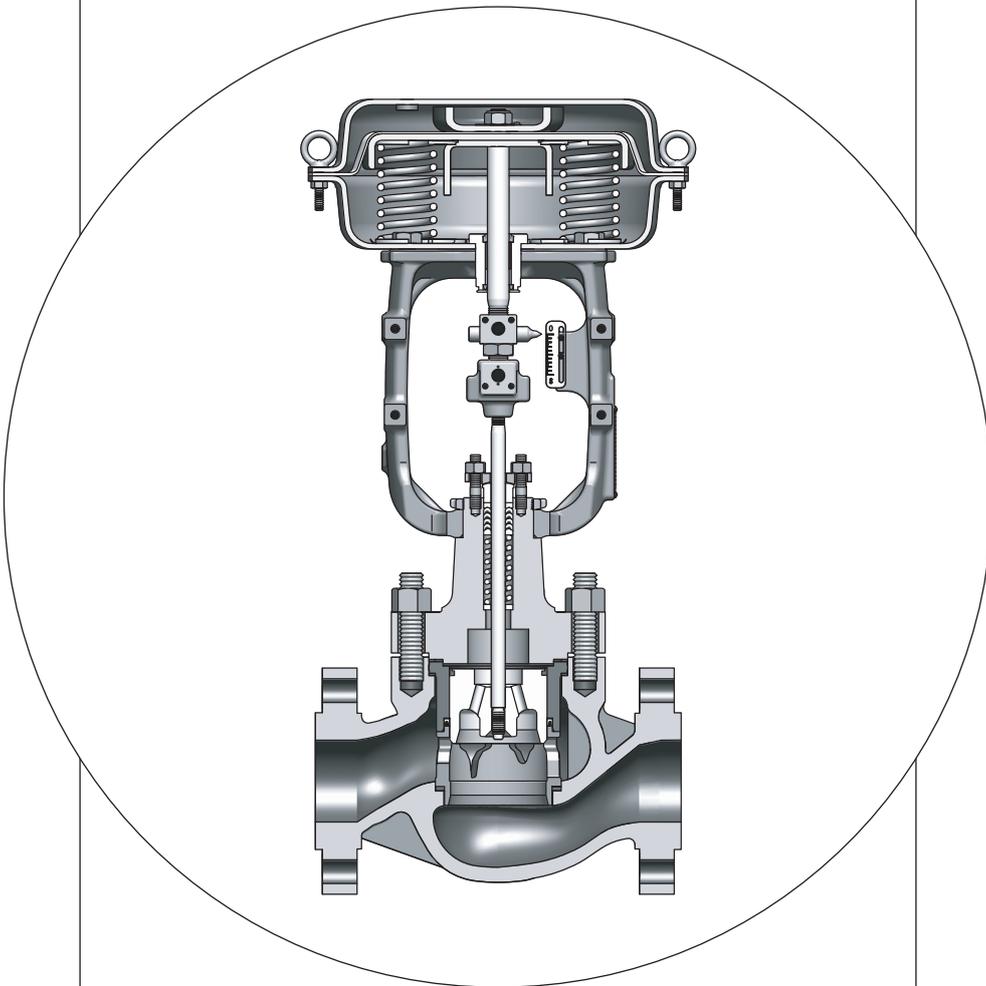


Control Valves

Model ACP___/ACN___

User's Manual



Azbil Control Instruments (Dalian) Co., Ltd.

NOTICE

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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.

Safety

1. Nomenclature of parts

For control valve terminologies and words in this guide, please read the following explanations before using the device.

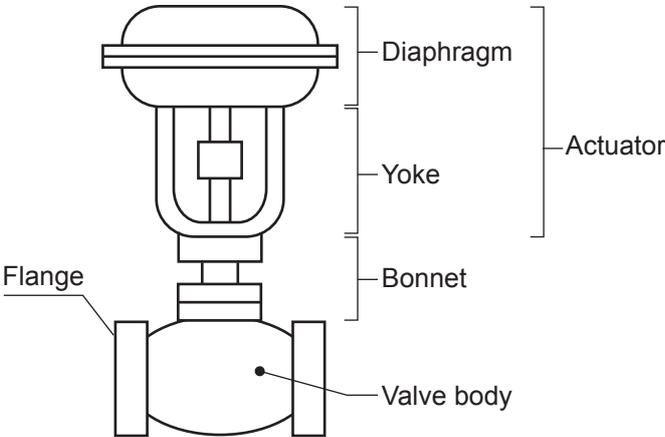


Fig. S-1. Nomenclature of globe valve

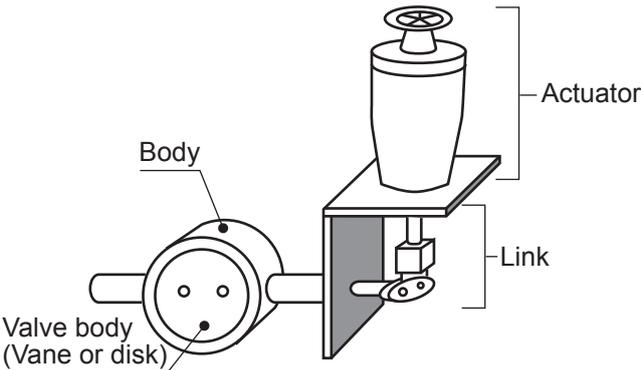


Fig. S-2. Nomenclature of butterfly valve

2. Safety precautions

Please read this guide before using the valve to ensure proper handling.

 WARNING
Denotes a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 CAUTION
Failure to observe these precautions may produce dangerous conditions that could result in operator injury or in physical damage to the device.

3. Verification of Valve specifications and precautions on storage

3-1. Unpacking

Control valve is a precision equipment. Handle it with care to avoid damaging it.

When unpacking, check for the following items in the crate:

- Main valve body, actuator and accessories as ordered,
- Additional equipment as ordered. Installation Options

3-2. Verification of specifications

Please check and see if that the process flow fluid conditions, and valve Tag No. agree with the purchasing specifications. The nameplate of each product are found as shown below. (Other products also have identical nameplates attached to the identical positions.)

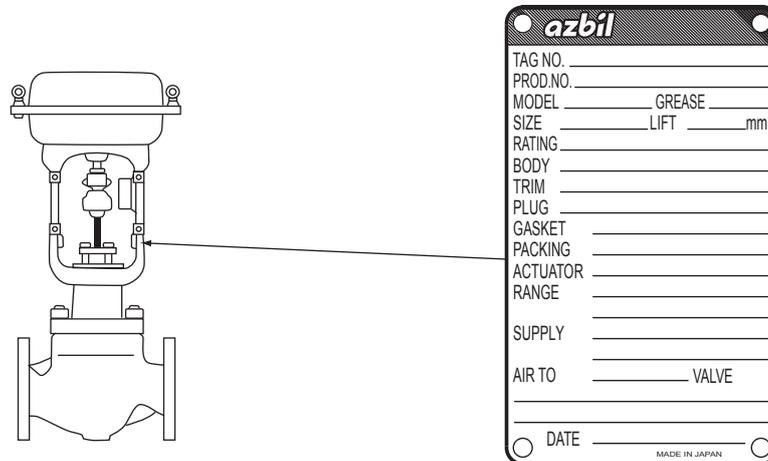


Fig. S-3. Position of nameplate on CV3000 Series

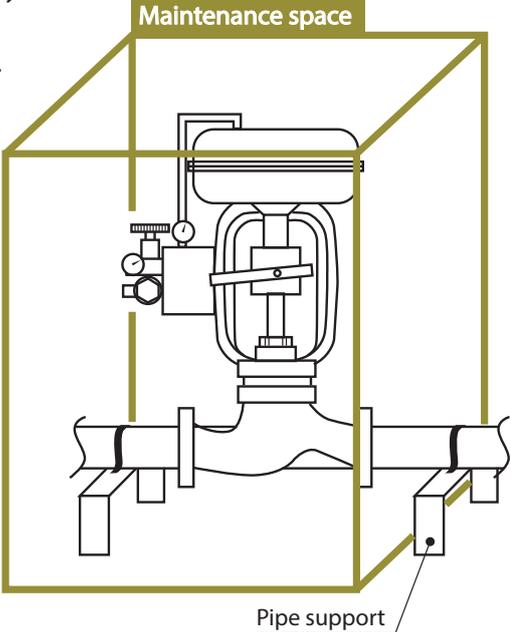
 **CAUTION on storage**

When storing the control valve, pay attention to the following precautions of caution:

- A Control valve that has been packed in a cardboard box should be stored indoors at normal temperature and humidity.
- A Control valve that has been packed in a wooden crate should be stored indoors at normal temperature and humidity as a rule. In the event of outdoor storage, open the crate, verify specifications and cover with polyethylene protecting sheet.
- When storing a used valve, follow the procedures as described below:
 - (1) Flush out the process fluid from inside the valve body and dry,
 - (2) When there is a possibility of the valve body rusting, preservation treatment should be given,
 - (3) To prevent water from getting in the instrument, cover pneumatic tubing connection and electric connector with watertight cap or tape. Also, protect connector threads,
 - (4) Place flange cap on the end of pipe connecting surface (flange face, butt welding connections) to avoid possible damage.

4. Installation

4-1. Installation environments

 CAUTION	
<ul style="list-style-type: none">• Ensure sufficient space for easy and safe operation and maintenance of control valve.• Avoid installing valve in a location where vibration or external stress may impair proper valve functions. If necessary, make appropriate provisions against these.• Consider providing a support for the valve so that the process piping is not burdened with the excessive weight of valve, or provide supports on the upstream and downstream pipe runs.• Provide a cover or protective fence around valve installation when a valve is installed facing a path or if physical contact with valve is expected.• Do not install a valve where it may be submerged water, or snow or where freezing may take place.• Provide a wall for protection against heat radiation.• Provide measures to protect valve against salt spray or corrosive atmospheres.• To stop operation of the Flowmeter:<ul style="list-style-type: none">- Switch the control equipment connected to the flowmeter to manual control.- Turn off power to the Converter.	 <p>The diagram shows a control valve assembly with a horizontal pipe passing through it. A green rectangular box labeled 'Maintenance space' encloses the valve and the pipe section immediately around it. Below the pipe, a 'Pipe support' is shown as a bracket-like structure under the pipe. The valve has a handwheel and various control components on top.</p>

 CAUTION	
<ul style="list-style-type: none">• In order to guard against accident while handling the valve, always wear safety gloves, goggles and safety shoes.	

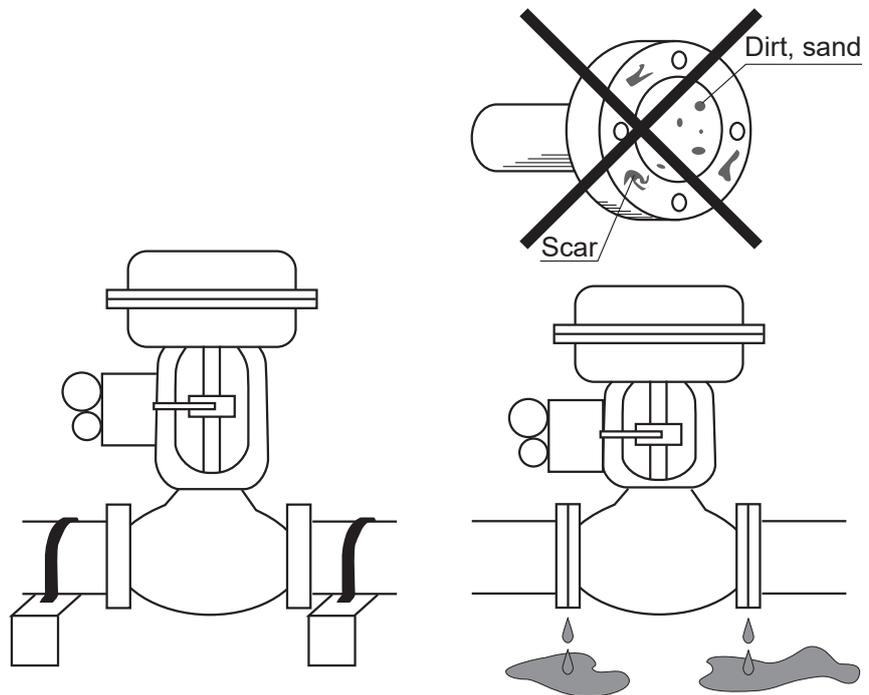
Prior to installation work, follow the items of caution as described below:

CAUTION

- Check and confirm that there is no external damage to the valve (body, actuator, accessories).
- Check and confirm that there is no damage on pipe connecting flanges or butt welding connections,
- Ensure that temperature of welded part of pipe has been reduced before proceeding,
- Make sure that the flanges on pipe have been chamfered.
- Remove dust, sand, welding spatter or any other foreign matter from pipe and clean out pipe. Any foreign matter will damage the valve seat and reduces shutoff characteristics.
- Ensure that upstream and downstream pipe supports are sufficiently strong. Otherwise, the valve's weight may cause leakage from flange connections.

WARNING

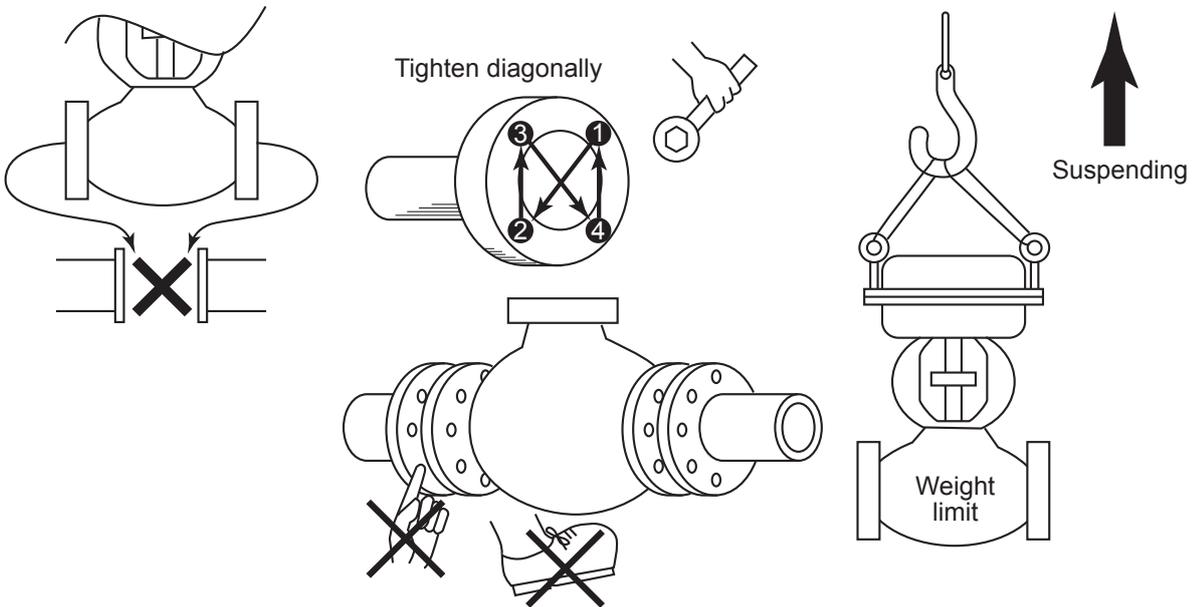
- Operation of valve over and beyond the rated pressure or connection other than recommended of specified connection may cause damage or leakage which may result in serious injury.



4-2. Installation work

CAUTION

- Ensure that centers of upstream and downstream pipes are aligned when pipe installation has been completed. Any mis-alignment of pipe will distort the valve and will cause leakage from the connections. (Gasket)
- Make sure that the face to face dimension of pipe flanges is equal to face to face dimension of valve body plus gasket thickness.
- Use proper gaskets for pipe flanges. Otherwise, process fluid may leak. Always use new gaskets for pipe flanges that will meet process fluid specifications, temperature and pressure conditions. Otherwise process fluid leakage may occur.
- When flushing pipes, keep valve in the fully open position and do not stroke valve. Welding spatter or foreign matters may damage valve.



WARNING

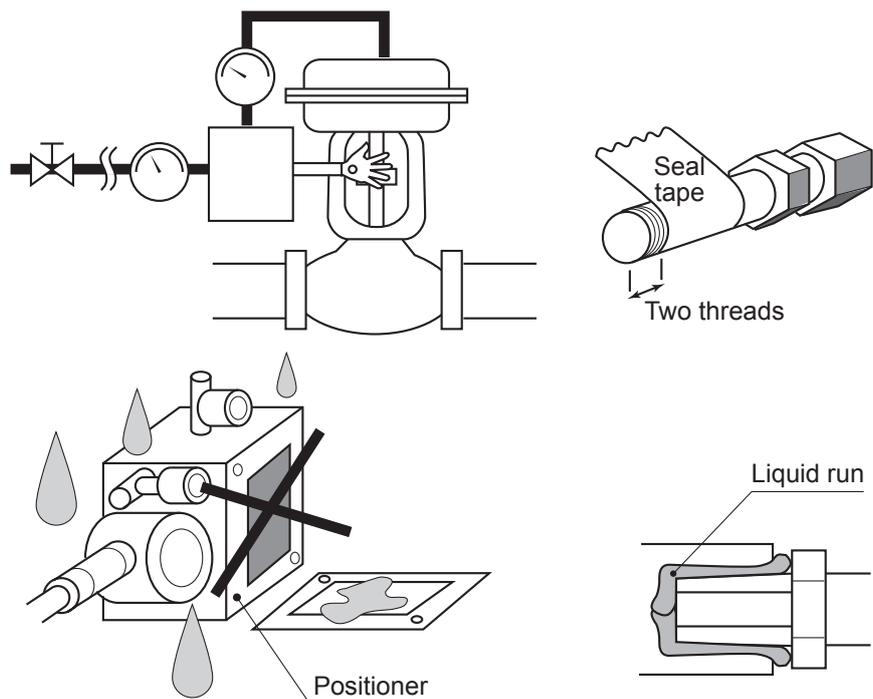
When installing a valve on a pipe, keep hands and feet away from valve body's bottom or between flanges to avoid physical injury.

When reinstalling the valve after inspection, maintenance or modification, flush out process fluid remaining in the pipe or replace it with safer liquid.

4-3. Pneumatic piping and electric work

CAUTION

- Pneumatic tubing should be sized so as not to cause dropping of air pressure when control valve is in operation, Pneumatic tubing should have an allowance in bend (use specialized tool) and bands should bind parallel tubing.
- Only qualified persons should do electric work in accordance to electrical facility engineering standards.
- Cable connections should be made to conform to the facility's conditions. A suitable adaptor or packing should be selected to suit the outer dimension of the completed installation.
- When using seal tape on pneumatic tubing, do not apply the tape on the first two threads from the tip of connector. This may block air passage and cause malfunction of valve.
- When using liquid packing (seize lock) on pneumatic tubing, care should be exercised so as not to leak the liquid into tubing. It may block the air passage, resulting in valve malfunction.
- Avoid electrical work in rainy weather or time of high humidity. Any intrusion of water into connector or terminal will cause rusting and electric leakage.
- Covers of accessories such as the positioner are provided with seal packing (gasket). Exercise care so as not to misplace or lose them while electric work is in progress.
- Exercise care so as not to lose fixing screws of accessories such as the positioner. When tightening screws, ensure that packing is in place and tighten screws with an even torque.
- Cable threads and conduit seal should be tightened so as to ensure that water does not get in.



