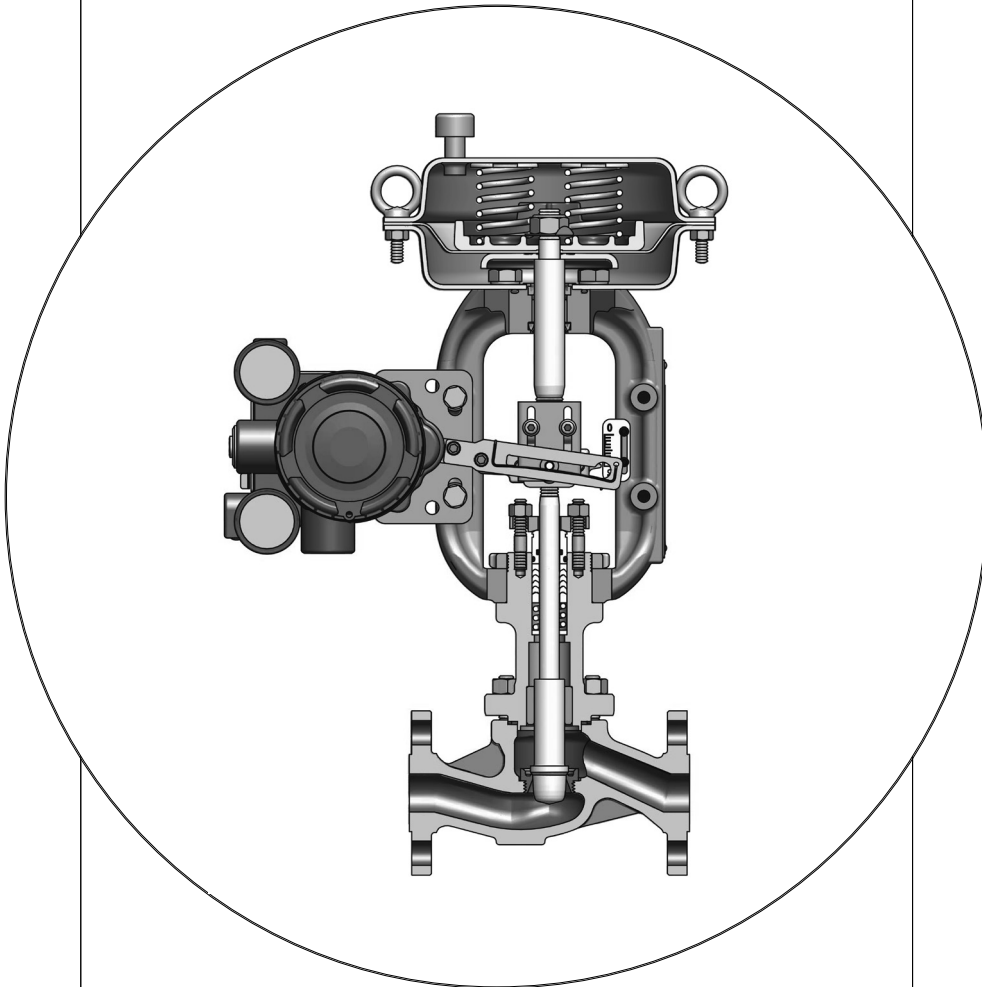


Top-Guided Single-Seated Control Valve

Model AGVB/AGVM

User's Manual



Azbil Corporation

NOTICE

While the information in this manual is presented in good faith and believed to be accurate, Azbil Corporation disclaims any implied warranty of merchantability or fitness for a particular purpose and makes no express warranty except as may be stated in its written agreement with and for its customer.

In no event shall Azbil Corporation be liable to anyone for any indirect, special or consequential damages. This information and specifications in this document are subject to change without notice.

Introduction

Thank you for purchasing Azbil's model AGVB / AGVM top-guided single-seated control valve. This device is a compact, high-performance single-seated control valve. Azbil is proud to provide high reliability and quality based on its abundant achievements and know-how in the field.

This user's manual describes how to use this device safely and reliably. Be sure to read this manual before using the product. After reading the manual, be sure to keep it in a place where users can refer to it at any time.

Unpacking and Storing the Product

■ Unpacking

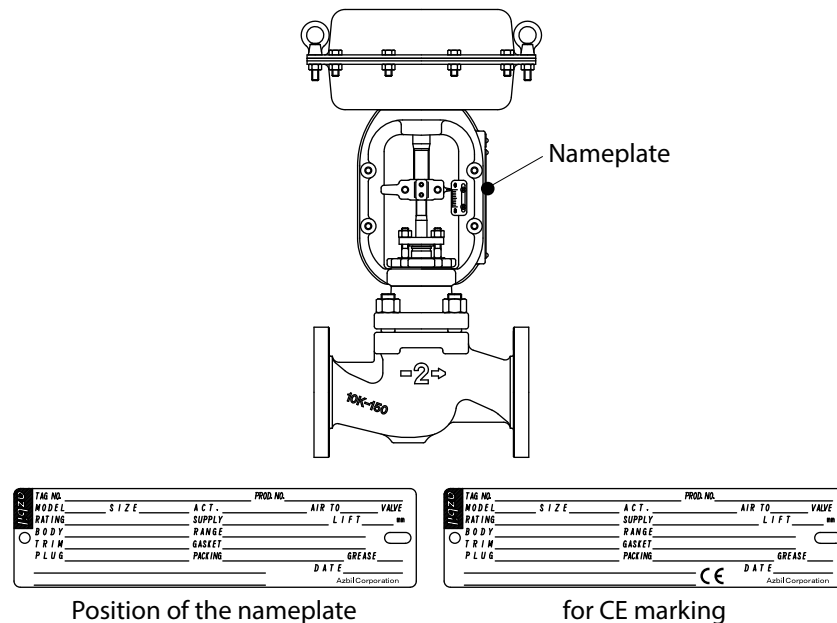
This device is a precision instrument. Take special care in handling it to prevent accidents, damage, etc.

When unpacking, check that the following items are included:

- The valve, actuator, and parts to be mounted
- Any auxiliary devices that you ordered

■ Checking the Specifications

Check that the fluid conditions, valve number (tag No.), and the specifications printed on the name plate are correct and appropriate. The location of the product's nameplate is shown in the figure below.



■ Inquiries

For inquiries about this device, please contact us. When making an inquiry, have your model number and product number ready.

Compliance with regulations

This product complies with the directive below.

- Pressure Equipment Directive (PED) 2014/63/EU

Requirements for workers (installation, operation, maintenance)

To ensure safety, only specialists who are skilled in instrumentation work should carry out the installation, operation, and maintenance of this device.

■ Precautions for Storage

Observe the following precautions in order to store the purchased valve properly.

- If the valve is packed in a cardboard box, store it indoors at room temperature and humidity.
- A valve packed in a wooden crate should also generally be stored indoors at room temperature and humidity. For outdoor storage, after unpacking the valve and checking the specifications, cover it with a polyethylene protective sheet to keep rainwater out.

To store a valve that has been used, follow the instructions below.

1. Wash out any fluid stuck to or remaining in the interior of the valve.
2. If it is likely that the valve will corrode, take preventive measures.
3. Cover the openings for air supply and electrical conduit connections with waterproof caps or tape to keep water out. In addition, protect the threads on the connectors.
4. Protect the ends of piping connections (flanges, welded surfaces) using flange caps or the like.
5. Store the product in a location that is subject to minimal vibration and shock.

Safety Precautions

■ Symbols

Safety precautions are for ensuring the safe and correct use of this product, and for preventing injury to the operator and other people or damage to property. Be sure to observe these safety precautions.

The safety precautions described in this manual are indicated by various icons.

Their meaning is explained below. Be sure to understand the meaning before reading the rest of the manual.



WARNING

Warnings are indicated when mishandling this product may result in death or serious injury.



CAUTION

Cautions are indicated when mishandling this product may result in minor injury or property damage only.

■ Examples



Indicates that caution is required in handling.



The indicated action is prohibited.



Be sure to follow the indicated instructions.

Notes for Safe Operation

WARNING



Before starting to work, check that the pressure in the pipes has dropped to atmospheric pressure. If fluid spews out, injury may result.

CAUTION



Do not stand on the device or use it as a step. There is a risk of falling.



Do not touch the device unnecessarily while it is operating. Depending on the operating conditions, the surface might be extremely hot or cold.



Since this product is heavy, when handling it, wear safety shoes and watch your step.



During work, wear protective goggles to prevent injury from flying objects and harm from chemicals.



During work, wear protective gloves to prevent injury from burrs on bolt heads or edges and harm from chemicals.



While this device is operating, do not touch movable parts such as the stem connector. Your hand, etc., may be caught in the mechanism and be injured.



When assembling or disassembling the diaphragm, which is part of the actuator, wear protective gloves to prevent prolonged contact with your skin. "Prolonged contact" refers to total daily skin contact of 10 minutes continuously or 30 minutes intermittently.

Handling Precautions

■ Installation Precautions

WARNING



If the rated pressure or standards for connection are ignored when this device is used, damage to the product or leakage may cause a serious accident.



When connecting the valve to the piping, do not put your hand or foot under the valve or between flanges. You may lose your fingers or your foot may be injured.



Before reinstalling the valve after maintenance or modification, wash out any residual fluid in the pipes or replace it with a safe fluid. Otherwise, the residual fluid may cause an injury.

CAUTION



Make sure that there is a straight pipe section at least 10 times the pipe diameter on the upstream side and 6 times the pipe diameter on the downstream side (D: nominal diameter).

If the straight pipe sections are not long enough, insufficient valve capacity or unusual noise or vibration could result.



Install the valve in the correct direction, leaving clearance around the valve as much as possible for easy maintenance (piping, wiring, adjustment, etc.).



Provide appropriate support for the valve itself and for connected pipes to prevent an excessive load from the weight and operation of the valve. (Care is needed especially for large valves and valves for low-temperature fluid.)



If the valve is installed along a passageway used by passersby, install a fence or cover as a protective measure.



Do not install the valve where it may be submerged by rainwater, covered with snow, or subject to freezing. Otherwise the valve might be damaged.



If the valve is exposed to radiant heat, provide a shielding plate or the like.

Failure to do so may result in damage to the actuator or auxiliary equipment.



If the valve is exposed to salt or a corrosive atmosphere, take measures against corrosion.

Otherwise the valve might be damaged.



Check that there is no damage to the valve (including the actuator and auxiliary equipment).



Check that there is no damage to the flanges or welded piping.

Otherwise fluid leakage could result.



If pipe flanges connected to the valve are being welded, the valve surface may also heat up. Do not touch the valve unnecessarily.



Chamfer the edges of the pipe flanges. Sharp edges can cause an injury.



Check that the pipes on both sides of the valve are firmly supported.

Insufficient support may cause leakage from pipe connections.

CAUTION



After installation, check that the pipes are still properly aligned. Misalignment may cause fluid leakage from pipe connections.



Install the butterfly valve with the valve (blade or disk) fully closed. Otherwise the valve might be damaged.



If the eyebolts (eyenuts) attached to the actuator are used to hoist the valve, make sure that the weight does not exceed the limit specified in the user's manual. An excessive load may damage the actuator or cause air leakage.



Use bolts and nuts that conform to the standards for the pipe flange. Otherwise fluid leakage could result.



Use new flange gaskets that are appropriate for the properties of the fluid, the operating temperature, and the pressure. Damaged gaskets may cause fluid leakage.



Open the valve fully before flushing the inside of the piping, and do not change the valve travel while the pipes are being flushed.

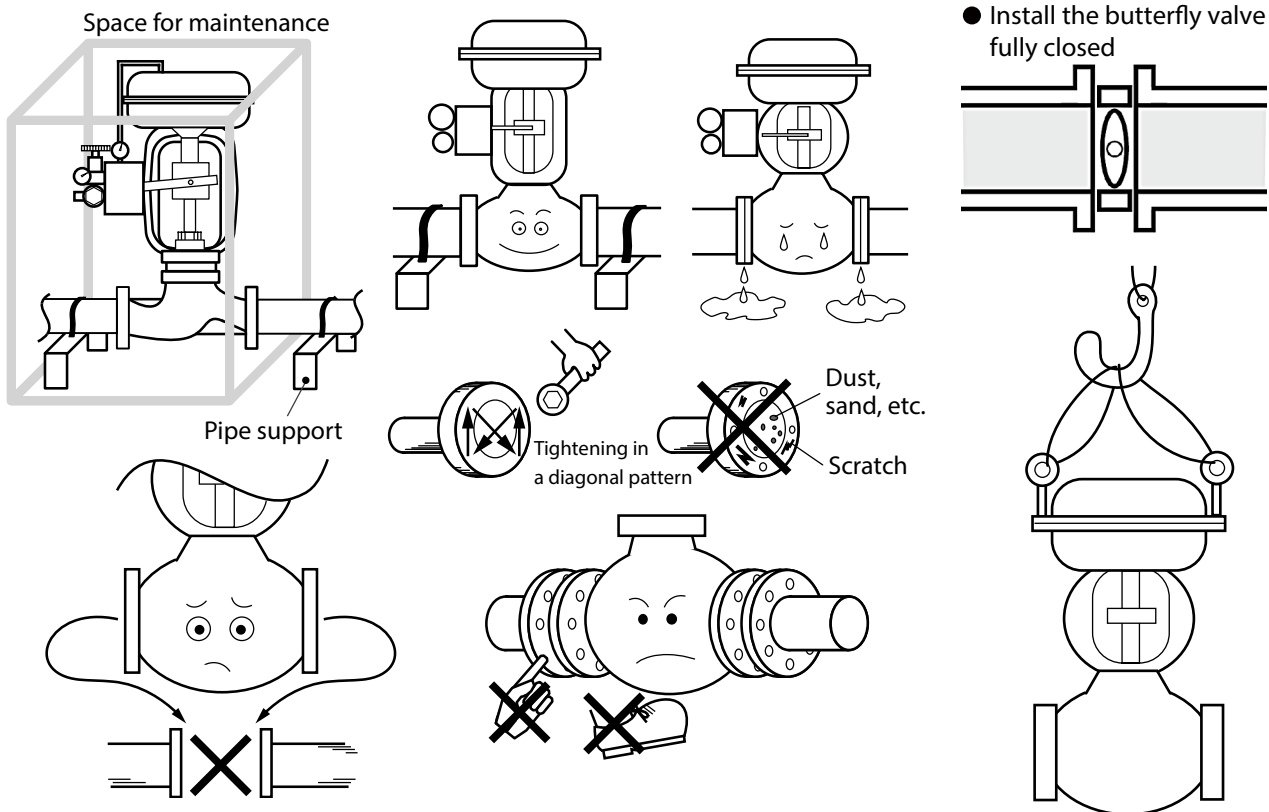
Otherwise, the valve may be damaged by welding spatter or other foreign matter.



When keeping the valve warm or cold, also keep the stud bolts and nuts that connect the valve and the bonnet warm or cold. Otherwise, fluid leakage due to thermal deformation may occur.

! Handling Precautions

- Avoid installing the valve where it will be subject to vibration or other external forces that may affect its performance.
- Protective covers are attached to the flanges to protect the gasket-contacting surfaces and to prevent foreign matter from entering the valve. When installing the valve, remove the covers.
- Check that there is no damage to the valve (including the actuator and auxiliary equipment).
- To prevent seat damage and impaired closing performance, remove foreign matter such as dust, sand, and welding spatter from the inside of the piping, and clean the inside of the valve.
- Check that the distance between the pipe flanges is equal to the total of the face-to-face length of the valve and the thickness of the gaskets.
- Tighten the bolts and nuts for the flanges evenly in a diagonal pattern.



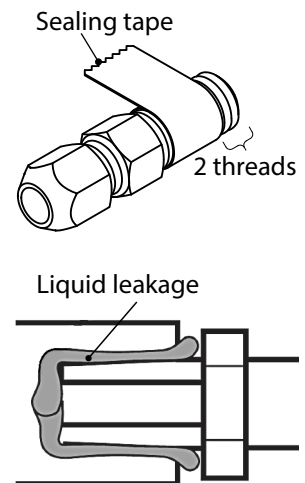
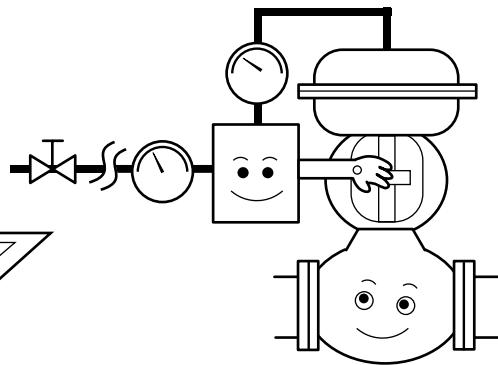
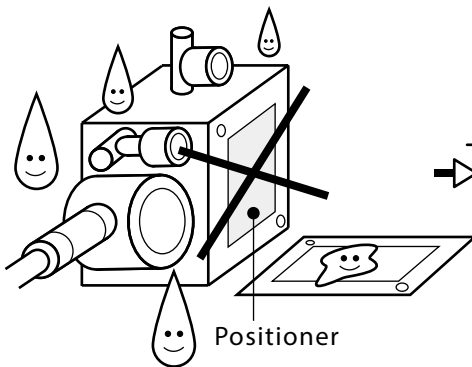
■ Precautions for Air Supply Piping and Electrical Work

⚠ CAUTION

- ⚠ **For air supply, use pipes with an appropriate internal diameter so that pressure will not drop while the valve is operating.**
Failure to do so may result in poor valve performance.
- ⚠ **Wiring work should be carried out only by qualified technicians following local electrotechnical standards.**
- ⚠ **Cabling should be carried out in accordance with facility conditions. Use an adapter (and packing) whose size is appropriate for the outer diameter of the cable.**
- ⊘ **If sealing tape is applied to air supply pipe threads, leave the two threads nearest the tip bare.**
Clogging caused by pieces of tape may result in poor valve performance.
- ⚠ **If liquid packing (thread lock sealant) is used for air supply piping work, do not allow it to enter inside the pipes. If it does, poor valve performance may result.**
- ⚠ **Avoid doing wiring work on a rainy day or in high humidity.**
Moisture inside connectors or the terminal box may cause a short-circuit or rust.

⚠ Handling Precautions

- A packing (gasket) is attached to the cap of auxiliary equipment such as positioners. Do not lose it during wiring work.
- If it is necessary to bend the air supply pipes, make gentle bends (using a dedicated tool like a tube bender), and use a band to hold parallel pipes together.



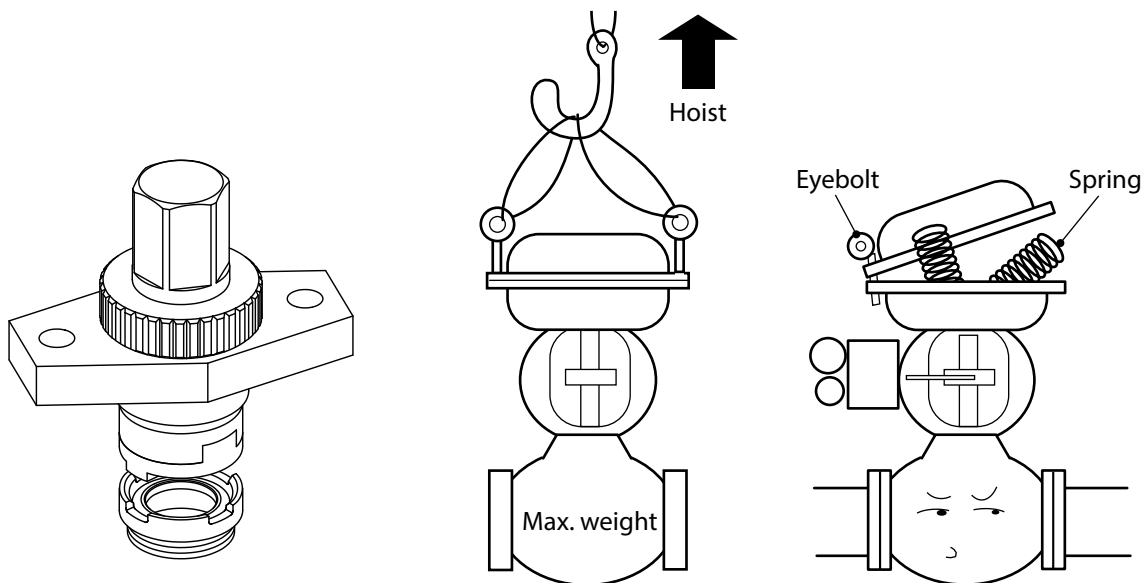
■ Precautions for Assembly and Disassembly

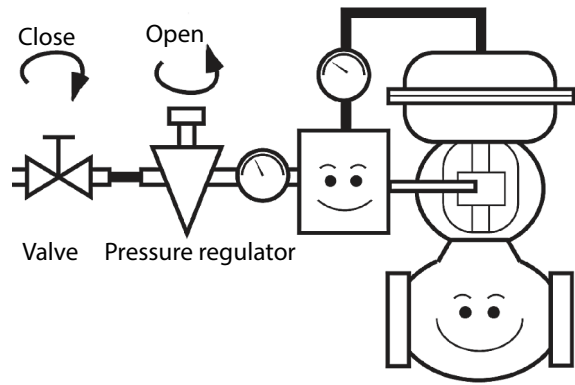
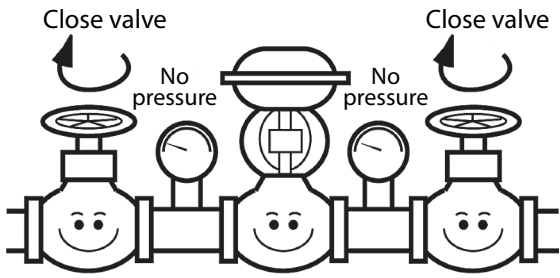
⚠ WARNING

- ⚠ Before starting work, clean the inside of the valve, replace any residual gas, etc. Otherwise, the residual fluid may cause an injury.
- ⊘ Do not disassemble the pneumatic actuator while supply air pressure is being applied. The compressed air may cause an injury.
- ⚠ Because damaged or corroded bolts and nuts may damage the valve and cause injury, replace them with new ones.

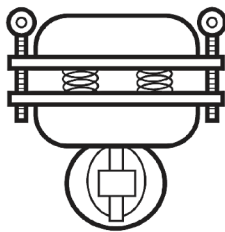
⚠ CAUTION

- ⚠ Observe the tightening torques indicated in the user's manual when tightening bolts and nuts.
- ⚠ For an actuator that incorporates springs, follow the disassembly procedure when removing bolts, nuts, etc. Otherwise, the springs may jump out, causing injury.
- ⚠ When removing the valve from the piping, if the eyebolts (eyenuts) attached to the actuator are used to hoist the valve, make sure that the weight does not exceed the limit specified in the user's manual. Otherwise, the valve may fall.
- ⚠ Before removing or attaching the trim (internal valve), check whether a dedicated tool is necessary. If it is needed, be sure to use it. Otherwise, parts may be damaged.
- ⚠ Assemble the valve using the parts, bolts, nuts, etc., in the order stated in the assembly procedure. Otherwise, malfunction may result.
- ⚠ When reassembling the valve body, always use new packing and gaskets. The reuse of old parts will cause fluid leakage.

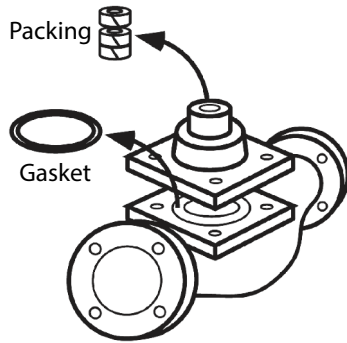




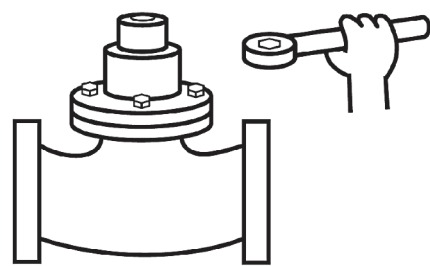
● Follow the assembly procedure



● Replace the packing and gasket



● Tighten bolts to specified torque



■ Precautions for Maintenance

WARNING



If fluid leakage from the valve is found, stay away from the valve until safety can be confirmed. Depending on the properties of the fluid, a serious accident or injury may result.

CAUTION



Check the gland daily, and tighten the packing if leakage is found.



Check valve operation daily, including a visual check for hunting.



During valve operation, look and listen for unusual noise or vibration.



Handling Precautions

- Avoid installing the valve where it will be subject to vibration or other external forces that may affect its performance.
- A packing (gasket) is attached to the cap of auxiliary equipment such as positioners. Do not lose it during wiring work.
- Take care not to lose screws for the cap of auxiliary equipment such as positioners.
- Make sure that the seal of cable glands and electrical conduits is sufficient to prevent the entry of moisture.
- Dispose of old parts that were replaced during valve disassembly or maintenance as industrial waste. If they are burned or discarded carelessly, environmental pollution will result.
- When assembling the valve, check that the packing (gaskets) are in place and tighten the screws evenly.

