Model GD - 400・400SS

PRESSURE REDUCING VALVE

Product Manual

Handling Precautions and Limitation of Warranty

Thank you for purchasing the Yoshitake pressure reducing valve. It is important that you carefully read through this manual before using it for your proper and safety use.

Keep this manual in convenient place so you can refer to it as you need.

If the product becomes failure or defective because it has been mishandled or improperly operated, the user shall agree to pay charges for repair or replacement.

————Please note the following caution icons and conventions used in this manual.————

⚠ Warning | **Failure to comply with a warning message could result in severe personal injury or death.**

⚠ Caution | **Failure to heed a caution message could result in personal injury or damage to the equipment or facilities.**

Contents

Yoshitake INC.

1. Product application

The GD-400/400SS pressure reducing valve is developed primarily for extremely low pressure control of air or nitrogen gas in a chemical, food or petrochemical plant.

2. Specification

⚠ CAUTION

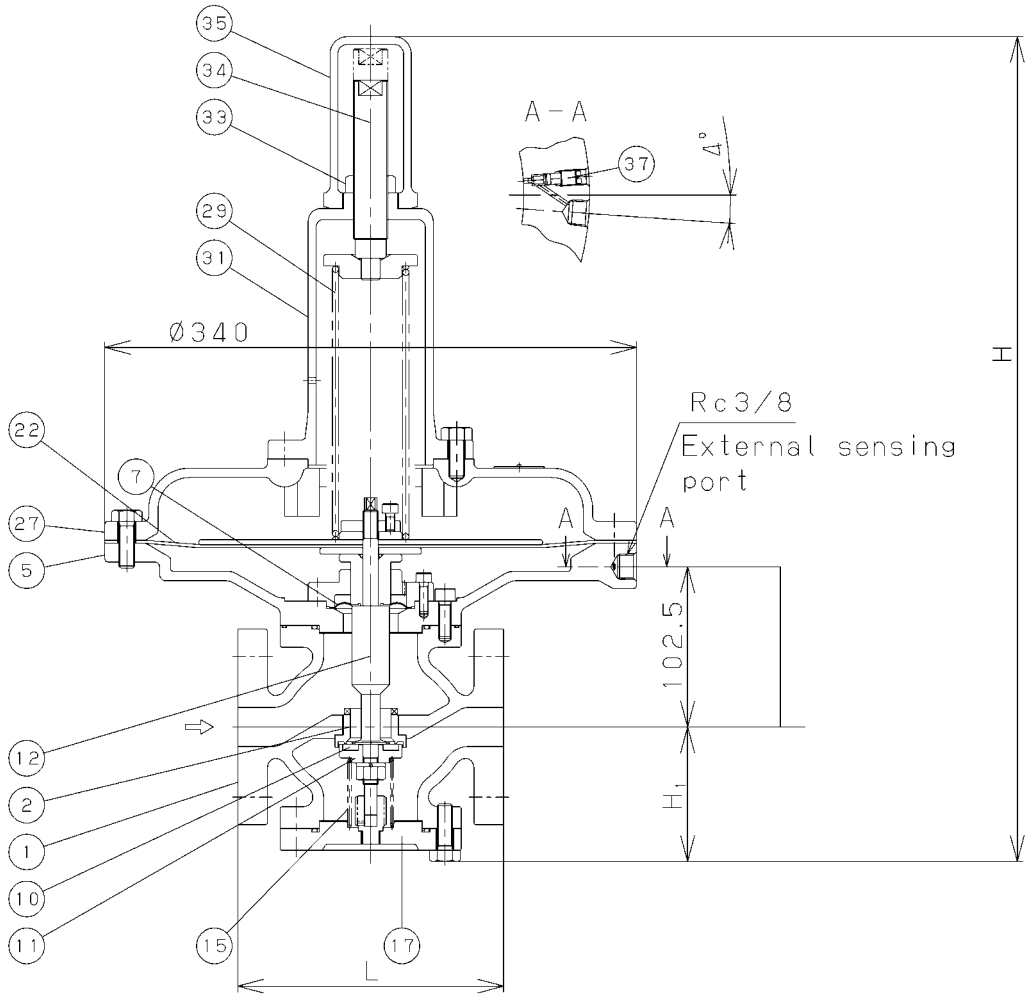
Check the data on the nameplate of the delivered product against the specifications of your order sheet.
※If you find any discrepancy, first contact us for confirmation.