5. Caution disassembly, reassembly

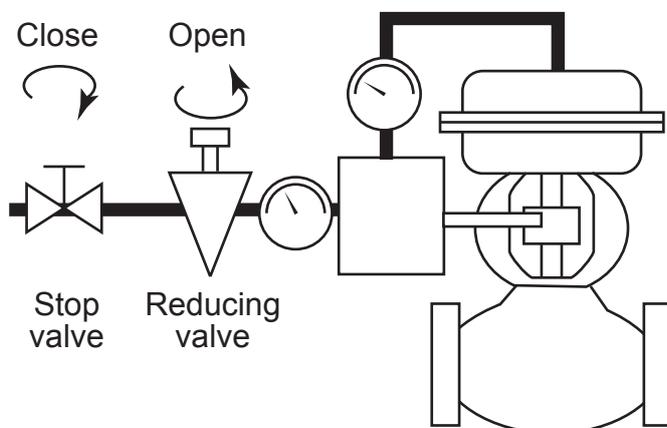
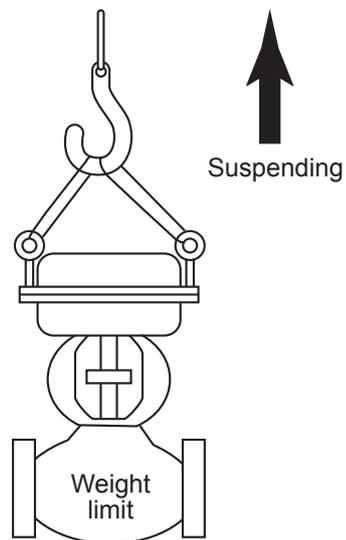
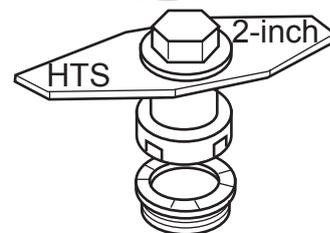
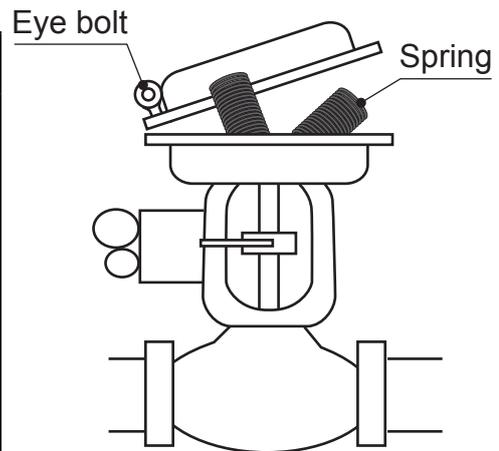
5-1. Disassembly

! CAUTION

- When disassembling a spring-incorporated positioner, follow the prescribed procedure in removing bolts and nuts. Otherwise, the spring may pop out, resulting in physical injury.
- When the eye-bolts of actuator are used to lift valve from pipe, ensure that the weight limitation as described in manual is adhered to. Otherwise, there is the danger of dropping the valve,
- When removing trim (inner valve) from the body, ensure that the proper type of specialized tool is used. Refer to the instruction manual for proper tools. Otherwise, the trim may be damaged.

! WARNING

- Before disassembling the valve, ensure that the pressure within piping has been reduced to atmospheric pressure. Flow out of process fluid may cause physical injury.
- When disassembling the valve, flush out interior of the valve or replace fluid inside. Residual process fluid may cause physical injury,
- Do not disassemble pneumatic actuator with supply air on. Compressed air may cause physical injury.



6. Assembly

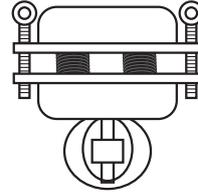
CAUTION

- When assembling the spring loaded actuator, adhere to the order of assembly procedure; install bolts and nuts as instructed. Disregard of procedure may result in malfunction.
- When installing a butterfly valve on a pipe line, fully close the valve (vane or disk). Tighten flange bolts and nuts diagonally and with even torque.
- When installing the valve the body, always use new gaskets. Old or reused gasket may cause leakage
- When assembling trim (inner valve), ensure that specialized tools are available and use only those which meet specifications.

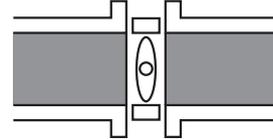
WARNING

- When assembling the valve, tighten bolts and nuts at a torque as specified in instruction manual. Any damage or corrosion on the bolts or nuts may cause destruction of control valve which will lead to physical injury. Always replace defective bolts and nuts with new ones.

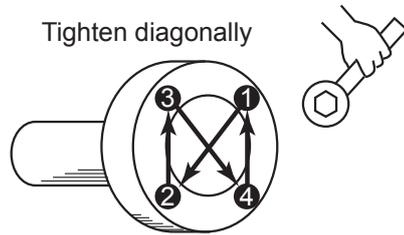
Follow assembly procedure



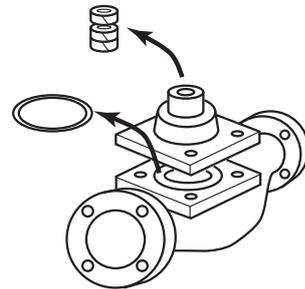
Install butterfly valve in fully closed position



Tighten diagonally



Replace packing / gasket



7. Maintenance and inspection

Adhere to the following items of Warning and Caution while conducting maintenance or inspection.

CAUTION

When leakage from a valve is found, do not come close to the valve until safety is assured of. A serious accident or physical injury may occur depending on the type of fluid.

WARNING

- Check gland daily and ensure that there is no leakage from it. Check valve operation daily, and confirm that it is not hunting.
- Make sure that there is no abnormal vibration or noise during operation,
- When the valve is repaired or disassembled, old parts should be properly disposed of as industrial waste. Otherwise, they may contaminate the environment.

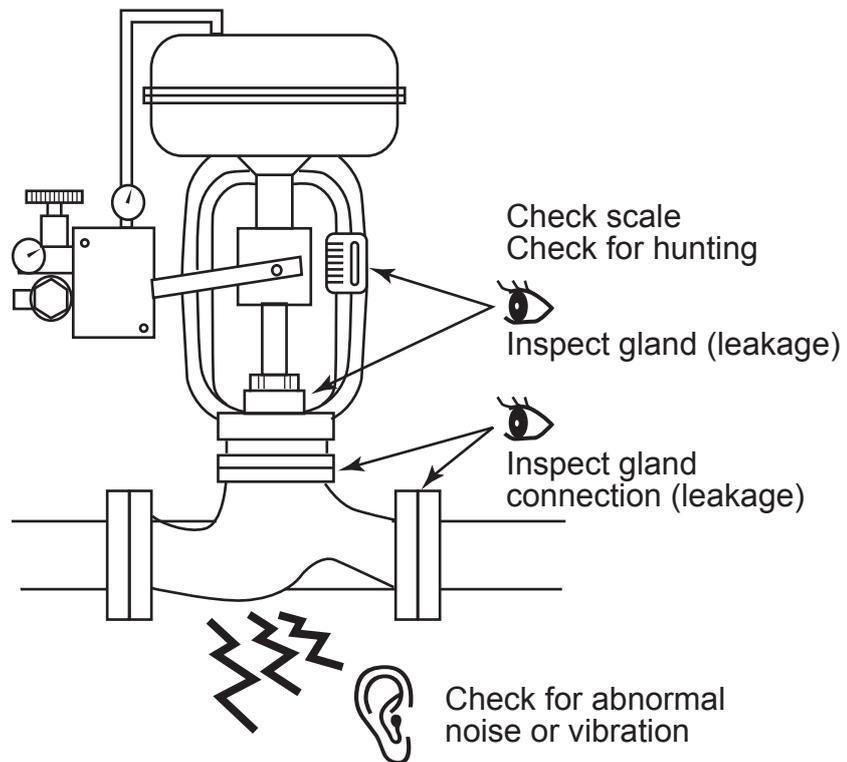


Fig. S-4.

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Chapter 1. General

1-1. Scope

This manual covers the instructions for:

- Mode ACPPressure-Balanced Cage-type Control Valves with piston ring
- Model ACNLow noise cage type control valves with piston ring

For the valve Positioners, refer to the following:

Model HTP	OM2-8310-0200
Model HEP28/29	CM2-HEP280-2001
Model HEP18/19	OM2-8313-0101
Model HEP15/16/17	OM2-8313-0100
Model HEP10/11.....	CM2-HEP100-2001
Model AVP300/301/302/200/201/202	CM2-AVP300-2001
Model AVP701/702	CM2-AVP302-2001
Model AVP703	CM2-AVP303-2001

1-2. Main components of control valves

Each control valve is comprised of two main components, namely, a valve body and an actuator. Various combinations of valve body and actuator are available to meet various types of uses with different valve sizes, pressure ratings, types of connections, types of materials, and actuator sizes.

(For details on specifications, refer to Specification Sheets SS2-ACP110-0100 or SS2- ACN110-0100.)

1-3. Structures

The structures of typical control valves are shown in Fig. 1-1.

The valve body is connected to the bonnet with stud bolts and nuts. Two gaskets are provided at the connection section to seal the internal fluid or to let the valve body make up a pressure vessel. The valve plug is supported by the guide ring and cage, and driven by the actuator. The actuator has multiple springs and a diaphragm, and converts the pneumatic control signal into a mechanical (positional) control signal with which to position the valve plug.

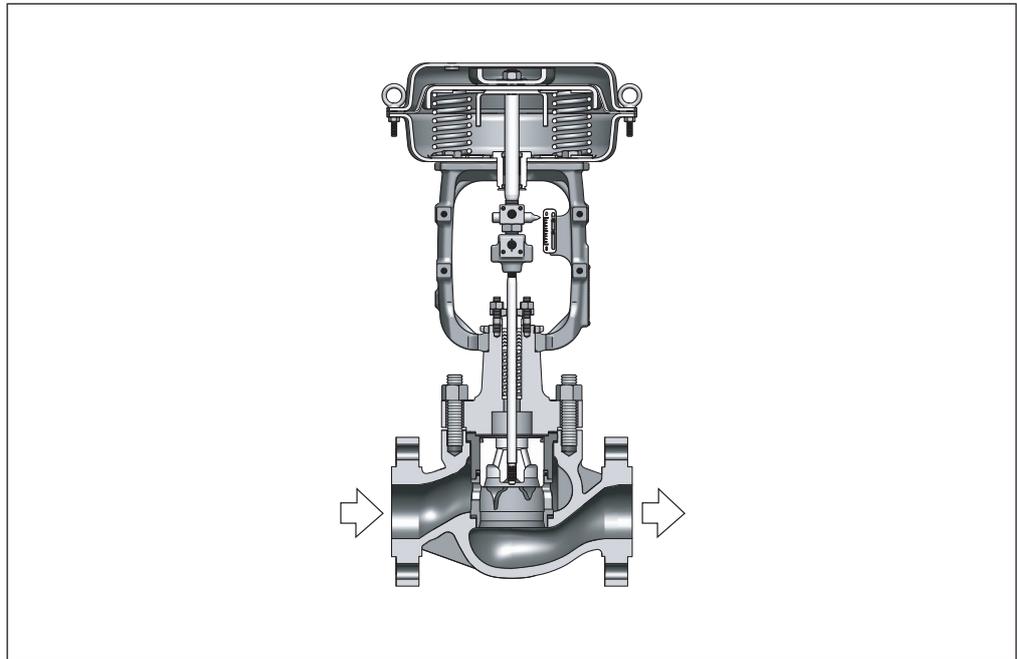


Fig. 1-1. Pressure-balanced cage-type control valve model ACP

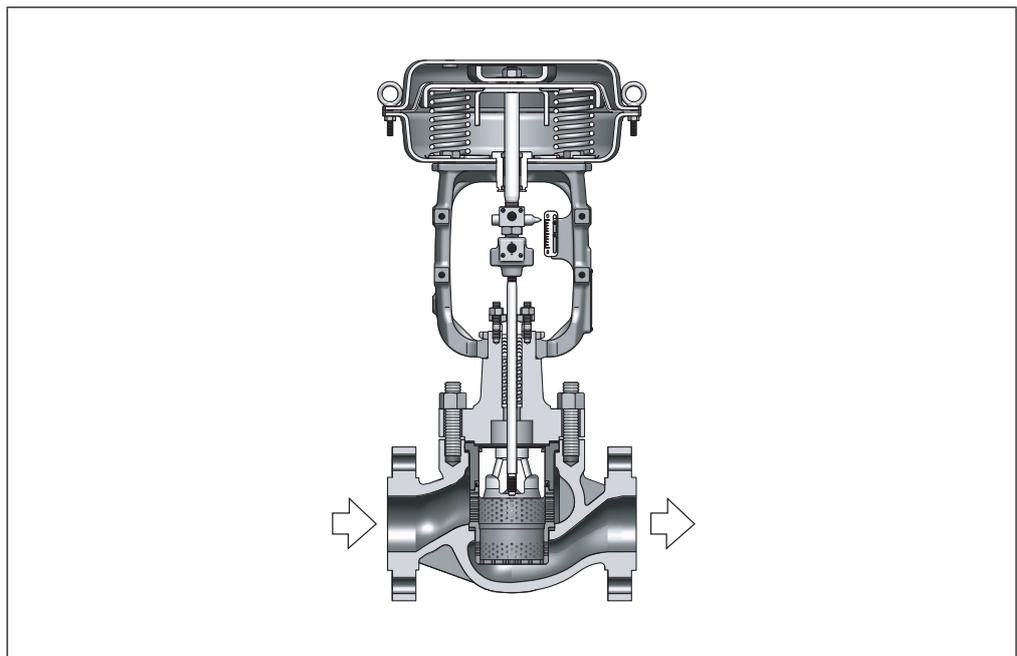


Fig. 1-2. Low-noise cage-type control valve model ACN

1-4. Nameplate

A nameplate, as shown in Fig. 1-3, is attached to each control valve. The nameplate indicates the model number, valve size, pressure rating, trim material, date of manufacture and other major specifications of the control valve. Before installing the control valve, make sure that the specifications indicated on the nameplate conform to the conditions of use. The nameplate also indicates the product number (PROD.NO.) of the control valve. Please mention this number also when consulting your Azbil Corporation agent for parts replacement or any other modification of the control valve.



Fig. 1-3. Nameplate

Chapter 2. Installation

2-1. Maximum lift limits of eyebolts

The diaphragm case has a pair of lifting eyebolts. These eyebolts primarily are for lifting the actuator alone. Before using the eyebolts for other purposes (such as lifting an actuator fixed to its valve body or other components), take note of the allowable maximum lifting loads of the eyebolts that are as shown in the following Table 2-1.

Table 2-1. Maximum lifting loads of eyebolts

Actuator model No.	Allowable Maximum Lifting Load of Eyebolts	Weight of Actuator Alone
HA2, HA2R	160 kg	16 kg
HA3D, HA3R	160 kg	32 kg
HA4D, HA4R	220 kg	68 kg

Note: The eyebolts may be used to lift the actuator together with its valve body (cast globe valve) of up to pressure rating "Class 600". When doing this, be extremely careful so that no shock or other abnormal force is applied to the actuator or the valve body.

2-2. Installing valve on process pipe

- (1) Before installing the valve on the process pipe, remove foreign substances (such as scales and welding chips) from both upstream and downstream sides of the process pipe.
- (2) Confirm that the direction of process fluid flow conforms with that of the arrow provided on the valve body.
- (3) Pay attention so that the pipe connection gaskets do not extrude into the process pipe inside. Be sure to use gaskets made of material which is suitable for the process fluid. The welded type of valve employ no gaskets.
- (4) Pay attention so that no excessively large stress is conveyed from the process pipe to the valve body. Uniformly tighten the bolts of the process pipe connection flanges. The high pressure type of valves have no flanges, since they are welded to the process pipe.
- (5) Before connecting the air pipes to the actuator and positioner, blow the pipes to clean them.
- (6) Do not install any heating or cooling provisions on the bonnet.

2-3. Items to be checked after installation and before starting operation

- (1) Check that there is no leak from air piping.
- (2) Check that the bolts and nuts of the diaphragm case are not loose. Standard tightening torques are listed below:
- (3) Tighten the packing flange nuts to prevent leak from the gland packing section. Standard tightening torques are given in Table 2-2

Table 2-2. Tightening torques of packing flange nuts

Valve stem diameter (mm)	V PTFE Packing	PTFE Yarn Packing (P4519)	Graphite Yarn Packing P6610CH + P6528 P6610CH + M8590 T2200 + P6710CH (Type2)	V PTFE + PTFE Yarn Packing PTFE + V7233 PTFE + TK2006
10	1 {8}	9 {90}	5 {50}	3 {30}
13		15 {150}	8 {80}	5 {50}
16		24 {240}	13 {130}	8 {80}
20		32 {320}	18 {180}	10 {100}
25		-	28 {280}	15 {150}
30		66 {660}	36 {360}	20 {200}

Note: The tightening torques mentioned in the above are only to given as reference values.
Note that tightening torques may vary depending on the type of packing.

Table 2-3. Tightening Torques of packing Flange Nuts for PTFE yarn (Certified ISO 15848-1-compliant low-emission gland packing)

Model	Actuator model	Stem size	Tightening torque
ACP, ACN	HA2	φ 10 mm	12 N·m
	HA3	φ 13 mm	20 N·m
	HA3	φ 16 mm	33 N·m
	HA4	φ 20 mm	44 N·m
	PSA6	φ 30 mm	54 N·m

Table 2-4. Tightening Torques of packing Flange Nuts for expanded graphite (Certified ISO 15848-1-compliant low-emission gland packing)

Model	Actuator model	Stem size	Tightening torque
ACP, ACN	HA2	φ 10 mm	12 → 0 (loosening) → 8 N·m
	HA3	φ 13 mm	20 → 0 (loosening) → 13N·m
	HA3	φ 16 mm	33 → 0 (loosening) → 22N·m
	HA4	φ 20 mm	44 → 0 (loosening) → 30N·m
	PSA6	φ 30 mm	54 → 0 (loosening) → 36N·m

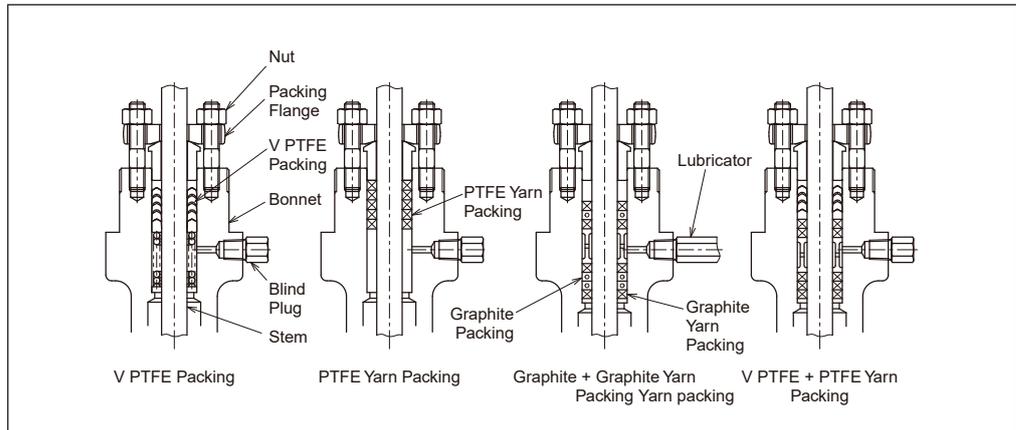


Fig. 2-1. Gland section

- (4) If the valve is provided with a lubricator as shown in Fig. 2-2, check whether the bonnet section has been lubricated or not. To do this, loosen the lubricator handwheel and turn the squeeze screw. If the squeeze screw turns easily, then apply grease following the lubricating procedure mentioned below. (If the squeeze screw turns stiffly, this means that grease has been applied.)

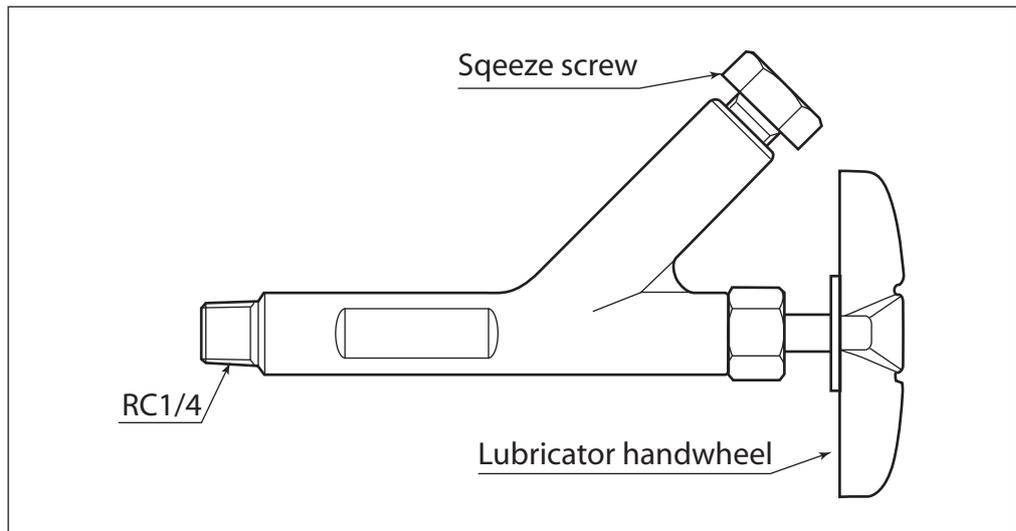


Fig. 2-2. Lubricator (Class 600 or under)

Lubricating Procedure

Step	Procedure
a	Prepare grease of the type indicated on the nameplate.
b	Tightly close the lubricator handwheel.
c	Remove the squeeze screw, apply grease, then reset the squeeze screw.
d	Loosen the lubricator handwheel and drive the grease by turning the squeeze screw.
e	Repeat the procedure of (b), (c) and (d) until turning of the squeeze screw becomes stiffer. Tightly close lubricator handwheel.