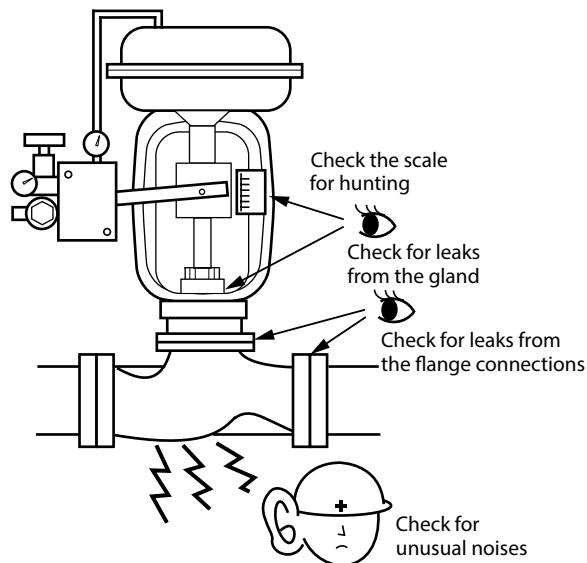


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Chapter 1. Structure of the Control System

1-1. Introduction

This control valve operates by receiving 4-20 mA DC or 20-100 kPa signals and is driven by 140-490 kPa clean supply air.

☞ Figure 1-1 illustrates a typical control valve system.

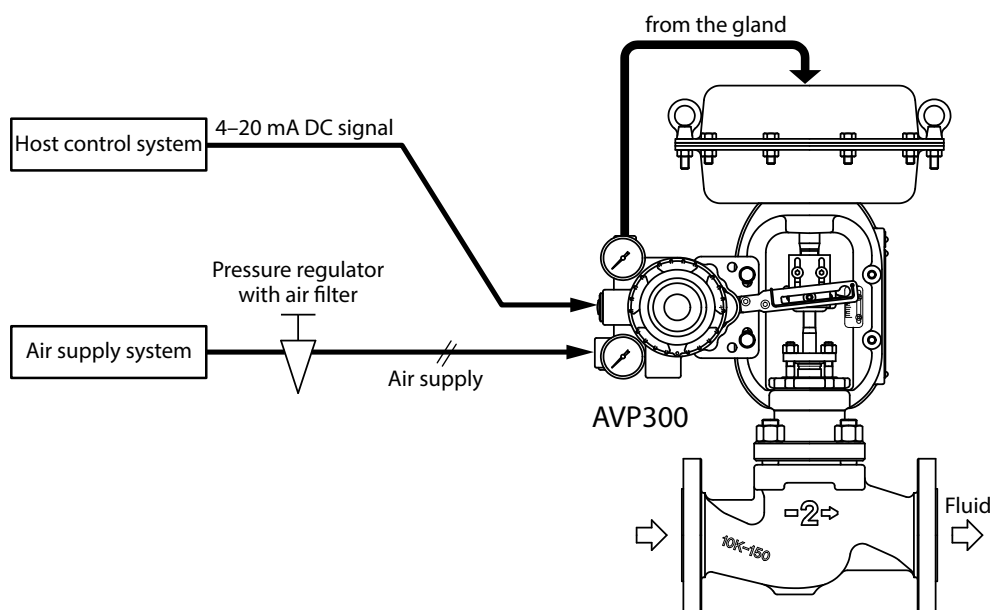


Figure 1-1. Control System

This manual contains operating instructions for a model AGVB/AGVM top-guided single-seated control valve. For details on positioners, refer to the user's manuals below.

- Pneumatic single-acting valve positioner (model HTP):
document No. OM2-8310-0200
- Pneumatic single-acting valve positioner (model VPE):
document No. OM2-8310-0410
- Smart valve positioner (model AVP300/301/302 (integral type)):
document No. CM2-AVP300-2001
- Smart valve positioner (model AVP200/201/202 (remote type)):
document No. CM2-AVP300-2001
- Smart valve positioner (model AVP701/702):
document No. CM2-AVP702-2001
- Smart valve positioner (with fieldbus)(model AVP703):
document No. CM2-AVP703-2001

1-2. Control Valve Structure

This device is composed of a valve body and an actuator. The valve body consists of a valve, bonnet, valve plug, and other components. The actuator consists of a diaphragm, spring, and other components. ➡ Figure 1-2 illustrates the structure of this device.

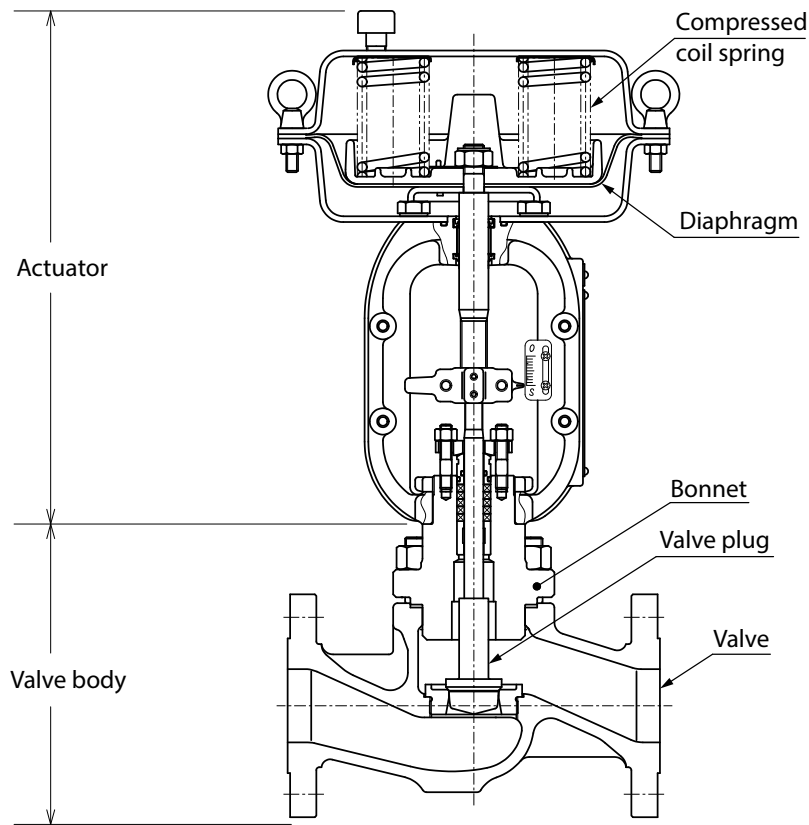


Figure 1-2. Structure


Names and functions of the components are described below.




Name	Function
Valve body	<ul style="list-style-type: none"> • Controls fluid flow. • Connects to a pipe and contains all valve components.
Valve plug	<ul style="list-style-type: none"> • Regulates flow rate, pressure, etc., by changing the size of the flow area.
Valve	<ul style="list-style-type: none"> • The part through which the fluid flows. Connects to a pipe. • The main component of the pressure vessel
Bonnet	<ul style="list-style-type: none"> • Regulates the valve plug performance in accordance with a change in flow. • A component of the pressure vessel
Actuator	<ul style="list-style-type: none"> • Adjusts valve travel in accordance with the signal received.
Diaphragm	<ul style="list-style-type: none"> • Converts air pressure.
Spring	<ul style="list-style-type: none"> • Adjusts valve plug position.

For details on the structure of the valve body, ➡ Figure 5-2 to Figure 5-4.


For details on the structure of the actuator, ➡ Figure 6-1 to Figure 6-4.

1-3. Specifications of the Control Valve

Since the control valve contacts the process fluid, its specifications must be appropriate for the process conditions and the purpose of use. The standard specifications for the AGVB and AGVM are described in  “Appendix A. Standard Specifications”.

 CAUTION	
	The specifications of the control valve, such as the rated pressure and material of the valve body and trim material, are determined by the conditions of the fluid. Do not use the control valve for applications other than those for which it was designed. Failure to comply with this caution may result in burns or injuries due to high temperature or leakage of hazardous fluid.
	This control valve must be used in compliance with all applicable safety regulations, specifications, and standards.





1-4. Dimensions and Weight












The dimensions and weight of the AGVB and AGVM are indicated in  “Appendix B. Dimensions and Weight”. Please refer to it during installation, etc.

Chapter 2. Installation

2-1. Installation Location

Please observe the following cautions when selecting the installation site for the control valve.

 WARNING	
	If the rated pressure or standards for connection are ignored when this device is used, damage to the product or leakage may cause a serious accident.
	When connecting the valve to the piping, do not put your hand or foot under the valve or between flanges. You may lose your fingers or your foot may be injured.
	Before reinstalling the valve after maintenance or modification, wash out any residual fluid in the pipes or replace it with a safe fluid. Otherwise, the residual fluid may cause an injury.

 CAUTION	
	Make sure that there is a straight pipe section at least 10 times the pipe diameter on the upstream side and 6 times the pipe diameter on the downstream side (D: nominal diameter). If the straight pipe sections are not long enough, insufficient valve capacity or unusual noise or vibration could result.
	Install the valve in the correct direction, leaving clearance around the valve as much as possible for easy maintenance (piping, wiring, adjustment, etc.).
	Provide appropriate support for the valve itself and for connected pipes to prevent an excessive load from the weight and operation of the valve. (Care is needed especially for large valves and valves for low-temperature fluid.)
	If the valve is installed along a passageway used by outsiders, install a fence or cover as a protective measure.
	Do not install the valve where it may be submerged by rainwater, covered with snow, or subject to freezing. Otherwise the valve might be damaged.
	If the valve is exposed to radiant heat, provide a shielding plate or the like. Failure to do so may result in damage to the actuator or auxiliary equipment.
	If the valve is exposed to salt or a corrosive atmosphere, take measures against corrosion. Otherwise the valve might be damaged.
	Check that there is no damage to the valve (including the actuator and auxiliary equipment).
	Check that there is no damage to the flanges or welded piping. Otherwise fluid leakage could result.
	If pipe flanges connected to the valve are being welded, the valve surface may also heat up. Do not touch the valve unnecessarily.

 **CAUTION**



**Chamfer the edges of the pipe flanges.
Sharp edges can cause an injury.**



**Check that the pipes on both sides of the valve are firmly supported.
Insufficient support may cause leakage from pipe connections.**



**After installation, check that the pipes are still properly aligned.
Misalignment may cause fluid leakage from pipe connections.**



**Install the butterfly valve with the valve (blade or disk) fully closed.
Otherwise the valve might be damaged.**



**If the eyebolts (eyenuts) attached to the actuator are used to lift the valve,
make sure that the weight does not exceed the limit specified in the user's
manual. An excessive load may damage the actuator or cause air leakage.**



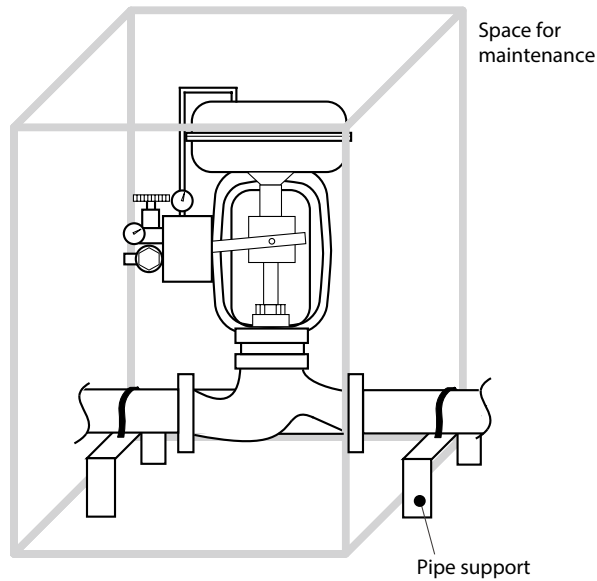
**Use bolts and nuts that conform to the standards for the pipe flange.
Otherwise fluid leakage could result.**



**Use new flange gaskets that are appropriate for the properties of the fluid,
the operating temperature, and the pressure. Damaged gaskets may cause
fluid leakage.**



**Open the valve fully before flushing the inside of the piping, and do not
change the valve travel while the pipes are being flushed. Otherwise, the
valve may be damaged by welding spatter or other foreign matter.**






The control valve is designed to withstand severe operating conditions. However, in order to achieve its optimal performance, install the valve to a location with the following conditions:

- Ambient temperature: -30 to +70 °C
- Relative humidity: 10 to 90 %
- Vibration: 2 G max. (5 to 400 Hz)




Handling Precautions

- The vibration specification is for the AVP positioner mounted on the PSA actuator.

 CAUTION	
	If the pressure regulator with air filter pressure regulator with air filter is mounted on this device, install this device on the piping so that the drain of the pressure regulator with air filter faces downward. If the pressure regulator with air filter cannot be vertical (if its drain does not face downward), remove it from this device.
	Rainwater may enter the pressure gauge, so install this device so that the gauge does not face upward or downward. Also, there is a rainwater drain hole at the bottom of the pressure gauge. The hole must be positioned facing downward.

2-2. Check before Installation on the Pipe

Check the following before installing the AGVB control valve on the piping.

1. The specifications printed on the name plate are appropriate for the use.
2. There is no damage to the valve (including the actuator and auxiliary equipment).
3. There is no damage to the flanges on the piping.
4. Eyebolts for hoisting are attached to the actuator. If the eyebolts are used to hoist the control valve, make sure that the weight including accessories does not exceed the limit specified in  “Table 2-1. Max. weight for hoisting with eyebolts”.
5. If the eyebolts are used to hoist the control valve, the angle between the actuator and the wire rope must be 60° or more. ( Figure 2-1).
6. The piping can support the weight of the control valve ( Table 2-1).

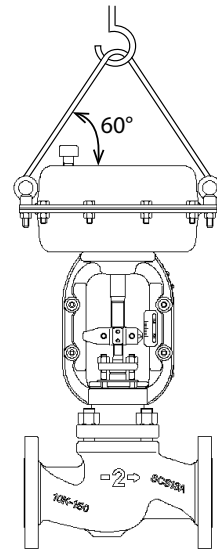


Figure 2-1. Example of hoisting

Table 2-1. Max. weight for hoisting with eyebolts

Unit: kg

Connection diameter (inches)	Actuator	Product weight (standard bonnet)		Max. weight for hoisting with eyebolts
		Without handwheel	With side handwheel	
1/2, 3/4, 1	PSA1D, R	17	24	160
	PSA2D, R	18	25	
1-1/2	PSA1D, R	25	32	160
	PSA2D, R	26	33	
	PSA3D, R	43	44	
	PSA4D, R	55	56	
2	PSA1D, R	26	33	160
	PSA2D, R	27	34	
	PSA3D, R	43	44	
	PSA4D, R	55	56	
2-1/2	PSA3D, R	58	82	160
	PSA4D, R	70	100	440
3	PSA3D, R	62	86	160
	PSA4D, R	74	104	440
4	PSA3D, R	67	91	160
	PSA4D, R	79	109	440

2-3. Installation on the Pipe

2-3-1. Standard Installation Example

☞ Figure 2-2 illustrates standard installation.

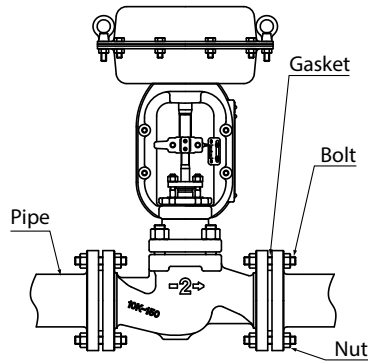
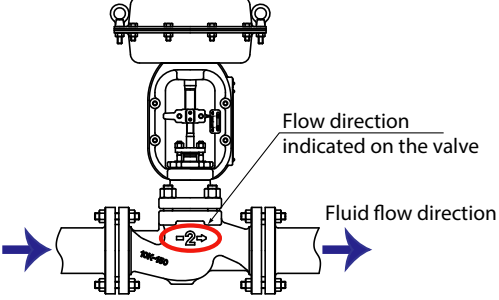
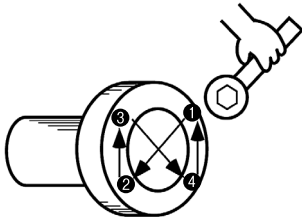


Figure 2-2. Installation on the pipe

2-3-2. Installation method

Step	Procedure
1	<p>Check that the flow direction of the process fluid is the same as the direction indicated on the control valve.</p>  <p>Figure 2-3. Flow direction indicated on the valve</p>
2	<p>Attach the valve and gaskets to the pipes. Loosely tighten the nuts of the flange bolts.</p>
3	<p>Make sure that the gaskets do not protrude into the flow path and constrict the inner diameter of the valve.</p>
4	<p>Tighten the bolts and nuts for the flanges evenly and securely in a diagonal pattern (☞ Figure 2-4).</p>  <p>Figure 2-4. Tightening in a diagonal pattern</p>
5	<p>After installation is complete, check that all bolts and nuts are securely tightened and there is no leak from the piping.</p>


2-4. Air supply connection

See the user's manual for your positioner.

- Pneumatic single-acting valve positioner (model HTP):
document No. OM2-8310-0200
- Pneumatic single-acting valve positioner (model VPE):
document No. OM2-8310-0410
- Smart valve positioner (model AVP300/301/302 (integral type)):
document No. CM2-AVP300-2001
- Smart valve positioner (model AVP200/201/202 (remote type)):
document No. CM2-AVP300-2001
- Smart valve positioner (model AVP701/702):
document No. CM2-AVP702-2001
- Smart valve positioner (with fieldbus)(model AVP703):
document No. CM2-AVP703-2001

2-5. Inspection after Installation and Precautions for Operation

Handling Precautions

- Check the air pipe connections for leakage before use.
- Make sure that the bolts and nuts of the diaphragm case, bonnet, etc., are firmly tightened.
- The temperature inside and outside the valve should be increased or decreased gradually (100 °C/h or less). Avoid operating the valve while the valve temperature is increasing or decreasing.
- When using the valve at low temperatures, gradually lower the temperature (50 °C/h or less)
- After applying pressure to the valve, check for leakage from the valve body, gland packing, and gaskets. It is especially important, if the process fluid temperature is 400 °C or higher, to tighten the nuts further after raising the temperature of the valve. By doing so, the valve will serve for a longer period without requiring maintenance. Use the torque indicated in  Table 5-1 to Table 5-3.
- For a valve with a lubricator, check whether the bonnet section has been lubricated or not. To do this, loosen the lubricator handle and turn the squeeze screw. If the squeeze screw turns lightly, replenish grease using the following procedure.

Grease replenishing procedure

- (1) Obtain grease of the type indicated on the nameplate.
- (2) Tightly close the lubricator handle.
- (3) Remove the squeeze screw, apply grease, and set the squeeze screw.
- (4) Repeat steps 2 and 3 until turning of the squeeze screw becomes heavier. Tightly close the lubricator handle.

Chapter 3. Operation

3-1. Trial-Run Inspection and Adjustment

(1) Operation test

Send a 4–20 mA DC or other dummy signal (0 to 100 %) to the valve positioner or actuator to check that the rated travel is achieved.



Refer to  Table 3-1 and if the allowable value is exceeded, adjust the valve positioner. For adjustment of the valve positioner, refer to the related user’s manual indicated in  “Chapter 1. Structure of the Control System”.


Table 3-1. Control valve performance (when shipped from factory)

Positioner	Hysteresis	Linearity
AVP, HTP	Within 1 % FS	Within ± 1 % FS
VPE	Within 1 % FS	Within ± 3 % FS

(2) Loop check

Send signals from the host control system, and check that signal wires are connected as specified and that the functional requirements for control are satisfied.




3-2. Use of the Side Handwheel

This section describes opening and closing the control valve with the side handwheel. If you need to use the side handwheel, refer to this section.  Figure 6-15 illustrates the side handwheel structure.


Precautions

If the handwheel is used when the equipment is running, make sure that manual opening/closing of the control valve does not affect the operation of the equipment.

Procedure

Step	Procedure
1	Remove the handle lock from the handwheel.
2	Check the OPEN and SHUT arrows cast on the handwheel, and rotate the handwheel in the desired direction to open or close the valve. The maximum turning torque: PSA1, PSA2: 190 N PSA3, PSA4: 450 N
3	When the handwheel does not turn any further, stop trying to turn it and check the amount of valve travel.
	<div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; align-items: center; justify-content: center;">  CAUTION </div> <div style="margin-top: 10px;">  <p>Do not apply excessive force when the mechanical stop position of the control valve has been reached. Otherwise you may damage the valve stem. If the valve stops at an abnormal position, refer to  “3-3. Troubleshooting” and take the necessary countermeasures.</p> </div> </div>
4	To resume automatic operation, turn the handwheel until the pointer on the side handwheel main unit reaches the AUTO position. Lock the handwheel, and resume automatic operation.

3-3. Troubleshooting

Problems that might occur during operation are described in  Table 3-2.

Take necessary measures such as replacing parts, depending on the circumstances

Table 3-2. Control valve problem causes and countermeasures

	Phenomenon	Cause	Countermeasure
Unreliable valve operation	The valve hunts near the fully closed position.	The valve capacity is too large.	<ul style="list-style-type: none"> • Reduce the differential pressure between the inlet and outlet of the valve. • Replace the valve trim with trim that has a smaller Cv.
		Reverse flow direction	<ul style="list-style-type: none"> • Check that the flow direction indicated on the valve is the same as the fluid direction. If not, change the direction.
	Fluctuation in supply air pressure	Insufficient instrumentation air capacity of the equipment	<ul style="list-style-type: none"> • Increase the capacity of the compressor. • Install an additional dedicated compressor.
		Failure of the air pressure regulator	<ul style="list-style-type: none"> • Check the air pressure regulator.
	Hunting of signal pressure	The resistance or air volume of the control loop is not suitable.	<ul style="list-style-type: none"> • Insert an air volume tank or restrictor into the signal pressure line.
		Failure of the controller	<ul style="list-style-type: none"> • Check the controller.
	The valve hunts even though signals and supply air pressure are stable.	Hunting of the positioner circuit	<ul style="list-style-type: none"> • Check for wear of the positioner • Check the positioner and pilot valve • Reduce the sensitivity of the positioner
Fluctuation in axial thrust due to changes in fluid pressure in pipes		<ul style="list-style-type: none"> • Reduce the differential pressure between the inlet and outlet of the valve. • Replace the actuator with one that has more rigidity. • Add a positioner. 	
Valve vibration	The valve vibrates at any travel.	Insufficient support for the piping	<ul style="list-style-type: none"> • Support the inlet and outlet of the valve.
		There is a source of vibration around the valve.	<ul style="list-style-type: none"> • Remove the source of vibration.
		The guide is worn out.	<ul style="list-style-type: none"> • Replace the guide bushing and/or the valve plug.
Slow valve stroke	Valve stroke is slow in both opening and closing directions.	The valve plug guide, the fluid retaining part of the bonnet, etc., is clogged with slurry.	<ul style="list-style-type: none"> • Disassemble and clean. • Install a steam jacket on the valve body.
		The gland packing is hardened.	<ul style="list-style-type: none"> • Replace the gland packing or the grease.

Table 3-2. Control valve problem causes and countermeasures

	Phenomenon	Cause	Countermeasure
Valve not operating	Supply air pressure is normal, but signal pressure does not increase	Leakage from the signal pipe	• Check the signal pipe (especially the fitting)
		Leakage from the diaphragm or damage to the diaphragm	• Replace the diaphragm.
		Leakage from the signal receiver of the positioner or damage to it	• Replace the bellows receiver and/or the diaphragm
		Failure of the controller	• Check the controller.
	Signal pressure is normal, but supply air pressure drops or air is not supplied	Clogging of the filter in the air pressure regulator	• Clean the filter.
		Leakage or clogging of the air pipe	• Check the air pipe (especially the fitting)
		Failure of the air pressure regulator	• Check the air pressure regulator.
	No positioner output	Failure of the positioner and pilot valve	• Check the positioner and pilot valve.
		Leakage from the actuator diaphragm or damage to the diaphragm	• Replace the diaphragm.
	The valve does not operate even though air is supplied to the actuator	The valve stem, valve plug guide, etc., is stuck due to heat or foreign matter.	• Disassemble and inspect the valve body, and reprocess or replace the valve stem or guide bushing with new ones.
		Foreign matter is caught in the valve plug.	• Disassemble, inspect, and clean the valve body.
		The valve stem is bent.	• Repair the valve stem.
Actuator failure		• Check the operation of the actuator.	
Valve does not fully open / leakage from the valve interior in large amounts	The valve stem is at the valve fully-open position.	The valve plug and/or the seat ring is corroded, eroded, abraded, or otherwise damaged.	• Lap the valve plug and seat • Re-machine the valve plug and seat. • Replace the valve plug or/and the seat ring (consider using hardened parts)
		Parts on the outer circumference of the seat ring (thread or gasket) are corroded or eroded.	• Replace the seat ring or the gasket. • Use a different mounting method for the seat ring (e.g., welding).
		The fluid leaks from the partition of the valve body.	• Weld pinholes. • Replace the valve body.
	The valve stem does not reach the fully closed position.	The differential pressure of the fluid is too great.	• Reduce the differential pressure. • Increase the output from the actuator.
		Foreign matter is caught in	• Disassemble, inspect, and clean the valve body.
		The valve stem, valve plug guide, etc., is stuck due to heat	• Separate these parts.

