NPS8）	2 min	3 min	5 min
DN300（NPS12）	3 min	5 min	8 min
≥DN400（NPS16）	15 min	15 min	15 min
Note: For nominal diameters or nominal pressures (pressure levels) not listed, the next higher value shall be used as the test duration.			

5-2-2 Air Pressure Test of Oil-free and Water-free Valves

The test pressure is 1.1 times the nominal pressure, and refer to Table 6 for the ANSI standard test pressure. The pressure withstand strength air pressure test shall be conducted with the specified test pressure and the test time specified in Table 5. There shall be no visible leakage during the test.

Table 6 Test pressure of oil-free valve and water-free valve

Nominal pressure	Test pressure MPa	Nominal pressure	Test pressure MPa	Nominal pressure	Test pressure MPa
Class 150	2.2	Class 600	12.1	Class 1500	28.6
Class 300	5.5	Class 900	17.1	-	-
Note 1: During the test, the air pressure shall be gradually increased from zero to the test pressure value in the table. Note 2: When the user has special requirements in the contract, the test pressure can be adjusted according to the user's stipulations.					

5-3 Sealing Test for Packing Box and Other Connections

The test pressure is 1.1 times the nominal pressure, and refer to Table 3 for the ANSI standard test pressure.

Conduct the test by introducing room-temperature water at the specified test pressure into the valve body of the control valve from the designated inlet direction, sealing the outlet end. The valve stem should reciprocate 1 to 3 times per minute for a duration of no less than 3 minutes. Observe for any leakage at the packing box or other connections of the control valve. Under normal temperature conditions, nitrogen shall be used to conduct sealing tests on the packing box and other connection parts of oil-free valves, water-free valves, and cryogenic valves.

Table 3 Test pressure of ANSI standard

Nominal pressure	Test pressure MPa	Nominal pressure	Test pressure MPa	Nominal pressure	Test pressure MPa
Class 150	2.2	Class 300	5.5	Class 600	12.1

Class 900	17.1	Class 1500	28.6	Class 2500	47.4

5-4 Normal Temperature Leakage Test

5-5-1 Test procedures

Class IV ~ VI: according to the requirements of 6.4 in GB/T 4213-2024 or Section 5 in ANSI/FCI 70-2-2021.

5-5-2 Test medium

The test medium shall be clean gas or room temperature water.

5-5-3 Allowable leakage

The leakage value shall meet the requirements of 5.3 in GB/T 4213-2024 or Table 1 in ANSI/FCI 70-2-2021.

Note: If the user requires, it can also be tested in accordance with API 598 or GB/T 26480.

5-5 Cryogenic Leakage Test

(1) After the normal temperature test is passed, the inlet and outlet of the low-temperature control valve shall be closed with a flange blind plate connected to the leak detection medium pipe. The part below the valve cover shall be placed in the low-temperature medium insulation storage tank at the use temperature specified on the nameplate. After sufficient cooling, open and close the operating valve. The low-temperature control valve can be opened and closed normally without jamming;

(2) Low-temperature sealing test: The leakage shall be measured according to the method specified in 6.7 of GB/T 24925-2019 or Appendix A of BS 6364-1984, and the test pressure and leakage shall meet the contract requirements.

5-6 Fundamental Error

Steadily input the specified signal into the actuator air chamber (or positioner) in an increasing or decreasing manner. Measure the stroke values at five points: 0%, 25%, 50%, 75%, and 100% of the signal range. The results should conform to the GB/T 4213-2024 standard.

5-7 Hysteresis

The test procedure follows that of the fundamental error check. Measure the absolute value of the maximum deviation between the forward and reverse stroke on the same input signal. The results should comply with the requirements of the GB/T 4213-2008 standard.

5-8 Dead Zone

(1) Slowly change (increase or decrease) the input signal until a perceptible stroke change is observed, and record the input signal value at this time;

(2) Slowly change (decrease or increase) the input signal in an opposite direction until a perceptible stroke change is observed, and record the input signal value at this time;

(3) The dead zone is defined as the absolute value of the difference between the aforementioned two input signal values, 1) and 2). It should be tested at three specific points: 25%, 50%, and 75% of the input signal range.