- (5) When pressuring the valve, check that there is no leak from the gasket sections between the valve body and process pipe. If leakage is found, tighten the nuts. (Especially when the process fluid temperature is 400°C or higher, tighten the nuts again after raising temperature of the valve so that it may be in serve for a longer period without requiring immediate maintenance service.) Standard tightening torques are given in Table 2-2 on page 2-1, Table 4-1 on page 4-4.
- (6) When raising the temperature to a valve which is used for high temperature service, raise the temperature gradually (standard rate is 100°C per hour) and do not operate the valve while the temperature is being raised.

Chapter 3. Inspection and Maintenance

Inspection and service the actuator as follows:

Tightening the gland:

Tighten the gland about once in every 6 months. The tightening procedure is as given in Chapter 2-3(3) on page 2-2.

Lubricating the gland:

Lubricate the gland about once every 6 months. The lubricating procedure is as given in Chapter 2-3(4) on page 2-2.

Check for hunting of valve position:

Refer to "Chapter 13. Troubleshooting" on page 12-1.

Check for abnormal noise and vibration:

Refer to "Chapter 13. Troubleshooting" on page 12-1.

Chapter 4. Disassembly and Assembly

This chapter covers the disassembly and assembly procedures of the actuator for its overhaul or modification.

4-1. Detaching actuator from valve body

- (1) Apply to the actuator an air pressure so that the valve position pointer is at a point of 10% - 20% above the fully closed point.
- (2) Loosen the clamping-bolts of the stem connector, remove the stem connector, and detach the actuator stem from the valve stem.
- (3) Remove the clamping-nut of the yoke.
- (4) Raise the actuator to detach it from the valve body.

Precautions: To detach the actuator from the valve body which is kept installed in the process pipe, be sure to shut down the process fluid and release the process pressure before detaching the actuator

4-2. Disassembly and assembly of valve body

To disassemble or assemble the each temperature range valve body.

(For the handling of bellows sealed type (optional type) valves, See "Chapter 9. Instruction for Mechanical Flow Stopper of Actuator Instructions for Bellows Sealed type of Control Valves")

4-2-1. Disassembly and assembly of plain ($-17 \leq t < 230 \text{ }^{\circ}\text{C}$) and extension 1 ($-45 \leq t < 17 \text{ }^{\circ}\text{C}$) bonnet type valve body

4-2-1-1. Disassembly procedure

Step	Procedure
1	Loosen the packing flange nut of the packing flange.
2	Remove the hex nuts (1) of the bonnet (extension bonnet).
3	Lift bonnet and remove. If the valve plug and cage (upper) are extracted together, turn the plug and cage (upper) to remove them from the bonnet, exercising care not to damage the stem. Then turn cage (upper) to extract plug from the cage (upper) exercising care not to damage seat ring. Seat ring and scraper ring may be damaged if the plug is extracted from the bottom of cage (upper).
4	Pull out the plug and then pull out the cage from the valve body.

4-2-1-2. Inspection

Inspect the disassembled parts for damage. If any damages is found, replace the parts. (When ordering parts, mention also the Prod. No. of the valve which is indicated on the nameplate.)

- (1) Do not re-use the removed gland packing. Use fresh packing when reassembling the valve.
- (2) Check and ensure that there is no scar on sliding portions of plug, cage (upper) cage (lower), seat face and stem.
- (3) Check and ensure that there is no scar on sliding parts of seal ring and scraper ring. For a guideline on parts replacement, Refer to "Chapter 14. Recommended spare parts".
- (4) Check and ensure that there is no scar on body, bonnet and gasket faces. Do not reuse the gasket once its removed. Always use a new one when reassembling. For a guideline on parts replacement, Refer to "Chapter 14. Recommended spare parts".

4-2-1-3. Assembly procedure

Step	Procedure
1	Insert a spiral gasket into valve body. (Apply Never-seize* on all valves except degreased valve for oxygen application.)
2	Insert cage (lower) into the valve body.
3	Coat seal ring lightly with silicon grease, assemble on a slot on cage (upper) and insert plug into cage. (Apply Never-seize* on all valves except degreased valve for oxygen application.)
4	Insert gasket (lower) into valve body. (Apply Never-seize* on all gaskets except degreased valve for oxygen application.)
5	Coat scraper ring lightly with silicon grease, assemble on a slot above the plug and push the plug into the cage. (Apply Never-seize* on all gaskets except those for degreased valve for oxygen application.) When the plug's tip passes through seal ring, apply even load on the plug to push it in until the tip of the plug touches and sits against the seat on the cage (lower).
6	Insert gasket (upper) into cage (upper). (Apply Never-seize* on all gaskets except those for degreased valve for oxygen application.)
7	Put the bonnet on the valve body and check that the bonnet is correctly mated with the indented section of the valve body. Tighten the hex nuts uniformly, paying attention so that they are not tightened unevenly (tighten alternately the ones located at symmetrical positions). For tightening torques, see Table 4-1.
8	Insert the gland packing as shown in Fig. 2-1. Note: When yarn packing sheets are used, overlap sheets in such manner that their cut ends are positioned alternately.
9	Place the packing follower and packing flange, and tighten the nuts. For the tightening torques, See "Table 2-2. Tightening torques of packing flange nuts" on page 2-2.

Table 4-1. Tightening torque of bonnet stud bolts

Bolt	Torque (N·m {kgf·cm})
M12	60 {600}
M16	100 {1,000}
M20	150 {1,500}
M22	200 {2,500}
M24	250 {2,500}
M27	350 {3,500}
M30	500 {5,000}
M33	660 {6,600}

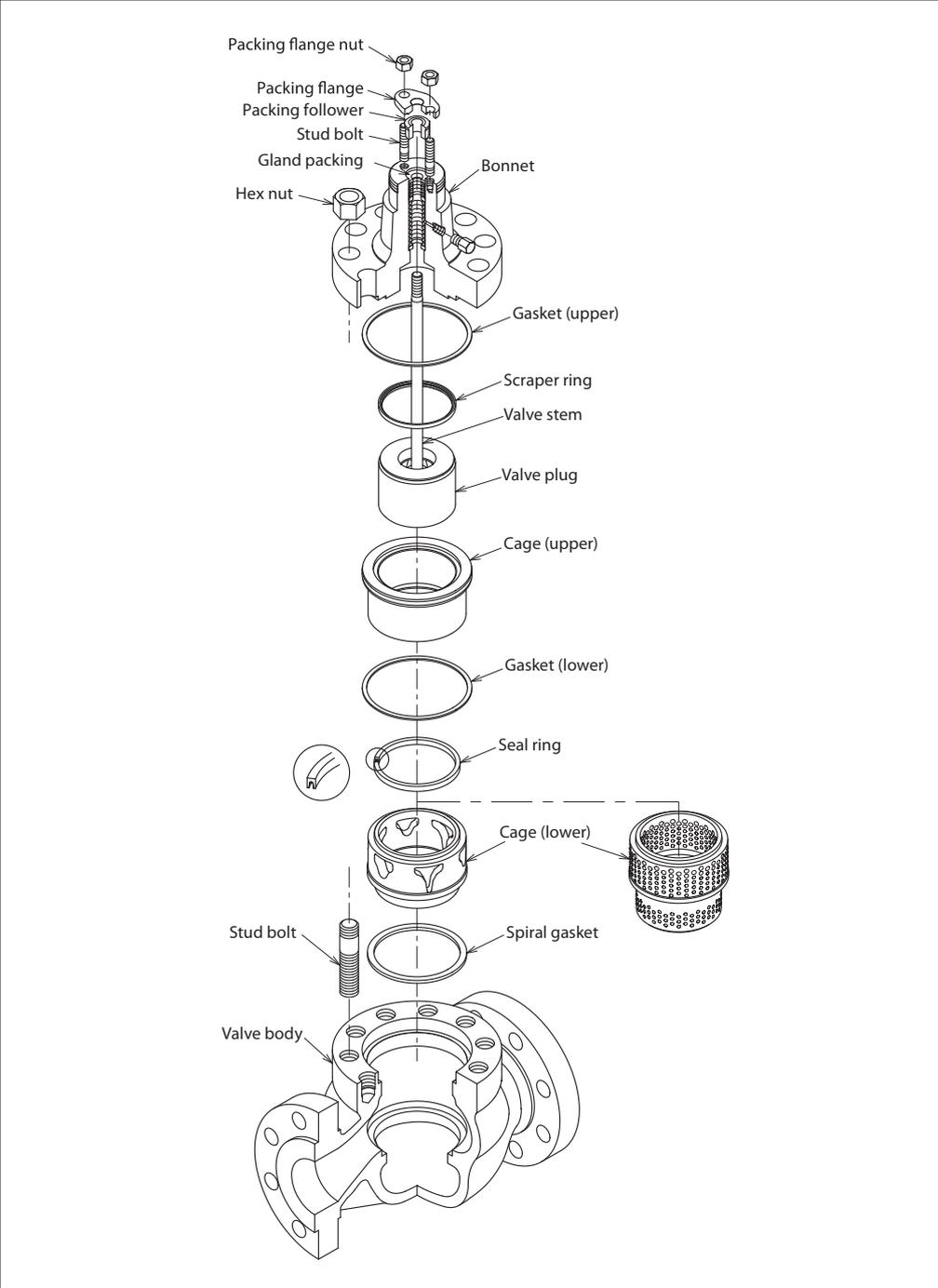


Fig. 4-1. Model ACP/ACN control valves

4-2-2. Disassembly and assembly of extension1 bonnet type ($230 \leq t < 400^{\circ}\text{C}$) valve body

4-2-2-1. Disassembly procedure

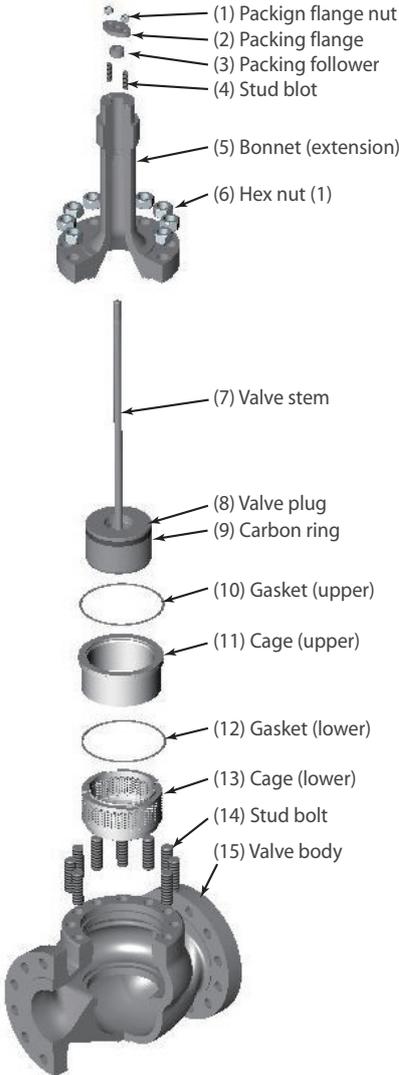
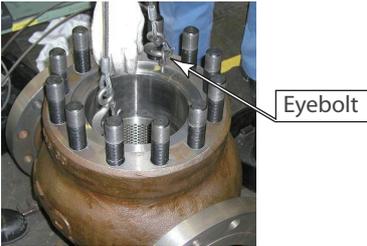
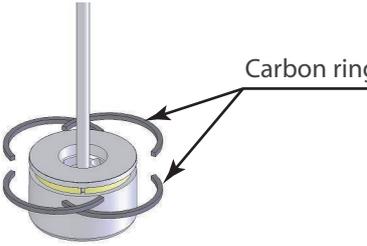
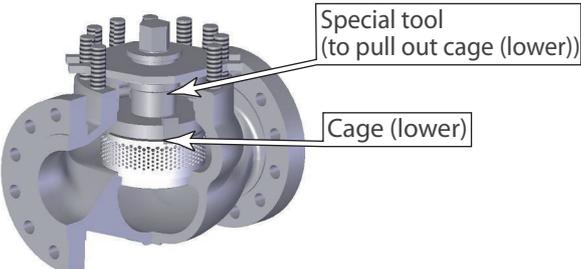
Step	Procedure
1	Loosen the packing flange nut of the packing Flange.
2	<p>Remove the hex nuts of the bonnet (extension 1 bonnet), using wrench.</p> 

Fig. 4-2. Extension 1 ($230 \leq t < 400^{\circ}\text{C}$)

Step	Procedure
3	<p>Lift the bonnet (5) and remove. Remove the gaskets (10)(12) which are attached to the upper and lower sides of the cage (upper) (11). If only the bonnet is extracted, remove cage (upper) from the body after removing the plug (8). When selecting a 4 inches or more size, remove using eyebolts. (Refer to Fig. 4-3.)</p> <p>If the valve plug and cage (upper) are extracted together, turn the plug and cage (upper) to remove them from the bonnet, exercising care not to damage the stem (7). Please take care not to drop the plug and cage (upper). Pull out the plug from the bonnet.</p>  <p style="text-align: center;">Fig. 4-3.</p>
4	<p>Pull out the carbon ring (9) from the plug, refer to Fig. 4-4. Since this breaks easily, be careful of handling.</p>  <p style="text-align: center;">Fig. 4-4.</p>
5	<p>Pull out the cage (lower) (12), using the special tools. (Refer to Fig. 4-5.)</p>
6	<p>Remove the packing flange nuts (1), and pull out the gland portions.</p>  <p style="text-align: center;">Fig. 4-5.</p>

4-2-2-2. Inspection

Inspect the disassembled parts for damage. If any damages are found, replace the parts. (When ordering parts, mention also the Prod. No. of the valve which is indicated on the nameplate.)

- (1) Check and ensure that there is no scar on gland packing box.
- (2) Check and ensure that there is no scar on sliding portions of plug, cage (upper) cage (lower), seat face and stem.
- (3) Check and ensure that there is no scar on carbon ring. For a guideline on parts replacement, refer to "Chapter 14. Recommended spare parts".
- (4) Check and ensure that there is no scar on body, bonnet and gasket faces.

4-2-2-3. Assembly procedure

Do not reuse the gasket once its removed. Always use a new one when reassembling. For a guideline on parts replacement, refer to “Chapter 14. Recommended spare parts”.

Step	Procedure
1	Insert the cage (lower) into the valve body, using special tools, refer to Fig. 4-5. For tightening torques, see Table 4-1.
2	Insert gasket (12) into valve body.
3	Insert cage (upper) into valve body.
4	Attach a carbon ring to valve plug, refer to Fig. 4-4.
5	<p>Push the plug into the cage, using special tools, refer to Fig. 4-6. When the plug's tip passes through seal ring, apply even load on the plug to push it in until the tip of the plug touches and sits against the seat the cage (lower).</p> <div data-bbox="716 880 1059 1270" data-label="Image"> </div> <p data-bbox="1098 965 1267 1025">Special tool (for insert plug)</p> <p data-bbox="940 1279 1031 1308">Fig. 4-6.</p>
6	Insert the gasket (10) into cage (upper).
7	<p>Attach carefully not to throw bonnet at a stem.</p> <p>Put the bonnet on the valve body and check that the bonnet is correctly mated with the intended section of the valve body. Tighten the nuts uniformly, paying attention so that they are not tightened unevenly (tighten alternately the ones located at symmetrical positions). For tightening torques, see Table 4-1.</p>
8	<p>Insert the gland packing into the gland box, refer to Fig. 2-1.</p> <p>Note: In case of using yarn-packing, which must be attached as each cut end becomes by turns.</p> <p>Insert the packing follower (3) and packing flange (2), and tighten the nuts uniformly. For tightening torques, see Table 4-1.</p>

Table 4-2. Tightening torque of cage (lower)

Nominal size (inches)	Torque N·m
1-3/4	255 to 314
2	382 to 461
2-3/4	510 to 617
3	637 to 764
4	784 to 980
5	784 to 980
6	1176 to 1470
8	1470 to 1862

4-3. Disassembly and assembly of actuator

Normally the actuator requires no adjustment. However, it should be disassembled and assembled when installing it on a valve body, when modifying its specifications, or when replacing damaged parts. The disassembly and assembly procedure of the actuator for such purposes are covered in "Chapter 4-3-1. Disassembly and assembly of model HA2, HA3 or HA4 actuator" on page 4-12.

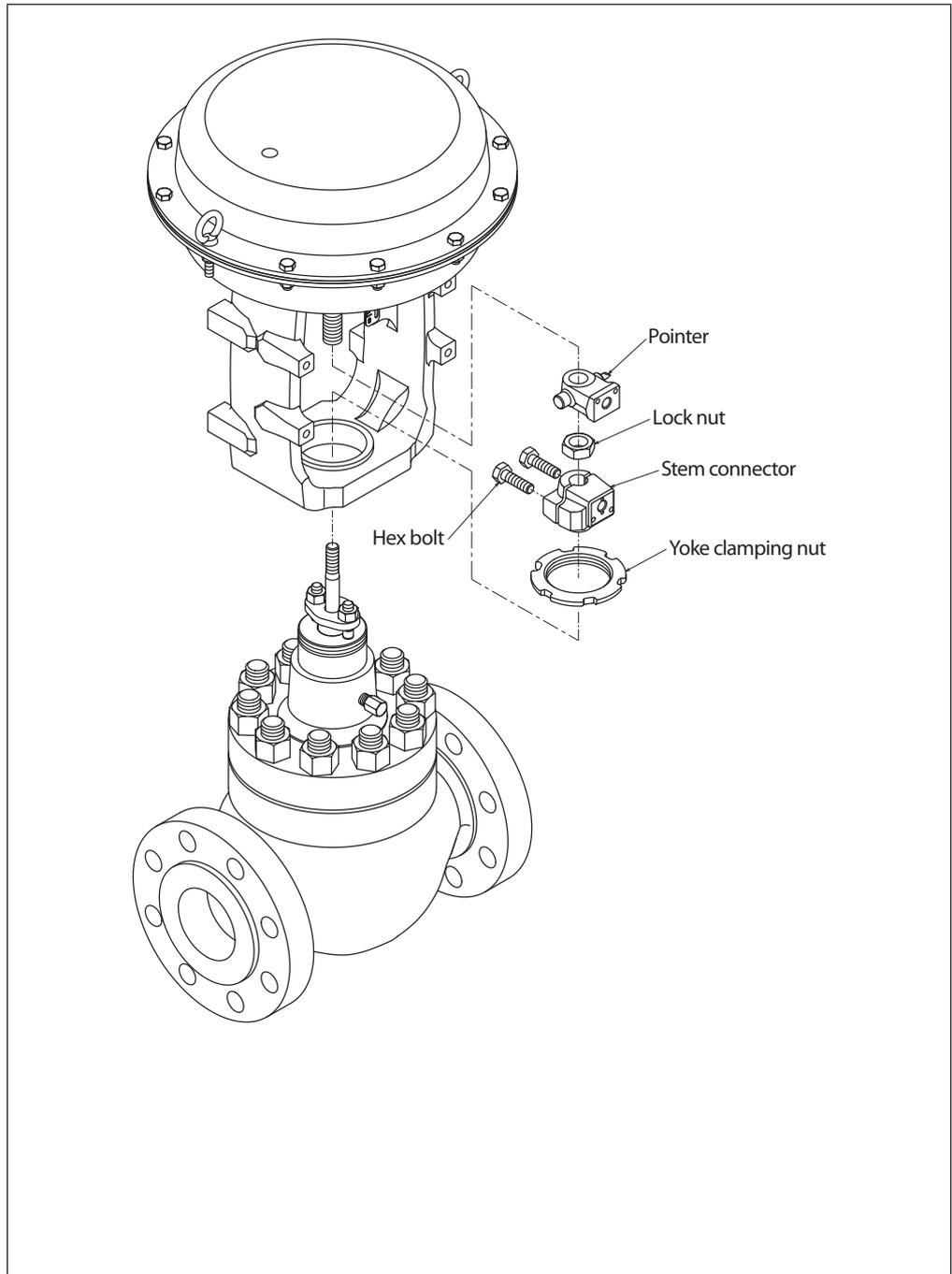


Fig. 4-7.

When disassembling or assembling the actuator, keep it in a vertical position. For the tightening torques of bolts and nuts, see Table 4-2 and Table 4-3.
For the names of parts, see Fig. 4-15.

Notes on Disassembly

- (1) The nuts for the eyebolts are made of stainless steel. Discriminate these nuts from other nuts when assembling the diaphragm case.
- (2) It is recommended to make locating marks on the top and bottom diaphragm cases before disassembly. This will help you to easily find the air piping connector location.
- (3) Store the removed parts in a clean place.