Table 3-2. Control valve problem causes and countermeasures

Phenomenon	Cause	Countermeasure
Fluid leaks from the gland packing.	Looseness of the gland packing or bolts	<ul style="list-style-type: none"> • Tighten the gland packing or bolts.
	Grease depleted (for graphite yarn packing)	<ul style="list-style-type: none"> • Replenish the grease.
	The gland packing has deteriorated.	<ul style="list-style-type: none"> • Replace the gland packing (consider using a packing of a different material)
	The valve stem, interior of the packing box, etc., is damaged, corroded, or eroded.	<ul style="list-style-type: none"> • Disassemble and re-machine or replace parts. • Attach a felt ring or rubber bellows to protect the valve stem (if there is a lot of foreign matter).
The fluid leaks from the gasket.	The gasket is damaged, corroded, or eroded.	<ul style="list-style-type: none"> • Replace the gasket (consider using a gasket of a different material)
The amount of valve travel or the control rangeability have narrowed	The valve characteristic has changed because the valve plug is corroded, eroded, or abraded.	<ul style="list-style-type: none"> • Replace the valve plug, seat ring, etc. (consider using parts of a different material for better corrosion-resistance and rigidity)

Chapter 4. Maintenance





4-1. Inspection of the Control Valve

Check the control valve in accordance with the following instructions in order to maintain proper performance, prevent accidents, and detect problems early. Daily inspection and periodic inspection (overhaul) must be carried out. When inspecting the valve, be sure to observe the instructions below.


4-1-1. Daily Inspection

The following items should be checked in daily inspections of the equipment.

Checklist

- (1) Gland
Check for a fluid leak from the gland. If a leak is found, take necessary measures, referring to  “3-3. Troubleshooting”.
- (2) Flange connections
Check the flange between the valve body and the bonnet, and the flange between the valve body and the piping, for fluid leakage. If a leak is found, take necessary measures, referring to  “3-3. Troubleshooting”.
- (3) Control valve operation
Check for any abnormal operation such as hunting. If the valve is hunting, take necessary measures, referring to  “3-3. Troubleshooting”.
- (4) Abnormal noise or sound
Check that there is no abnormal sound or vibration from the device during operation. If any problem is found, take necessary measures, referring to  “3-3. Troubleshooting”.

WARNING

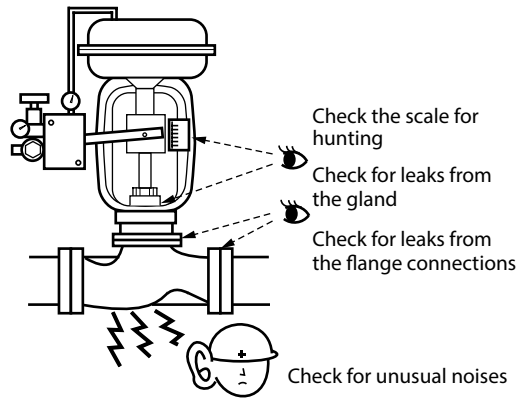
 If fluid leakage from the valve is found, stay away from the valve until safety can be confirmed. Depending on the properties of the fluid, a serious accident or injury may result.

CAUTION


 Check the gland daily for leakage.

 Check valve operation daily for hunting.

 Check that there is no abnormal sound or vibration from the device during operation.




4-1-2. Periodic Inspection

Disassemble the control valve once every two or three years. Replace consumables and repair or replace any parts that have deteriorated. When disassembling the valve, be sure to observe the instructions in  “Chapter 5. Disassembly and Reassembly of the Control Valve”.

Recording inspection results

Recording the results of periodic inspection on the following items is recommended. The records will be useful in estimating the remaining service life of the product, troubleshooting, identifying consumables that should be replaced, and in other various circumstances.

Precautions

- Before uninstalling the control valve from the equipment, check that removal of the valve will not affect the performance of the equipment.
- When disassembling the control valve, refer to  “5-4. Disassembling the Valve Body” for the particular model and take necessary notes for reassembly of the valve.
- Before disassembling the control valve, send dummy inputs to the actuator or the positioner to check for any problems.

Checklist

- (1) Appearance
Check the diaphragm case, waterproof cap, yoke, stem connector, bonnet, valve, bolts, nuts, and air piping for damage or corrosion, and check that all necessary parts are attached. In addition, check if the paint is worn out.
- (2) Damage to stems
Check the valve stem and actuator stem for damage.
- (3) Leakage from the valve body and bonnet connection
Check the connection between the valve and bonnet for any signs of leakage.
- (4) Leakage from the gland
Check the gland for any signs of leakage.
- (5) Damage to the valve plug or seat ring
Check the valve plug and seat ring seats for damage or deterioration such as corrosion that will cause a leak from the valve seat. If a problem is found, lap, re-machine, or replace the part.
- (6) Damage to the guide caused by foreign matter
Check the guide for the valve plug and the guide in the bonnet for burrs, deformation, and damage caused by foreign matter. If a problem is found, repair or replace the part.
- (7) Scale in the valve
Check the valve, valve plug, inside surface of the bonnet, gland box, seat ring, etc., for scaling. Remove any scale that has accumulated in the valve.
- (8) Damage or corrosion on the inside of the gland box
Check the gland box for damage or deterioration, such as corrosion, which will cause a leak from the gland. If such problem is found, re-machine or replace the part.

- (9) Damage or corrosion on the gasket-contacting surface
Check the gasket-contacting surface of the valve and bonnet for damage or deterioration, such as corrosion that will cause a leak. If a problem is found, repair, re-machine, or replace the part.

CAUTION



Dispose of old parts that were replaced during valve disassembly or maintenance as industrial waste. If they are burned or discarded carelessly, environmental pollution will result.

4-2. Removing the Control Valve

This section provides instructions for removing the control valve from the equipment for a periodical inspection or other purposes.

Refer to the following instructions or cautions when removing the valve.

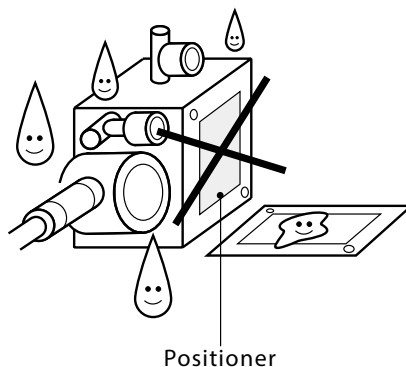
Handling Precautions








- Allow enough space to work.
- Check that removal of the valve will not affect the performance of the equipment.
- Be sure to shut off the fluid in the piping and release the process pressure.
- Check that the temperature near the control valve is safe.
- Before removing the control valve from the equipment, remove all the bolts at pipe connections to avoid applying excessive force.

Removing the control valve

(1) Removing wires

Shut off all signals and power from electric equipment that is connected to the control valve, and remove the wires.



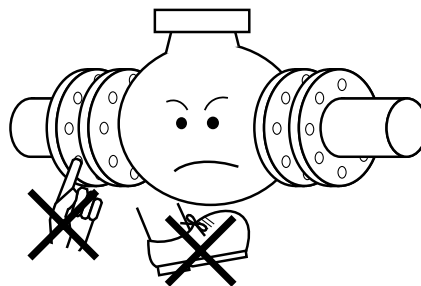
 CAUTION	
	Wiring work should be carried out only by qualified technicians following local electrotechnical standards.
	Avoid doing wiring work on a rainy day or in high humidity. Moisture inside the connectors or the terminal box may cause a short-circuit or rust.
	A packing (gasket) is attached to the cap of auxiliary equipment such as positioners. Do not lose it during wiring work.
	Take care not to lose screws for the cap of auxiliary equipment such as positioners.
	When assembling the valve, check that the packing (gaskets) are in place and tighten the screws evenly.
	Make sure that the seal of cable glands and electrical conduits is sufficient to prevent the entry of moisture.

(2) Removing air pipes

Shut off the air supply to the control valve with a stop valve, etc., and remove the air pipes. Seal the ends of the removed pipes with tape, etc.

(3) Removal from the piping

Secure the control valve by slinging or by other means. Then, remove bolts and nuts from the flanges and detach the control valve from the piping.



 WARNING	
	When connecting the valve to the piping, do not put your hand or foot under the valve or between flanges. You may lose your fingers or your foot may be injured.

 CAUTION	
	If the eyebolts (eyenuts) attached to the actuator are used to hoist the valve, make sure that the weight does not exceed the limit specified in the user's manual. An excessive load may damage the actuator or cause air leakage.

Chapter 5. Disassembly and Reassembly of the Control Valve

This section gives instructions on disassembly and reassembly of the control valve. If you need to disassemble and reassemble the valve for periodic inspection, troubleshooting, or other circumstances, refer to the instructions.

5-1. Before Disassembly

- Allow enough space to work. If you disassemble several control valves at the same time, allow extra space to avoid mixing parts up.
- If you detach only the actuator, leaving the control valve on the piping, be sure to shut off the fluid in the piping and release the process pressure.
- Check that the temperature near the control valve is normal.
- Have all tools necessary for disassembly or detachment ready.
- Write down the information printed on the nameplate and the model No. of the positioner.

5-2. Necessary Tools


A hammer, chisel, punch, open-end wrench or box wrench, a special wrench for the seat ring, compressed air source (390 kPa max.) to test the valve.

Contact us for a special wrench for the seat ring.

5-3. Removal of the Actuator from the Valve Body and Reassembly, and Changing the Orientation of the Actuator

5-3-1. Removal of the Actuator from the Valve Body and Reassembly

Removal procedure

Step	Procedure
1	<ul style="list-style-type: none">• Detaching the air pipes Detach the air pipes, etc., from the actuator. Keep supplying air from the air supply system to the actuator.
2	<ul style="list-style-type: none">• Marking With the hammer and chisel or punch, place matching marks indicated in  Figure 5-1 so that the actuator, valve body, and bonnet can be reassembled in the same positions.
3	<ul style="list-style-type: none">• Detaching the stem connector Apply air pressure to the actuator so that the pointer indicates about 10 to 20 % above the fully closed position, and maintain that pressure. Loosen the hex bolts that hold the stem connector, remove the stem connector, and detach the actuator stem from the valve stem.
4	<ul style="list-style-type: none">• Removing the accessories Remove accessories such as the positioner and limit switch. Protect the air supply and air output connections of the removed positioner with plastic tape, etc.



Step	Procedure
5	<ul style="list-style-type: none"> Removing the actuator from the valve body With the hammer and chisel, loosen and remove the nuts that hold the yoke. Lift and remove the actuator from the valve body.

Note: Before disassembling a control valve that is installed on the piping, be sure to shut off the fluid in the piping and release the process pressure.



Assembly procedure

Step	Procedure
1	<ul style="list-style-type: none"> Mounting the actuator on the valve body Mount the actuator on the valve body, aligning the matching marks. Tighten the nuts that hold the yoke to secure the actuator in place.
2	<ul style="list-style-type: none"> Attaching the accessories Attach the accessories such as the positioner and limit switch.
3	<ul style="list-style-type: none"> Attaching the stem connector Apply air pressure to the actuator and adjust the position of the actuator stem, and temporarily attach the stem connector. Make adjustment so that the threads on the actuator stem and valve stem fit properly into the threads on the stem connector. (Be careful not to rotate the valve stem during adjustment.) Firmly tighten the hex bolts on the stem connector.
4	<ul style="list-style-type: none"> Attaching the air pipes Attach the air pipes, etc., to the actuator.
5	<ul style="list-style-type: none"> Readjusting the positioner Readjust the positioner (for the AVP, use the auto setup function).

5-3-2. Procedure for Changing the Mounting Orientation of the Actuator

	CAUTION
	<p>Note that the specification for leakage from the valve seat cannot be guaranteed if the mounting orientation of the actuator is changed by anyone other than our service personnel.</p>

Procedure

Step	Procedure
1	Remove the actuator from the valve body by using the disassembly procedure in  "5-3-1. Removal of the Actuator from the Valve Body and Reassembly".
2	Rotate the actuator to the desired position, paying attention not to rotate the valve stem.
3	Assemble the valve body and the actuator by using the assembly procedure in  "5-3-1. Removal of the Actuator from the Valve Body and Reassembly".

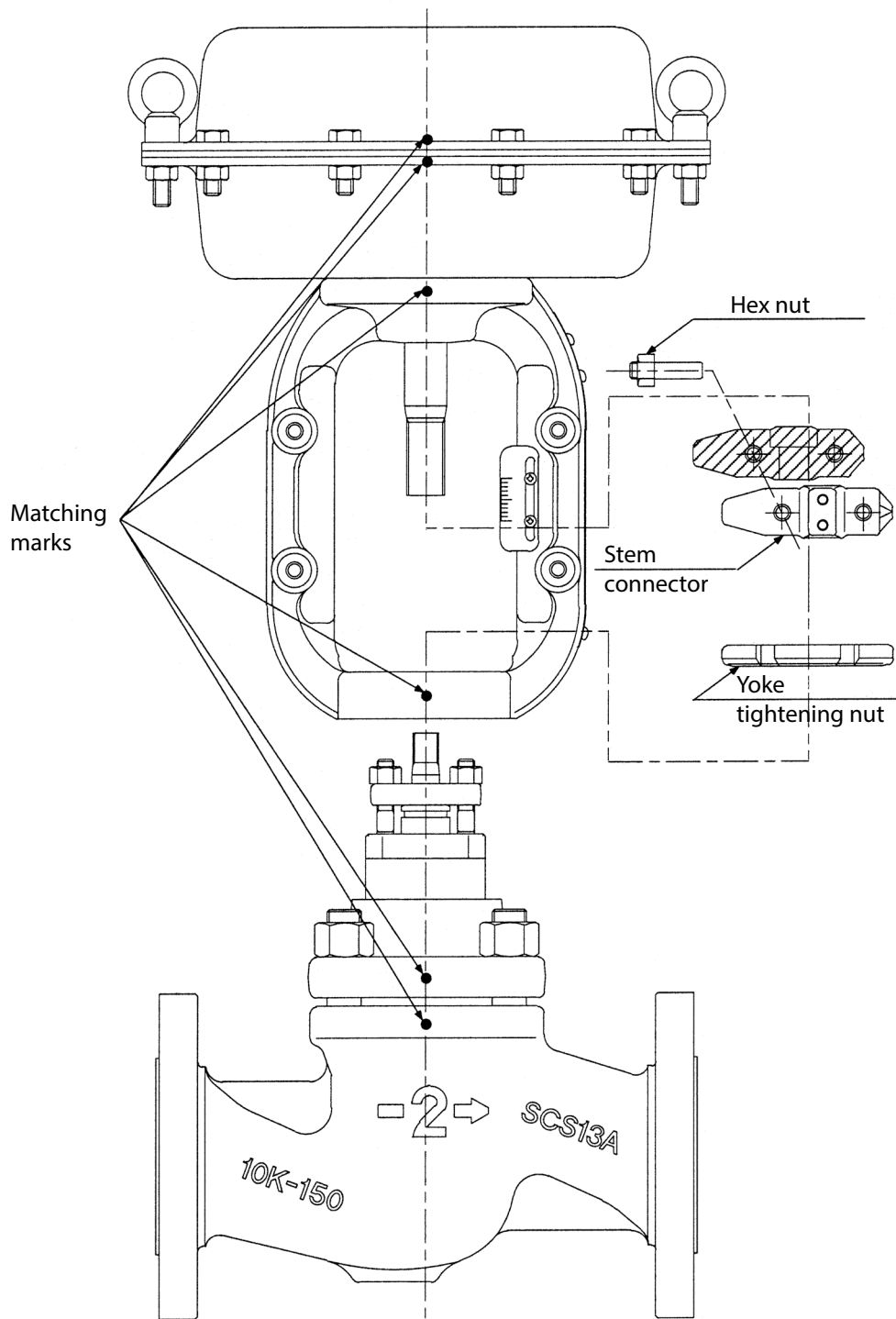




Figure 5-1. Removal of the actuator from the valve body and reassembly

5-4. Disassembling the Valve Body

Precautions for disassembly

- Disassemble the valve body on a rag, etc., to avoid damaging the valve.
- After disassembling the valve body, protect the gasket-contacting surfaces, the valve plug-contacting surfaces, sliding areas, seat ring, etc., with a rag or the like.




 CAUTION	
	Dispose of old parts that were replaced during valve disassembly or maintenance as industrial waste. If they are burned or discarded carelessly, environmental pollution will result.

Disassembly procedure

Disassemble the control valve, referring to  Figure 5-2 to Figure 5-4 “Valve body structure.”

(1) Detaching the bonnet from the valve

Step	Procedure
1	Loosen the nuts for the packing flange.
2	With the open-end wrench or box wrench, loosen the hex nuts that hold the bonnet to the valve.
3	Check if the pressure in the valve has been released completely. Remove the nuts.
4	Remove the bonnet from the valve. Be sure to hoist the bonnet slowly and vertically by, for example, using a hoisting tool, so that the valve stem does not move to the side. If the valve plug comes off along with the bonnet, tap the plug lightly with a plastic hammer so that the seat of the valve plug and the seat ring is not damaged, and slide it off from the bonnet by its own weight.
5	Remove the gasket between the valve and the bonnet.

 WARNING	
	Before disassembling the valve body, check that the pressure in the valve has dropped to atmospheric pressure. If fluid spews out, injury may result.
	Before disassembling the valve body, wash out the inside the valve or replace the fluid. Otherwise, the residual fluid in the pipe may cause an injury.

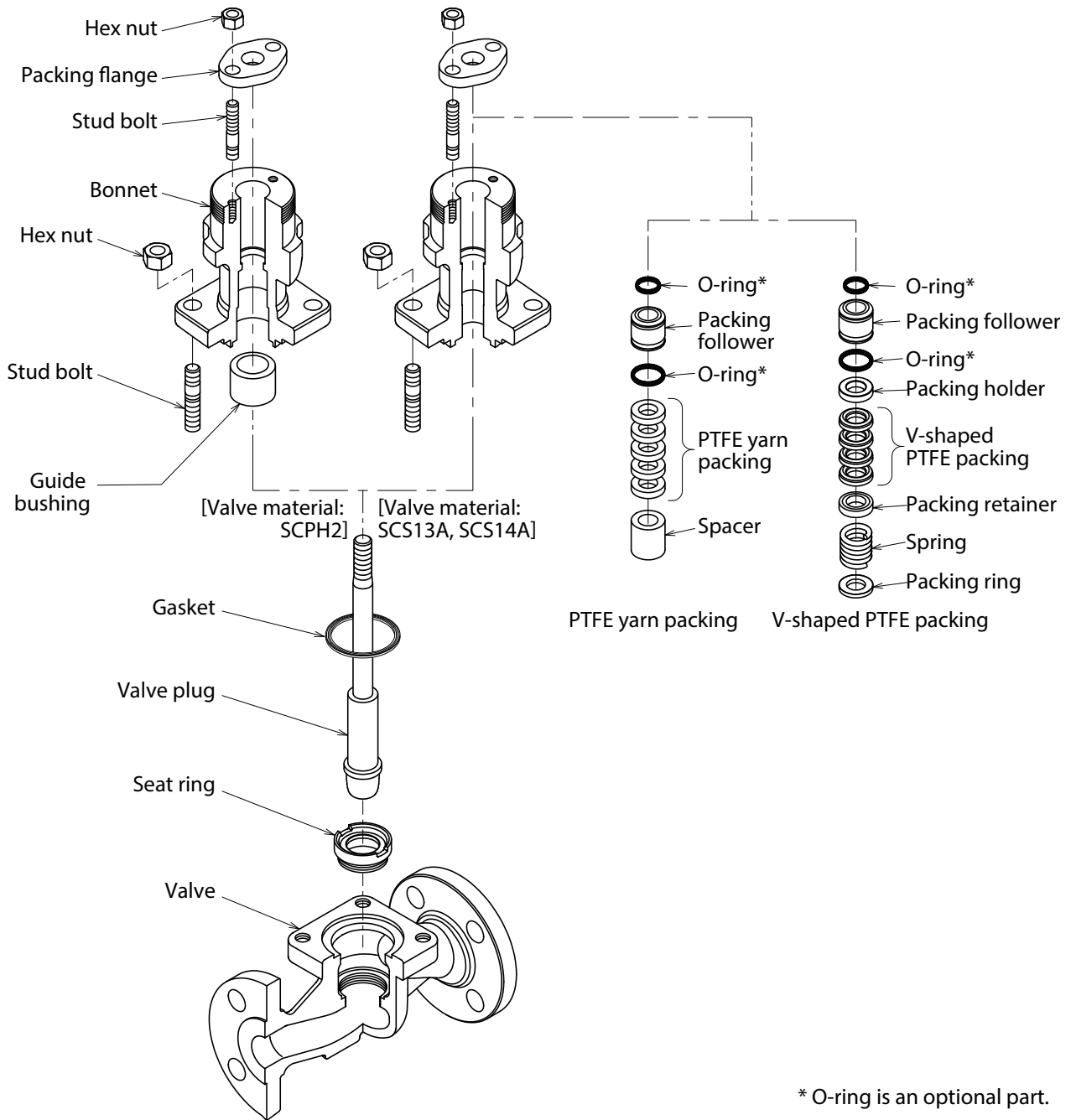


Figure 5-2. Valve body structure (connection diameter: ½ or 1 inch)

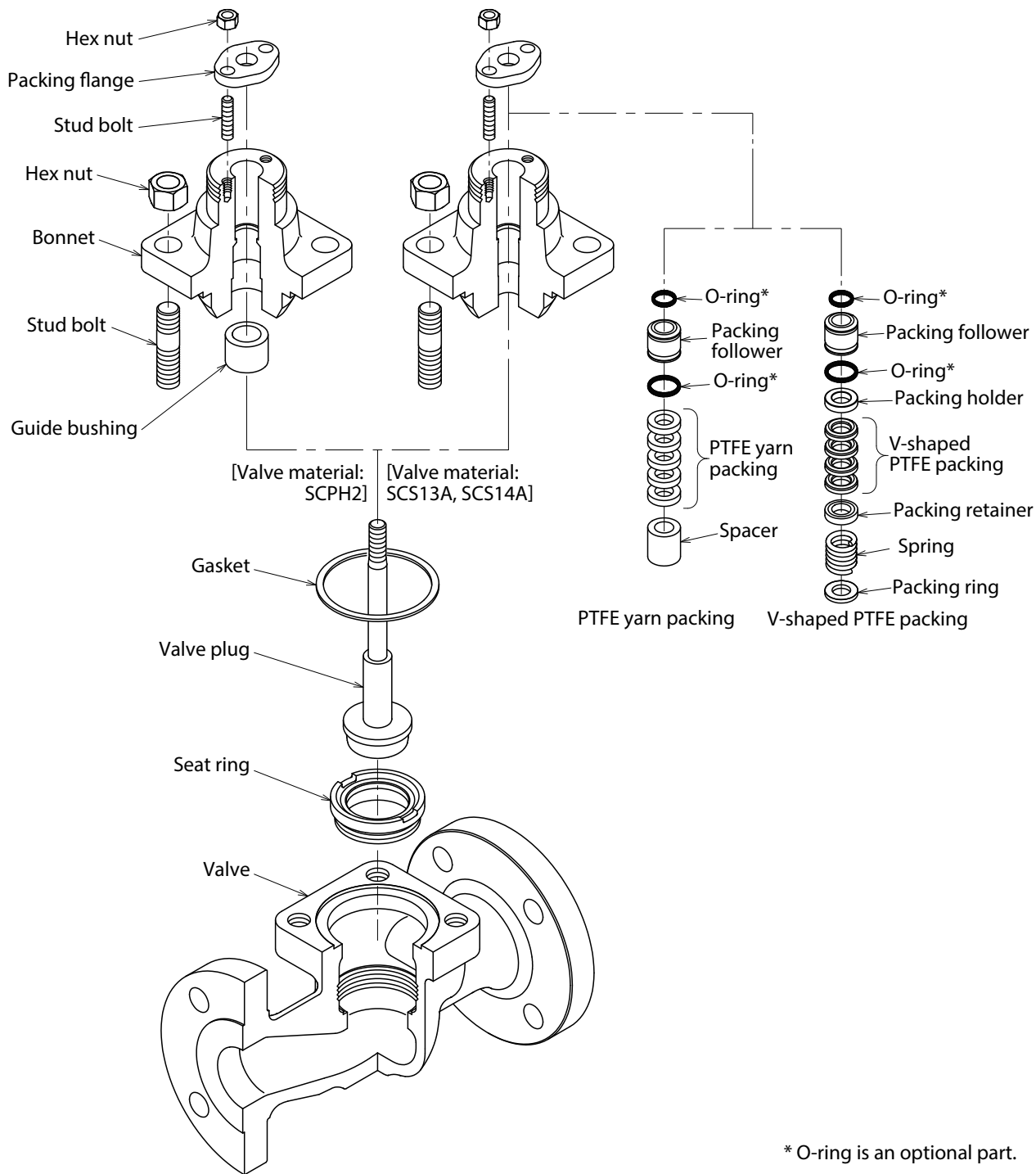


Figure 5-3. Valve body structure (connection diameter: 1½ or 2 inches)

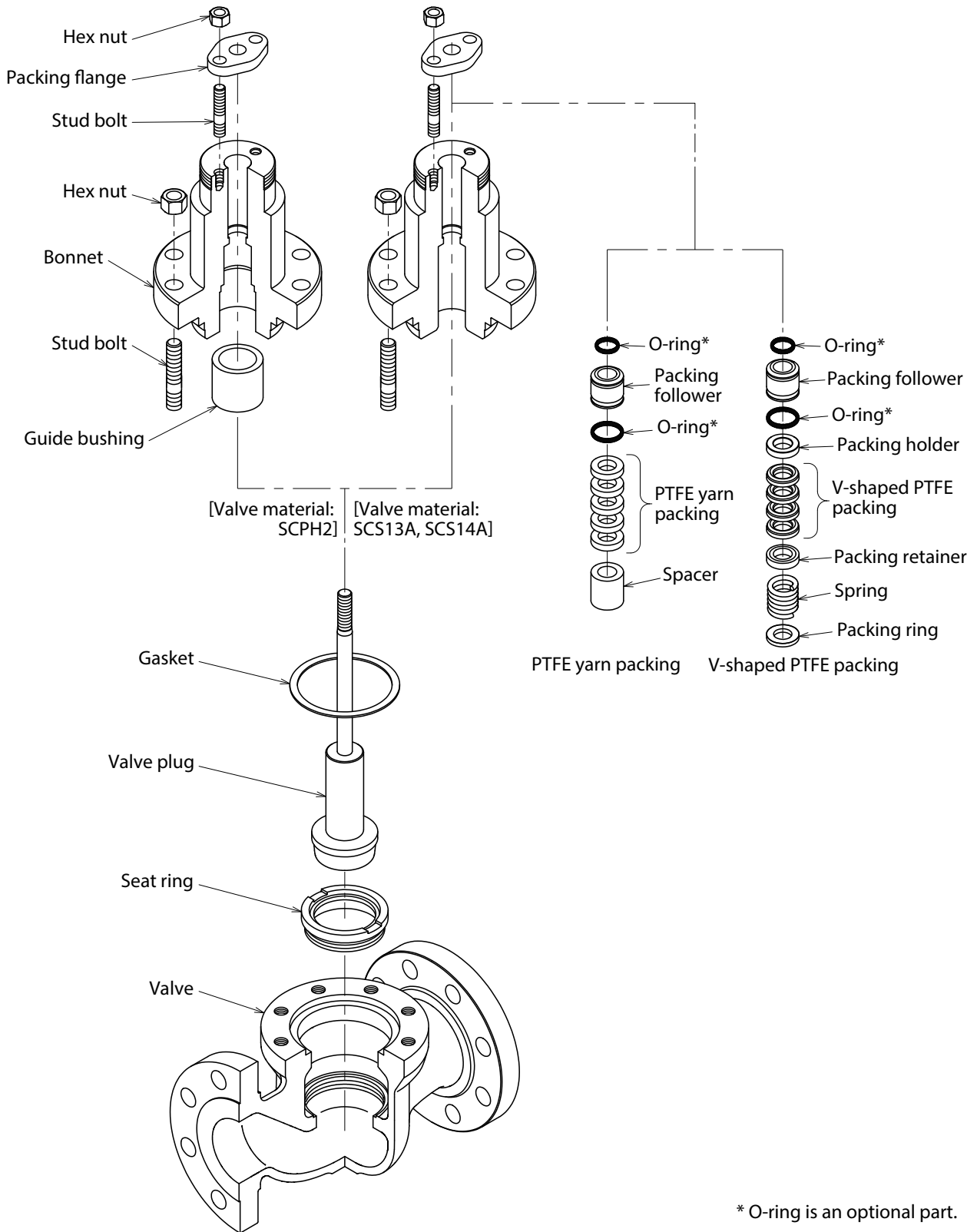


Figure 5-4. Valve body structure (connection diameter: 2½ to 4 inches)

(2) Removing the trim

After removing the valve plug, remove the seat ring with the special wrench for the seat ring.