Model		GD－４００		GD－４００ＳＳ（※１）
Application		Air、 nitrogen gas		
Nominal size		１５A、２０A、２５A		
Inlet pressure		２．５～４００ kPa		
Reduced pressure		A	０．５～１．４ kPa	
		B	１．２～３．３ kPa	
		C	３．０～８．０ kPa	
		D	７．０～２０ kPa	
Operating temperature		５～６０ ℃		
Minimum pressure difference		２．０ kPa		
Maximum reduction ratio		４００：１		
Connection		ＪＩＳ１０K ＦＦ Flanged		
Material	Body	Cast iron		Stainless Steel
	Valve seat	Stainless steel		
	Valve	Stainless steel		
	Disc	Synthetic rubber		
	Spindle	Stainless steel		
	Diaphragm	Synthetic rubber		
Airtightness test pressure (※２)		Inlet		４００ kPa
		Outlet	A	１．８ kPa
			B	４．２ kPa
			C	１０ kPa
			D	２５ kPa

※１ Wetted parts of GD-400SS are made of stainless steel.

※２ Do not apply pressure higher than those used for pressure test or airtightness test, whichever lower, to the installed piping. Higher pressure may damage internal parts.

3. Dimensions and parts



GD－400、400SS

Dimensions (mm)

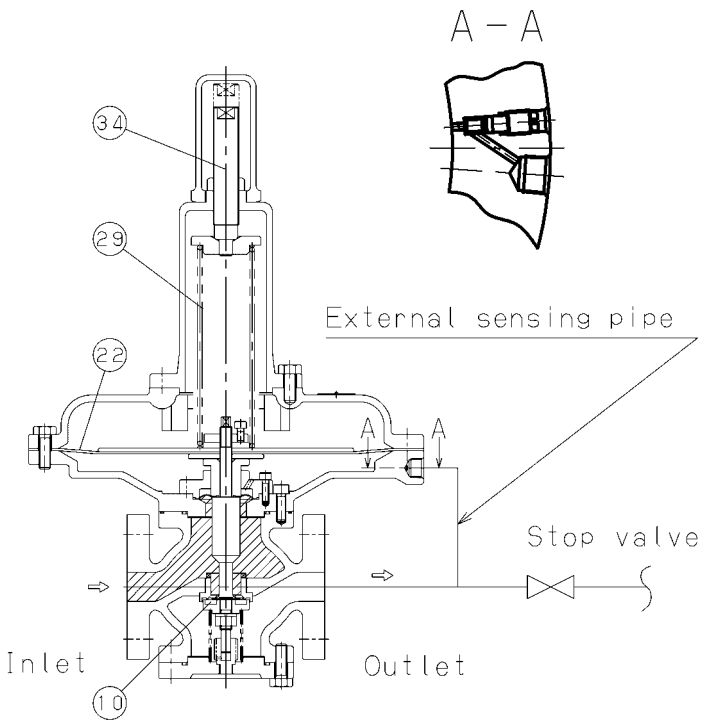
Nominal size	L	H_1	H	Weight (kg)
15A	166	86	526	29.0 (32.0)
20A	170	86	526	29.0 (32.0)
25A	170	86	526	30.0 (33.0)

( )：GD－400SS

Parts

№	Parts	№	Parts
1	Body	22	Diaphragm
2	Valve seat	27	Top diaphragm case
5	Bottom diaphragm case	29	Adjusting spring
7	Balance diaphragm	31	Spring chamber
10	Disc	33	Lock nut
11	Valve	34	Adjusting screw
12	Spindle	35	Cap
15	Valve spring	37	Needle valve
17	Bottom cover		

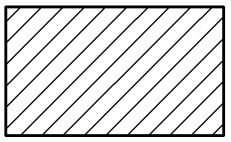
4. Theory of operation



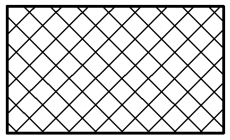
The adjusting screw ㉞ compresses the adjusting spring ㉙ to press down the diaphragm ㉓ that will open the directly connected disc ⑩.

The fluid from the inlet flows through above the disc ⑩ to outlet side and also to the external sensing pipe. The pipe directly applies the fluid pressure to the diaphragm ㉓ as reduced pressure.

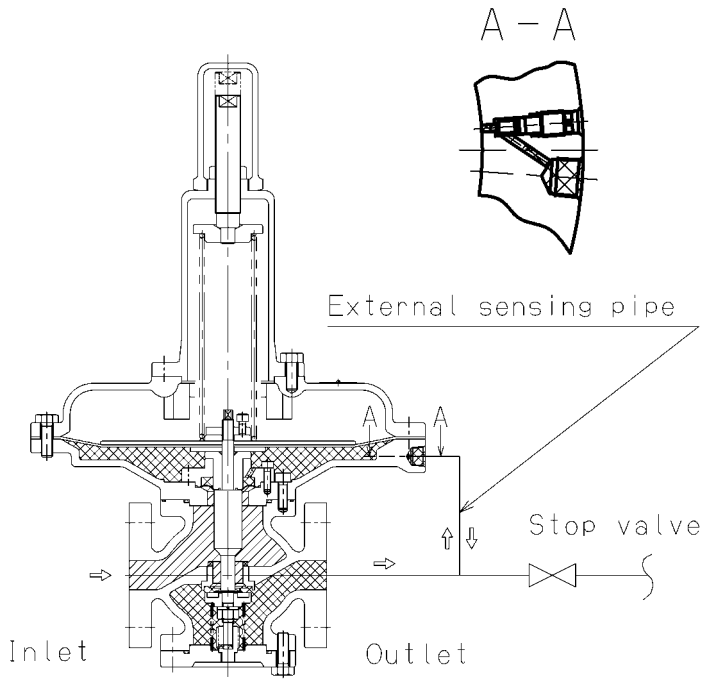
While the stop valve at the outlet is closed, the pressure on the diaphragm ㉓ increases until it overcomes the load from the spring ㉙, allowing the disc ⑩ to close.