 CAUTION
<p>Never loosen or remove carelessly the bolts and nuts of the actuator. The actuator employs powerful compressed springs and if you remove the bolts and nuts carelessly, the springs may leap out causing hazards. When removing the bolts and nuts, be sure to observe the instructions given for the disassembly and assembly procedures of the actuator and top handwheel..</p>

4-3-1. Disassembly and assembly of model HA2, HA3 or HA4 actuator

4-3-1-1. Disassembly procedure

(a) Direct action type (See Fig. 4-8 or Fig. 4-9)

Step	Procedure
1	Disconnect the air piping and detach the accessories from the actuator.
2	Remove the stem connector, pointer and lock nut.
3	Remove the hex-bolts (except the pair of eyebolts) and nuts of the diaphragm case.
4	Loosen evenly and alternately the pair of eyebolts. (The initial setting of the springs is done by these eyebolts.)
5	Remove the diaphragm case. Pull the actuator rod upward together with the diaphragm.

Step	Procedure
6	<p data-bbox="582 273 805 302">Remove the springs.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="654 324 1013 1344"> </div> <div data-bbox="1021 324 1380 1344"> </div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div data-bbox="606 1377 965 1444"> <p>Fig. 4-8. Actuator Model HA2D or HA3D</p> </div> <div data-bbox="1045 1377 1404 1411"> <p>Fig. 4-9. Actuator Model HA4D</p> </div> </div>

(b) Reverse action type (See Fig. 4-10 or Fig. 4-11)

Step	Procedure
1	Disconnect the air piping and detach other external items from the actuator.
2	Remove the stem connector, pointer and lock nut.
3	Remove the clamping-bolts (except the pair of eyebolts) of the diaphragm case.
4	Loosen evenly and alternately the pair of eyebolts. (The initial setting of the springs is done by these eyebolts.)
5	Remove the diaphragm case. Remove the springs.
6	<p>Pull the actuator rod upward together with the diaphragm.</p> <p>Fig. 4-10. Actuator Model HA2R or HA3R</p> <p>Fig. 4-11. Actuator Model HA4R</p>

4-3-1-2. Assembly procedure

Before assembly, check the parts for scrapes, damage, deformation, peeling off of paint, or any other abnormalities. To assemble the actuator, proceed as follows:

(a) Direct action type

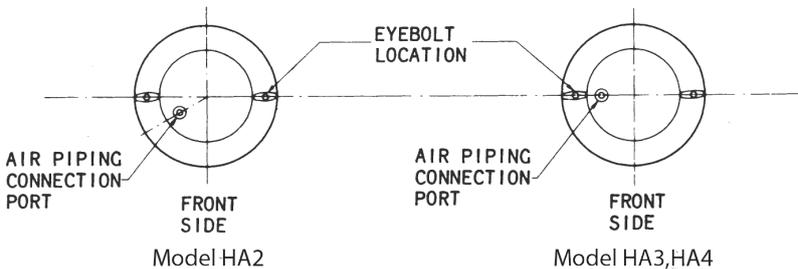
Step	Procedure
1	Fix the bottom diaphragm case and yoke with the bolts. (For models HA2D and HA3D, install the diaphragm case and spring plate together.)
2	Install the springs on the spring plate. The quantities of springs are as follows: Model HA2 4 springs Model HA3, HA4 8 springs Except particular models as follows: Model HA2, 38 mm stroke, 80 - 240 kPa {0.8 - 2.4 kgf/cm ² }..... Total 8 springs (with double springs) Model HA3, 50 mm stroke, 80 - 240 kPa {0.8 - 2.4 kgf/cm ² }..... Total 16 springs (with double springs) Model HA4, 75 mm stroke, 80 - 240 kPa {0.8 - 2.4 kgf/cm ² }..... Total 16 springs (with double springs)
3	Insert the actuator rod (to which the diaphragm is connected) into the bushing, exercising care not to damage the bushing inside surface or dust seal with the threaded section of the rod. (For example, cover the threaded section with adhesive tape to prevent damaging the bushing.) Set the stopper in parallel with the yoke.
4	Place the top diaphragm case and fix it with the pair of eyebolts. Note: Set the air piping connection port in the location shown in the illustration. (Fig. 4-12) Note: Tighten the pair of eyebolts uniformly by tightening them alternately. The initial setting of the springs is complete by tightening of these eyebolts. <div style="text-align: center;">  <p>The diagram shows two circular cross-sections of diaphragm cases. The left one is labeled 'Model HA2' and the right one is labeled 'Model HA3, HA4'. Both are labeled 'FRONT SIDE'. On each case, there is a small circle labeled 'AIR PIPING CONNECTION PORT' and two small circles labeled 'EYEBOLT LOCATION'.</p> </div>
5	Clamp the diaphragm case with clamping-bolts other than the pair of eyebolts.
6	Install the pointer, secure the lock nut, and install the stem connector. (Connect the air pipe to the air piping connection port of the top diaphragm case.)

Fig. 4-12. Direct action type

Step	Procedure
7	<p>After the assembly is complete as above, check the following.</p> <ol style="list-style-type: none"> 1. Applying an air pressure of 490 kPa {5 kgf/cm²} via the air piping connection port of the top diaphragm case, check the diaphragm periphery for air leak by using soapsuds. 2. Check that the actuator smoothly operates at its full stroke. <p>Note: Check this operation by operating the actuator as an independent unit.</p>

(b) Reverse action type

Step	Procedure
1	Fix the bottom diaphragm case and yoke with the bolts.
2	Insert the actuator rod (to which the diaphragm is connected) into the bushing, exercising care not to damage the bushing inside surface or dust seal with the thread section of the rod. (For example, cover the threaded section with adhesive tape to prevent damaging the bushing.)
3	Make the stopper (in the diaphragm plate) in parallel with the yoke by turning the rod.
4	<p>Install the springs on the spring plate. The quantities of springs are as follows:</p> <p>Model HA2.....4 springs</p> <p>Model HA3, HA48 springs</p> <p>Except particular models as follows:</p> <p>Model HA2, 38 mm stroke, 80 - 240 kPa {0.8 - 2.4 kgf/cm²} Total 8 springs (with double springs)</p> <p>Model HA3, 50 mm stroke, 80 - 240 kPa {0.8 - 2.4 kgf/cm²} Total 16 springs (with double springs)</p> <p>Model HA4, 75 mm stroke, 80 - 240 kPa {0.8 - 2.4 kgf/cm²} Total 16 springs (with double springs)</p>
5	<p>Place the top diaphragm case and fix it with the pair of eyebolts. Set the air vent hole in the location shown in the illustration (Fig. 4-13). Uniformly and alternately tighten the eyebolts. The initial setting of the springs is complete by tightening these eyebolts.</p> <div style="text-align: center;"> <p>The diagram illustrates the front side of two diaphragm cases. On the left is Model HA2, and on the right are Models HA3 and HA4. Each case has a central horizontal axis. On the left side of each case, there is an 'AIR VENT PORT' indicated by a small circle with a dot. On the right side, there is an 'EYEBOLT LOCATION' indicated by a small circle with a dot. The cases are shown as concentric circles representing the diaphragm and the outer case.</p> </div> <p>Fig. 4-13. Reverse action type</p>
6	Clamp the diaphragm case with other clamping-bolts other than the pair of eyebolts.

Step	Procedure
7	Install the pointer, secure the lock nut, and install the stem connector.
8	Install the rain cap on the air vent port.
9	Connect the air pipe to the air piping connection port of the bottom diaphragm case.
10	<p>After the assembly is complete as above, check the following.</p> <ol style="list-style-type: none"> 1. Applying an air pressure of 490 kPa {5 kgf/cm} via the air piping connection port of the bottom diaphragm case, check the diaphragm periphery for air leak by using soapsuds. 2. Check that the actuator smoothly operates at its full stroke unit. <p>Note: Check this operation by operating the actuator as an independent.</p>

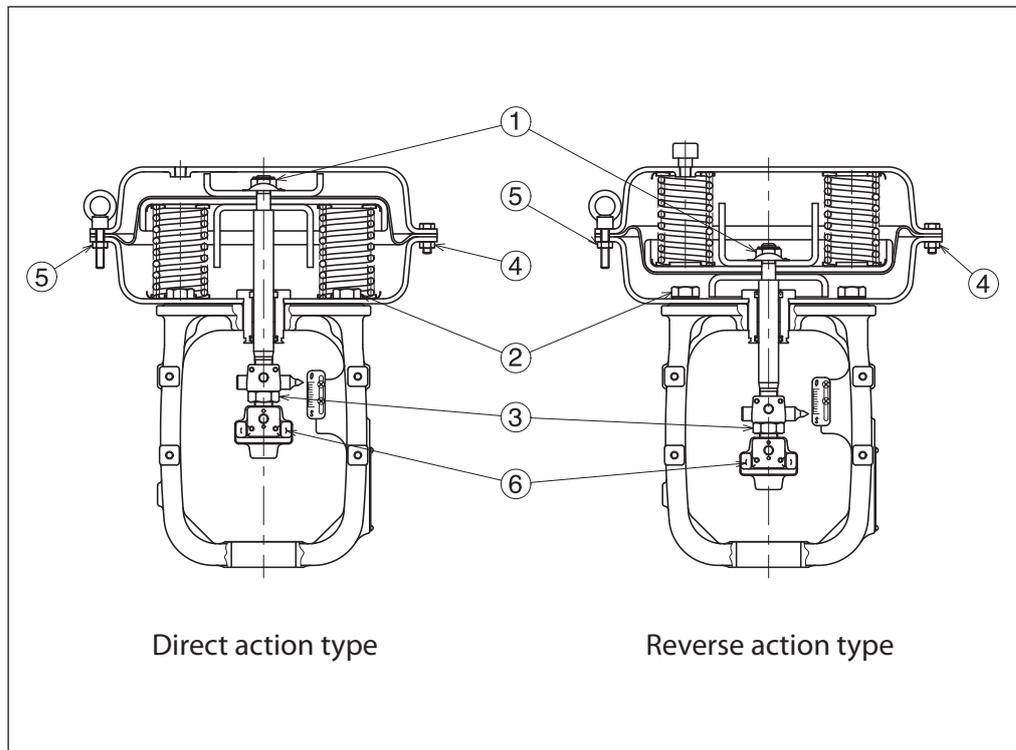


Fig. 4-14. Bolts and nuts of actuator

Table 4-3. Tightening torque bolts and nuts of actuator

[Unit: N·m {kgf/cm}]

No.	Material	For Model HA2		For Model HA3		For Model HA4	
		M10	37 {370}	M14	100 {1,050}	M20	310 {3,170}
2	S30C	M12	42 {420}	M16	100 {1,050}	M24	360 {3,600}
3	S20C	M14	69 {690}	M18	145 {1,450}	M30	700 {7,160}
4	S20C	M8	16 {160}	M8	16 {160}	M12	42 {420}
5	SUS304	M8	18 {185}	M8	18 {185}	M12	63 {630}
6	S30C	M10	37 {375}	M10	37 {375}	M12	42 {420}
			56 {560}		56 {560}		63 {630}

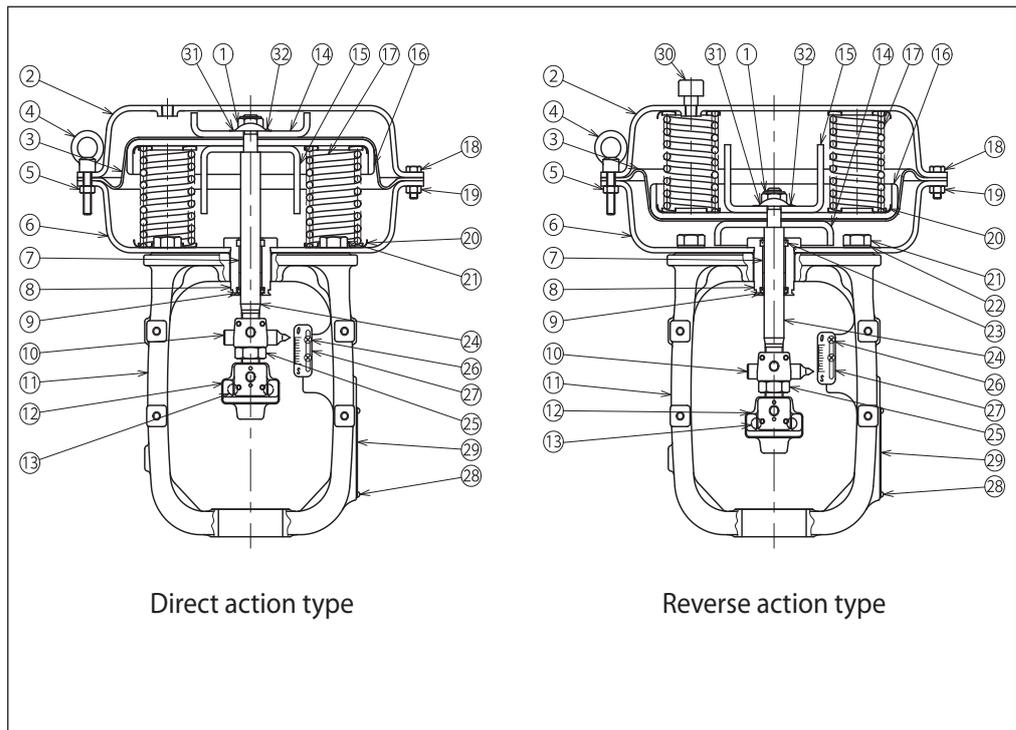


Fig. 4-15. Cut view of actuator

No.	Parts name	Material	No.	Parts name	Material
1	Nut	S45C, SUS301	17	Coil spring	SWOSM-B
2	Diaphragm case (top)	SAPH370	18	Hex bolt	SUS304
3	Diaphragm	EPDM, Nylon 66	19	Hex nut	SUS304
4	Eye bolt	SUS304	20	Spring plate	SPCC
5	Hex nut	SUS304	21	Hex bolt	S30C
6	Diaphragm case (bottom)	SAPH370	22	Ssal Washer	NBR, SPCC
7	Bushing	SPCC, PTFE	23	Rod packing	NBR
8	Bearing	S20C	24	Rod	SUS304
9	Dust seal	NBR	25	Lock nut	SUS304
10	Pointer	S25C	26	Trus screw, spring washer, or speed nut	SUS304, SUS304, SK5
11	Yoke	SCPH2	27	Scale plate	SUS304
12	Stem connector	S25C	28	Screw	SUS304
13	Stem connector Bolt	SUS304,S30C	29	Nameplate	SUS304
14	Diaphragm retainer	SS400	30	Cap	SUS304
15	Stopper	SS400	31	Washer	SPCC
16	Diaphragm plate	SS400	32	Tapping screw	S20C

Chapter 5. Adjustment

As a general rule, diaphragm type control valves require no adjustment. However, when coupling an actuator to a valve body after removing the actuator for overhaul or other purposes, adjustment of the travel (stroke) is necessary. For this adjustment, refer to Fig. 4-7, Fig. 5-1 and proceed as follows:

- (1) Fix the actuator to the valve body by securely tightening the yoke clamping-nut (use a chisel and hammer).
- (2) Connect an adjustable air pressure (with a pressure regulator) to the actuator -- to the top diaphragm case for the direct action type or the bottom diaphragm case for the reverse action type.
- (3) Lower the valve seat and check that it is touching the valve seat.

5-1. For direct action type

- (4) Apply to the actuator the maximum air pressure corresponding to the spring range indicated on the nameplate.
- (5) Increase the air pressure once. Then increase it again to the maximum value corresponding to the spring range, in the increasing direction.
- (6) In the above state, align the actuator stem and valve stem in a straight line, adjust so that the thread of the stem connector mates with those of actuator stem and valve stem, and securely tighten the clamping-bolts of the stem connector.

5-2. For reverse action type

- (4) Apply to the actuator the minimum air pressure corresponding to the spring range indicated on the nameplate, and check that the actuator stem moves by 1~2 mm in response.
- (5) Increase the air pressure once. Then decrease it again to the minimum value corresponding to the spring range, in the decreasing direction.
- (6) Perform a procedure identical with that of Item (7) of "For Direct Action type".

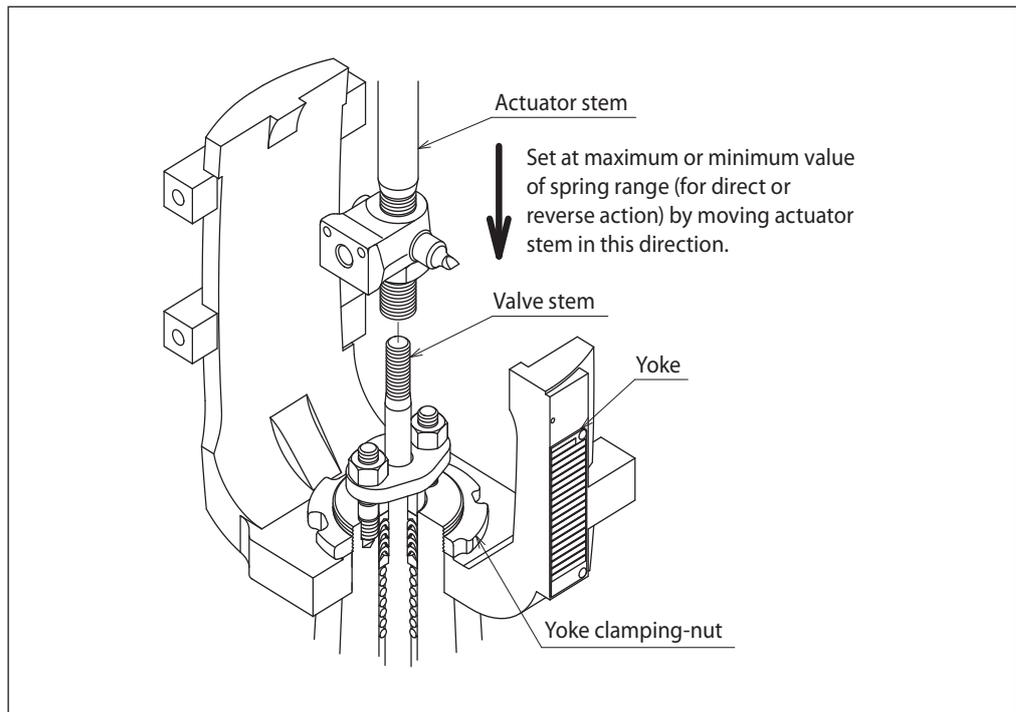


Fig. 5-1.

Chapter 6. Direct / Reverse Action type Conversion and Spring range Change of Actuator

6-1. Direct / Reverse action change

As a general rule it is most recommendable to prepare separately the direct type and reverse type of actuators and not to convert actuators into different types. However, when it has become unavoidable to convert actuators into other types, conversions may be done by using the parts mentioned below (Table 6-1 on page 6-2 and Table 6-2 on page 6-3). The parts marked “+” are the ones which are newly needed and those marked “-” are ones which are not used.

Table 6-1. To convert the direct action type into the reverse action type

Model HA2D -> Model HA2R			
Part name	Qty	For stroke 14.3 mm, 25 mm	For stroke 38 mm
Seal washers	+4	82521069-101	82521069-101
Rod packing	+1	82521067-101	82521067-101
Rod unit	+1	82521431-101 (14.3 mm) 82521431-102 (25 mm)	82521431-103
Rain cap	+1	82553334-101	82553334-101
Rod	(-1)	82521427-101 (14.3 mm) 82521427-102 (25 mm)	82521427-103

Model HA3D -> Model HA3R				
Part name	Qty	For stroke 14.3 mm	For stroke 14.3 mm, 25 mm	For stroke 38 mm
Seal washers	+2	82521069-102	82521069-102	82521069-102
Rod packing	+1	82521067-102	82521067-102	82521067-102
Rod unit	+1	82521431-201	82521063-103 (25 mm) 82521063-104 (38 mm)	82521431-204
Rain cap	+1	82553334-101	82553334-101	82553334-101
Rod	(-1)	82521428-101	82521428-102 (25 mm) 82521428-103 (38 mm)	82521428-104

Model HA4D -> Model HA4R			
Part name	Qty	For stroke 25 mm	For stroke 38 mm, 50 mm, 75 mm
Seal washers	+2	82521069-103	82521069-103
Rod packing	+1	82521067-103	82521067-103
Rod unit	+1	82521431-302	82521431-303
Rain unit	(-1)	82521429-102	82521429-103 (38 mm) 82521429-104 (50 mm) 82521429-105 (75 mm)
Rain cap	+1	82553334-101	82553334-101
Flat washers	(-2)	82592131-201	82592131-201

Table 6-2. To convert the reverse action type into the direct action type

Model HA2D -> Model HA2R			
Part name	Qty	For stroke 14.3 mm, 25 mm	For stroke 38 mm
Seal washers	(-2)	82521069-101	82521069-101
Rod packing	(-1)	82521067-101	82521067-101
Rod unit	+1	82521427-101 (14.3 mm) 82521427-102 (25 mm)	82521427-103
Rain unit	(-1)	82521431-101 (14.3 mm) 82521431-102 (25 mm)	82521431-103
Rain cap	(-1)	82553334-101	82553334-101

Model HA3D -> Model HA3R				
Part name	Qty	For stroke 14.3 mm	For stroke 14.3 mm, 25 mm	For stroke 38 mm
Seal washers	(-2)	82521069-102	82521069-102	82521069-102
Rod packing	(-1)	82521067-102	82521067-102	82521067-102
Rod unit	+1	82521428-101	82521428-102 (25 mm) 82521428-103 (38 mm)	82521428-104
Rain unit	(-1)	82521431-201	82521431-202 (25 mm) 82521431-203 (38 mm)	82521431-204
Rain cap	(-1)	82553334-101	82553334-101	82553334-101

Model HA4D -> Model HA4R			
Part name	Qty	For stroke 25 mm	For stroke 38 mm, 50 mm, 75 mm
Seal washers	(-2)	82521069-103	82521069-103
Flat washers	+2	82592131-201	82592131-201
Rod packing	(-1)	82521067-103	82521067-103
Rod unit	(-1)	82521431-302	82521431-303
Rain unit	+1	82521429-102	82521429-103 (38 mm) 82521429-104 (50 mm) 82521429-105 (75 mm)
Rain cap	(-1)	82553334-101	82553334-101

6-2. Stroke and range spring change

As a general rule it is most recommendable to prepare separate actuators for different strokes and spring ranges to avoid modifications. However, modifications can be done by using the parts mentioned below.