(3) Taking out the gland parts

Take out the gland parts with a pipe, etc. Take notes of the type, quantity, order, etc., of parts such as the packing and spacers in order to facilitate reassembly.


	CAUTION
	Use the special seat ring wrench to remove the trim (internal valve). Otherwise, the trim may be damaged.

5-5. Reassembling the Valve Body


Precautions for assembly



- Check that there is no problem with the parts, referring to  "5-4. Disassembling the Valve Body". If a problem is found, repair or replace the part as needed.
- Always use new gland packing and gaskets.
- Note that the quantity, stacking order and direction of packing differs depending on the type of packing and fluid conditions.
- Check that foreign matter produced by maintenance do not remain inside the valve.
- For washing-restricted models (e.g., degreased or waterproof models), additional materials and sealing material with special specifications are required. Please refer to the specifications.

Assembly procedure

Check the nominal diameter of the pipe connection of the control valve, and reassemble the valve referring to  Figure 5-2 to Figure 5-4 "Valve body structure."

(1) Mounting the seat ring

Step	Procedure
1	Screw the seat ring into the valve with your hand. For a model with standard specifications, apply an agent to prevent galling*1 to the screws and between the valve and seat ring. For a degreased model, use a seat ring gasket. Apply lubricant*2 to the above-mentioned locations, position the seat ring gasket, and screw the seat ring into the valve.
2	Place the special seat ring wrench on the valve, and tighten the seat ring to the torque specified in  Table 5-1.

	CAUTION
	Before attaching the trim (internal valve), check whether a dedicated tool that is appropriate for the specification is necessary. If it is needed, be sure to use it.

*1. Use Never-Seez made by the U.S. company Bostik or the equivalent.

*2. Use GPL 207 made by Krytox or the equivalent.

Table 5-1. Seat ring tightening torque

Unit: N·m

Connection diameter (inches)	Seat ring tightening torque
1/2, 3/4, 1	140 to 150
1-1/2, 2	210 to 230
2-1/2, 3	340 to 380
4	590 to 650

Table 5-2. Bonnet hex nut tightening torque

Unit: N·m

Connection diameter (inches)	Bonnet hex nut	Tightening torque
1/2, 3/4, 1	M10	39 to 43
1-1/2, 2	M16	88 to 97
2-1/2, 3	M16	88 to 97
4	M16	88 to 97

Table 5-3. Packing flange hex nut tightening torque

Unit: N·m

Valve stem size	PTFE* yarn packing	V-shaped PTFE packing
φ 13 mm	6	0.8
φ 16 mm	16	0.8
φ 30 mm	34	0.8

* Polytetrafluoroethylene








Note: The torque may vary depending on the type of packing. Use the indicated torque as a rough guideline.

(2) Lap the contacting surfaces

Lap the mating valve plug and the seat ring surfaces.

Step	Procedure
1	Put an old gasket in place on the valve.
2	Apply a small amount of compound to the surface of the seat ring where the valve plug makes contact.
3	Insert the valve plug into the bonnet, and mount the bonnet on the valve loosely with stud bolts and nuts.
4	To keep the stem at the center during lapping, insert old packing into the gland.
5	Press the valve plug gently onto the seat ring and turn the plug to lap it (if you attach the stem connector to the top of the valve plug, you can use it as a knob). Remove the bonnet and valve plug from the valve, and check that there are no fine scratches, etc., on the surface.
6	When lapping is complete, wipe off the compound. Remove the stem connector, old packing, and old gasket.








(3) Assembling the valve plug and bonnet

Step	Procedure
1	Apply an agent for preventing galling* to a new gasket and set the gasket on the valve in place.
2	Insert the valve plug into the bonnet, then place the bonnet on the valve. Be sure to align the matching marks, which were placed before disassembly, in order to set the bonnet in the right position.
3	Apply an agent for preventing galling* to the threads of the stud bolts. Mount the bonnet on the valve and tighten the nuts using a wrench. Be sure to tighten the nuts evenly in a diagonal pattern to prevent uneven compression of the bonnet and to keep the valve stem centered.
4	<p>When done, all the nuts should be tightened to the torque specified in  Table 5-2.</p> <div data-bbox="550 658 1417 712" style="border: 1px solid black; background-color: #f0f0f0; padding: 5px; text-align: center;">  WARNING </div> <div data-bbox="550 719 1417 801" style="border: 1px solid black; padding: 5px;">  Because damaged or corroded bolts and nuts may damage the valve and cause injury, replace them with new ones. </div> <div data-bbox="550 837 1417 891" style="border: 1px solid black; background-color: #f0f0f0; padding: 5px; text-align: center;">  CAUTION </div> <div data-bbox="550 898 1417 981" style="border: 1px solid black; padding: 5px;">  When reassembling the valve body, always use new packing and gaskets. The reuse of old parts will cause fluid leakage. </div> <div data-bbox="550 987 1417 1070" style="border: 1px solid black; padding: 5px;">  Observe the tightening torques indicated in the user's manual when tightening bolts and nuts. </div> <div data-bbox="550 1077 1417 1160" style="border: 1px solid black; padding: 5px;">  Tighten the nuts for connecting the bonnet to the valve evenly in a diagonal pattern. </div>

* For a model of standard specifications, use Never-Seez made by the American company Bostik or the equivalent.

For a degreased model, use GPL 207 made by Krytox or the equivalent.

(4) Assembling the gland


Step	Procedure
1	Insert the parts of the gland in the right order, referring to the notes that were taken during disassembly and to the figure in  Figure 5-2 to Figure 5-4, which illustrates the structure of the gland. If Azbil's low-emission gland packing system is used, refer to  Chapter 8. Insert the parts all the way to the bottom with a pipe, etc. If PTFE yarn packing is used, insert it with the cut part of the packing shifted by 180°.
2	Check that the O-ring for the packing follower is inside the gland box. If extra parts are inserted or an incorrect amount of packing is inserted, the packing follower and packing flange will not be in the right place.
3	<p>Apply an agent for preventing galling* to the stud bolts and nuts. Tighten the packing flange with the stud bolts and nuts. The nuts should be tightened to the torque specified in  Table 5-3.</p> <div data-bbox="560 669 1426 725"><p> WARNING</p></div> <div data-bbox="560 725 1426 815"><p> Because damaged or corroded bolts and nuts may damage the valve and cause injury, replace them with new ones.</p></div> <div data-bbox="560 848 1426 904"><p> CAUTION</p></div> <div data-bbox="560 904 1426 994"><p> Observe the tightening torques indicated in the user's manual when tightening bolts and nuts.</p></div>

* Use Never-Seez made by Bostik, Inc., or the equivalent.



Chapter 6. Disassembly and Reassembly of Model PSA Actuator

6-1. Disassembly of the Actuator


Precautions

- All the nuts for the eyebolts are stainless steel. Do not mix them up with other nuts.
- Place the removed parts in a clean place.
- Stand the actuator up vertically during disassembly.
- For actuators that are equipped with a side handheel, refer to  "6-4. Removing the Side Handwheel from the Actuator".
- Release the air in the diaphragm case before disassembly.

	WARNING
	Do not disassemble the pneumatic actuator while supply air pressure is being applied. The compressed air may cause an injury.

	CAUTION
	Dispose of old parts that were replaced during valve disassembly or maintenance as industrial waste. If they are burned or discarded carelessly, environmental pollution will result.



Disassembly procedure

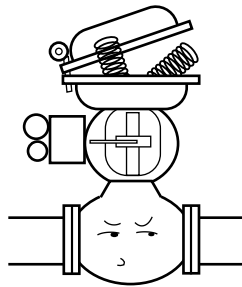
Check the size of the actuator and disassemble it, referring to  Figure 6-1 to Figure 6-4.

(1) Marking and parts protection

Step	Procedure
1	Place matching marks on the upper and lower diaphragm case and on the boss of the yoke for remounting the case.
2	Wrap plastic tape around the threads of the rod to protect the sealing parts and the bushing.

(2) Removing bolts and nuts from the diaphragm case

Step	Procedure
1	Loosen and remove the hex nuts and bolts, except for the eyebolt nuts, from the diaphragm case.
2	Loosen the two eyebolt nuts evenly and remove them. <div data-bbox="550 443 1417 613" style="border: 1px solid black; padding: 5px;"><p style="text-align: center;"> CAUTION</p><p> For disassembly of an actuator that contains springs, follow the disassembly procedure when removing bolts, nuts, etc. Otherwise, the springs may jump out, causing injury.</p></div>



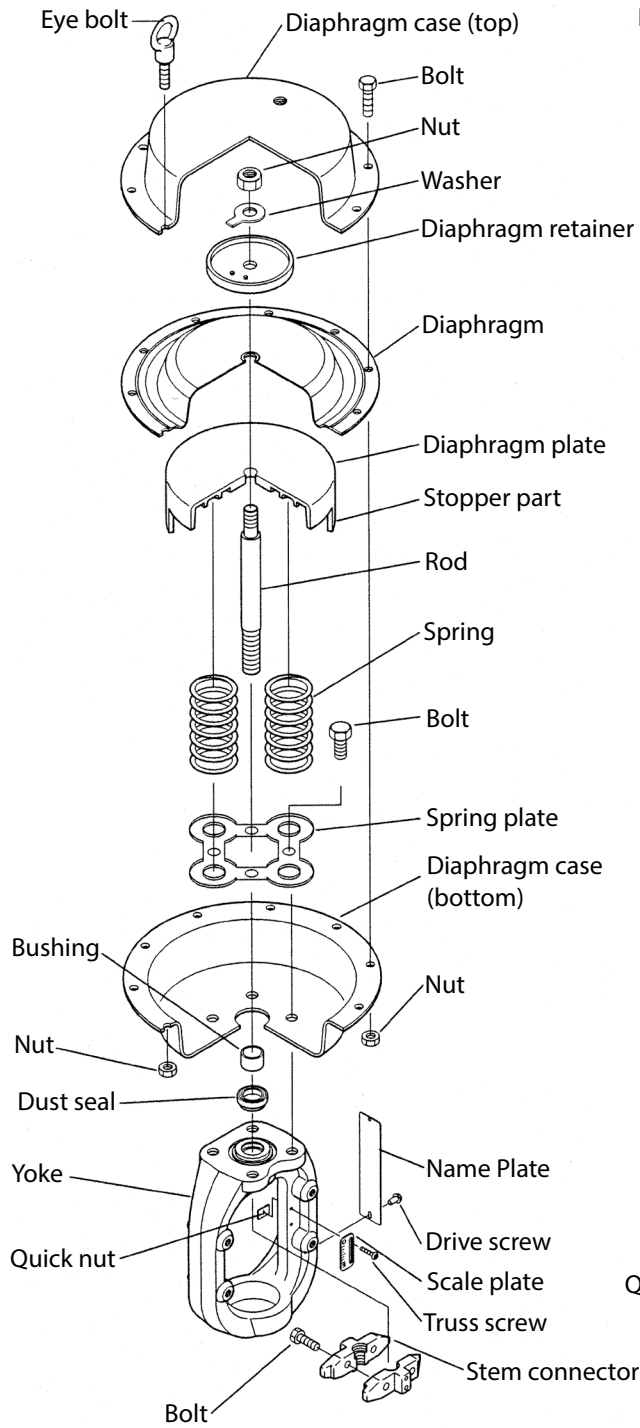


Figure 6-1. PSA1D, PSA2D

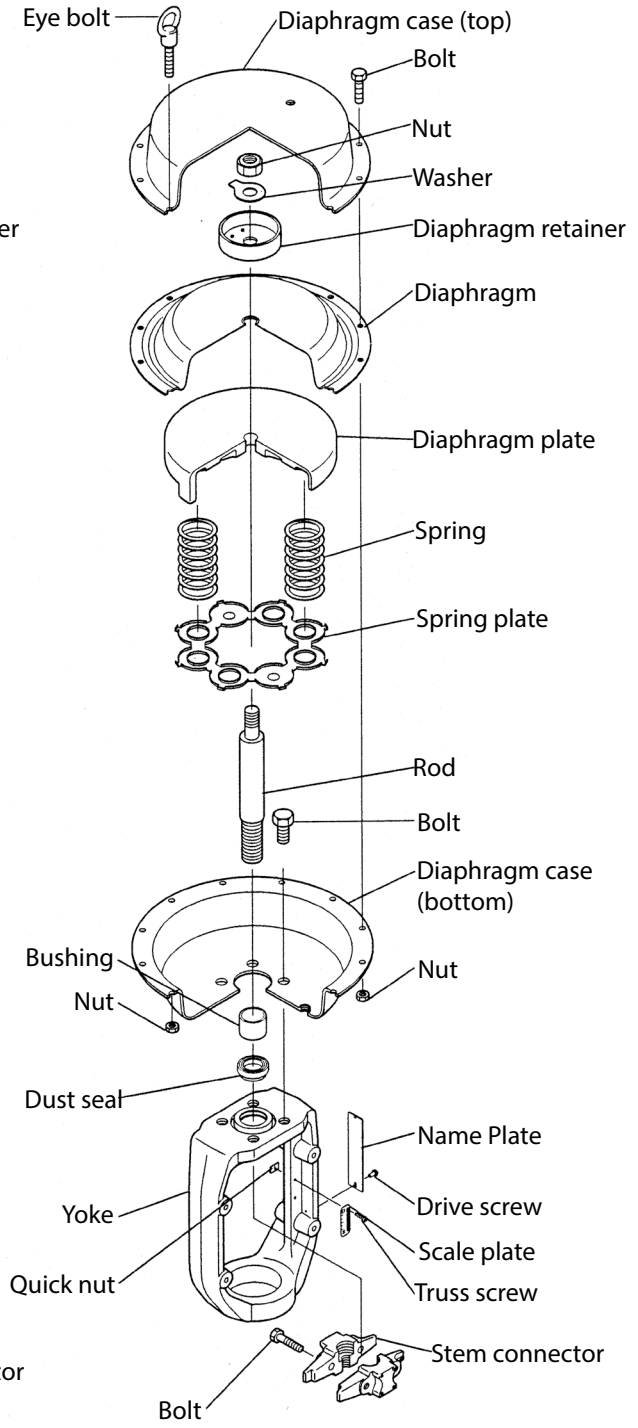


Figure 6-2. PSA3D, PSA4D

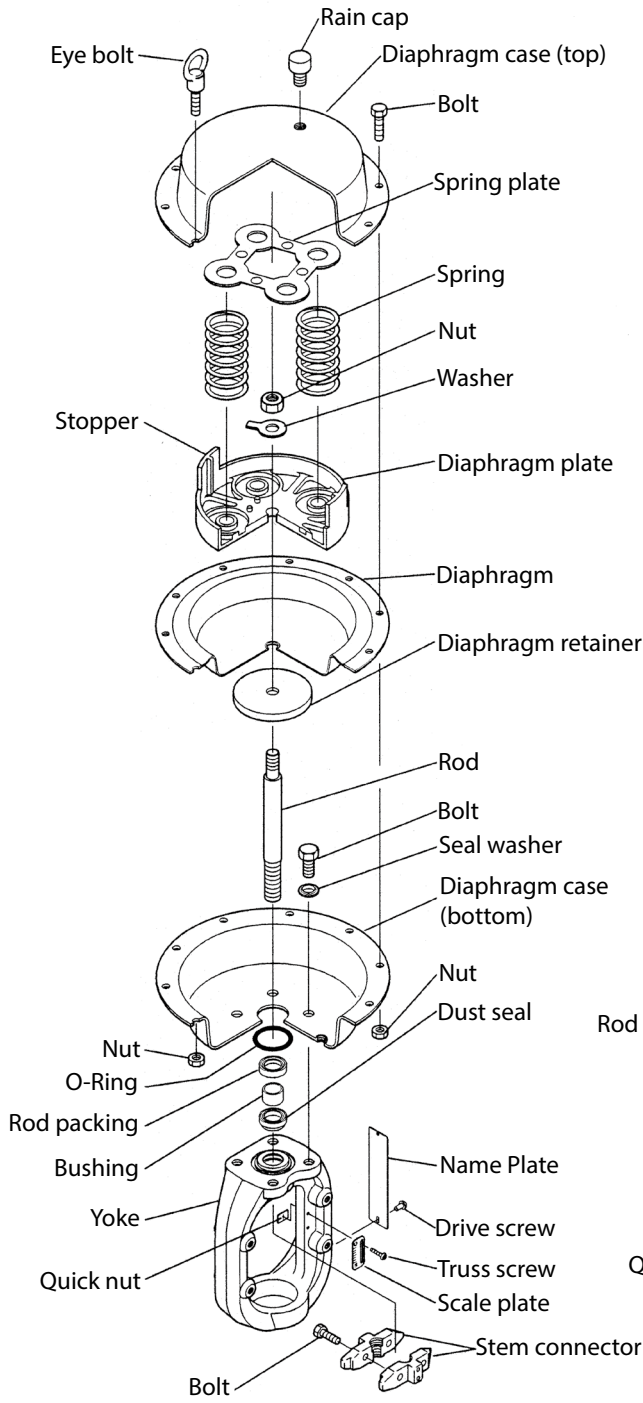


Figure 6-3. PSA1R, PSA2R

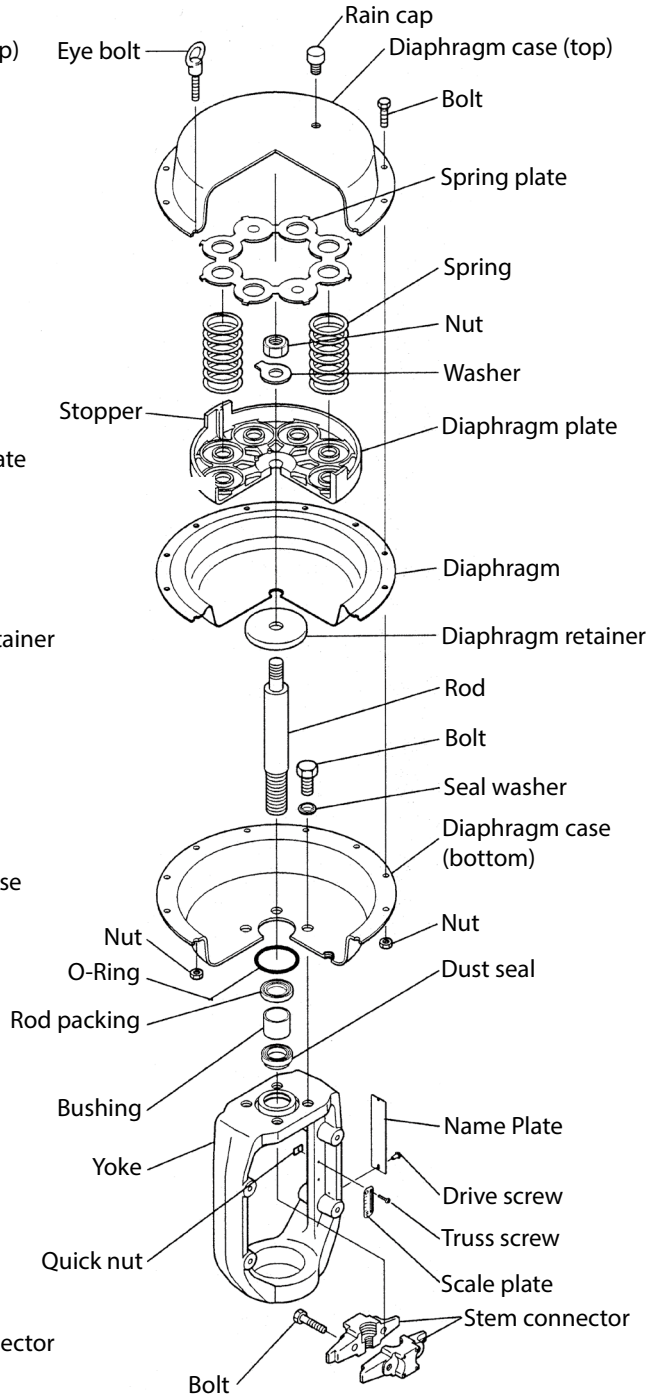
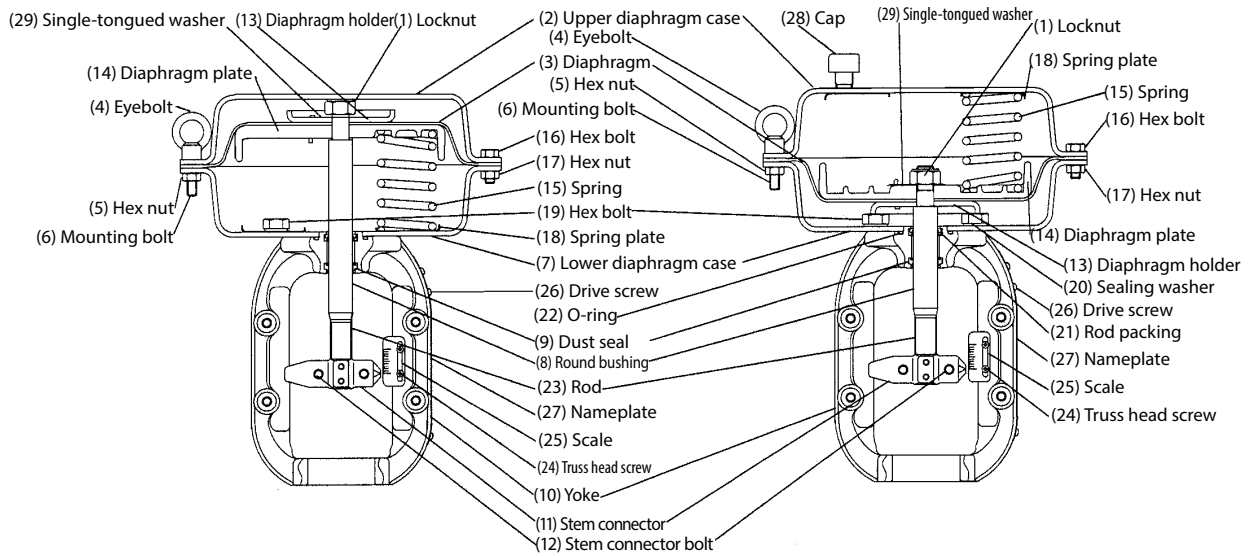


Figure 6-4. PSA3R, PSA4R



No.	Part name	No.	Part name	No.	Part name	No.	Part name
1	Locknut	8	Round bushing	15	Spring	22	O-ring
2	Upper diaphragm case	9	Dust seal	16	Hex bolt	23	Rod
3	Diaphragm	10	Yoke	17	Hex nut	24	Truss head screw
4	Eyebolt	11	Stem connector	18	Spring plate	25	Scale
5	Hex nut	12	Stem connector bolt	19	Hex bolt	26	Drive screw
6	Mounting bolt	13	Diaphragm holder	20	Sealing washer	27	Nameplate
7	Lower diaphragm case	14	Diaphragm plate	21	Rod packing	28	Cap
						29	Single-tongued washer

Figure 6-5. Structure of the PSA1-4 actuator

(3) Removing the upper diaphragm case and the diaphragm unit

Step	Procedure
1	Remove the upper diaphragm case.
2	For direct operation actuators, remove parts in the order: diaphragm unit, springs, and spring plate(s). For reverse operation actuators, remove parts in the order: spring plates, springs, and diaphragm unit. When removing the diaphragm unit, pull out the rod along with it. Note that, for model PSA2D, the spring plate cannot be removed in this step.