Fluid at inlet side



Fluid at outlet side

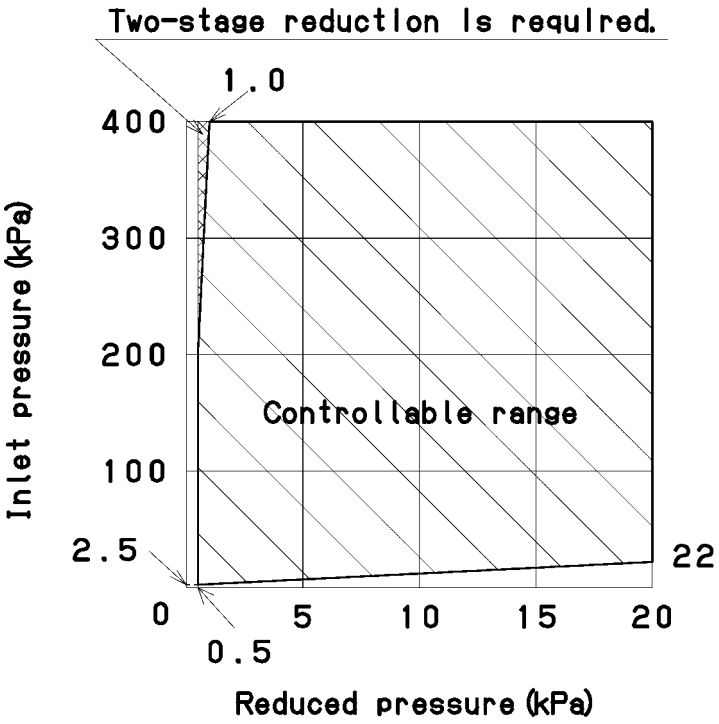


Gradually opening the outlet stop valve proportionally decreases the pressure applied on the diaphragm ㉓ until the load from the spring ㉙ enables the disc ⑩ to open.

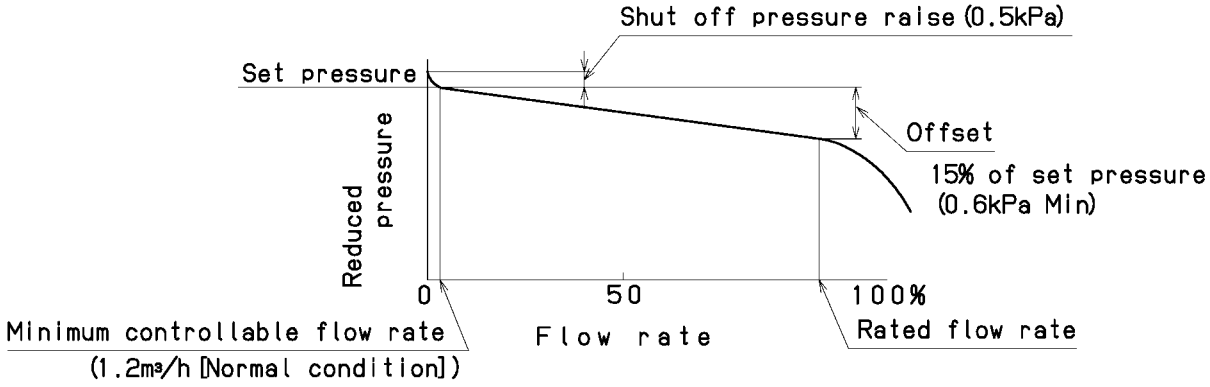
Portion of fluid flowing toward outlet applies pressure to the diaphragm ㉓ to balance between the load from the spring ㉙, adjusting the valve openings to keep outlet pressure constant.