Of models HA2 and HA3, there are two different diameters of bonnet connecting sections. For these models, note the following:

Of model HA, modification for change between rated stroke of 14.3 or 25 mm and that of 38mm cannot be done.

Of model HA3, modification for change between rated stroke of 25 or 38 mm and that of 50mm cannot be done.

Table 6-3. Parts required for respective stroke range

Actuator		Model HA2D -> Model HA2R		
Part name		Qty	Stroke 25 → 14.3 mm	Stroke 14.3 → 25 mm
Scale plate		1	80225032-164	80225037-164
Spring	20-98 {0.2 -0.1}	4	82521205-101	82521205-103
	80-240 {0.8-2.4}	4	82521205-102	82521208-101
Rod unit	R (reverse action)	1	82521431-101	82821431-102
	D (Direct action)	1	82521427-101	82521427-102

Actuator		Model HA3D -> Model HA3R		
Part name		Qty	Stroke 25 → 14.3 mm	Stroke 14.3 → 25 mm
Scale plate		1	80225037-164	80225039-164
Spring	20-98 {0.2 -0.1}	8	82521206-101	82521206-103
	80-240 {0.8-2.4}	8	82521206-102	82521209-101
Rod unit	R (reverse action)	1	82521431-202	82821431-203
	D (Direct action)	1	82521428-102	82521428-103

Actuator		Model HA4D -> Model HA4R				
Part name		Qty	Stroke 25 mm	Stroke 38 mm	Stroke 50 mm	Stroke 75 mm
Scale plate		1	80225037-164	80225039-164	80225041-164	80224425-164
Spring	20-98 {0.2-0.1}	8	82521244-104	82521207-101	82521207-102	82521210-103
	80-240 {0.8-2.4}	8	82521244-106	82521210-101	82521210-102	82521210-104* 82521210-105*
Rod unit	R (reverse action)	1	82521429-102	82521429-103	82521429-104	82521429-105
	D (Direct action)	1	82521431-302	82521431-303	82521431-303	82521431-303

Note: Spring force is equivalent to air pressure (kPa{kgf/cm²})

*: The quantity of springs is 8 set, with 2 springs for each set, or total 16 springs.

Color codes and dimensions of the springs of model HA actuators

The color codes and dimensions of the springs of model HA Actuators are as shown in the following table. The color codes may help you confirm springs when disassembling and assembling actuators for modification or other purpose.

Table 6-4. Color codes and dimensions of springs

Rated stroke	Actuator Model		PSA1	HA2	HA3	HA4
	Range					
14.3	20-98 {0.2-1.0}	Red 64.6	Red 86.1	Yellow and 99.2		
	80-240 {0.8-2.4}	Blue 69.8	Blue 90.7	Red and green 103.6		
25	20-98 {0.2-1.0}	Green 68.7	Yellow 89.8	Red 100.3	Yellow and green 148.1	
	80-240 {0.8-2.4}	Purple 78.8	Brown 98.3	Blue 108.1	Red and green 155.3	
38	20-98 {0.2-1.0}		Green 93.9	Yellow 103.9	Red 151.8	
	80-240 {0.8-2.4}		Purple 107	Brown 115.9	Blue 162.7	
50	20-98 {0.2-1.0}			Green 107.5	Yellow 155.3	
	80-240 {0.8-2.4}			Purple 123.2	Brown 169.6	
75	20-98 {0.2-1.0}				Green 162.4	
	80-240 {0.8-2.4}				Purple (Note1) 181, 185.7	

- Note: 1. Each set is comprised of two springs.
2. “0.2-1.0” and “0.8-2.4” are spring forces corresponding to air pressures in the unit of kPa{kgf/cm²}.
3. The dimensions indicated in the Table 6-4 are free lengths of springs.

Chapter 7. Instructions for Top

7-1. Model HA2, HA3, or HA4 actuator

Operating Instructions

To manually operate the actuator, refer to Fig. 7-1 through Fig. 7-6 and proceed as follows:

First, loosen the lock nut (which has a bar-shape handle and which locks the handwheel) and turn the handwheel in the direction indicated by the corresponding arrowhead mark.

As you turn the handwheel clockwise, the actuator stem moves downward regardless of whether the actuator is of the direct action type or reverse action type. The handwheel bears the “SHUT” mark to indicate that the valve is closed as the handwheel is turned clockwise and the “OPEN” mark to indicate that the valve is open as the handwheel is turned counterclockwise.

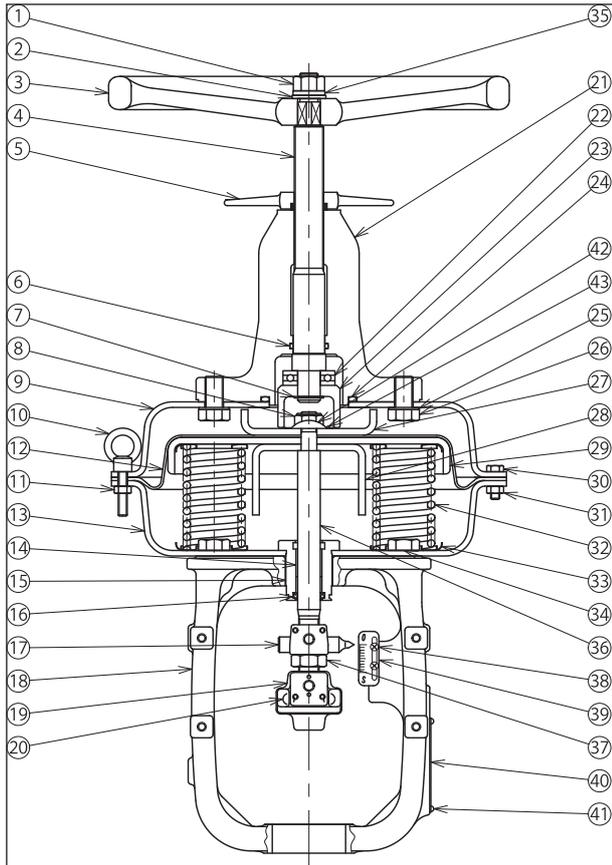
For automatic operation of the actuator, fully raise the handwheel if the actuator is of the direct action type or fully lower the handwheel if the actuator is of the reverse action type, and then tighten the lock nut to secure the handwheel to that position.

Precautions: If you force turn the handwheel after it has reached the mechanical stop position, the valve stem may be damaged. Do not turn the handwheel with forces larger than the mentioned below limits.

Model HA2: 190 N {19 kgf}

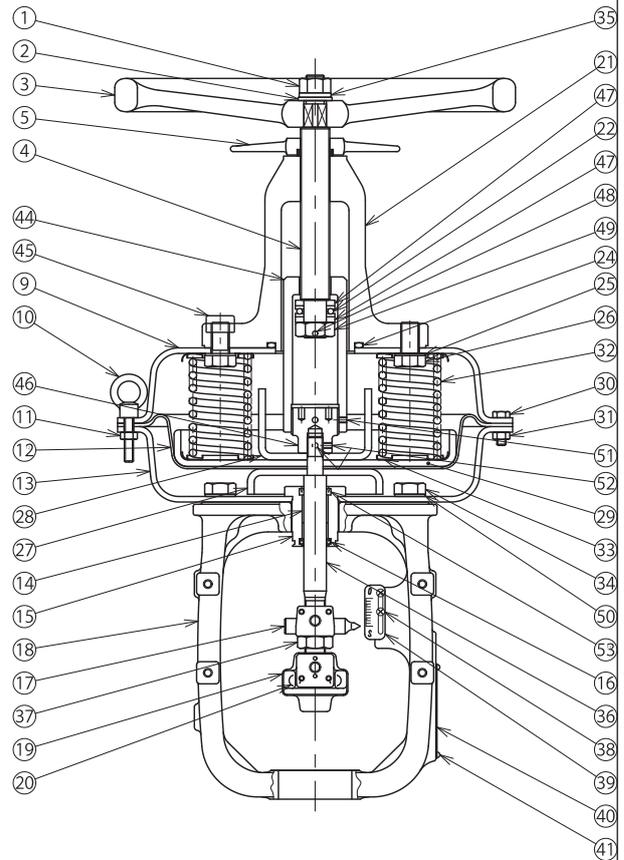
Model HA3: 260 N {26 kgf}

Model HA4: 410 N {41 kgf}



Direct action type

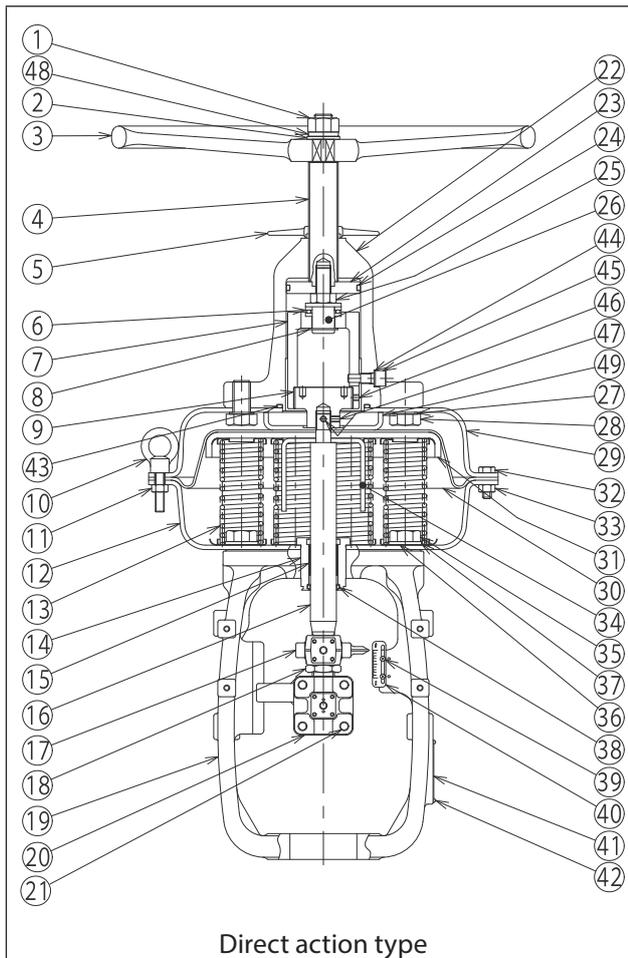
Fig. 7-1. Model HA 2/3 actuator with top handwheel (Direct action type)



Reverse action type

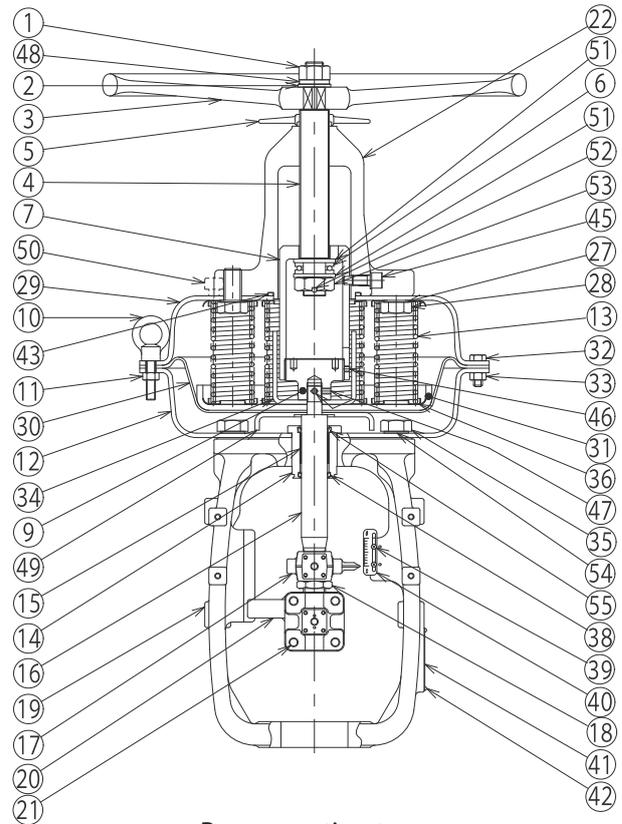
Fig. 7-2. Model HA2/3 actuator with top handwheel (Reverse Action type)

No	Parts name	No	Parts name	No	Parts name	No	Parts name
1	Hex nut	15	Bearing	29	Diaphragm plate	43	Tapping screw
2	Washer	16	Dust seal	30	Hex bolt	44	Bearing case
3	Handwheel	17	Pointer	31	Hex nut	45	Cap
4	Screw shaft	18	Yoke	32	Compressed coil spring	46	Connection
5	Lock nut	19	Stem connector	33	Spring plate	47	Bearing washer
6	O-ring	20	Stem connector bolt	34	Hex bolt	48	Cotter pin
7	Cotter	21	Housing	35	Spring washer	49	Castle nut
8	Nut	22	Bearing	36	Rod	50	Seal washer
9	Diaphragm case (top)	23	Spring retainer	37	Lock nut	51	Setscrew
10	Eye-bolt	24	O-ring	38	Truss screw, spring washer, or speed nut	52	Setscrew
11	Hex nut	25	Seal washer	39	Scale	53	Packing for rod
12	Diaphragm	26	Hex nut	40	Nameplate		
13	Diaphragm case (bottom)	27	Diaphragm retainer	41	Drive screw		
14	Bushing	28	Stopper	42	Washer		



Direct action type

Fig. 7-3. Model HA4 Actuator with top handwheel
(Direct action type)



Reverse action type

Fig. 7-4. Model HA4 actuator with top handwheel
(Reverse action type)

No.	Parts name	No.	Parts name	No.	Parts name	No.	Parts name
1	Hex nut	15	Bushing	29	Diaphragm case (top)	42	Drive screw
2	Washer	16	Rod	30	Diaphragm	43	O-ring
3	Handwheel	17	Pointer	31	Diaphragm plate	44	Seal washer
4	Srew shaft	18	Lock nut	32	Hex bolt	45	Keybolt
5	Lock nut	19	Yoke	33	Hex nut	46	Setscrew
6	Bearing	20	Stem connector	34	Stopper	47	Setscrew
7	Bearing case	21	Stem connector bolt	35	Hex bolt	48	Spring washer
8	Cotter	22	Housing	36	Spring plate	49	Diaphragm retainer
9	Connection	23	Piston plate	37	Washer	50	Cap
10	Eye-bolt	24	O-ring	38	Dust seal	51	Washer
11	Hex nut	25	Hex bolt	39	Truss screw, spring washer, or speed nut	52	Cotter pin
12	Diaphragm case (bottom)	26	Bearing retainer			53	Castle nut
13	Compressed coil spring	27	Seal washer	40	Scale	54	Seal washer
14	Bearing	28	Hex bolt	41	Nameplate	55	Packing for rod

7-1-1. Disassembly and assembly of top handwheel

To disassemble or assemble the top handwheel, refer to Fig. 7-1 through Fig. 7-6 and proceed as described in this Chapter. For disassembly and assembly work, keep the actuator in the vertical attitude.

(a) Direct action type

Step	Procedure
1	Disconnect the air piping.
2	Set the handwheel shaft to the automatic operation position (fully raise the handwheel shaft).
3	Remove the top diaphragm case. When doing this, loosen the pair of eyebolts uniformly and alternately, after removing all other clamping- bolts of the diaphragm case.
4	Sufficiently insert the handle shaft by turning it and then remove the handwheel and the lock nut. Insert the shaft further and then remove the screw shaft from the housing.
5	Remove the O-ring.

To assemble the top handwheel, follow the disassembly procedure in the reverse order.

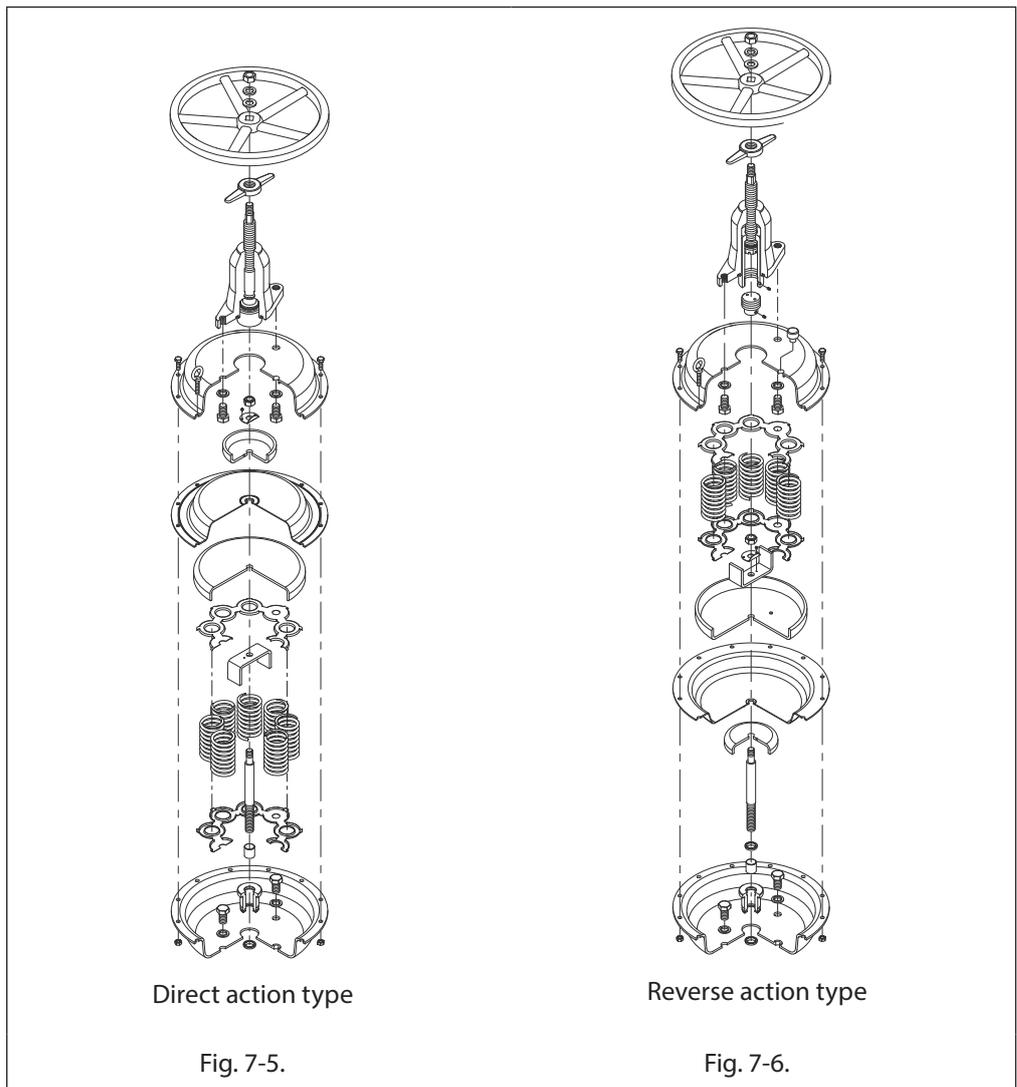
(b) Reverse action type

Step	Procedure
1	Disconnect the air piping.
2	Set the handwheel shaft to the automatic operation position (fully lower the handwheel shaft).
3	Remove the handwheel and the lock nut. Insert the shaft into the housing by uniformly and alternately, after removing all other clamping-bolt of the diaphragm case.
4	Remove the top diaphragm case. When doing this, loosen the pair of eyebolts uniformly and alternately, after removing all other clamping- bolts of the diaphragm case.
5	Remove the housing by loosening its clamping-screws.
6	Remove the setscrew and then remove the bearing case.
7	Remove the pin and then remove the castle nut.
8	Remove the bearing retainer and then remove the bearing.