(4) Removing the lower diaphragm case and sealing parts



Step	Procedure
1	Remove the hex nuts that connect the diaphragm case to the yoke in order to separate them. For model PSA2D, remove the spring plate in this step.
2	For reverse operation actuators, remove the sealing washer, O-ring, rod packing, and dust seal. For direct operation actuators, remove only the dust seal.

(5) Disassembling the diaphragm unit


Step	Procedure
1	Using a screwdriver, etc., straighten the single-tongued washer whose tongue was bent.
2	Loosen and remove the setnut.
3	Separate the rod, diaphragm, diaphragm plate, and diaphragm holder.

6-2. Reassembly of Model PSA Actuator


Precautions

- Check that there is no problem with the parts, referring to the checklist in  "4-1-2. Periodic Inspection". If any damage is found, repair or replace the parts as needed.
- Always use a new sealing washer, dust seal, and rod seal.
- Before starting assembly, check the inside of the diaphragm case to make sure there is no foreign matter produced by maintenance. · For mounting of the side handwheel on the actuator after assembly of the actuator, refer to  "6-7. Mounting the Side Handwheel on the PSA Actuator".

Assembly procedure

Check the size of the actuator and assemble it, referring to  Figure 6-1 to Figure 6-4.

(1) Assembling the diaphragm unit

Step	Procedure
1	Assemble the rod, diaphragm, diaphragm plate, and diaphragm holder with the single-tongued washer and nuts. If you use a new single-tongued washer, bend the tongue in the same manner as the old one.
2	Mount the lower diaphragm case on the yoke temporarily (do not mount the sealing parts). Set the diaphragm unit in place, and attach the stem connector to the threads of the rod temporarily.
3	Fix the stem connector in place utilizing the rotation stopper and then tighten the set nut of the diaphragm unit with the tightening torque indicated in  Table 6-1.
4	Apply a sealant *1 to the threads of the rod. Then, bend the single-tongued washer along the set nut.
5	After assembly of the diaphragm is completed, separate the lower diaphragm case, yoke, and the stem connector.



*1. Use No. 1104 liquid gasket made by ThreeBond Holdings Co., Ltd., or the equivalent.

(2) Attaching the sealing parts

Step	Procedure
1	Apply a lubricant*2 to the rod packing, O-ring, and dust seal (for reverse action actuators) or to the dust seal (for direct action actuators), and attach them to the yoke. For each of these parts, apply even pressure over the entire surface.

*2. Use Plastilube No. 3 made by U.S. company Sulflo Inc., or the equivalent.

(3) Mounting the lower diaphragm case

Step	Procedure
1	Check the matching marks and put the lower diaphragm case on the yoke in the manner illustrated in  Figure 6-7 to Figure 6-14.
2	For reverse operation actuators, apply a liquid sealant to the sealing washer and set it around the screw hole of the lower diaphragm case.
3	Apply an anti-seizing agent*3 to the hex bolts and tighten them with the tightening torque indicated in  Table 6-1.

*3. Use Never-Seez made by the U.S. company Bostik or the equivalent.

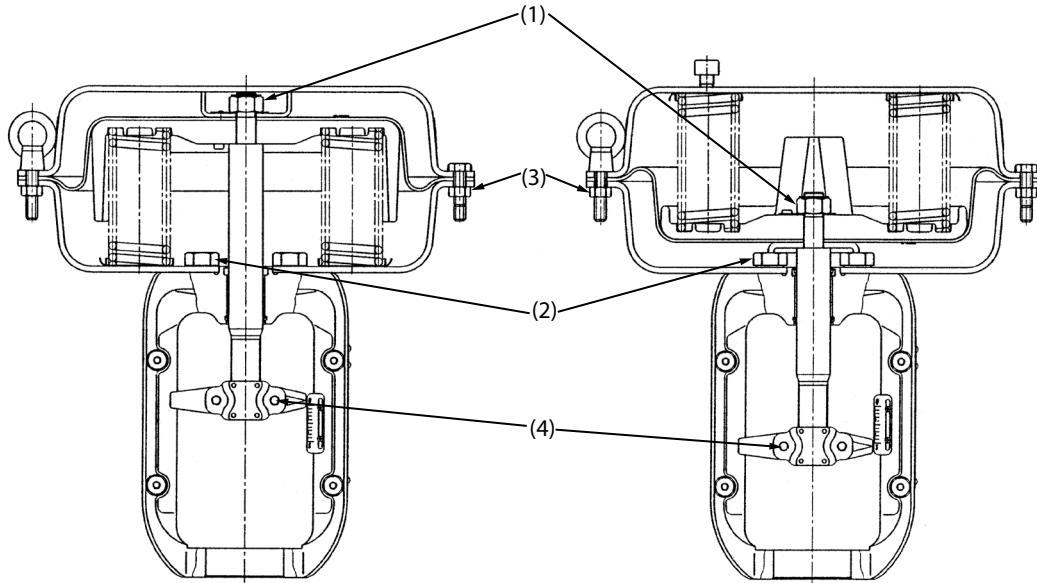


Figure 6-6. Threaded parts to tighten (on PSA1-4 actuators)

Table 6-1. Tightening torque for the actuator

Unit: N·m

Key No.	Material	PSA1, PSA2		PSA3		PSA4	
1	S45C, SK5	M14	45 to 70	M20	151 to 169	M20	151 to 169
2	S30C	M12	35 to 50	M16	90 to 120	M16	90 to 120
3	SUS304	M8	15 to 20	M8	15 to 20	M12	50 to 60
4	SUS304	M8	15 to 20	M10	50 to 60	M10	50 to 60

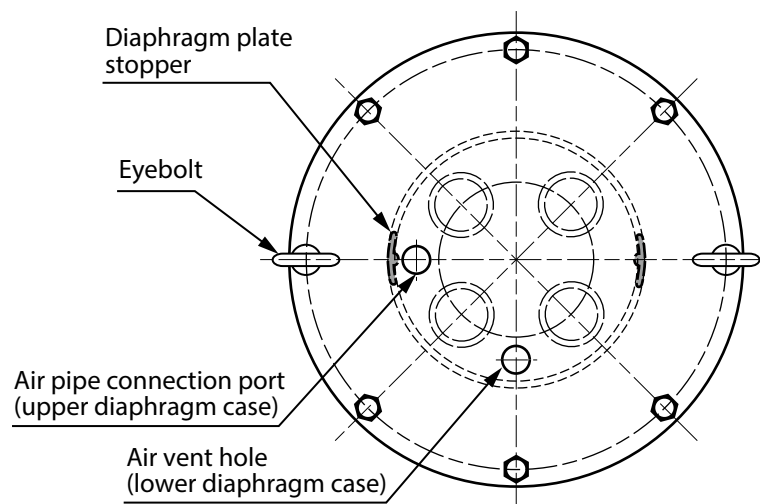


Figure 6-7. Direct action (PSA1D)

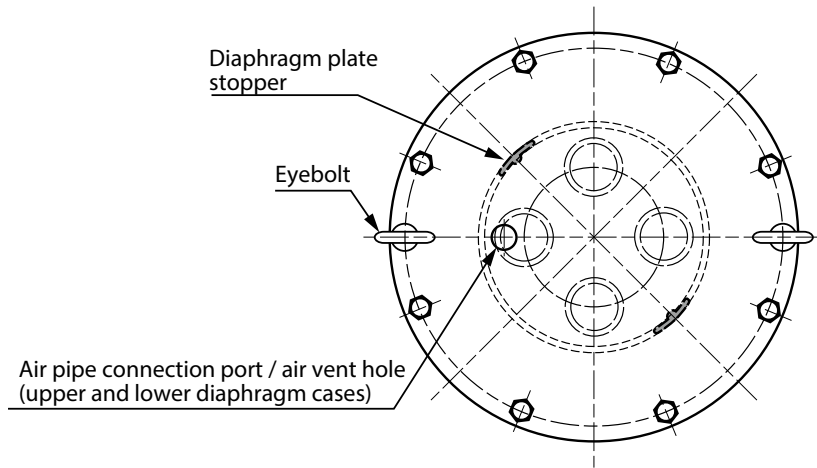


Figure 6-8. Direct action (PSA2D)

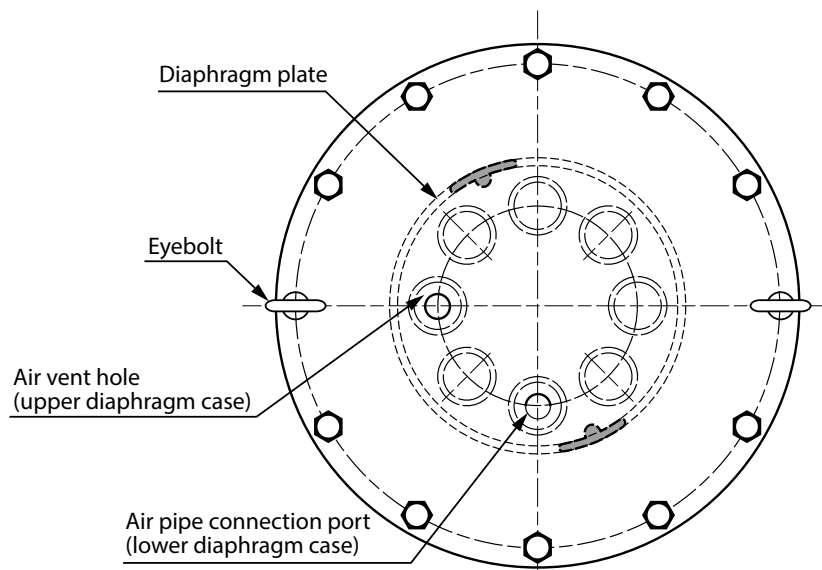


Figure 6-9. Direct action (PSA3D)

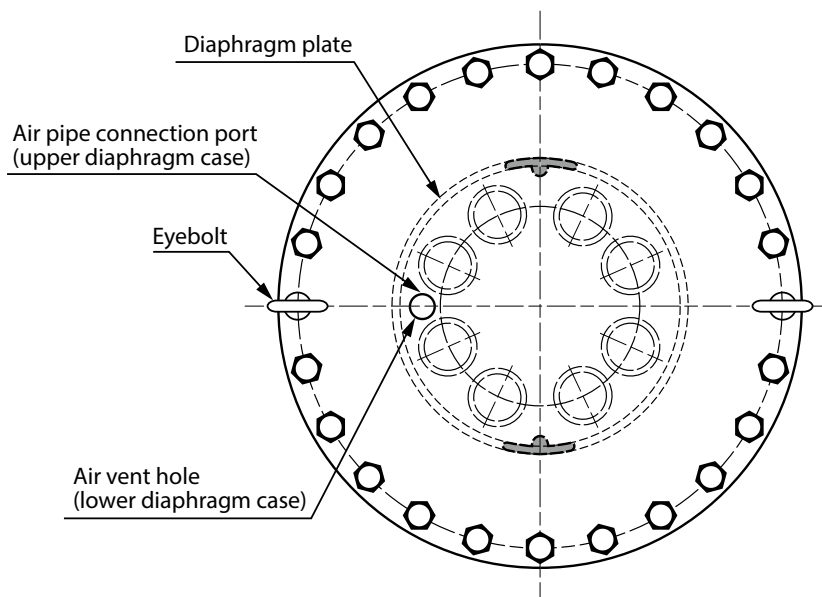


Figure 6-10. Direct action (PSA4D)

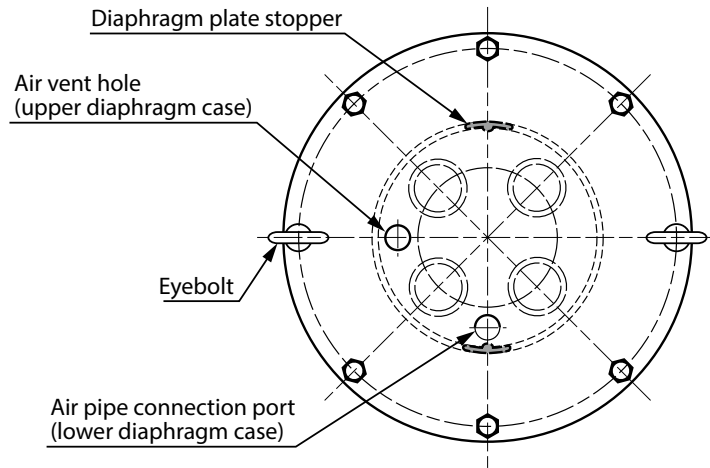


Figure 6-11. Reverse action (PSA1R)

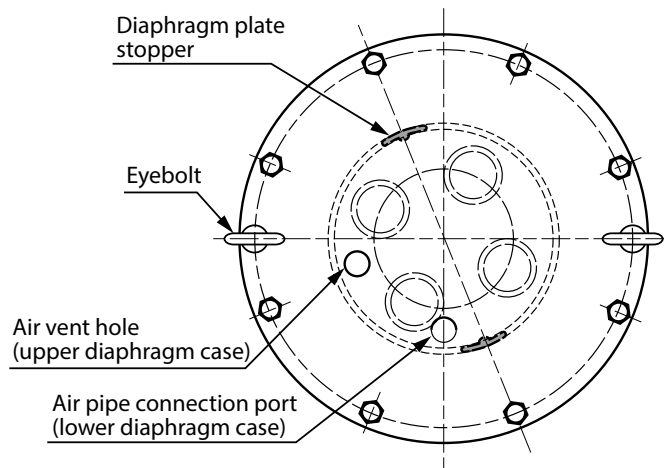


Figure 6-12. Reverse action (PSA2R)

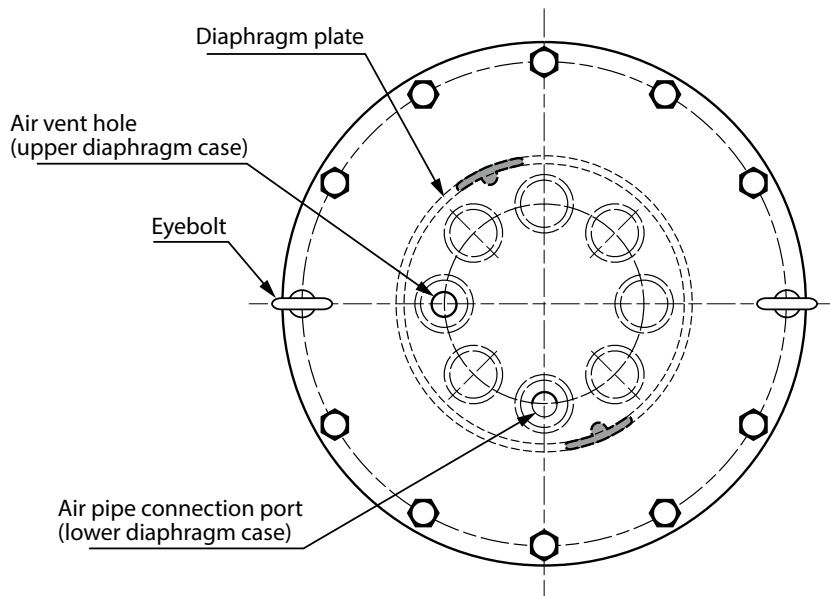


Figure 6-13. Reverse action (PSA3R)

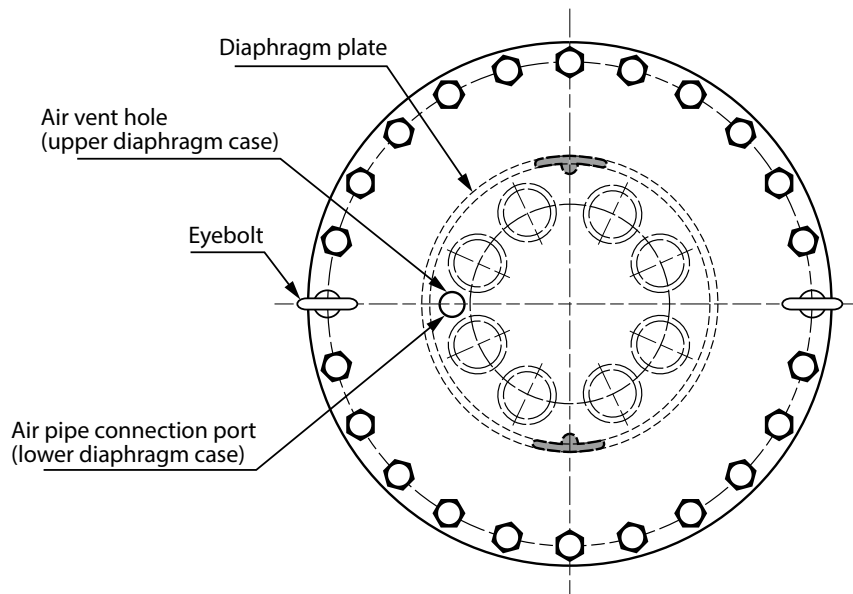





Figure 6-14. Reverse action (PSA4R)

(4) Mounting the diaphragm unit and springs






- For direct-action actuators

Step	Procedure
1	Place the spring plate so that springs can be set in the diaphragm case in the manner illustrated in  Figure 6-7 to Figure 6-10, and then attach the springs to the spring plate. For model PSA2D, first attach springs to the spring plates and then mount them on the case.
2	Check that the threads of the rod are covered with plastic tape or the like.
3	Insert the rod of the diaphragm unit into the yoke, taking care not to damage the wrap bushing and dust seal.
4	Rotate the diaphragm unit so that the diaphragm plate stopper and the air pipe connection port of the diaphragm case are in the positions illustrated in  Figure 6-7 to Figure 6-10.

- For reverse-action actuators

Step	Procedure
1	Check that the threads of the rod are covered with plastic tape or the like.
2	Insert the rod of the diaphragm unit into the yoke, taking care not to damage the wrap bushing, dust seal, and rod packing.
3	Rotate the diaphragm unit so that the diaphragm plate stopper and the air pipe connection port of the diaphragm case are in the positions illustrated in  Figure 6-11 to Figure 6-14.
4	Mount springs on the diaphragm plate.
5	Mount the spring plate on top of the springs.

(5) Mounting the upper diaphragm case

Step	Procedure
1	Set the upper diaphragm case such that the air pipe connection port is in the position indicated in  Figure 6-7 to Figure 6-10 (for direct operation models) or the air vent hole is in the position indicated in  Figure 6-11 to Figure 6-14 (for reverse operation models). Check that the matching marks that were made before disassembly are aligned.
2	Tighten the eyebolts alternately and evenly.
3	Secure the upper and lower diaphragm case using hex nuts.
4	Tighten the nuts evenly in a diagonal pattern with the tightening torque indicated in  Table 6-1.
5	For reverse operation actuators, screw the waterproof cap onto the air vent hole of the upper diaphragm case.
<div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; align-items: center; justify-content: center;">  CAUTION </div> <div style="display: flex; align-items: center; justify-content: center; margin-top: 5px;">  <div style="margin-left: 10px;"> <p>For an actuator that incorporates springs, be sure to follow the assembly procedure when attaching bolts and nuts. Otherwise, malfunction may result.</p> </div> </div> </div>	

(6) Inspection after reassembly


Step	Procedure
1	Apply air at a pressure of 490 kPa to the diaphragm case through the air pipe connection port of the case. Using soapy water, check the exterior of the diaphragm case (for direct operation models) or the exterior of the rod (for reverse operation models) for air leakage.
2	Change the air pressure within the supply air pressure specified for the actuator to check that the valve moves smoothly for all openings, and that the spring range for a valve opening is the same as the range printed on the nameplate.

6-3. Mounting the Actuator on the Valve Body

Precautions

For a side handwheel–equipped actuator, attach the side handwheel to the actuator first, and then mount the actuator on the valve.

Assembly procedure

In addition to the following instructions, refer to  Figure 6-15.


(1) Inspection after reassembly

Step	Procedure
1	Apply an anti-galling agent* to the connections of the bonnet, yoke, and the yoke nut.
2	Place the actuator and yoke nut on the valve body. Rotate the actuator so that the matching marks that were placed before disassembly are aligned.
3	Tighten the yoke nut by hand. Tighten the yoke nut firmly with a hammer and chisel.


* Use Never-Seez made by Bostik, Inc., or the equivalent.

(2) Attaching the stem connector

- For direct-action actuators

Step	Procedure
1	Push the valve plug down to set it on the seat.
2	Check the spring range indicated on the nameplate and apply the upper-limit air pressure to the actuator.
3	Further increase the pressure to the supply air pressure.
4	Reduce the air pressure slightly and set the air pressure to the spring range upper limit again. In this state, temporarily connect the actuator stem and the valve stem with the stem connector.
5	Decrease the air pressure until the valve travel is several percent. In this state, tighten the hex bolts of the stem connector to the torque indicated in  Table 6-1.

- For reverse-action actuators

Step	Procedure
1	Push the valve plug down to set it on the seat.
2	Check the spring range indicated on the nameplate and apply the lower-limit air pressure to the actuator.
3	Further decrease the air pressure and check that the actuator stem moves several mm in response.
4	Increase the air pressure slightly, and then lower the air pressure to the spring range lower limit. In this state, temporarily connect the actuator stem and the valve stem with the stem connector.
5	Increase the air pressure until the valve travel is several percent. In this state, tighten the hex bolts of the stem connector to the torque indicated in  Table 6-1.

(3) Attaching the accessories


Attach the accessories in their original position.

(4) Inspection after reassembly

- Send the specified control signals and air pressure to the positioner or the actuator. Check the air pipes and their joints for leakage.
- Change the control signal to check if the valve operates properly in accordance with the signal.
- Check seat leakage to confirm that the performance meets the specification.
- Carry out a pressure shell test for the valve body to confirm that fluid does not leak from between the valve and bonnet and from the gland.
- For models with a handwheel, turn the handwheel to check that the valve opens and closes smoothly. Then, turn the handwheel so that the pointer indicates AUTO, and check that the valve opens and closes smoothly in accordance with input signals.

6-4. Removing the Side Handwheel from the Actuator

Removal procedure

Check the size of the actuator and disassemble the side handwheel from the actuator, referring to  Figure 6-15.