试验结果符合 GB/T 4213-2024 的要求。

5-9 Deviation of Initial and Terminal Points

The upper limit (terminal point) and the lower limit (initial point) values of the input signal are respectively applied to the air chamber of the pneumatic actuator (or positioner). Subsequently, the corresponding travel values are measured, focusing exclusively on the initial point deviation for air-to-open valves. The test outcomes comply with the GB/T 4213-2024 standard requirements.

5-10 Rated Travel Deviation Test

Apply the input signal to the air chamber of the pneumatic actuator (or positioner), allowing the valve stem to complete its full range of travel. The test results comply with the requirements of GB/T 4213-2024.

VI. Handling and Storage

6-1 Transport

> ⚠ Warning
>
> Due to the heavy weight of control valves, attention must be paid to the following points during handling. Failure to do so may cause significant harm to personal safety.
>
> ● Use lifting equipment that complies with labor safety and health regulations for loading, unloading, and handling. Avoid standing or operating lifting equipment under suspended objects.
>
> ● For small-sized products packaged in corrugated cardboard boxes, the boxes may have reduction packaging intensity if they are wet. Therefore, extra care should be taken when handling them in such conditions.

6-2 Custody

(1) Control valves must be kept in its original packaging until installation on pipelines.
(2) Storage in the following locations is not allowed:
(a) Places exposed to rainwater.
(b) Places with temperatures exceeding 60°C.
(c) Places exposed to excessive dust.
(d) Places with humidity exceeding the allowable limits.
(3) If the packaging is opened for performance inspection during acceptance inspection, it must be repackaged until installation begins.
(4) Do not remove the plugs and covers of air piping interfaces and electrical wiring interfaces before starting the air piping and electrical wiring work.
(5) In cases where the period of custody is over one year, packing materials tend to harden and age. Therefore, please open the package, loosen the hex nut that tightens the packing materials by two turns, and store it in this state. With respect to its use, please tighten the hex nut and apply air pressure or water pressure equivalent to the operating fluid pressure from the pipe flange connection to check for any leakage in the packing area. If there is any leakage, please replace with new packing materials. Please follow the instructions for disassembly and assembly when replacing.
(6) For cases where a control valve is to be stored after use, please follow the instructions below:
(a) Carefully clean the inside of the control valve with water and dry it.
(b) Do not damage the sealing surface of the pipe flange connection.
(c) Apply anti-rust treatment to areas prone to rusting.
Apply waterproof treatment to the air pipe connection and electrical wiring interface.

VII. Disposal of Used Valves

⚠ Caution

● The term "abandoned valves” refers to valves that have been abandoned as fixed assets according to relevant regulations and are no longer in production.

● After abandonment, parts contaminated by the media should be disposed of by qualified professional institutions.

1. After planned shutdown, the identification and evaluation of safety and environmental factors shall be performed on abandoned valves, and corresponding countermeasures shall be formulated for thorough technological processing. Sampling analysis should be conducted to ensure that no residual materials are present inside, achieving a state of safe shutdown and controlled pollution.
2. During the technological processing of abandoned valves, the venting, depressurization, replacement, and blowdown operations should be strictly executed according to the emptying and replacement plan. The discharged "three wastes” must be disposed of in accordance with relevant regulations to ensure that wastewater and waste gas are discharged within standard limits. It is prohibited to discharge any type of wastewater or wastes into open ditches or rainwater drainage systems. Waste residues should be sent to locations designated by the environmental protection department. Noise elimination and insulation facilities should be installed during the blowdown process to ensure that the noise does not disturb residents or cause pollution to the surrounding environment.
3. Abandoned Valves. In connection with washing and cleaning operation, a detailed cleaning plan should be formulated to clarify the types, toxicity, hazards, and control measures of substances discharged during the cleaning process. The cleaning wastewater must be treated and analyzed to ensure it meets discharge requirements before being discharged or further processed.
4. Valves that have been applied for asset abandonment should be stored, dismantled, or disposed of as waste materials. They should not be put back into production, leased, or transferred.

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