To assemble the top handwheel, follow the disassembly procedure in the reverse order.

(c) Inspection after assembly

Step	Procedure
1	Check that the handwheel turns smoothly within its full stroke.
2	For the direct action type of actuator, check by means of soapsuds that there is no air leak from the connecting sections of the housing and top diaphragm case.



Chapter 8. Instruction for Side Handwheel of Actuator

As you turn the handwheel clockwise, the actuator stem moves downward regardless of whether the actuator is of the direct action type or reverse action type. The handwheel bears the “SHUT” mark to indicate that the valve is closed as the handwheel is turned clockwise and the “OPEN” mark to indicate that the valve is made open as the handwheel is turned counterclockwise.

8-1. Installation procedure

To install the side handwheel, refer to Fig. 8-1 and procedure as follows:

Step	Procedure
1	Prepare a manual operation kit (a side handwheel set and its mounting accessories).
2	To install the handwheel, no machining or other physical processing on the actuator is necessary.
3	By turning the handwheel, set the pointer of the operation nut to the AUTO position.
4	Loosen the bolt (item number 6 as shown in Fig. 8-1) and widen the distance between levers.
5	Install the handwheel on the mounting pad at the back of the actuator, with the mounting-bolts.
6	Engage the holes at the end of two levers to the pointer boss and engage those of the other ends to the boss of the operation nut, and then tighten the bolt.
7	When the control valve is in the automatic mode of operation, set the pointer of the operation nut at to AUTO position and keep the handwheel locked.

8-2. Operating instructions

- (1) To manually operate the actuator, remove the handwheel lock (the fork-shaped component) which locks the handwheel and turn the handwheel in the direction indicated by the corresponding arrowhead mark.
- (2) To return to the automatic operation, turn the handwheel so that the pointer of the operation nut is set AUTO position and then apply the handwheel lock.

Precautions: If you forcefully turn the handwheel after it has reached the mechanical stop position, the valve stem may be damaged. Do not turn the handwheel with forces larger than the below-mentioned limits.

Model HA2: 190 N {19 kgf}

Model HA3: 290 N {29 kgf}

Model HA4: 460 N {46 kgf}

(at the outmost periphery of the handwheel)

8-3. Disassembly and assembly of side handwheel (Refer to Fig. 8-1)

Before starting disassembly, check that the pointer is set to the AUTO position.

Step	Procedure
1	Loosen the bolt 6 which connects the levers 2 and then disengage the levers from the pointer.
2	Undo the mounting-bolts 1 of the side handwheel unit and detach it from the actuator.
3	Remove the lock nut of the handwheel and then remove the handwheel.
4	Loosen the bolt 8 of the bearing holder and then remove the feed shaft 7.
5	To assemble the side handwheel, refer to Fig. 8-1 and follow the disassembly procedure in the reverse order.

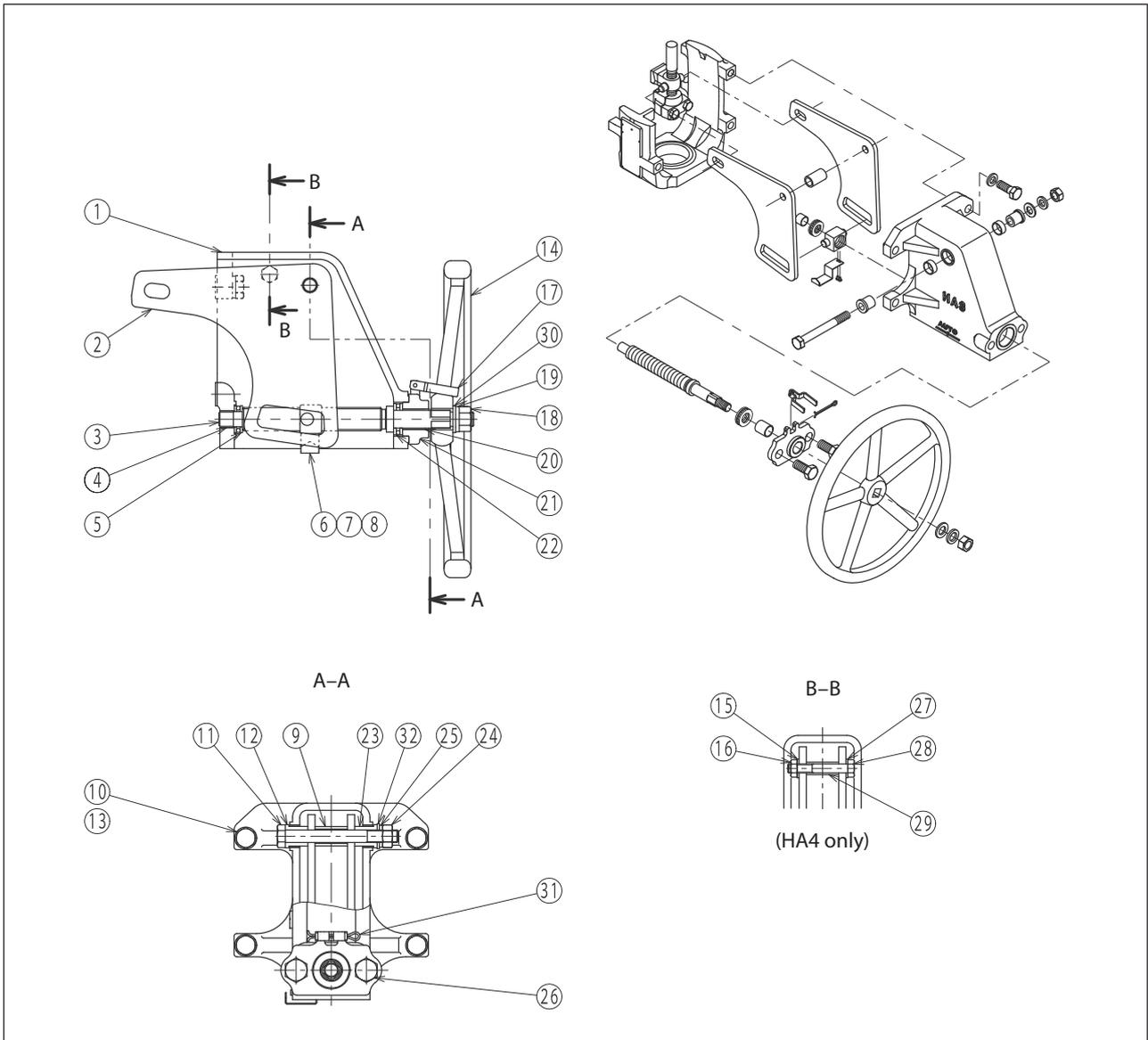


Fig. 8-1. View of side-handwheel

No.	Parts name	No.	Parts name	No.	Parts name	No.	Parts name
1	Housing	9	Color	17	Handle lock	25	Washer
2	Lever	10	Hex bolt	18	Hex nut	26	Hex bolt
3	Shaft	11	Hex bolt	19	Washer	27	Washer
4	Bushing	12	Bushing	20	Bushing	28	Hex bolt
5	Bearing	13	Spring washer	21	Bearing holder	29	Color
6	Nut	14	Wheel	22	Bearing	30	Spring washer
7	Screw	15	Washer	23	Bush	31	Pin
8	Pointer	16	Hex nut	24	Hex nut	32	Spring washer

Chapter 9. Instruction for Mechanical Flow Stopper of Actuator

Refer to Fig. 9-1. This flow stopper can be used as minimum flow stopper and maximum flow stopper as necessary.

9-1. Adjustment for Minimum Flow Stopper

- (1) Loosen the whirl-stop to remove the adjust cover for maximum flow stopper from the housing.
- (2) Loosen the hex nuts for minimum flow stopper to remove them from the shaft stopper. Valve can move in full stroke because the flow stoppers don't work in this state.
- (3) Set the valve position to the desired point of flow stopper.
- (4) Screw the hex nuts for minimum flow stopper to the shaft stopper until hitting the housing.
- (5) Tighten the adjust cover for maximum flow stopper and the whirl-stop. Please don't hit the maximum stopper and the whirl-stop to the shaft stopper when tightening them.
- (6) Lock the whirl-stop.

9-2. Adjustment for Maximum Flow Stopper

- (1) Loosen the whirl-stop to remove the adjust cover for maximum flow stopper from the housing.
- (2) Loosen the hex nuts for minimum flow stopper to remove them from the shaft stopper. Valve can move in full stroke because the flow stoppers don't work in this state.
- (3) Set the valve position to full open.
- (4) Screw the hex nuts for minimum flow stopper to the shaft stopper. In this case, adjust the distance between the hex nut for minimum flow stopper (lower) and the housing to be greater than rated lift.
- (5) Set the valve position to the desired point of flow stopper.
- (6) Screw the hex nuts for minimum flow stopper to the shaft stopper until hitting the hex nuts for minimum flow stopper or the shaft stopper.
- (7) Lock the whirl-stop.

9-3. Adjustment for Minimum and Maximum Flow Stopper

Adjust with the procedure of section 9-1 and 9-2

Note: When tightening or loosening the hex nuts for minimum flow stopper, please don't apply the excessive torque to the shaft stopper.

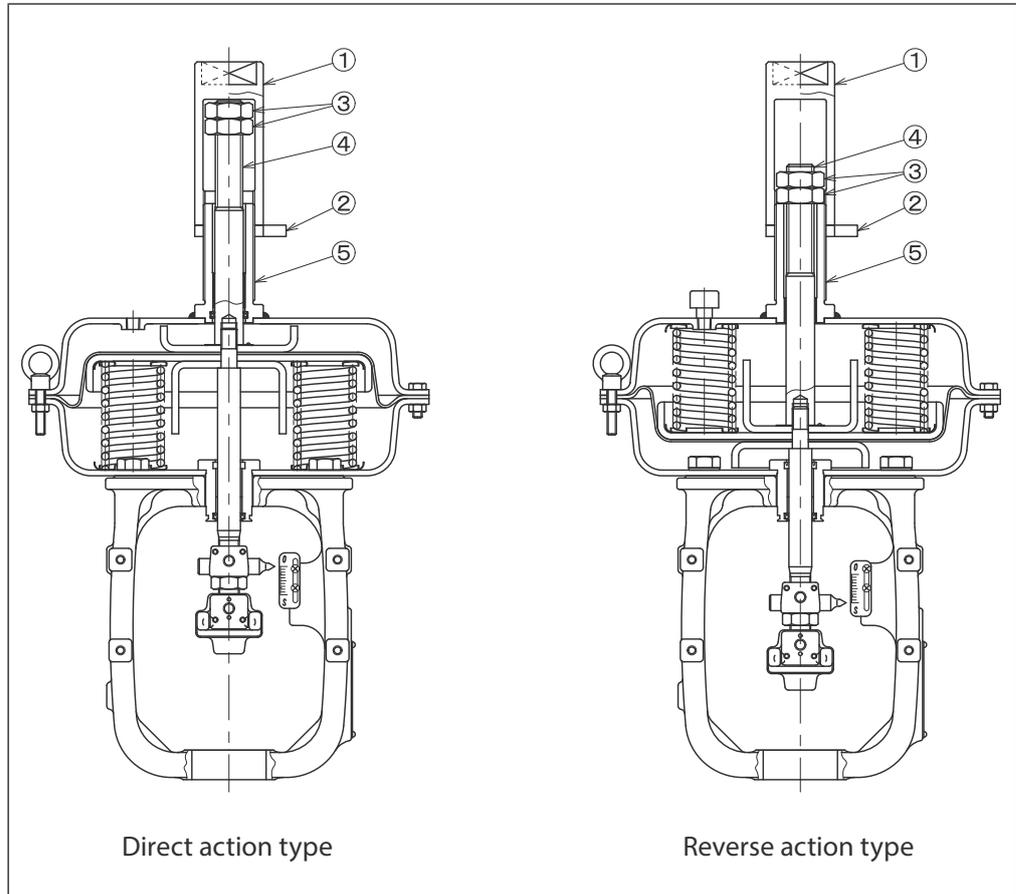


Fig. 9-1. Cut view of actuator with mechanical flow stopper

No.	Parts name
1	Adjust cover for maximum flow stopper
2	Whirl-stop
3	Hex nut for minimum flow stopper
4	Shaft stopper
5	Housing

Chapter 10. Instructions for Bellows Sealed type of Control Valves

The bellows sealed type of control valves differ from other control valves in that the former employ a bellows for a seal. This Chapter covers primarily the particular items related to bellows sealed type of control valves.

Note: The bellows seal assembly should be replaced periodically. The frequency of replacements depends on the conditions of use. When handling a mechanism which as a bellows seal assembly, exercise care so that the mechanism is not twisted. Note that the bellows is not highly resistant against torsion.

10-1. Structures

The structures of Model ACP/ACN Control Valves are shown in Fig. 10-1.

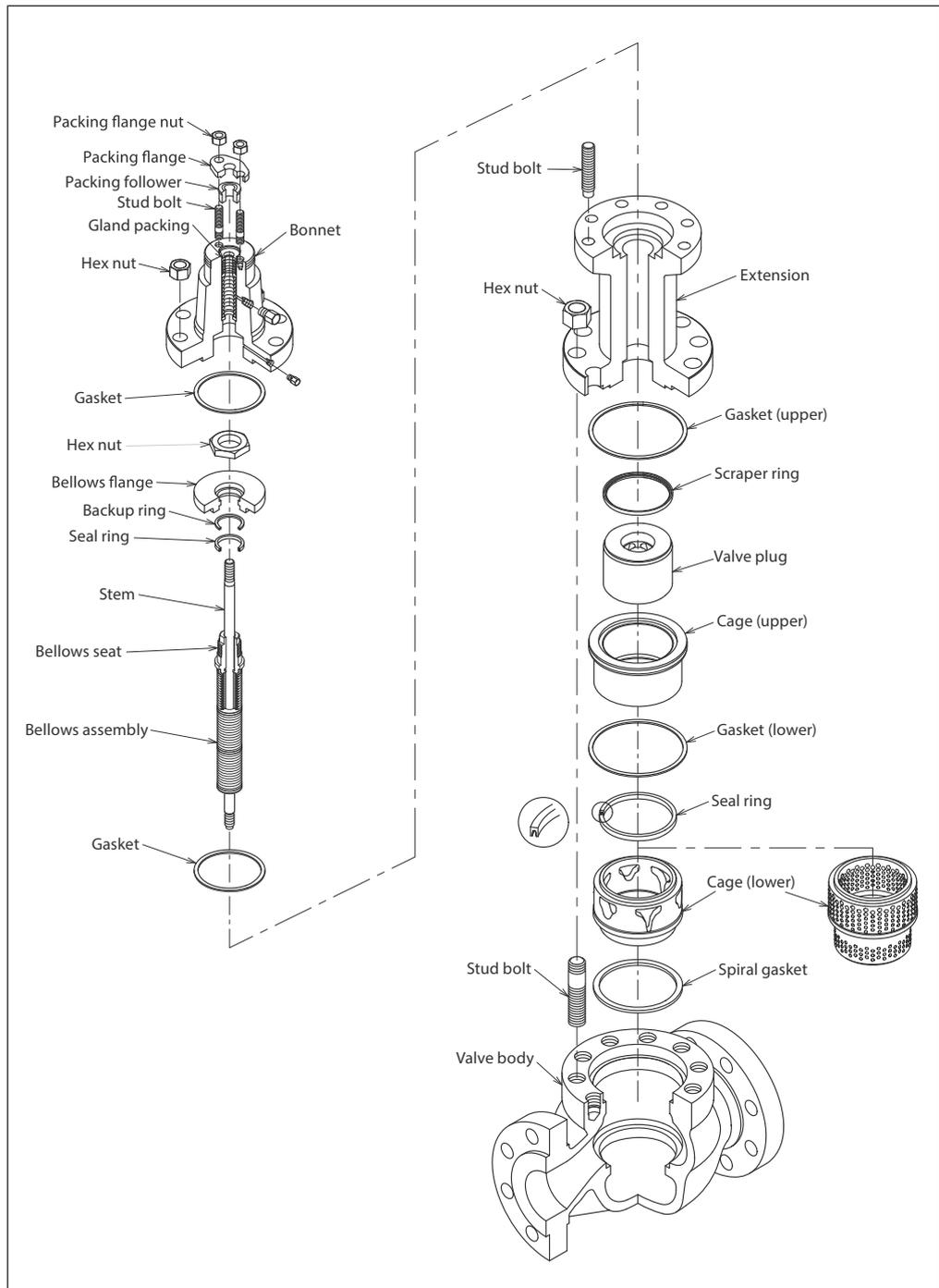


Fig. 10-1. Model ACP/ACN Control Valve

10-2. Disassembly and assembly

Step	Procedure
1	Detach the actuator from the valve as described in 4-1: Detaching actuator from valve body.
2	Loosen the packing flange nut.
3	Loosen the hex nut of the bonnet, using wrench.
4	Raise the bonnet and remove the gasket. Note: When raising the bonnet, press the stem down so that it will not come up together with the bonnet.
5	Remove the hex nut which fixes the bellows flange and bellows seat. Note: When loosening the nut, hold the bellows seat stationary so that no unreasonably large torsion is applied to the bellows, which is not highly resistant against torsion.
6	Remove the bellows flange and gasket. Note: The bellows seat can be readily detached by lightly tapping its top. (The most effective method is to tap it by passing a pipe onto the stem.)
7	Remove the hex nut which fixes the extension, with a wrench. Detach the extension from the valve body.
8	Remove the stem and plug. Note: The stem section has a valve plug, bellows seat and bellows assembly, which are welded together.
9	For disassembly of cage part, please refer to Chapter 4.

For assembly of the control valve, follow the disassembly procedure in the reverse order.

Chapter 11. Azbil Low Emission standard-compliant gland packing

11-1. Overview

Azbil low emission gland packing is a gland structure that employs a Live Load structure to its performance for a long period of time. In order to meet the emission regulations for Volatile Organic Compounds (VOC) required by the U.S. Clean Air Act Amendments (CAAA), we confirmed that the amount of gland leakage was not more than 500 ppm in terms of the atmospheric concentration of the equivalent methane value on the basis of Azbil Corporation's own evaluation criteria. * For the structure of the gland, refer to the structural drawing of Azbil low emission gland packing in Fig. 11-1.

* In Japan and overseas as of October, 2005, there are no industry standards that lay down any evaluation method for gland leakage.

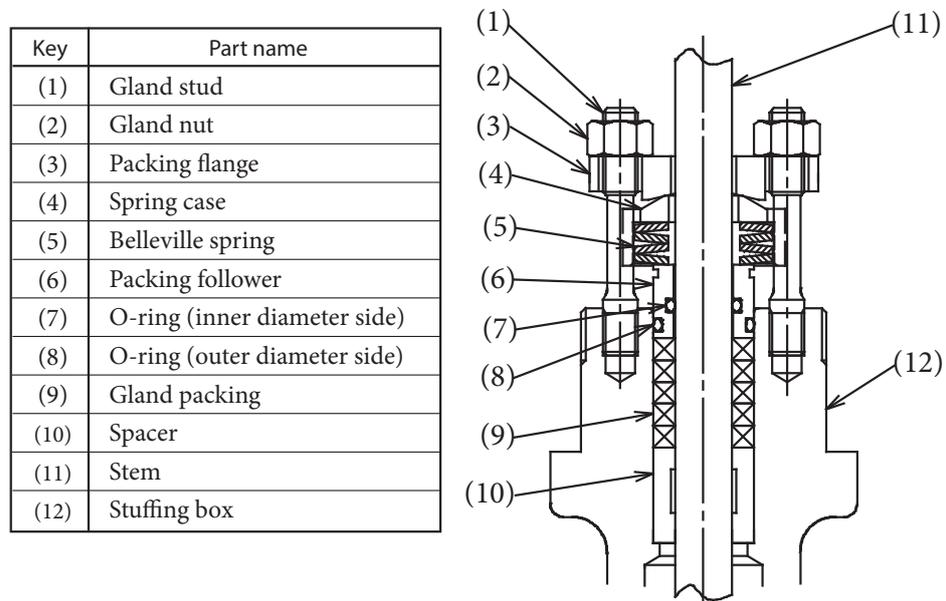


Fig. 11-1. Structural drawing of Azbil low emission gland packing

11-2. Structure

The gland packing P4519 for use in Azbil low emission gland packing is woven PTFE yarn with carbon fiber core. This gland packing provides asbestos-free properties in addition to low sliding friction and adaptability to heat cycles, and is adaptable to a wide range of fluids.