(1) Before disassembly

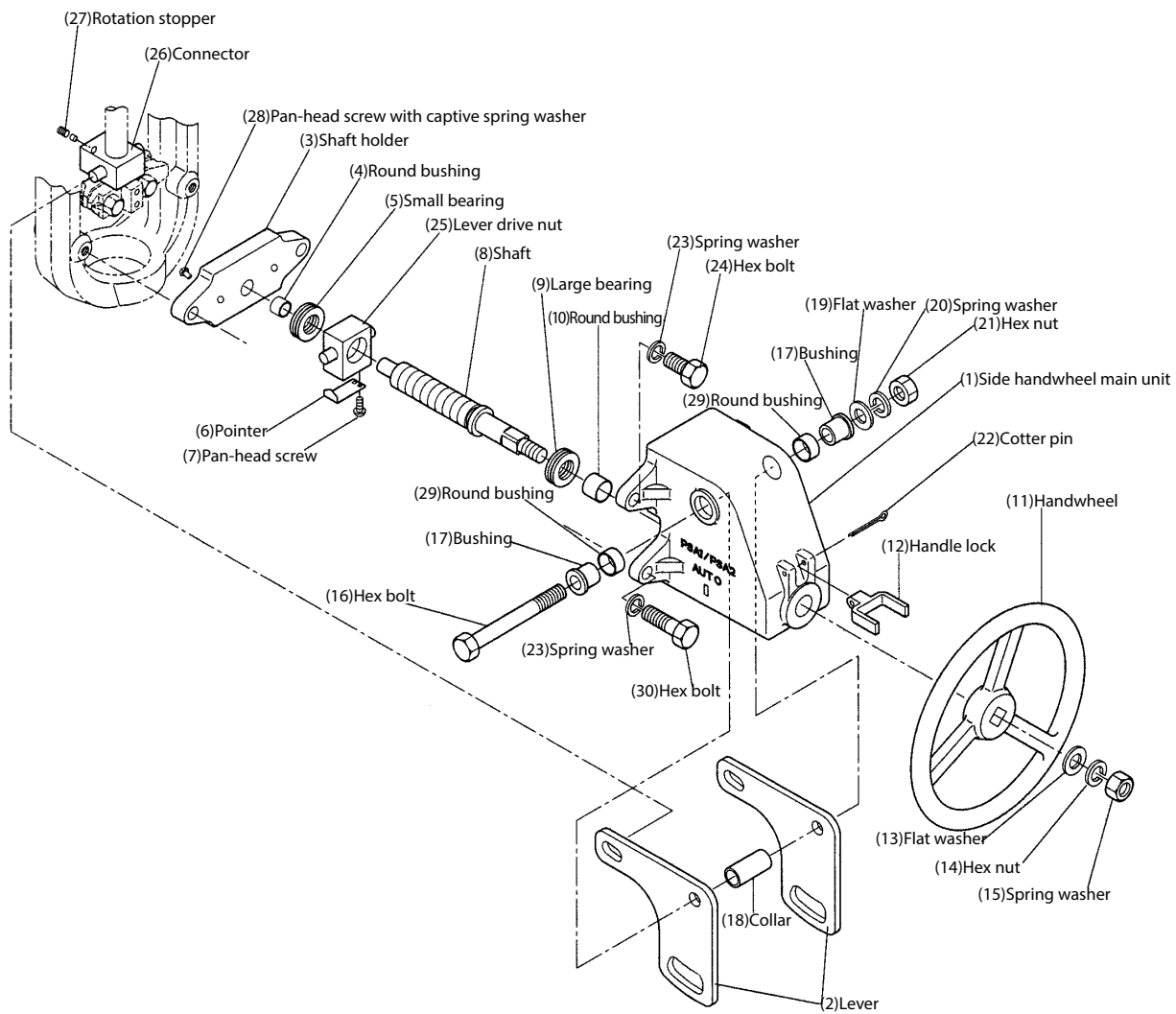
Check that the pointer on the side handwheel main unit is in the AUTO position.

(2) Removal from the actuator stem

Loosen the bolts and nuts that hold the levers. Remove the levers from the boss of the connector.

(3) Removing the side handwheel from the actuator

Remove the bolts that connect the yoke to the side handwheel main unit, and remove the side handwheel from the actuator.




No.	Name	No.	Name	No.	Name	No.	Name
1	Side handwheel main unit	9	Large bearing	17	Bushing	25	Lever drive nut
2	Lever	10	Round bushing	18	Collar	26	Connector
3	Shaft holder	11	Handwheel	19	Flat washer	27	Rotation stopper
4	Round bushing	12	Handle lock	20	Spring washer	28	Pan-head screw with captive spring washer
5	Small bearing	13	Flat washer	21	Hex nut	29	Round bushing
6	Pointer	14	Hex nut	22	Cotter pin	30	Hex bolt
7	Pan-head screw	15	Spring washer	23	Spring washer		
8	Shaft	16	Hex bolt	24	Hex bolt		

Figure 6-15. Side handwheel structure

6-5. Disassembly of the Side Handwheel


Disassembly procedure

Check the size of the actuator and disassemble the side handwheel, referring to  Figure 6-15.

Step	Procedure
1	Check that the pointer on the side handwheel main unit is in the AUTO position. Remove the side handwheel from the actuator.
2	Loosen the bolts and nuts that hold the levers. Remove the bosses of the lever drive nut from the holes near the bottom edge of the levers.
3	Loosen and remove the lock nut from the handwheel, and remove the handwheel from the side handwheel main unit.
4	Loosen and remove the pan-head screw with captive spring washer that hold the shaft holder. Remove the shaft holder and the shaft. Remove the bearing and the lever drive nut from the shaft holder.
5	Remove the bolts and nuts that hold the levers, and remove the levers from the side handwheel main unit to complete the disassembly.

6-6. Assembly of the Side Handwheel

Assembly procedure

Check the size of the actuator and assemble the side handwheel, referring to  Figure 6-15.

Step	Procedure
1	Insert the levers into the side handwheel main unit, and hold them temporarily with the bolts and nuts for the levers.
2	Attach the operation nut and the pair rings to the shaft. Insert the threaded part of the shaft through the hole for the shaft in the side handwheel main unit.
3	Put the other end of the shaft into the shaft holder.
4	Hook the bosses of the lever drive nut into the holes near the bottom of the levers and tighten the bolts and nuts holding the levers.
5	Connect the side handwheel main unit to the shaft holder using the pan-head screw with captive spring washer, allowing the pointer attached to the lever drive nut to stick out of the main unit.
6	Pass the shaft through the handwheel and fasten the wheel with the lock nut to complete assembly of the side handwheel.

6-7. Mounting the Side Handwheel on the PSA Actuator


Step	Procedure
1	Turn the handwheel so that the pointer on the lever drive nut indicates AUTO.
2	Remove the stem connector from the actuator, screw the connector onto the rod, and fasten it with the rotation stopper.
3	Loosen the bolts and nuts on the levers to widen the space between the levers.
4	Attach the side handwheel main unit to the actuator tightly with the bolt.
5	Hook the bosses on the connector into the holes near the leading edge of the levers.
6	Secure the lever with the bolts and nuts to complete assembly.
7	Rotate the handwheel to check for smooth operation of the control valve.
8	Before starting automatic operation of the control valve on the equipment, set the pointer of the side handwheel to the AUTO position and lock the handwheel with the handle lock.

Chapter 7. Disassembly and Reassembly of Model PSA6 Spring Type Piston Cylinder Actuator

7-1. Overview

Structure

This actuator consists of a cylinder, a spring unit, a lift stopper, a spring holder, hex staybolts, a yoke, a handwheel, and a single-acting positioner.

For an external view of the actuator, refer to  “Figure 7-1. Exterior of PSA6R”.

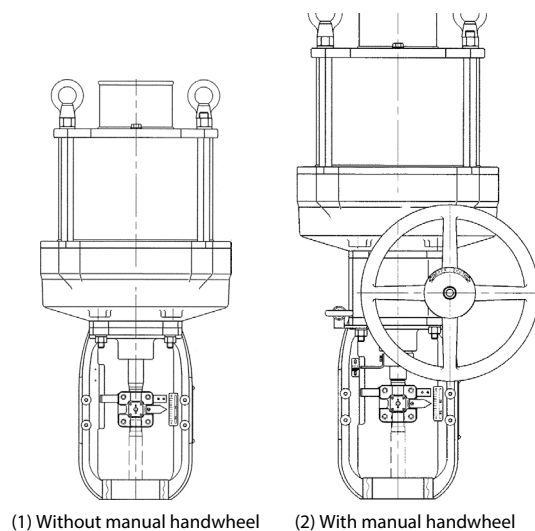


Figure 7-1. Exterior of PSA6R

Mounting on the Valve Body

Mount the yoke on the valve body with the assembly nuts that are supplied with the valve body. Connect the actuator rod and the valve stem with the stem connector.

Air piping

When using the PSA6 as part of a control valve, install a single-acting positioner and connect the air piping to it. For details on single-acting positioners, refer to the user's manuals below.

- Pneumatic single-acting valve positioner (model HTP):
document No. OM2-8310-0200
- Pneumatic single-acting valve positioner (model VPE):
document No. OM2-8310-0410
- Smart valve positioner (model AVP300/301/302 (integral type)):
document No. CM2-AVP300-2001
- Smart valve positioner (model AVP200/201/202 (remote type)):
document No. CM2-AVP300-2001
- Smart valve positioner (model AVP701/702):
document No. CM2-AVP702-2001
- Smart valve positioner (with fieldbus)(model AVP703):
document No. CM2-AVP703-2001





Calibration

This actuator does not need calibration.


When connecting the valve stem of the valve body and the actuator rod with the stem connector, adjust so that the valve plug contacts the seat ring when the valve is fully closed. Next, loosen the screws on the actuator scale and position the scale so that the pointer indicates the correct position in accordance with the valve stroke.

Then, adjust the single-acting positioner, referring to its user's manual.

Cautions on operation and handling

 CAUTION	
	Before operating a handwheel-equipped actuator automatically, check that the auto/manual switching pin is inserted in the pin holder, the chain is holding the handwheel, and the slide screw rotation lock is in the AUTO position of the indicator.
	When disassembling and assembling the actuator, stand it up vertically (top: spring unit, bottom: yoke).
	The eyebolts can be used to hoist the actuator only. Do not use them for hoisting the actuator when it is still mounted on the valve body. Doing so is dangerous.

7-2. Auto/Manual Switching Method

Refer to  “Figure 7-2. Auto/manual switching mechanism”.

For a handwheel-equipped actuator, automatic operation that uses input signals and manual operation that uses the handwheel can be switched.

Auto/manual can be switched at any valve travel during operation.

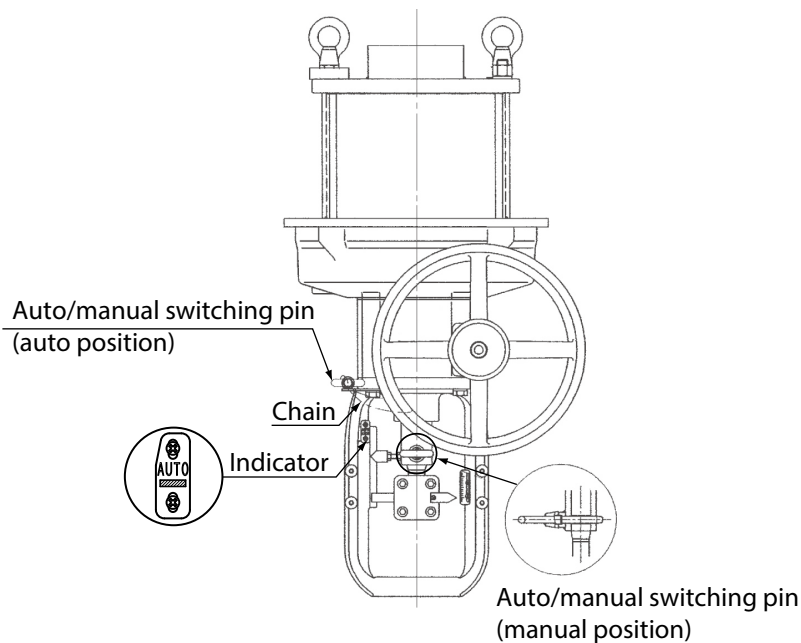


Figure 7-2. Auto/manual switching mechanism

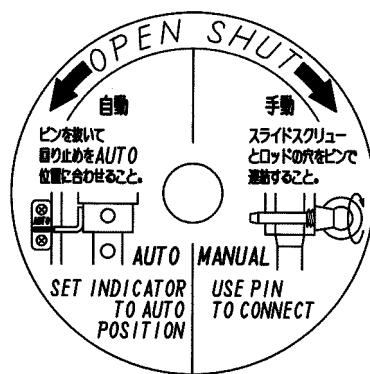




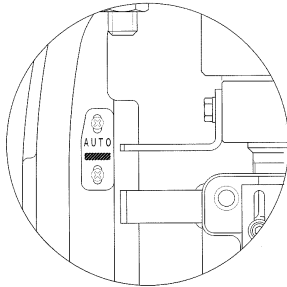


Figure 7-3. Operation instruction label

Step	Procedure
1	Pull the auto/manual switching pin out of its holder, and disengage the chain that holds the handwheel.
2	Check  "Figure 7-3. Operation instruction label" on the handwheel, and turn the handwheel in the SHUT direction to lower the slide screw.
3	Align the round hole of the slide screw with that of the actuator rod, and insert the switching pin all the way, and then turn the pin to fix it.
4	Check the OPEN and SHUT arrows shown on the operation instruction label, and rotate the handwheel in the desired direction in order to open or close the valve. The turning torque should be 127 N (13 kgf) or less.
5	<p>When the handwheel does not turn any further, stop trying to turn it and check the amount of valve travel.</p> <div data-bbox="550 674 1417 909" style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;"> CAUTION</p> <p> Do not apply excessive force when the mechanical stop position of the control valve has been reached. Otherwise you may damage the valve stem. If the valve stops at an abnormal position, refer to  "3-3. Troubleshooting" and take the necessary countermeasures.</p> </div>
6	<p>To resume automatic operation, remove the switching pin and turn the handwheel until the slide screw rotation lock reaches the AUTO position of the indicator (see the figure below).</p> <p>Run the chain attached to the pin through the handwheel in order to restrict its movement, and then set the pin into its holder.</p> <p>After checking the position of these parts, resume automatic operation.</p> <div data-bbox="842 1144 1129 1429" style="text-align: center;">  </div> <p style="text-align: center;">Figure 7-4.</p>


7-3. Disassembly and Reassembly of the Actuator

This section gives instructions on disassembly and reassembly of the actuator.

If you need to disassemble and reassemble the valve for periodic inspection, troubleshooting, or other circumstances, refer to the instructions.

7-3-1. Disassembly of the actuator

Disassembly procedure

This section describes the procedure for disassembling the actuator.  Figure 7-5, Figure 7-6

(1) Marking and parts protection

Step	Procedure
1	Place matching marks on the spring holder at the top of the actuator and lift stopper, cylinder, and yoke boss for cylinder assembly.
2	Wrap plastic tape around the threads of the rod to protect the sealing parts and the guide bushing.

(2) Removing the slide screw rotation lock

Step	Procedure
1	Remove the hex bolt (No. 50) and hex nut (No. 51) that hold the slide screw rotation lock (No. 49).
2	Remove the slide screw rotation lock (No. 49).

(3) Removing the spring holder

Step	Procedure
1	Loosen and remove the hex nuts (No. 2) and eyenuts (No.1) at the top of the actuator.
2	Lift the spring holder (No. 17) straight up to remove it.

(4) Removing the lift stopper and spring unit

Step	Procedure
1	Loosen and remove the long and short hex staybolts, Nos. 4 and 9 (two each) that connect the lift stopper (No. 20) and the cylinder (No. 21).
2	Lift the lift stopper (No. 20) straight up to remove it.
3	Attach eyebolts to the screw holes (M12 × 2) of the spring flange (No. 59) at the top of the spring unit, and lift the spring unit (about 120 kg) upward with a crane.
4	At this point, remove the tape liner (No. 7) and O-ring (No. 8) that seal the piston (No. 57).

(5) Removing the slide screw and cylinder

Step	Procedure
1	Turn and pull out the slide screw (No. 34) by hand from the bottom.
2	Loosen and remove the four hex bolts (No. 12) that connect the cylinder (No. 21) and the handwheel.
3	Lift the cylinder (No. 21) straight up to remove it.

(6) Removing the worm wheel unit

Step	Procedure
1	Remove the bearing holder (No. 31), upper single-column angular bearing (No. 32), worm wheel (No. 33), lower single-column angular bearing (No. 32) in that order.
2	Loosen and remove the four hex bolts (No. 12) that connect the gear case (No. 30) and the yoke (No. 29).

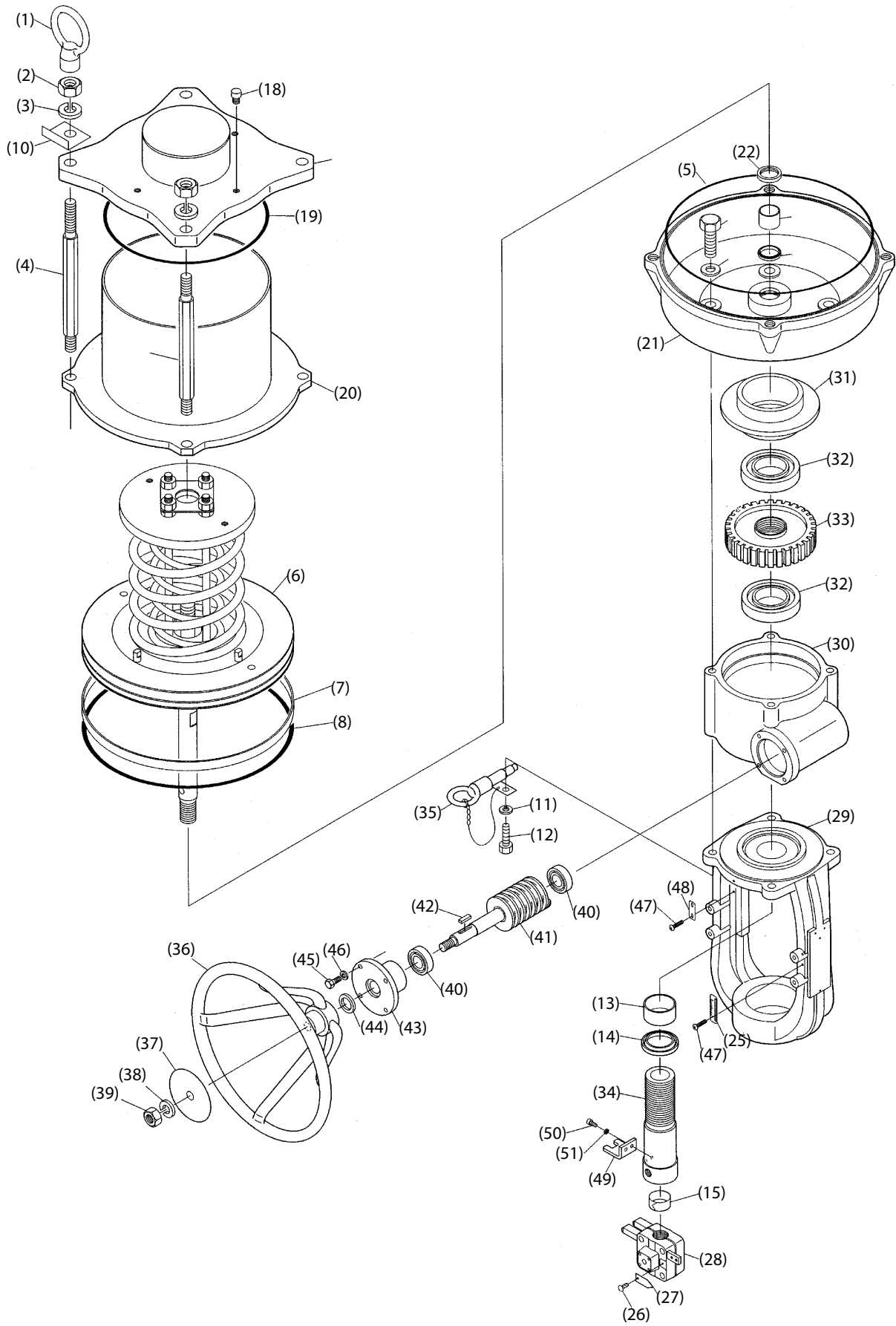
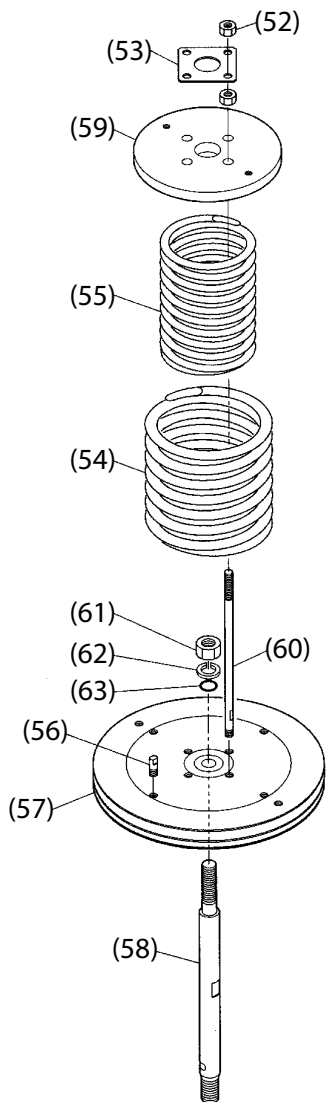


Figure 7-5. Structure of the PSA6R

Table 7-1.




No.	Part name	No.	Part name
1	Eyenuit	33	Worm wheel
2	Hex nut	34	Slide screw
3	Spring washer	35	Lock pin
4	Long hex staybolt	36	Handwheel
5	O-ring	37	Operation instruction label
6	Piston unit	38	Spring washer
7	Tape liner	39	Locknut
8	O-ring	40	Single-column angular bearing
9	Short hex staybolt	41	Worm shaft
10	Sealing washer	42	Key
11	Spring washer	43	Gear case cap
12	Hex bolt	44	Dust seal
13	Round bushing	45	Hex bolt
14	Dust seal	46	Spring washer
15	Wear ring	47	Truss head screw
16	Nameplate	48	Indicator
17	Spring holder	49	Slide screw rotation lock
18	Rain cap	50	Hex bolt
19	O-ring	51	Hex nut
20	Lift stopper	52	Hex nut
21	Cylinder	53	Stopper holder
22	Rod packing	54	Spring (large)
23	Guide bushing	55	Spring (small)
24	Dust seal	56	Spring stopper
25	Scale	57	Piston
26	Truss head screw	58	Rod
27	Pointer	59	Spring flange
28	Stem connector	60	Stopper
29	Yoke	61	Locknut
30	Gear case	62	Spring washer
31	Bearing holder	63	O-ring
32	Single-column angular bearing		

Figure 7-6. Structure of the spring unit



7-3-2. Disassembly of the Spring Unit

Disassembly procedure

This section describes the procedure for disassembling the spring unit.  Figure 7-6

Disassembly is not necessary when only the piston sealing parts (tape liner, O-ring) are replaced.

(1) Removing the spring


Step	Procedure
1	Loosen and remove the upper four hex nuts (No. 52).
2	Remove the stopper holder (No. 53).
3	Loosen the lower four hex nuts (No. 52) evenly until the compression of the large spring (No. 54) and small spring (No. 55) is reduced to zero, and remove the nuts.
<div style="border: 1px solid black; padding: 5px;"> <div style="display: flex; align-items: center; justify-content: center;">  CAUTION </div> <div style="display: flex; align-items: center; justify-content: center; margin-top: 5px;">  <div style="margin-left: 10px;"> <p>For disassembly of the spring unit, follow the procedure when removing bolts, nuts, etc. Otherwise, the springs may jump out, causing injury.</p> </div> </div> </div>	
4	Remove the spring flange (No. 59).
5	Remove the large and small springs (Nos. 54-55).

(2) Removing the piston

Step	Procedure
1	Loosen and remove the stopper (No. 60).
2	Loosen and remove the setnut (No. 61), utilizing the flat surfaces of the rod (No. 58).
3	Remove the spring washer (No. 62) and O-ring (No. 63). Be careful not to damage the O-ring with the threaded part of the rod.
4	Separate the rod (No. 58) from the piston (No. 57).


7-3-3. Reassembly of the Actuator

Precautions

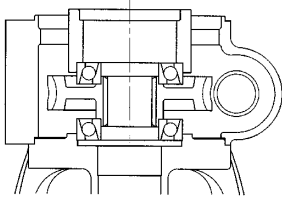
- Check that there is no problem with the parts, referring to the checklist in  “4-1-2. Periodic Inspection” If a problem is found, repair or replace the part as needed.
- The O-ring on the sliding parts should always be replaced at the time of periodic disassembly. Replace the O-ring on the fixed part if it is deformed, expanded, or damaged during disassembly.
- Clean the O-ring, oil seal, wear ring, and tape liner O-ring groove, and then apply lubricant sufficiently.
- Check that any foreign matter produced by maintenance work does not remain on the cylinder’s sliding parts or in the guide bushing.

● Actuator with Handwheel

Assembly procedure

In addition to the following instructions, refer to  Figure 7-5.


(1) Assembly of the handwheel section and cylinder

Step	Procedure
1	With the yoke (No. 29) set up vertically, place the gear case (No. 30) on it and temporarily attach them together with four hex bolts (No. 12).
2	Apply lubricant on the upper and lower single-column angular bearings (No. 32), and assemble the lower bearing, worm wheel (No.33), upper bearing, and the bearing holder (No. 31) in that order. Refer to the figure below for how to assemble the bearings and worm wheel.
	
	Figure 7-7.
3	Mount the tape liner (No. 7) on the slide screw (No. 34). From the bottom, screw in the side screw. Apply lubricant on the threaded part of the slide screw (No. 34).
4	Attach the slide screw rotation lock (No. 49) to the slide screw (No. 34) with the hex bolt (No. 50) and the hex nut (No. 51). Assemble them so that the recessed part of the screw rotation lock fits the rib of the yoke.
5	Apply lubricant on the rod packing (No. 22) and the dust seal (No. 24), and assemble them on the cylinder (No. 21).
6	Place the cylinder (No. 21) on the gear case (No. 30), and temporarily attach them with four hex bolts (No. 12) and sealing washers (No. 10) that are coated with a liquid sealant.
7	Adjust the position of the the cylinder (No. 21) using the rod (No. 58), check that the rod moves smoothly, and then tighten screws to the torque specified in Table 7-2. If the rod does not move smoothly, tap the cylinder or the gear case with a plastic hammer to adjust the position.

(2) Mounting the piston unit, lift stopper, and spring holder

Step	Procedure
1	Screw eyebolts into the screw holes (M12 × 2) in the spring holder (No. 59) at the top of the piston unit, and hoist the unit straight up with a crane.
2	With the piston unit hoisted, assemble the lubricated O-ring (No. 8) and tape liner (No. 7) on the piston (No. 57).
3	Insert the piston unit into the cylinder (No. 21) from the top. Make sure that the round hole on the rod (No. 58) faces the front.
4	Mount the O-ring (No. 5) for the lift stopper onto the groove on the top of the cylinder (No. 21).
5	Insert the lift stopper (No. 20) from the top, and connect the stopper and the cylinder with the long and short hex staybolts, Nos. 4 and 9 (two each). Tighten the ones of the same length in a diagonal pattern.
6	Pass the long and short hex staybolts (No. 4, No. 9) through the bolt holes in the spring holder (No. 17).
7	Secure the spring holder (No. 17) in place with four hex nuts (No. 2).
8	Screw the two eyenuts (No. 1) onto the long hex staybolts (No. 4).

● **Actuator without Handwheel**

For an actuator without a handwheel, use the procedure described in  "● Actuator with Handwheel", excluding the steps for assembling the handwheel.

7-4. Main Parts to be Replaced

Parts of this actuator can be used for a long period of time, but the following parts should be replaced at every periodic inspection.

- Tape liner: Every five years
- Bushing: Every five years
- Wear ring: Every five years
- Sealing washer: Every five years
- Dust seal: Every five years (and whenever disassembling)
- Rod seal: Every five years (and whenever disassembling)
- O-ring: Every five years (and whenever disassembling)

Tightening torque for the actuator


The tightening torque for the actuator is shown below. Please also refer to  “Figure 7-8. Tightening torque for the actuator”.

Table 7-2.

Key No.	Size	Tightening torque (N·m)
(1)	M14	80 to 120
(2)	M20	270 to 365
(3)	M24	305 to 415
(4)	M14	80 to 120
(5)	M12	50 to 60

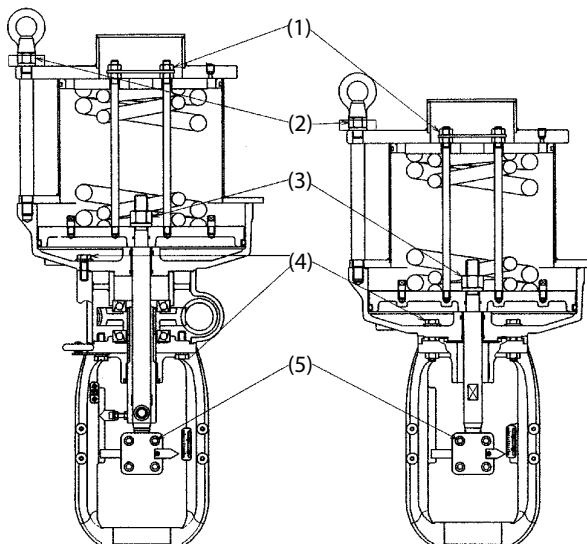



Figure 7-8. Tightening torque for the actuator

Chapter 8. Low-Emission Gland Packing System

8-1. Overview

Azbil's low-emission gland packing system employs a live-loaded packing system to maintain valve seal performance for a long period of time. In order to meet the emission regulations for volatile organic compounds (VOC) required by U.S. Clean Air Act Amendments (CAAA), we confirmed that the amount of leakage from the gland was the equivalent of not more than 500 ppm in terms of atmospheric concentration of methane based on Azbil Corporation's own evaluation criteria.*

For the structure of the gland,  Figure 8-1. Structure of Azbil's low-emission gland packing system.

* As of October 2005, there were no industrial standards that specify the method of evaluation for gland leakage, either in Japan or overseas.

No.	Name
(1)	Gland stud bolt
(2)	Gland nut
(3)	Packing flange
(4)	Spring case
(5)	Belleville spring
(6)	Packing follower
(7)	O-ring for inner side of packing follower
(8)	O-ring for outer side of the packing follower
(9)	Gland packing
(10)	Spacer
(11)	Stem
(12)	Stuffing box

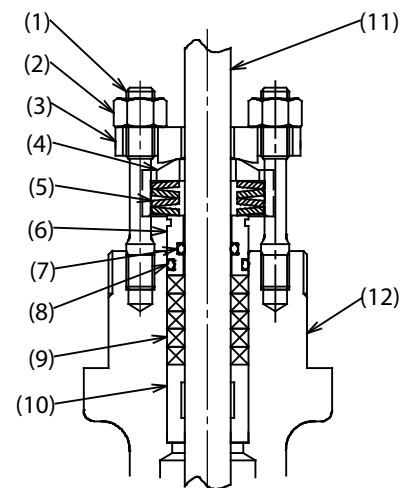


Figure 8-1. Structure of Azbil's low-emission gland packing system

8-2. Structure

The gland packing (P4519) is PTFE yarn with a carbon fiber core. It features asbestos-free properties in addition to low sliding friction and adaptability to heat cycles, and can be used for various types of fluids.

The gland packing is fastened by the live-loaded packing system composed of Belleville springs. At the initial fastening, the Belleville springs should be fully compressed. With other systems, in the course of valve operation, seal performance deteriorates due to loosening of the gland packing. The restoring force of the Belleville springs automatically retightens the packing to maintain the seal. The Belleville springs are installed in the spring case for the purposes of positioning and protection from the surrounding environment. The load on the Belleville springs can be observed by checking their position through the front window of the spring case using the scale on the case.

The low-emission gland packing system can be added to an existing control valve, if it is an applicable model, without replacing the valve body or actuator.

8-3. Assembling the Parts of the Gland

8-3-1. Preparation for Assembly

(1) Checking the surface condition of the parts

Any flaw or the like on the surface of the parts may cause leakage from that area, and the specified seal performance may not be achieved. Therefore, check the surface of the following parts.

Table 8-1. Parts to be checked for surface condition

Part name	Checkpoints	Possible problems
Stem	<ul style="list-style-type: none"> • No flaws or defects, including scratches and dents • No rust or corrosion • The entire surface is even. • No burrs • Clean surface, with no adhering coating material, powder, or dirt. 	Any flaw, rust, corrosion, burrs, dirt, etc., may cause leakage from that area, and the specified seal performance may not be achieved.
Stuffing box		
Both ends of the spacer		
Packing follower Packing contact surface O-ring groove		
Packing flange Gland nut contact surface	<ul style="list-style-type: none"> • If necessary, take necessary measures such as cleaning with alcohol. 	Any flaw, rust, corrosion, burrs, dirt, etc., may cause insufficient tightening, and the specified seal performance may not be achieved.
Packing flange Entire surface Gland stud bolt Gland nut		Any flaw, rust, defect, etc., may cause control valve damage, leading to injuries.

(2) New parts

When assembling or reassembling, for the parts indicated in the table below, be sure to use new parts.

Table 8-2. Parts requiring replacement

Part name	Checkpoints	Possible problems
Gland packing	No flaws. No coating materials or dirt stuck to the surface.	Any flaw, coating material, dirt, etc., may cause leakage from that area, and the specified seal performance may not be achieved.
Belleville spring		Any flaw, coating material, dirt, etc., may cause insufficient tightening and leakage from the gland in a short period of time, and the specified seal performance may not be achieved.

(3) Lubricating grease and anti-seizing agent



Have an appropriate amount of the following lubricating grease and anti-seizing agent (or equivalent) on hand.

Table 8-3. Lubricating grease and anti-seizing agent



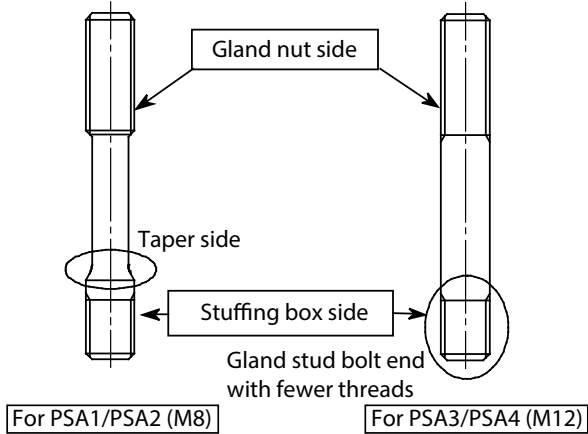

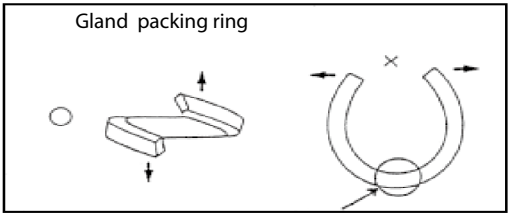


Product name	Applied area
G40M silicone grease, made by Shin-Etsu Chemical Co., Ltd.	Entire surface of the gland packing
Plastilube No. 3 non-dripping grease, made by Sulflo Inc.	Entire surface of the backup O-rings
Never-Seez anti-seizing agent, made by Bostik Inc.	Threads of the gland stud bolts
	Bottom of the gland nuts



8-3-2. Assembly

(1) Applying lubricating grease


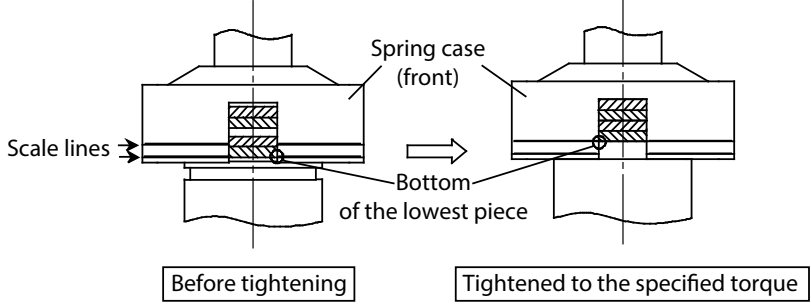

- Step 1 Apply a thin film (not more than 0.3 mm thick) of G40M silicone grease made by Shin-Etsu Chemical Co., Ltd., as indicated in  Table 8-3, to the surface of all gland packing material.
- Step 2 Apply Plastilube No.3 grease made by the U.S. company Sulflo, Inc., as indicated in  Table 8-3, to the two backup O-rings, which are placed around the inner and outer diameter of the packing follower.

(2) Assembling

Step	Procedure
1	<p>Check the correct direction of the gland stud bolts in  Figure 8-2. Apply anti-seizure agent Never-Seez made by Bostik Inc. indicated in  Table 8-3 to the threads on the stuffing box end, and screw the stud into the stuffing box.</p> <div data-bbox="699 817 1289 1249" style="text-align: center;">  </div> <p style="text-align: center;">Figure 8-2. Direction of the gland stud bolt</p>
2	First, insert the spacer, paying extra attention not to damage the surface of the stem.
3	<p>Insert one of the gland packing rings. Be sure to open the ring in the manner illustrated in  Figure 8-3. Insert the packing all the way to the bottom with a pipe, etc., and push it lightly. Insert the remaining packing rings with the position of the gap shifted by 180° each time.</p> <div data-bbox="742 1489 1252 1702" style="text-align: center;">  </div> <p style="text-align: center;">Figure 8-3. How to open the gland packing ring</p>
4	With reference to  Figure 8-1, check the correct mounting orientation of the packing follower (the outer O-ring should face the gland packing). Insert it, paying extra attention not to damage the surface of the stem.
5	With reference to  Figure 8-1, insert the Belleville springs, paying extra attention not to damage the surface of the stem.

Step	Procedure
6	<p>With reference to  Figure 8-4, install the spring case so that the two opposed side grooves are guided by the gland stud bolts. (The two pairs of opposed side grooves are the same size.)</p> <p>During installation, pay extra attention not to damage the surface of the stem. Note that, when the Belleville springs are in the spring case, they should not be in contact with the stem.</p> <div data-bbox="751 472 1220 853" data-label="Image"> </div> <p style="text-align: center;">Figure 8-4. Installation of the spring case (top view)</p>
7	<p>Install the packing flange, paying extra attention not to damage the surface of the stem.</p>
8	<p>Apply the anti-seizure agent Never-Seez, made by Bostik, Inc., as indicated in  Table 8-3, to the threads on the gland nut end of the gland stud bolts and to the seating end of the gland nuts, and screw the nuts on by hand.</p>

(3) Tightening

Step	Procedure									
1	<p>With reference to  Figure 8-5, check the position of the Belleville springs through the front window of the spring case. When the Belleville springs are set properly, the bottom of the lowest Belleville spring and the lower scale line on the spring case will be at almost the same level. (The level may not be exactly the same due to the dimensional tolerance of the Belleville springs)</p>  <p style="text-align: center;">Figure 8-5. Load on Belleville springs</p>									
2	<p>Tighten the left and right gland nuts alternately, making approximately a half turn each, until the torque indicated in  Table 8-4 is reached. Note that if the tightening torque is insufficient, the amount of leakage may exceed the specified value. On the other hand, tightening the gland nuts with excessive torque increases the friction on the stem and causes the gland packing to wear out faster, which may lead to an amount of leakage exceeding the specified value in a short period of time.</p> <p style="text-align: center;">Table 8-4. Gland nut tightening torque</p> <table border="1" data-bbox="651 1099 1337 1238"> <thead> <tr> <th>Actuator model</th> <th>Valve stem size</th> <th>Tightening torque</th> </tr> </thead> <tbody> <tr> <td>PSA1, PSA2</td> <td>φ 13 mm</td> <td>6 to 7 N·m</td> </tr> <tr> <td>PSA3, PSA4</td> <td>φ 16 mm</td> <td>15 to 17 N·m</td> </tr> </tbody> </table>	Actuator model	Valve stem size	Tightening torque	PSA1, PSA2	φ 13 mm	6 to 7 N·m	PSA3, PSA4	φ 16 mm	15 to 17 N·m
Actuator model	Valve stem size	Tightening torque								
PSA1, PSA2	φ 13 mm	6 to 7 N·m								
PSA3, PSA4	φ 16 mm	15 to 17 N·m								

8-3-3. Retightening

In the following cases, retighten the gland nuts with the specified torque:


- a) In the inspection before control valve installation
- b) In a trial operation or start-up operation of the equipment
- c) If the amount of leakage from the gland exceeds the specified value during operation of the equipment

Note that, if the amount of leakage from the gland still exceeds the specified value after retightening, reassemble all parts of the gland. In that case, replacement of the gland packing and Belleville springs with new ones is recommended.

Chapter 9. ISO 15848-1 Certified Low-Emission Gland Packing System

9-1. Overview

Azbil's low-emission gland packing system employs a live-loaded packing system to maintain valve seal performance for a long period of time. The gland packing system has acquired third-party certification for compliance with ISO 15848-1, which is the international standard for low-emission performance of valves.

For the structure of the gland, see  Figure 9-1 and Figure 9-2.

No.	Name
(1)	Gland stud bolt
(2)	Gland nut
(3)	Packing flange
(4)	Belleville spring
(5)	Packing follower
(6)	Carbon ring (P6210C2FS)
(7)	Adapter packing (P6720)
(8)	Main packing (P4519)
(9)	Spacer
10	Stem
(11)	O-ring for inner side of packing follower (optional)
(12)	O-ring for outer side of the packing follower (optional)
(13)	Stuffing box

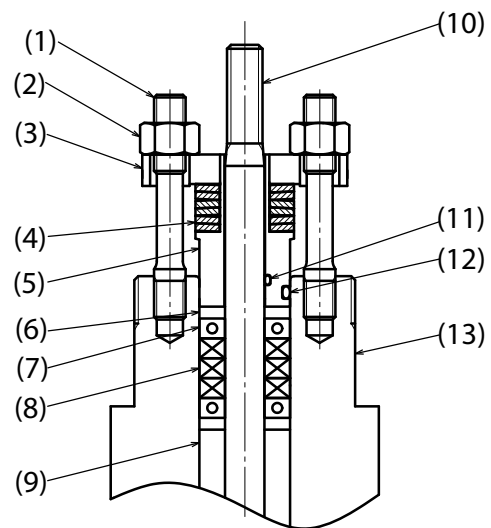


Figure 9-1. Structure of Azbil's low-emission gland packing system (PTFE yarn)

No.	Name
(1)	Gland stud bolt
(2)	Gland nut
(3)	Packing flange
(4)	Belleville spring
(5)	Packing follower
(6)	Carbon ring (P6210)
(7)	Adapter packing (P6720)
(8)	Main packing (P6617CL)
(9)	Spacer
(10)	Stem
(11)	O-ring for inner side of packing follower (optional)
(12)	O-ring for outer side of the packing follower (optional)
(13)	Stuffing box

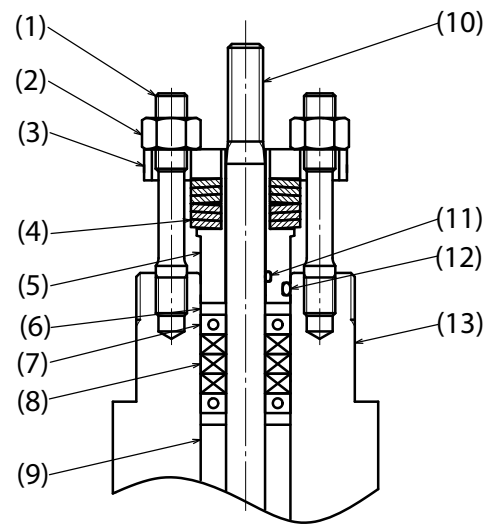


Figure 9-2. Structure of Azbil's low-emission gland packing system (expanded graphite)

9-2. Structure



The main packing (No. P4519) is PTFE yarn with a carbon fiber core. It features low friction and can be used for various types of fluids. The main packing (No. P6617CL) is an expanded graphite packing. The part of it that slides is aligned with an expanded graphite sheet that was specially modified and lubricated. The adapter packing (No. P6720) is made by braiding expanded graphite yarn reinforced with PTFE fiber, and features low friction.

These gland packings are tightened by the live-loaded packing system, which is composed of Belleville springs and other parts. With other systems, in the course of valve operation, seal performance deteriorates due to loosening of the gland packing. The force of the Belleville springs reduces the release of tension to maintain the seal. The load on the Belleville springs can be observed from the position of the packing flange and packing follower.

9-3. Starting Operation

Before operating the valve, tighten (or retighten) the gland.

For instructions, refer to  9-4-2"(3) Tightening".

If leakage from the gland continues even after proper tightening, obtain and prepare parts as indicated in  "9-4-1. Preparation for assembly", and follow the procedure given in  "9-4-2. Assembly".

9-4. Assembling the Parts of the Gland

9-4-1. Preparation for assembly

(1) Checking the surface condition of the parts

Any flaw or the like on the surface of the parts may cause leakage from that area, and the specified seal performance may not be achieved. Therefore, check the surface of the following parts.

Table 9-1. Parts to be checked for surface condition

Part name	Checkpoints	Possible problems
Stem	<ul style="list-style-type: none"> • No flaws or defects, including scratches and dents • No rust or corrosion • The entire surface is even. • No burrs • Clean surface, with no adhering coating material, powder, or dirt. 	Any flaw, rust, corrosion, burrs, dirt, etc., may cause leakage from that area, and the specified seal performance may not be achieved.
Stuffing box		
Both ends of the spacer		
Packing follower Packing contact surface O-ring groove		
Packing flange Gland nut contact surface		Any flaw, rust, corrosion, burrs, dirt, etc., may cause insufficient tightening, and the specified seal performance may not be achieved.
Packing flange (entire surface) Gland stud bolt Gland nut	<ul style="list-style-type: none"> • No flaws, rust, or defects 	Any flaw, rust, defect, etc., may cause control valve damage, leading to injuries.

(2) New parts

When assembling or reassembling, for the parts indicated in the table below, be sure to use new parts.

Table 9-2. Parts requiring replacement

Part name	Checkpoints	Possible problems
Gland packing (main packing and adapter packing) Carbon ring	No flaws. No coating materials or dirt stuck to the surface.	Any flaw, coating material, dirt, etc., may cause leakage from that area, and the specified seal performance may not be achieved.
Belleville spring		Any flaw, coating material, dirt, etc., may cause insufficient tightening and leakage from the gland in a short period of time, and the specified seal performance may not be achieved.

(3) Lubricating grease and anti-seizing agent



Have an appropriate amount of the following lubricating grease and anti-seizing agent (or equivalent) on hand.

Table 9-3. Lubricating grease and anti-seizing agent

Product name	Applied area	PTFE yarn	Expanded graphite
Krytox GPL207 fluoropolymer grease made by DuPont Co.	Entire surface of the gland packing (main packing and adapter packing)	Needed	–
Plastilube No. 3 non-dripping grease, made by Sulflo Inc.	Entire surface of the O-rings	Needed	Needed
Never-Seez anti-seizing agent, made by Bostik Inc.	Threads of the gland stud bolts	Needed	Needed
	Bottom of the gland nuts	Needed	Needed



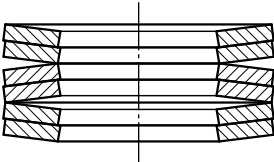
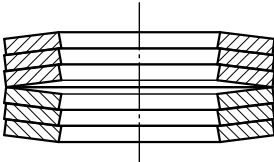

9-4-2. Assembly

(1) Applying lubricating grease


- Step 1 For PTFE yarn gland packing, apply a thin film of Krytox GPL207 grease, as indicated in  Table 9-3, to the entire surface of all gland packing (main packing and adapter packing). For expanded graphite packing, greasing is not necessary.
- Step 2 For the gland packing system with two O-rings, which are placed around the inner and outer diameter of the packing follower, apply Plastilube No. 3 grease made by the U.S. company Sulflo, Inc., to both rings, as indicated in  Table 9-3.





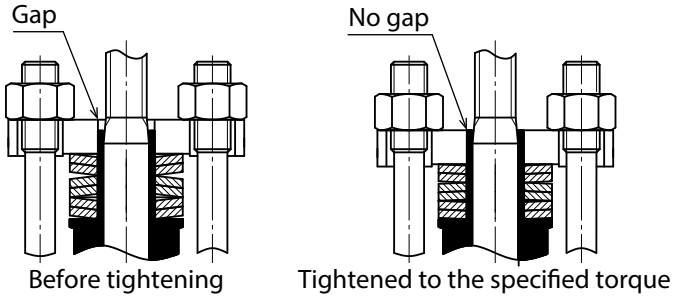
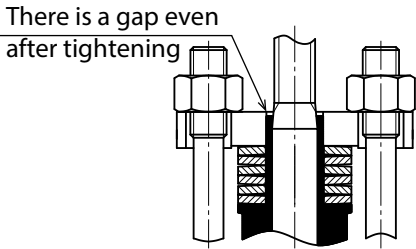

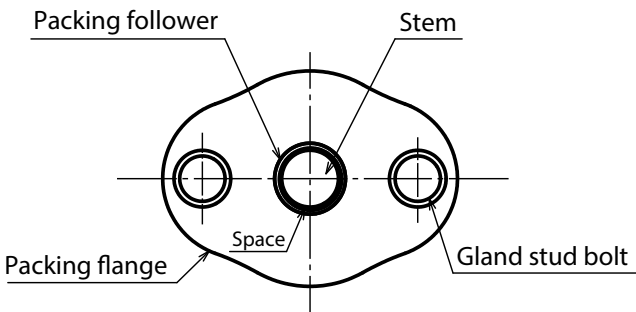
(2) Assembling

Step	Procedure
1	<p>Check the correct direction of the gland stud bolts in Figure 9-3.</p> <p>Apply anti-seizure agent Never-Seez made by Bostik Inc. indicated in Table 9-3 to the threads on the stuffing box end, and screw the stud into the stuffing box.</p> <div data-bbox="778 421 1193 817" data-label="Image"> </div> <p>Figure 9-3. Direction of the gland stud bolt</p>
2	<p>First, insert the spacer, paying extra attention not to damage the surface of the stem.</p>
3	<p>Gently insert a carbon ring all the way to the bottom with a pipe, etc., taking care not to damage the ring.</p>
4	<ul style="list-style-type: none"> • PTFE yarn <p>Insert one adapter packing ring, without opening the gap, all the way to the bottom with a pipe, etc., and push it lightly.</p> <p>Insert one of the main packing rings. Be sure to open the ring in the manner illustrated in Figure 9-4. Insert the packing ring all the way to the bottom with a pipe, etc., and push it lightly. Insert the remaining two main packing rings with the position of the gap shifted by 180° each time.</p> <p>Insert one adapter packing ring, without opening the gap, all the way to the bottom with a pipe, etc., and push it lightly.</p> <div data-bbox="735 1361 1241 1592" data-label="Image"> </div> <p>Figure 9-4. How to open the main packing rings</p> <ul style="list-style-type: none"> • Expanded graphite <p>Insert one adapter packing ring, without opening the gap, all the way to the bottom with a pipe, etc., and push it lightly.</p> <p>Insert one of the main packing rings, without opening the gap, with the marking facing upward, all the way to the bottom with a pipe, etc., and push it lightly. Insert the remaining two main packing rings in the same manner.</p> <p>Insert one adapter packing ring, without opening the gap, all the way to the bottom with a pipe, etc., and push it lightly.</p>
5	<p>Gently insert a carbon ring all the way to the bottom with a pipe, etc., taking care not to damage the ring.</p>

Step	Procedure
6	Check the correct mounting orientation of the packing follower in  Figure 9-1 or Figure 9-2. Insert it, paying extra attention not to damage the surface of the stem.
7	Stack the Belleville springs as shown in  Figure 9-5, and insert them into the packing follower. <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>2 same-direction washers × 3 PTFE yarn</p> </div> <div style="text-align: center;">  <p>3 same-direction washers × 2 Expanded graphite</p> </div> </div> <p style="text-align: center;">Figure 9-5.</p>
8	Place the packing flange onto the packing follower.
9	Apply the anti-seizure agent Never-Seez, made by Bostik, Inc., as indicated in  Table 9-3, to the threads on the gland nut end of the gland stud bolts and to the seating end of the gland nuts, and screw the nuts on by hand.