This gland packing is fastened with a Live Load structure comprised of Belleville springs. The Belleville springs are made to be tight compressing at the time of initial fastening. As a valve is operated, the seal performance of the gland packing becomes deteriorated because of strain release, but the restoring force of the Belleville springs automatically retightens it to maintain seal performance. The Belleville springs are installed in the spring case for the purposes of positioning and environmental protection. The loading conditions of the Belleville springs can be determined by checking a front window and scale marks of the spring case.

The set of parts can be added to an existing product without any change of its main body or actuator if it is an applicable control valve.

11-3. Installation into the gland

11-3-1. Preparation for installation

1. Checking for the surface conditions of parts

If there is any flaw or the like on the surface of a part, the total amount of gland leakage may exceed a specified value because of fluid leakage from the periphery. For this reason, check the surface conditions of the following parts:

Table 11-1. Parts whose surface conditions need to be checked

Part name	Finding:	Assumption
Stem	<ul style="list-style-type: none"> No flaws or defects, including scratches and dents No rust or corrosion The finished surface should be uniform over its entire area. No burrs Clean, without adhesion of any coating material, powdery material, or dirt When necessary, measures should be taken, such as cleaning with alcohol. 	The total amount of gland leakage may exceed the specified value because of fluid leakage from the periphery of a flaw .
Stuffing box		
Both ends of the spacer		
Packing follower		
Packing contact surface		
O-ring groove		
Packing flange	<ul style="list-style-type: none"> When necessary, measures should be taken, such as cleaning with alcohol. 	The amount of gland leakage may exceed the specified value because of insufficient tightening.
Gland nut contact surface		
Packing flange	<ul style="list-style-type: none"> No flaws, rust, or defects. 	Damage to the control valve may be caused, and may lead to physical injury.
Entire surface Gland stud		
Gland nut		

2. Preparation of new parts

Be sure to prepare new parts at the time of the first installation or reinstallation of the following parts.

Table 11-2. Parts that need to be renewed

Part name	Finding	Assumption
Gland packing	No flaws, coating materials, or dirt on the surface	The amount of leakage may exceed the specified value because of fluid leakage from the periphery of a flaw or the like.
Belleville spring		The amount of gland leakage may exceed the specified value in a short period of time because of overtightening or insufficient tightening.

3. Preparation of lubricating grease and anti-seize compound

Prepare proper amounts of lubricating grease and anti-seize compound indicated in the following table. (Equivalents also can be used.)

Table 11-3. Lubricating grease and anti-seize compound

Product name	Area to be coated
Silicone grease G40M made by Shin-Etsu Chemical Co., Ltd.	Entire surface of the gland packing
Plastilube No. 3 made by Sulflo, Inc., in the U.S.	Entire surface of the backup O-rings
Anti-seize compound Never-Seez made by Bostik, Inc., in the U.S.	Surface of the threads of the gland studs
	Bearing surface of the gland nuts

11-3-2. Start of installation

1. Coating with lubricating grease

Step 1: Apply a thin film (not more than 0.3 mm thick) of the grease indicated in Table 11-3 [G40M made by Shin-Etsu Chemical Co., Ltd.] to the entire surface of all the gland packing.

Step 2: Apply the grease indicated in Table 11-3 [Plastilube No. 3 made by Sulflo, Inc., in the U.S.] to each of the two backup O-rings on the inner diameter side and the outer diameter side of the packing follower.

2. Installation of parts

Step 1:

With reference to Fig. 11-2, check the direction of the gland studs. After applying the anti-seize compound indicated in Table 11-3 [Never-Seez made by Bostik, Inc., in the U.S.] to the surface of the threads, install them into the stuffing box.

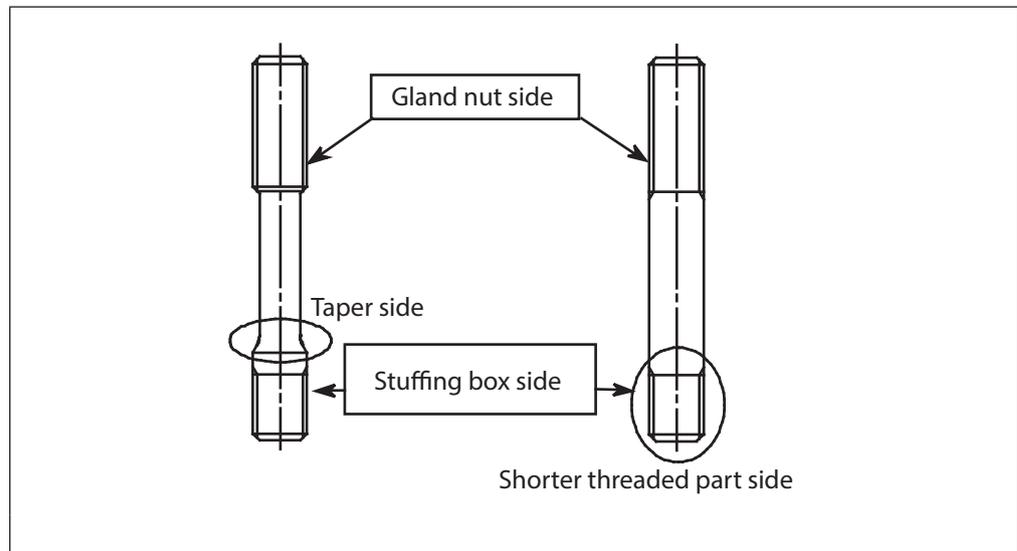


Fig. 11-2. Direction of the gland studs

Step 2:

Being careful not to damage the surface of the stem, install the spacer first.

Step 3:

Next, install one piece of the gland packing. Be sure to note how to open indicated in Fig.10-3. Insert it tightly with a pipe or the like. Finally, press it lightly.

Insert the second and subsequent pieces, with the gap position shifted by 180 degrees.

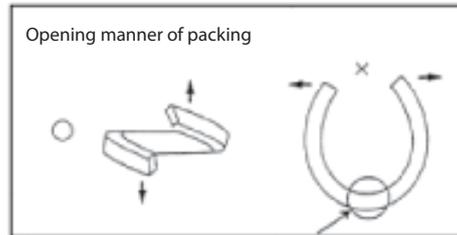


Fig. 11-3. How to handle gland packing

Step 4:

Next, check the direction of the packing follower. (See Fig. 11-1.) The outside O-ring side is the packing side.) Install it while being careful not to damage the surface of the stem.

Step 5:

With reference to Fig. 11-1, install the Belleville springs while being careful not to damage the surface of the stem.

Step 6:

With reference to Fig. 11-4, install the spring case in such a manner that two opposed side grooves are guided with the gland studs. (Two pairs of opposed side grooves are the same in dimension.) At the time of the installation, be careful not to damage the surface of the stem. Incidentally, when the Belleville springs are set in the spring case, they do not come into contact with the stem.

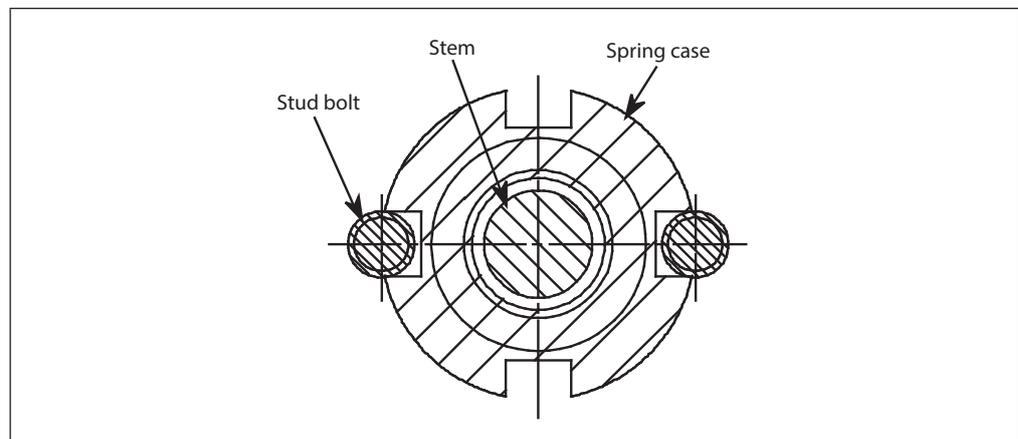


Fig. 11-4. Installation of the spring case Top view

Step 7:

Being careful not to damage the surface of the stem, install the packing flange.

Step 8:

After applying the anti-seize compound indicated in Table 11-3 [Never-Seez made by Bostik, Inc., in the U.S.] to the surface of the threads of the stud bolts and the bearing surface of the nuts, tighten them by hand.

3. Tightening

Step 1:

With reference to Fig. 11-5, check the position of the Belleville springs through the front window of the spring case. When the Belleville springs are set properly, the lower edge of the outer diameter of the lowest Belleville spring almost coincides with the lower scale mark of the spring case. (In some cases, it does not exactly coincide because of the dimensional tolerance of the Belleville springs.)

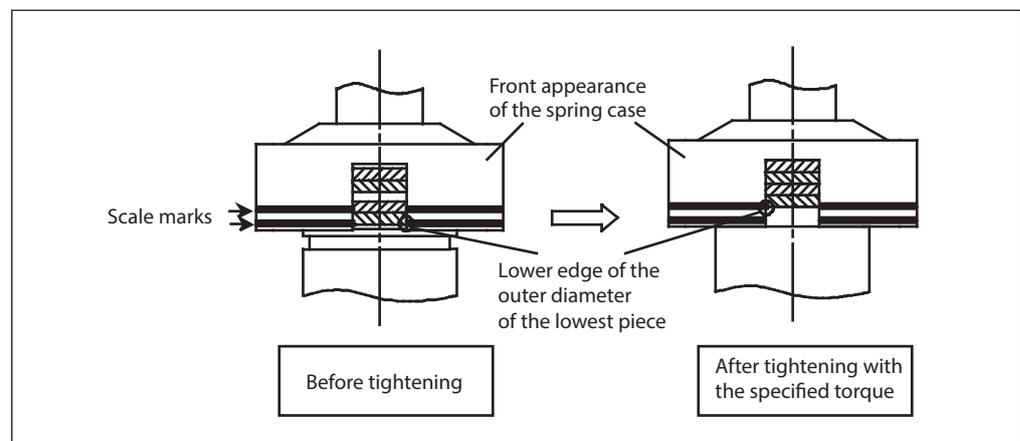


Fig. 11-5. Loading conditions of the Belleville springs

Step 2:

Tighten each of the right and left gland nuts by half a turn alternately to the specified torque. Table 11-4 shows the tightening torque.

If the tightening torque is less than the specified value, be aware that the amount of leakage may exceed the specified value because of insufficient tightening.

If the tightening torque is more than the specified value, be aware that the amount of leakage may exceed the specified value in a short period of time because of the accelerated wear of the gland packing, in addition to the increased sliding friction of the stem.

Table 11-4. Tightening torque of the gland nuts

Actuator model	Stem size	Tightening torque
PSA1, HA2	φ 10 mm	8 to 10 N·m
HA2, HA3	φ 13 mm	13 to 16 N·m
HA3	φ 16 mm	22 to 26 N·m
HA4	φ 20 mm	29 to 35 N·m

11-3-3. Retightening

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

- a) At the time of an inspection before the installation of the control valve
- b) At the time of a test operation or start-up operation of the equipment
- c) In case the leakage amount of the gland exceeds the specified value during operation of the equipment.

If the leakage amount of the gland still exceeds the specified value after retightening, reinstall the complete set of gland parts. In addition, it is recommended that the gland packing and the Belleville springs be replaced with new parts.

11-4. Parts List

Part name	Actuator model	Stem size	Material	Part No.	Qty.		
Main packing	PSA1	φ10 mm	P4519	80255384-111	5		
Belleville spring			SUS304	82571710-101	4		
O-ring (small)			Viton	82592220-897	1		
O-ring (large)			Viton	82592221-897	1		
Stem connector			SCS13A	82557767-101	1		
Gland stud			SUS304	82559311-012	2		
Gland nut			SUS304	82592448-163	2		
Spring case			SUS304	82571708-101	1		
Packing follower			SUS304	82571711-101	1		
Packing follower for O-ring use			SUS304	82571715-101	1		
Spacer			SUS304	82555645-066	1		
Spacer for O-ring use			SUS304	82555645-566	1		
Main packing			HA2	φ10 mm	P4519	80255384-111	5
Belleville spring					SUS304	82571710-101	4
O-ring (small)	Viton	82592220-897			1		
O-ring (large)	Viton	82592221-897			1		
Stem connector	S20C/S25C	82520978-201			1		
Gland stud	SUS304	82559311-012			2		
Gland nut	SUS304	82592448-163			2		
Spring case	SUS304	82571708-101			1		
Packing follower	SUS304	82571711-101			1		
Packing follower for O-ring use	SUS304	82571715-101			1		
Spacer	SUS304	82555645-066			1		
Spacer for O-ring use	SUS304	82555645-566			1		
Main packing	HA2	φ13 mm			P4519	80255385-111	5
Belleville spring					SUS304	82559308-101	4
O-ring (small)			Viton	82592221-497	1		
O-ring (large)			Viton	82592222-297	1		
Stem connector			S20C/S25C	82520978-206	1		
Gland stud			SUS304	82571706-011	2		
Gland nut			SUS304	82592448-173	2		
Spring case			SUS304	82559309-101	1		
Packing follower			SUS304	82571712-101	1		
Packing follower for O-ring use			SUS304	82571716-101	1		
Spacer			SUS304	82555645-166	1		
Spacer for O-ring use			SUS304	82555645-666	1		
Main packing			HA3	φ13 mm	P4519	80255385-111	5
Belleville spring					SUS304	82559308-101	4
O-ring (small)	Viton	82592221-497			1		
O-ring (large)	Viton	82592222-297			1		
Stem connector	S20C/S25C	82571706-011			1		
Gland stud	SUS304	82571706-011			2		
Gland nut	SUS304	82592448-173			2		
Spring case	SUS304	82559309-101			1		
Packing follower	SUS304	82571712-101			1		
Packing follower for O-ring use	SUS304	82571716-101			1		
Spacer	SUS304	82555645-166			1		
Spacer for O-ring use	SUS304	82555645-666			1		

Part name	Actuator model	Stem size	Material	Part No.	Qty.		
Main packing	HA3	φ16 mm	P4519	80255386-111	5		
Belleville spring			SUS304	82559308-102	4		
O-ring (small)			Viton	82592221-797	1		
O-ring (large)			Viton	82592222-897	1		
Stem connector			S20C/S25C	82521091-201	1		
Gland stud			SUS304	82559312-011	2		
Gland nut			SUS304	82592448-013	2		
Spring case			SUS304	82559310-101	1		
Packing follower			SUS304	82571713-101	1		
Packing follower for O-ring use			SUS304	82571717-101	1		
Spacer			SUS304	82555645-766	1		
Spacer for O-ring use			SUS304	82555645-101	1		
Main packing			HA4	φ20 mm	P4519	80255387-111	5
Belleville spring					SUS304	82571710-201	4
O-ring (small)	Viton	82592221-997			1		
O-ring (large)	Viton	82592223-397			1		
Stem connector	S20C/S25C	82551348-202			1		
Gland stud	SUS304	82571707-011			2		
Gland nut	SUS304	82592448-023			2		
Spring case	SUS304	82571709-101			1		
Packing follower	SUS304	82571714-101			1		
Packing follower for O-ring use	SUS304	82571718-101			1		
Spacer	SUS304	82555645-866			1		
Spacer for O-ring use	SUS304	82555645-201			1		

Chapter 12. Certified ISO 15848-1 compliant low emission gland packing

12-1. Overview

Certified ISO 15848-1 low emission gland packing 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 ISO15848-1, which is the international standard for low-emission performance of valves. For the structure of the gland, see Fig. 12-1 and Fig. 12-2.

No.	Name
(1)	Gland stud
(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 packing follower (optional)
(13)	Stuffing box

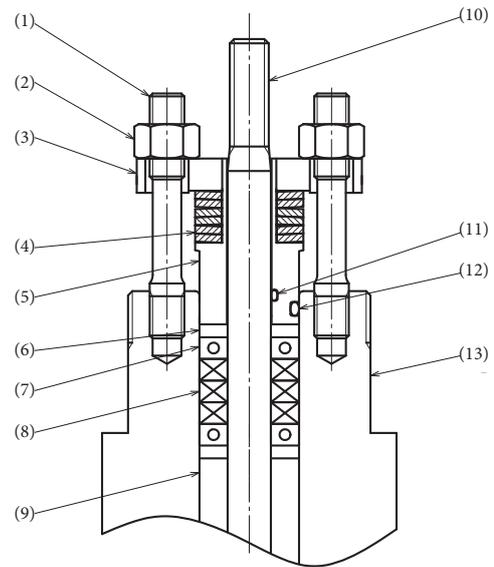


Fig. 12-1. Structure of Certified ISO 15848-1 low emission gland packing (for PTFE yarn)

No.	Name
(1)	Gland stud
(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

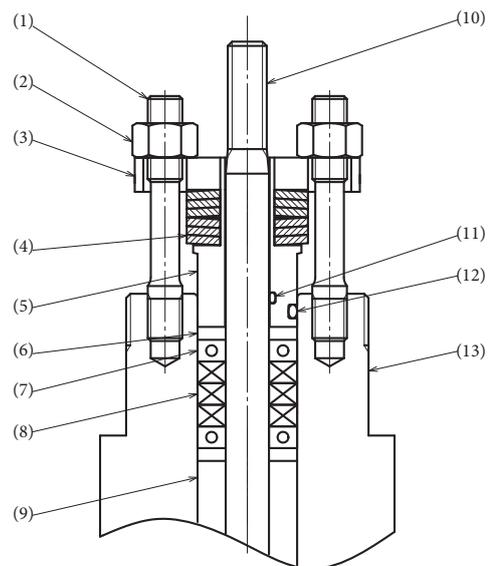


Fig. 12-2. Structure of Certified ISO 15848-1 low emission gland packing (for expanded graphite)

12-2. 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.

12-3. Starting Operation

Before operating the valve, tighten (or retighten) the gland. For instructions, refer to 12-4-2, “(3) Tightening”.

If leakage from the gland continues even after proper tightening, obtain and prepare parts as indicated in “12-4-1. Preparation for assembly”, and follow the procedure given in “12-4-2. Assembly”.

12-4. Assembling the parts of the gland

12-4-1. 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, resulting in a total amount of leakage from the gland that exceeds the specified value. Therefore, check the surface of the following parts.

Table 12-1. Parts to be checked for surface condition

Part	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. • If necessary, take necessary measures such as cleaning with alcohol. 	<p>If the problems stated on the left remain, fluid leaks from flawed areas may cause the total amount of leakage from the gland to exceed the specified value.</p>
Stuffing box		
Both ends of the spacer		
Packing follower		
Packing contact surface		
O-ring groove		
Packing flange Gland nut contact surface	<p>The total amount of leakage from the gland may exceed the specified value because of insufficient tightening.</p>	
Packing flange (entire surface)		
Gland stud Gland nut		<p>The problems on the left, if they remain, can cause control valve damage, leading to injuries.</p>

(2) New parts

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

Table 12-2. Parts requiring treatment

Part name	Checkpoints	Possible problems
Gland packing (main packing and adapter packing) Carbon ring	<ul style="list-style-type: none">• No flaws.• No coating materials or dirt stuck to the surface.	Fluid leaks from flawed areas can cause the total amount of leakage from the gland to exceed the specified value.
Belleville spring		The total amount of leakage from the gland may exceed the specified value in a short period of time because of insufficient tightening.

(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 12-3. Lubricating grease and anti-seizing agent

Product name	Applied area	Gland for PTFE yarn	Gland for 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 studs	Needed	Needed
	Bottom of the gland nuts	Needed	Needed

12-4-2. Assembly

(1) Applying lubricating grease

Step 1

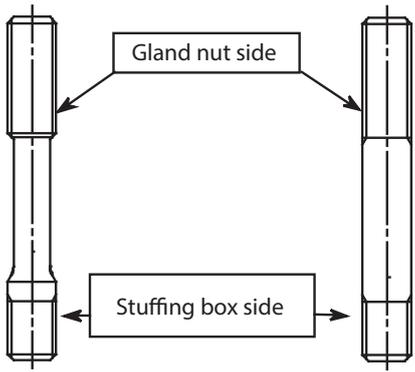
For Certified ISO 15848-1 low emission gland packing for PTFE yarn, apply a thin film of grease Krytox GPL207 indicated in Table 12-3 to the surface of all gland packings (main packing and adapter packing). For Certified ISO 15848-1 low emission gland packing for expanded graphite, greasing is not necessary.

Step 2

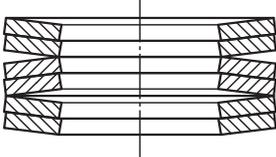
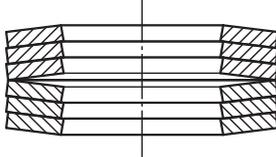
For Certified ISO 15848-1 low emission gland packing with two O-rings, which are placed inner and outer sides of the packing follower, apply grease Plastilube No.3 made by Sulflo Inc. indicated in Table 12-3 to both rings.

(2) Assembling

(1/3)

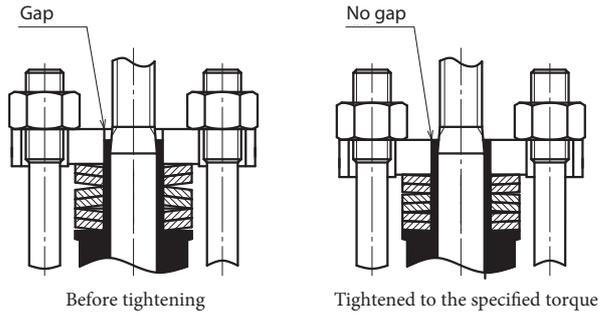
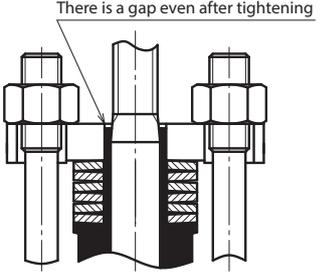
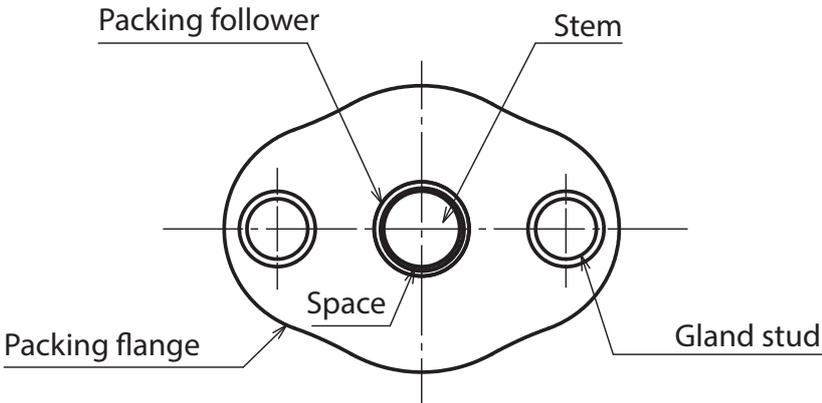
Step	Procedure
1	<p>Check the correct direction of the gland studs in Fig. 12-3. Apply Never-Seez anti-seizing agent made by Bostik Inc. (indicated in Table 12-3) to the threads on the stuffing box end of the studs, and screw them into the stuffing box.</p>  <p style="text-align: center;">Gland stud end with fewer threads</p> <p style="text-align: center;">Fig. 12-3. Direction of the gland stud</p>
2	First, insert the spacer, paying extra attention not to damage the surface of the stem.
3	Gently insert a carbon ring all the way to the bottom with a pipe, etc., taking care not to damage the ring.

Step	Procedure
4	<p>[Certified ISO 15848-1 low emission gland packing for PTFE yarn]</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> <p>Open the gap of the main packing rings as illustrated in Fig. 12-4 and insert one of them all the way to the bottom with a pipe, etc., and push it lightly. Insert the remaining two main packing rings with the gap position shifted by 180°.</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="746 591 1203 824" style="text-align: center;"> <p>The diagram, titled "Opening manner of packing", illustrates the process in two stages. On the left, a circular packing ring is shown with a gap. An arrow points to the gap opening, and another arrow points to the ring's thickness. On the right, the ring is shown inserted into a gland. An arrow points to the gap position, and an 'X' marks the top of the ring. A small circle at the bottom of the gland indicates the stem.</p> </div> <p>Fig. 12-4. How to open the main packing rings</p> <p>[Certified ISO 15848-1 low emission gland packing for expanded graphite]</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> <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	Gently insert a carbon ring all the way to the bottom with a pipe, etc., taking care not to damage the ring.
6	Check the correct mounting orientation of the packing follower in Fig. 12-1. or Fig. 12-2. Insert it, paying extra attention not to damage the surface of the stem.

Step	Procedure
7	<p>Stack the Belleville spring washers as shown in Fig. 12-5, and insert them into the packing follower.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>2 same-direction washers × 3 [For PTFE yarn]</p> </div> <div style="text-align: center;">  <p>3 same-direction washers × 2 [For expanded graphite]</p> </div> </div> <p style="text-align: center;">Fig. 12-5.</p>
8	Place the packing flange onto the packing follower.
9	Apply anti-seizing agent Never-Seez made by Bostik Inc. (Table 12-3) to the threads on the gland nut end of the gland studs, 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 12-4 or Table 12-5 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>Table 12-4. Gland nut tightening torque (for PTFE yarn)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Model</th> <th>Actuator model</th> <th>Stem size</th> <th>Tightening torque</th> </tr> </thead> <tbody> <tr> <td rowspan="5" style="text-align: center;">ACP, ACN</td> <td>HA2</td> <td>φ 10 mm</td> <td>12 N·m</td> </tr> <tr> <td>HA3</td> <td>φ 13 mm</td> <td>20 N·m</td> </tr> <tr> <td>HA3</td> <td>φ 16 mm</td> <td>33 N·m</td> </tr> <tr> <td>HA4</td> <td>φ 20 mm</td> <td>44 N·m</td> </tr> <tr> <td>PSA6</td> <td>φ 30 mm</td> <td>54 N·m</td> </tr> </tbody> </table> <p>Table 12-5. Gland nut tightening torque (for expanded graphite)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Model</th> <th>Actuator model</th> <th>Stem size</th> <th>Tightening torque</th> </tr> </thead> <tbody> <tr> <td rowspan="5" style="text-align: center;">ACP, ACN</td> <td>HA2</td> <td>φ 10 mm</td> <td>12 → 0 (loosening) → 8 N·m</td> </tr> <tr> <td>HA3</td> <td>φ 13 mm</td> <td>20 → 0 (loosening) → 13N·m</td> </tr> <tr> <td>HA3</td> <td>φ 16 mm</td> <td>33 → 0 (loosening) → 22N·m</td> </tr> <tr> <td>HA4</td> <td>φ 20 mm</td> <td>44 → 0 (loosening) → 30N·m</td> </tr> <tr> <td>PSA6</td> <td>φ 30 mm</td> <td>54 → 0 (loosening) → 36N·m</td> </tr> </tbody> </table>	Model	Actuator model	Stem size	Tightening torque	ACP, ACN	HA2	φ 10 mm	12 N·m	HA3	φ 13 mm	20 N·m	HA3	φ 16 mm	33 N·m	HA4	φ 20 mm	44 N·m	PSA6	φ 30 mm	54 N·m	Model	Actuator model	Stem size	Tightening torque	ACP, ACN	HA2	φ 10 mm	12 → 0 (loosening) → 8 N·m	HA3	φ 13 mm	20 → 0 (loosening) → 13N·m	HA3	φ 16 mm	33 → 0 (loosening) → 22N·m	HA4	φ 20 mm	44 → 0 (loosening) → 30N·m	PSA6	φ 30 mm	54 → 0 (loosening) → 36N·m
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	HA4	φ 20 mm	44 → 0 (loosening) → 30N·m																																						
	PSA6	φ 30 mm	54 → 0 (loosening) → 36N·m																																						

Step	Procedure
2	<p data-bbox="507 280 1412 405">By tightening the gland nuts to the torque indicated in Table 12-4 or Table 12-5, the top of the packing flange and packing follower will be at almost the same level, as illustrated in Fig. 12-6 below (the level may not be exactly the same due to the tolerance of the Belleville springs and friction on the gland studs or gland nuts).</p> <p data-bbox="507 421 1401 577">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 12-4 and Table 12-5, the level of the top of the packing flange and packing follower will not be the same (see Fig. 12-7). Check if the direction of washers of the Belleville springs and the tightening torque are correct.</p> <div data-bbox="651 593 1252 907"></div> <p data-bbox="651 922 1284 958">Fig. 12-6. Load on Belleville springs (correctly assembled)</p> <div data-bbox="805 981 1125 1254"></div> <p data-bbox="651 1265 1295 1301">Fig. 12-7. Load on Belleville springs (incorrectly assembled)</p>
3	<p data-bbox="507 1314 1369 1377">View the assembly from above to check that the space between the stem and the packing follower is even (see Fig. 12-8).</p> <div data-bbox="550 1411 1372 1814"></div> <p data-bbox="861 1832 1077 1865">Fig. 12-8. Top view</p>

12-5. Parts List

Table 12-6. Parts list For PTFE yarn

Part name	Actuator model	Material	Part No.	Qty.
Main packing	HA2	P4519	80255384- 111	3
Adapter packing		P6720	82573475- 101	2
Carbon ring		P6210C2FS	82573484- 001	2
Belleville spring		SUS304	82573462- 101	6
O-ring (small)		Viton	82592220- 897	1
O-ring (large)		Viton	82592221- 897	1
Gland stud		A193 GrB8CL2	82559311- 012	2
Gland nut		SUS304	82592448- 163	2
Packing flange		SCS13	82573456- 101	1
Packing follower		SUS304	82573463- 101	1
Packing follower for O-ring use		SUS304	82573464- 101	1
Spacer		SUS304	82573476- 110	1
Main packing		HA3 (except 6B)	P4519	80255385- 111
Adapter packing	P6720		82573475- 102	2
Carbon ring	P6210C2FS		82573484- 002	2
Belleville spring	SUS304		82573462- 102	6
O-ring (small)	Viton		82592221- 497	1
O-ring (large)	Viton		82592222- 297	1
Gland stud	A193 GrB8CL2		82571706- 012	2
Gland nut	SUS304		82592448- 173	2
Packing flange	SCS13		82573457- 101	1
Packing follower	SUS304		82573465- 101	1
Packing follower for O-ring use	SUS304		82573466- 101	1
Spacer	SUS304		82573476- 111	1
Stem connector	S25C/S20C		82571732- 101	1

Table 12-6. Parts list For PTFE yarn

Part name	Actuator model	Material	Part No.	Qty.
Main packing	HA3 (6B)	P4519	80255386- 111	3
Adapter packing		P6720	82573475- 103	2
Carbon ring		P6210C2FS	82573484- 003	2
Belleville spring		SUS304	82573462- 103	6
O-ring (small)		Viton	82592221- 797	1
O-ring (large)		Viton	82592222- 897	1
Gland stud		A193 GrB8CL2	82559312- 012	2
Gland nut		SUS304	82592448- 013	2
Packing flange		SCS13	82573458- 101	1
Packing follower		SUS304	82573467- 101	1
Packing follower for O-ring use		SUS304	82573468- 101	1
Spacer		SUS304	82573476- 112	1
Main packing		HA4	P4519	80255387- 111
Adapter packing	P6720		82573475- 104	2
Carbon ring	P6210C2FS		82573484- 004	2
Belleville spring	SUS304		82573462- 104	6
O-ring (small)	Viton		82592221- 997	1
O-ring (large)	Viton		82592223- 397	1
Gland stud	A193 GrB8CL2		82571707- 012	2
Gland nut	SUS304		82592448- 023	2
Packing flange	SCS13		82573459- 101	1
Packing follower	SUS304		82573469- 101	1
Packing follower for O-ring use	SUS304		82573470- 101	1
Spacer	SUS304		82573476- 113	1
Main packing	PSA6R		P4519	82571048- 109
Adapter packing		P6720	82573475- 204	2
Carbon ring		P6210C2FS	82573484- 010	2
Belleville spring		SUS304	82573462- 105	6
O-ring (small)		Viton	82592223- 397	1
O-ring (large)		Viton	82592224- 197	1
Gland stud		A193 GrB8CL2	82592006- 769	2
Gland nut		SUS304	82592448- 033	2
Packing flange		SCS13	82573460- 101	1
Packing follower		SUS304	82573471- 101	1
Packing follower for O-ring use		SUS304	82573472- 101	1
Spacer		SUS304	82553331- 781	1

Table 12-7. Parts list For expanded graphite

Part name	Actuator model	Material	Part No.	Qty.
Main packing	HA2	P6617CL	82573489- 001	3
Adapter packing		P6720	82573475- 101	2
Carbon ring		P6210	82573488- 001	2
Belleville spring		SUS304	82571711- 101	6
O-ring (small)		Viton	82592220- 897	1
O-ring (large)		Viton	82592221- 897	1
Gland stud		A193 GrB8CL2	82559311- 012	2
Gland nut		SUS304	82592448- 163	2
Packing flange		SCS13	82573456- 101	1
Packing follower		SUS304	82573463- 201	1
Packing follower for O-ring use		SUS304	82573464- 201	1
Spacer		SUS304	82573476- 114	1
Main packing		HA3 (except 6B)	P6617CL	82573489- 002
Adapter packing	P6720		82573475- 102	2
Carbon ring	P6210		82573488- 002	2
Belleville spring	SUS304		82573462- 107	6
O-ring (small)	Viton		82592221-497	1
O-ring (large)	Viton		82592222-297	1
Gland stud	A193 GrB8CL2		82571706- 012	2
Gland nut	SUS304		82592448- 173	2
Packing flange	SCS13		82573457- 101	1
Packing follower	SUS304		82573465- 201	1
Packing follower for O-ring use	SUS304		82573466- 201	1
Spacer	SUS304		82573476- 115	1
Stem connector	S25C/S20C		82571732- 101	1

Table 12-7. Parts list For expanded graphite

Part name	Actuator model	Material	Part No.	Qty.
Main packing	HA3 (6B)	P6617CL	82573489- 003	3
Adapter packing		P6720	82573475- 103	2
Carbon ring		P6210	82573488- 003	2
Belleville spring		SUS304	82559308- 102	6
O-ring (small)		Viton	82592221- 797	1
O-ring (large)		Viton	82592222- 897	1
Gland stud		A193 GrB8CL2	82559311- 012	2
Gland nut		SUS304	82592448- 163	2
Packing flange		SCS13	82573458- 101	1
Packing follower		SUS304	82573467- 201	1
Packing follower for O-ring use		SUS304	82573468- 201	1
Spacer		SUS304	82573476- 116	1
Main packing		HA4	P6617CL	82573489- 004
Adapter packing	P6720		82573475- 104	2
Carbon ring	P6210		82573488- 004	2
Belleville spring	SUS304		82573462- 108	6
O-ring (small)	Viton		82592221- 997	1
O-ring (large)	Viton		82592223- 397	1
Gland stud	A193 GrB8CL2		82571707- 012	2
Gland nut	SUS304		82592448- 023	2
Packing flange	SCS13		82573459- 101	1
Packing follower	SUS304		82573469- 201	1
Packing follower for O-ring use	SUS304		82573470- 201	1
Spacer	SUS304		82573476- 117	1
Main packing	PSA6R		P6617CL	82573489- 009
Adapter packing		P6720	82573475- 204	2
Carbon ring		P6210	82573488- 010	2
Belleville spring		SUS304	82573462- 109	6
O-ring (small)		Viton	82592223- 397	1
O-ring (large)		Viton	82592224- 197	1
Gland stud		A193 GrB8CL2	82592006- 769	2
Gland nut		SUS304	82592448- 033	2
Packing flange		SCS13	82573460- 101	1
Packing follower		SUS304	82573471- 201	1
Packing follower for O-ring use		SUS304	82573472- 201	1
Spacer		SUS304	82553331- 779	1

12-6. Application to existing control valves

If Certified ISO 15848-1 low emission gland packing is used for an existing control valve, please note the following:

- If there are scratches on the inner surface of the stuffing box or the surface of the stem of the current valve, the specified seal performance of Certified ISO 15848-1 low emission gland packing may not be achieved. If scratches are found, replace the affected parts with new ones.
- Check if Certified ISO 15848-1 low emission gland packing can be used for the current valve and actuator by referring to the specification sheet for Certified ISO 15848-1 low emission gland packing (SS2-SSL100-0100) or by contacting us. Because the resistance to sliding of Certified ISO 15848-1 low emission gland packing is greater than general gland packing systems, it may not be possible to use Certified ISO 15848-1 low emission gland packing 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 Certified ISO 15848-1 low emission gland packing meets the temperature requirements of the current control valve. Attention is needed for expanded graphite Certified ISO 15848-1 low emission gland packing in particular, because the operating temperature high limit of the main packing used for this packing system is lower than that of general expanded graphite packings.

12-7. 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 any part of it.

Chapter 13. Troubleshooting

This Chapter covers problem, causes and remedial actions regarding most probable types of troubles. Parts may be required to be replaced depending on the type of. For further problem, please contact an Azbil Corporation agent for repair.

Table 13-1. Troubleshooting

Problem	Cause and Remedial Action
<p>Unstable valve operation</p> <ul style="list-style-type: none"> • Valve position hunting occurs when almost fully closed. • Air supply pressure is unstable. • Signal pressure is unstable. • Valve position hunting occurs even when signal pressure is stable 	<ul style="list-style-type: none"> • Cv value is too large. • Reduce Cv value • For a single seat valve, the valve is installed in the reverse flow direction. • Large air consuming equipment is hooked up to the same air supply line. • Check that the air supply capacity, piping capacity and restriction capacity are appropriate. • Supply air pressure regulator is inadequate or not operating properly. • Controller is not properly tuned. • Property tune the controller (properly set the proportional band and other parameters). • Check that the controller output does not change abnormally. • Hunting of output of positioner itself. • Check and repair or replace the positioner. • Being affected by pressure change of process fluid as power of the actuator is insufficient. Replace the actuator with a larger one.
<p>Vibration of valve</p> <ul style="list-style-type: none"> • Valve vibrates (generate noise) at any position of valve plug • Valve vibrates (generate noise) only when valve plug is set at a certain position. 	<ul style="list-style-type: none"> • Piping is vibrating. • Securely fix the piping. • Check for other sources of vibration. • Worn valve plug or guides. • Check for change in process fluid flow conditions. • (Change in restriction orifice, Cv value, etc.) • Check for change in plug configuration (change in flow control characteristics.)

Table 13-1. Troubleshooting

Problem	Cause and Remedial Action
Sluggish valve operation or inoperative valve	<ul style="list-style-type: none"> • Air leak from piping • Air leak from actuator • Foreign matter entrapped in guide section of valve plug • Aged and hardened gland packing, causing increased hysteresis • Malfunctioning positioner • (Check the positioner by operating it directly on an air supply know to be operating normally.)
Fluid leak from gland section	<ul style="list-style-type: none"> • Check for loose packing flange. • Check for insufficient grease. • Check for damaged valve shaft.
Liquid leak from gasket section	<ul style="list-style-type: none"> • Check for loose nuts of bonnet. • Check for defective gasket (deformed or damaged).
Even when valve plug is in closed position, large flow leaks to downstream side.	<ul style="list-style-type: none"> • Air leak at actuator section • For trial, apply the air supply pressure or atmospheric pressure to the actuator. (Check the air supply source pressure to the actuator.) • Check whether the valve plug is actually in the closed position or not.(Check the valve plug lift.) • Check the plug seat ring for corrosion and erosion. • Check the guide sections for binding. • Check for damaged seal ring.

Chapter 14. Recommended spare parts

It is recommended to replace the following parts when servicing the control valve.

Valve Body

Be sure to replace the following parts with new ones whenever the valve body is disassembled:

- Gland packing
- Gaskets

The frequency of replacement of seal ring or scraper ring differs drastically depending upon such conditions as type of flow fluid, fluid temperature or pressure. As a general rule, replace them once every 100,000 full stroke cycles or once every three years.

The frequency of replacement of carbon ring differs drastically depending upon such conditions as type of flow fluid, fluid temperature or pressure. As a general rule, replace them once every totalized stroke of 2.5 km or once every three years.

Actuator

Replace the following parts at every 5 years or thereabouts:

- Diaphragm
 - Bushing
 - Seal washer
 - Dust seal
 - Rod seal
- } Be sure to replace these parts whenever the actuator is dissembled

Of the bellows sealed type of control valves, the bellows seal assembly* must be replaced periodically. The period of replacement depends on temperature, pressure and order conditions of use. A typical service longevity of the bellows assembly is 10,000 vertical stroke cycles.

Note: *The bellows seal assembly has the seal bellows and valve stem (including the bellows seat) assembled together.

Please mention the parts name and the product number indicated on the name plate when ordering spare parts.

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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