(3) Tightening

Step	Procedure																								
1	<p>Tighten the left and right gland nuts alternately, making approximately a half turn each, until the torque indicated in  Table 9-4 or Table 9-5 is reached. Note that if the tightening torque is insufficient, the specified seal performance may not be achieved. On the other hand, tightening the gland nuts with excessive torque increases the friction on the stem and causes the gland packing (main packing and adapter packing) to wear out faster, which may lead to an amount of leakage exceeding the specified value in a short period of time.</p> <div style="text-align: center; margin-bottom: 10px;"> <p>Table 9-4. Gland nut tightening torque (for PTFE yarn packing)</p> <table border="1"> <thead> <tr> <th>Actuator model</th> <th>Stem size</th> <th>Tightening torque</th> </tr> </thead> <tbody> <tr> <td>PSA2</td> <td>φ 13 mm</td> <td>11 N·m</td> </tr> <tr> <td>PSA3, PSA4</td> <td>φ 16 mm</td> <td>25 N·m</td> </tr> <tr> <td>PSA6</td> <td>φ 30 mm</td> <td>54 N·m</td> </tr> </tbody> </table> </div> <div style="text-align: center;"> <p>Table 9-5. Gland nut tightening torque (for expanded graphite packing)</p> <table border="1"> <thead> <tr> <th>Actuator model</th> <th>Stem size</th> <th>Tightening torque</th> </tr> </thead> <tbody> <tr> <td>PSA2</td> <td>φ 13 mm</td> <td>11 → 0 (loosening) → 7 N·m</td> </tr> <tr> <td>PSA3, PSA4</td> <td>φ 16 mm</td> <td>25 → 0 (loosening) → 17 N·m</td> </tr> <tr> <td>PSA6</td> <td>φ 30 mm</td> <td>54 → 0 (loosening) → 36 N·m</td> </tr> </tbody> </table> </div>	Actuator model	Stem size	Tightening torque	PSA2	φ 13 mm	11 N·m	PSA3, PSA4	φ 16 mm	25 N·m	PSA6	φ 30 mm	54 N·m	Actuator model	Stem size	Tightening torque	PSA2	φ 13 mm	11 → 0 (loosening) → 7 N·m	PSA3, PSA4	φ 16 mm	25 → 0 (loosening) → 17 N·m	PSA6	φ 30 mm	54 → 0 (loosening) → 36 N·m
Actuator model	Stem size	Tightening torque																							
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PSA6	φ 30 mm	54 → 0 (loosening) → 36 N·m																							

Step	Procedure
2	<p>By tightening the gland nuts to the torque indicated in  Table 9-4 or Table 9-5, the top of the packing flange and packing follower will be at almost the same level, as illustrated in  Figure 9-6 below (the level may not be exactly the same due to the dimensional tolerance of the Belleville springs and friction on the gland stud bolts or gland nuts).</p> <p>If the Belleville springs are mounted in the wrong direction, or if the gland nuts are tightened to a torque that does not comply with the torque specified in  Table 9-4 or Table 9-5, the level of the top of the packing flange and packing follower will not be the same ( Figure 9-7). Check if the direction of the Belleville springs and the tightening torque are correct.</p> <div data-bbox="651 595 1326 891" style="text-align: center;">  </div> <p style="text-align: center;">Figure 9-6. Load on Belleville springs (correctly assembled)</p> <div data-bbox="786 976 1203 1223" style="text-align: center;">  </div> <p style="text-align: center;">Figure 9-7. Load on Belleville springs (incorrectly assembled)</p>
3	<p>View the assembly from above to check that the space between the stem and the packing follower is even ( Figure 9-8).</p> <div data-bbox="667 1361 1305 1671" style="text-align: center;">  </div> <p style="text-align: center;">Figure 9-8. Top view</p>

9-5. Application to Existing Control Valves

If the low-emission gland packing system is used for an existing control valve, please note the following:

- If there are scratches on the inner surface of the stuffing box or on the surface of the stem of the current valve, the specified seal performance of the system may not be achieved. If scratches are found, replace the affected parts with new ones.
- Check if the low-emission gland packing system can be used for the current valve and actuator by referring to the specification sheet for the system (SS2-SSL100-0100) or by contacting us. Because the resistance to sliding of the low-emission gland packing system is greater than for general gland packing systems, it may not be possible to use the system with the current actuator. In addition, if it is used with the actuator, the shutoff differential pressure will decrease. If supply air pressure to the actuator is increased in order to meet the required shutoff differential pressure, check that the specifications for the pressure gauge of the positioner and pressure reducing valve are satisfied and that there is no effect on the pressure at the source.
- Check if the operating temperature range of the gland packing (main packing and adapter packing) of the system meets the temperature requirements of the current control valve. Attention is needed for the system with expanded graphite packing in particular, because the operating temperature of the main packing used for this packing system is lower than the operating temperature for general expanded graphite packing.

Chapter 10. Maintenance Information

■ Maintenance Information

Maintenance parts and our maintenance support are explained below. Please refer to the following when ordering consumables or if there is a problem with the control valve.

■ Ordering

Please contact the azbil Group, having the name of the necessary parts ready.

■ Maintenance service

The azbil Group offers various service programs that provide the advantage of maintenance know-how accumulated over a long period.

We also offer a prompt response to problems in cooperation with our Quality Assurance Department.


Please contact the azbil Group for maintenance of the control valve.

Chapter 11. Disposal


If this product is no longer needed, dispose of it appropriately as industrial waste, in accordance with local regulations. Do not reuse all or a part of the device.

Appendix A. Standard Specifications

■ Valve body

Basic model No.	: AGVB____ (for JIS10K, ANSI150, JPI150) AGVM____ (for JIS16K, 20K, 30K, ANSI300, JPI300)
Type	: Straight-through, cast globe valve
Connection diameter (inches)	: 1/2, 3/4, 1, 1-1/2, 2, 2-1/2, 3, 4
Pressure rating:	JIS10K, 16K, 20K, 30K, ANSI150, 300, JPI150, 300 Flange type: RF Welding type (optional): socket welded, butt welded
Material	: For body and trim material combinations and operating temperature ranges,  Table A-1.
Bonnet	: General (-17 to +230 °C) Extension, type 1 (230 to 400 °C and -45 to -17 °C) Extension, type 2 (-196 to -45 °C)
Gland type	: Bolted gland
Packing, grease	: PTFE yarn packing (for general use): grease not included V-shaped PTFE packing (for degreased models, for low temperature): grease not included V-shaped PTFE packing (direct + reverse)(for vacuum service): grease not included Graphite yarn (for high temperature): grease included
Gasket	: For combination of the bonnet-body gasket and the seat ring-body gasket, see table 5, "Selection of Gasket" in the specifications sheet for this product (No. SS2-AGV200-0001).

■ Trim

Valve plug	: Contoured plug
Seat type	: Metal seat, soft seat
Flow characteristics	: Equal percentage But linear characteristics if the rated Cv is 0.1, 0.16, or 0.25
Material	: For body and trim material combinations and operating temperature ranges,  Table A-1.

■ Actuator

Type	: Multi-spring diaphragm actuator (PSA)
Action	: Direct action, reverse action
Diaphragm material	: Cloth-embedded ethylene-propylene material
Yoke material	: SCPH2 (A216WCB)
Spring range:	20–98 kPa, 80–240 kPa, 100–180 kPa, 200–340 kPa
Supply air pressure:	140–400 kPa
Air supply connection:	Rc 1/4 or NPT 1/4 female thread
Ambient temperature:	-30 to +70 °C

■ Valve action

Direct action (use in combination with a direct-action actuator)

Reverse action (use in combination with a reverse-action actuator)

■ Optional accessories

Positioner, pressure regulator with air filter, handwheel, limit switch, solenoid valve, travel transmitter, booster relay, lock-up valve, etc.

Note: The VPE positioner can be installed only on the PSA1 actuator.

■ Additional specifications

- Material certificate (mill test report)
- Radiographic testing
- Liquid penetrant inspection
- Flow characteristic inspection
- Degreasing and moisture removal
- Copper-free treatment (fluid contact part)
- SUS304 for bolts and nuts exposed to the air
- Salt-resistant coating
- Cold-area use specifications
- Tropical-area use specifications

Table A-1. Materials of the body, plug, and seat ring

Trim material		Operating temperature (°C)		
		-5 to +300	-45 to +300	-45 to +300
SUS316		-5 to +300	-45 to +300	-45 to +300
SUS316 CoCr-A		-5 to +400	-196 to +400	-196 to +400
SUS440C		-5 to +400	-45 to +400	-
SUS316, soft seat		-5 to +230	-45 to +230	-45 to +230
SUS316, CoCr-A surface		-5 to +400	-196 to +400	-196 to +400
SUS316L		-	-45 to +300	-45 to +300
SUS316L CoCr-A		-	-196 to +400	-196 to +400
Body mate- rial	JIS	SCPH2	SCS13A	SCS14A
	ASTM	A216WCB	A351CF8	A351CF8M

Note: The set of parts for adjusting the flow (plug, seat ring, etc.) is referred to as the trim.

Appendix B. Dimensions and Weight


Dimensions and weight of the control valve are indicated in  Table B-1 and Table B-2. Note that these values may vary depending on the optional accessories.

Table B-1. Dimensions

Unit: mm

Connection diameter (inches)	Actuator	A			H			ϕB	Positioner (C)			
		JIS 10K ANSI 150 JPI 150	JIS 16K	JIS 20K/30K ANSI 300 JPI 300	General bonnet	Extension bonnet type 1	Extension bonnet type 2		VPE	HTP	AVP	
											Pressure regulator (integrated)	Pressure regulator (separate)
1/2, 3/4	PSA1D/R	184	190	194	420	545	945	218	145	225	312	221
	PSA2D/R				450	575	975					
1	PSA1D/R	184	193	197	420	545	945	218	145	225	312	221
	PSA2D/R				450	575	975					
1-1/2	PSA1D/R	222	231	235	420	605	945	218	145	225	312	221
	PSA2D/R				450	635	975					
	PSA3D/R				630	760	1160	350	--	270	318	227
	PSA4D/R				680	815	1215	470	--	270	318	227
2	PSA1D/R	254	263	267	420	605	945	218	145	225	312	221
	PSA2D/R				450	635	975					
	PSA3D/R				630	760	1160	350	--	270	318	227
	PSA4D/R				680	815	1215	470	--	270	318	227
2-1/2	PSA3D/R	276	288	292	675	800	1155	350	--	270	318	227
	PSA4D/R				725	855	1210					
	PSA6R				1145	1315	--	470	--	348	257	
3	PSA3D/R	298	313	317	675	800	1155	350	--	270	318	227
	PSA4D/R				725	855	1210					
	PSA6R				1145	1315	1710	470	--	348	257	
4	PSA3D/R	352	364	368	680	800	1155	350	--	270	318	227
	PSA4D/R				730	860	1210					
	PSA6R				1150	1315	1710	470	--	348	257	

Note: If a handwheel-equipped PSA6 is mounted, add 135 mm to H.

Among the positioners above, only the AVP is CE-marked.

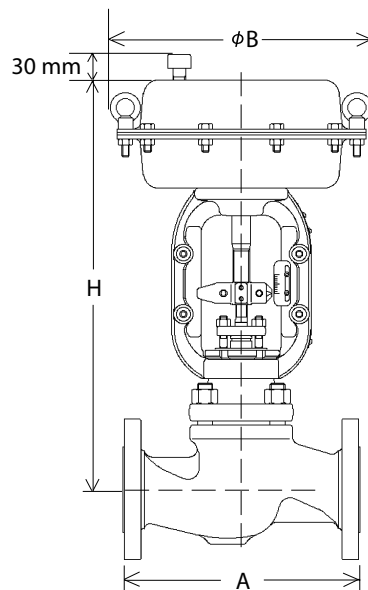


Figure B-1. Face-to-face length and dimensions

Table B-2. Weight

Unit: kg

	Port size (inches)	1/2						3/4					
	Pressure rating	JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300			JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300		
	bonnet type	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2
Actuator	PSA1	19	20	26	20	21	26	20	21	26	22	23	28
	PSA2	22	23	28	23	24	29	23	24	29	25	26	31
	PSA3												
	PSA4												
	PSA6												

	Port size (inches)	1						1-1/2					
	Pressure rating	JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300			JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300		
	bonnet type	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2
Actuator	PSA1	21	22	27	23	24	29	28	32	36	33	37	41
	PSA2	24	25	30	26	27	32	31	35	38	36	40	43
	PSA3							51	55	63	56	60	68
	PSA4							69	73	81	74	78	86
	PSA6												

	Port size (inches)	2						2-1/2					
	Pressure rating	JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300			JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300		
	bonnet type	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2
Actuator	PSA1	31	35	38	34	38	42						
	PSA2	34	38	41	37	41	45						
	PSA3	54	58	66	57	61	70	75	76	79	81	82	86
	PSA4	72	76	84	75	79	88	93	94	97	99	100	104
	PSA6							194	195	199	201	202	205

	Port size (inches)	3						4					
	Pressure rating	JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300			JIS10K ANSI150 JPI150			JIS16K JIS20K JIS30K ANSI300 JPI300		
	bonnet type	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2	general bonnet	extension bonnet type 1	extension bonnet type 2
Actuator	PSA1												
	PSA2												
	PSA3	77	78	82	85	86	90	93	94	109	110	111	126
	PSA4	95	96	100	103	104	108	111	112	127	128	129	144
	PSA6	196	197	201	205	206	210	212	213	228	229	230	245

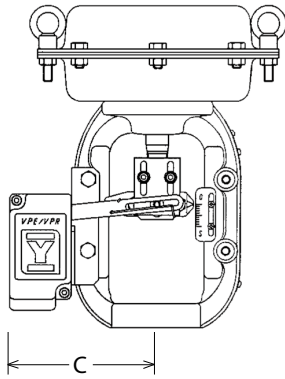


Figure B-2. When VPE positioner mounted

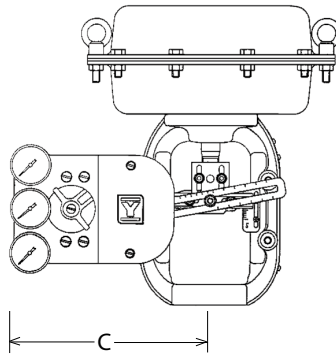


Figure B-3. When HTP positioner mounted

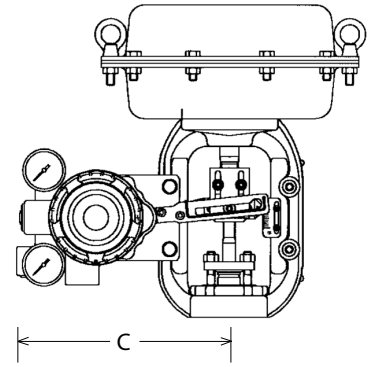


Figure B-4. When AVP positioner mounted

Dimensions and weight will change if a handwheel is mounted. In the case of a standard assembly, the side handwheel will be located in the back of the actuator (at the 180° position when viewing from the positioner-mounted side).

Table B-3. Handwheel dimensions

Handwheel type	Actuator	Dimensions (mm)			Maximum operating force of the handwheel (N)	Weight (kg)
		l max	ϕF	K		
Side handwheel	PSA1D/R	--	200	215	80	7
	PSA2D/R	--	200		150	
	PSA3D/R	--	355	345	260	27
	PSA4D/R	--	355		450	
	PSA6R	--	380		310	

Note: The weight is the weight of the handwheel.

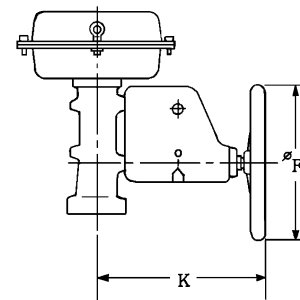


Figure B-5. Side handwheel-equipped actuator

Appendix C. Main Parts to be Replaced

Parts of this actuator can be used for a long period of time, but the following parts should be replaced at every periodic inspection.

Valve body

Gland packing

Gasket

Actuator

- Diaphragm: Every five years
- Bushing: Every five years
- Cap: Every five years
- Sealing washer: Every five years (and whenever disassembling)
- Dust seal: Every five years (and whenever disassembling)
- Rod seal: Every five years (and whenever disassembling)

Terms and Conditions

We would like to express our appreciation for your purchase and use of Azbil Corporation's products.

You are required to acknowledge and agree upon the following terms and conditions for your purchase of Azbil Corporation's products (system products, field instruments, control valves, and control products), unless otherwise stated in any separate document, including, without limitation, estimation sheets, written agreements, catalogs, specifications and instruction manuals.

1. Warranty period and warranty scope

1.1 Warranty period

Azbil Corporation's products shall be warranted for one (1) year from the date of your purchase of the said products or the delivery of the said products to a place designated by you.

1.2 Warranty scope

In the event that Azbil Corporation's product has any failure attributable to azbil during the aforementioned warranty period, Azbil Corporation shall, without charge, deliver a replacement for the said product to the place where you purchased, or repair the said product and deliver it to the aforementioned place. Notwithstanding the foregoing, any failure falling under one of the following shall not be covered under this warranty:

- (1) Failure caused by your improper use of azbil product (noncompliance with conditions, environment of use, precautions, etc. set forth in catalogs, specifications, instruction manuals, etc.);
- (2) Failure caused for other reasons than Azbil Corporation's product;
- (3) Failure caused by any modification or repair made by any person other than Azbil Corporation or Azbil Corporation's subcontractors;
- (4) Failure caused by your use of Azbil Corporation's product in a manner not conforming to the intended usage of that product;
- (5) Failure that the state-of-the-art at the time of Azbil Corporation's shipment did not allow Azbil Corporation to predict; or
- (6) Failure that arose from any reason not attributable to Azbil Corporation, including, without limitation, acts of God, disasters, and actions taken by a third party.

Please note that the term "warranty" as used herein refers to equipment-only-warranty, and Azbil Corporation shall not be liable for any damages, including direct, indirect, special, incidental or consequential damages in connection with or arising out of Azbil Corporation's products.

2. Ascertainment of suitability

You are required to ascertain the suitability of Azbil Corporation's product in case of your use of the same with your machinery, equipment, etc. (hereinafter referred to as "Equipment") on your own responsibility, taking the following matters into consideration:

- (1) Regulations and standards or laws that your Equipment is to comply with.
- (2) Examples of application described in any documents provided by Azbil Corporation are for your reference purpose only, and you are required to check the functions and safety of your Equipment prior to your use.
- (3) Measures to be taken to secure the required level of the reliability and safety of your Equipment in your use

Although azbil is constantly making efforts to improve the quality and reliability of Azbil Corporation's products, there exists a possibility that parts and machinery may break down. You are required to provide your Equipment with safety design such as fool-proof design,*1 and fail-safe design*2 (anti-flame propagation design, etc.), whereby preventing any occurrence of physical injuries, fires, significant damage, and so forth. Furthermore, fault avoidance,*3 fault tolerance,*4 or the like should be incorporated so that the said Equipment can satisfy the level of reliability and safety required for your use.

*1. A design that is safe even if the user makes an error.

*2. A design that is safe even if the device fails.

*3. Avoidance of device failure by using highly reliable components, etc.

*4. The use of redundancy.

3. Precautions and restrictions on application

3.1 Restrictions on application

Please follow the table below for use in nuclear power or radiation-related equipment.

	Nuclear power quality*5 required	Nuclear power quality*5 not required
Within a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Cannot be used (except for limit switches for nuclear power*7)
Outside a radiation controlled area*6	Cannot be used (except for limit switches for nuclear power*7)	Can be used

*5. Nuclear power quality: compliance with JEAG 4121 required

*6. Radiation controlled area: an area governed by the requirements of article 3 of "Rules on the Prevention of Harm from Ionizing Radiation," article 2 2 4 of "Regulations on Installation and Operation of Nuclear Reactors for Practical Power Generation," article 4 of "Determining the Quantity, etc., of Radiation-Emitting Isotopes," etc.

*7. Limit switch for nuclear power: a limit switch designed, manufactured and sold according to IEEE 382 and JEAG 4121.

Any Azbil Corporation's products shall not be used for/with medical equipment.

The products are for industrial use. Do not allow general consumers to install or use any Azbil Corporation's product. However, azbil products can be incorporated into products used by general consumers. If you intend to use a product for that purpose, please contact one of our sales representatives.

3.2 Precautions on application

you are required to conduct a consultation with our sales representative and understand detail specifications, cautions for operation, and so forth by reference to catalogs, specifications, instruction manual, etc. in case that you intend to use azbil product for any purposes specified in (1) through (6) below. Moreover, you are required to provide your Equipment with fool-proof design, fail-safe design, anti-flame propagation design, fault avoidance, fault tolerance, and other kinds of protection/safety circuit design on your own responsibility

to ensure reliability and safety, whereby preventing problems caused by failure or nonconformity.

- (1) For use under such conditions or in such environments as not stated in technical documents, including catalogs, specification, and instruction manuals
- (2) For use of specific purposes, such as:
 - * Nuclear energy/radiation related facilities
[When used outside a radiation controlled area and where nuclear power quality is not required]
[When the limit switch for nuclear power is used]
 - * Machinery or equipment for space/sea bottom
 - * Transportation equipment
[Railway, aircraft, vessels, vehicle equipment, etc.]
 - * Antidisaster/crime-prevention equipment
 - * Burning appliances
 - * Electrothermal equipment
 - * Amusement facilities
 - * Facilities/applications associated directly with billing
- (3) Supply systems such as electricity/gas/water supply systems, large-scale communication systems, and traffic/air traffic control systems requiring high reliability
- (4) Facilities that are to comply with regulations of governmental/public agencies or specific industries
- (5) Machinery or equipment that may affect human lives, human bodies or properties
- (6) Other machinery or equipment equivalent to those set forth in items (1) to (5) above which require high reliability and safety

4. Precautions against long-term use

Use of Azbil Corporation's products, including switches, which contain electronic components, over a prolonged period may degrade insulation or increase contact-resistance and may result in heat generation or any other similar problem causing such product or switch to develop safety hazards such as smoking, ignition, and electrification. Although acceleration of the above situation varies depending on the conditions or environment of use of the products, you are required not to use any Azbil Corporation's products for a period exceeding ten (10) years unless otherwise stated in specifications or instruction manuals.

5. Recommendation for renewal

Mechanical components, such as relays and switches, used for Azbil Corporation's products will reach the end of their life due to wear by repetitious open/close operations.

In addition, electronic components such as electrolytic capacitors will reach the end of their life due to aged deterioration based on the conditions or environment in which such electronic components are used. Although acceleration of the above situation varies depending on the conditions or environment of use, the number of open/close operations of relays, etc. as prescribed in specifications or instruction manuals, or depending on the design margin of your machine or equipment, you are required to renew any Azbil Corporation's products every 5 to 10 years unless otherwise specified in specifications or instruction manuals. System products, field instruments (sensors such as pressure/flow/level sensors, regulating valves, etc.) will reach the end of their life due to aged deterioration of parts. For those parts that will reach the end of their life due to aged deterioration, recommended replacement cycles are prescribed. You are required to replace parts based on such recommended replacement cycles.

6. Other precautions

Prior to your use of Azbil Corporation's products, you are required to understand and comply with specifications (e.g., conditions and environment of use), precautions, warnings/cautions/notices as set forth in the technical documents prepared for individual Azbil Corporation's products, such as catalogs, specifications, and instruction manuals to ensure the quality, reliability, and safety of those products.

7. Changes to specifications

Please note that the descriptions contained in any documents provided by azbil are subject to change without notice for improvement or for any other reason. For inquires or information on specifications as you may need to check, please contact our branch offices or sales offices, or your local sales agents.

8. Discontinuance of the supply of products/parts

Please note that the production of any Azbil Corporation's product may be discontinued without notice. After manufacturing is discontinued, we may not be able to provide replacement products even within the warranty period.

For repairable products, we will, in principle, undertake repairs for five (5) years after the discontinuance of those products. In some cases, however, we cannot undertake such repairs for reasons, such as the absence of repair parts. For system products, field instruments, we may not be able to undertake parts replacement for similar reasons.

9. Scope of services

Prices of Azbil Corporation's products do not include any charges for services such as engineer dispatch service. Accordingly, a separate fee will be charged in any of the following cases:

- (1) Installation, adjustment, guidance, and attendance at a test run
- (2) Maintenance, inspection, adjustment, and repair
- (3) Technical guidance and technical education
- (4) Special test or special inspection of a product under the conditions specified by you

Please note that we cannot provide any services as set forth above in a nuclear energy controlled area (radiation controlled area) or at a place where the level of exposure to radiation is equivalent to that in a nuclear energy controlled area.

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Model AGVB/AGVM
User's Manual

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