5. Nominal size selection

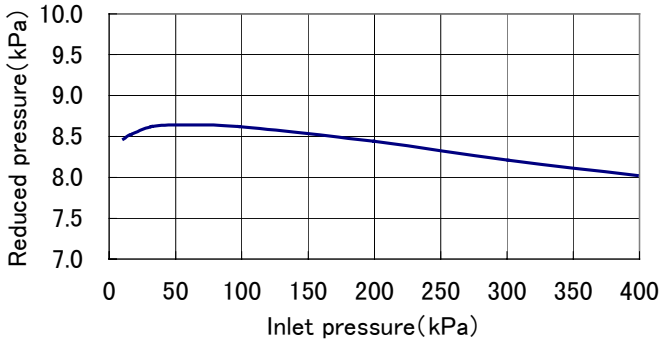
5.1 Pressure reducing valve specification selection chart



5.2 Flow characteristics chart



5.3 Pressure characteristics chart

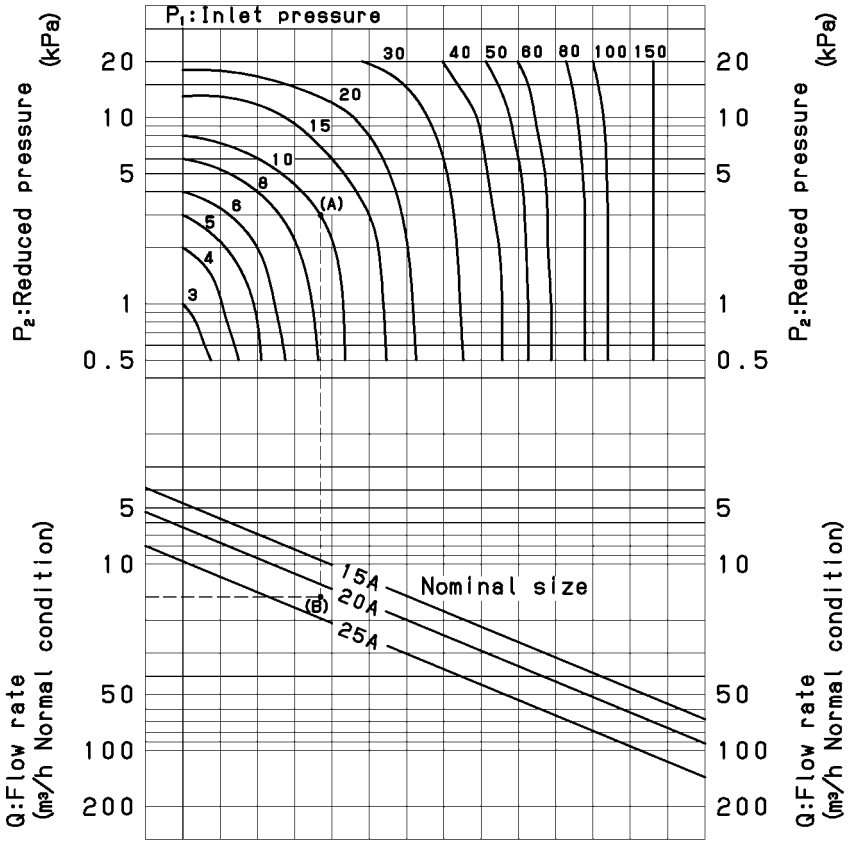


The chart shows changes in the reduced pressure when the inlet pressure is decreased from 400 kPa to 10 kPa with the reduced pressure set at 8.0 kPa.

5.4 Nominal size selection

5.4.1 Nominal size selection chart

Determination of nominal size when the inlet pressure is in a range 2.5 kPa to 200 kPa (fluid: air, at 20℃)



《Example》

Select the nominal size of a pressure reducing valve to be operated with the inlet pressure 10 kPa and reduced pressure 3 kPa at a flow rate 15 m^3/h (normal condition): First locate the point (A) on the chart where the inlet pressure 10 kPa line and reduced pressure 3 kPa line intercross. Draw a line from the intersection straight down to the point (B) where it meets the line representing flow rate 15 m^3/h (normal condition). The point (B) locates between nominal size 20 A and 25 A. It is selected to use 25 A (larger one) as the desired nominal size.

Table 1　Determination of nominal size when inlet pressure in the range 200 to 400 kPa

Nominal size	Inlet pressure (kPa)	Rated flow rate (Nm^3/h)	
		Reduced pressure (kPa)	
		0.5-4 excl.	4-20 incl.
15A	200-400 incl.	60	60
20A	200-300 excl.	90	90
	300-400 incl.	90	120
25A	200-300 excl.	120	120
	300-400 excl.	120	150
	400	120	190

5.4.2 Calculating a nominal size

Determine the required Cv value by using the formula shown below and then the corresponding nominal size based on the Cv value.

To calculate a Cv value (for selecting nominal size when valve-inlet pressure is 2.5 kPa up to 200 kPa):

If $P_2 > P_1/2$,

$$Cv = \frac{Q\sqrt{\frac{(273+t)G}{\Delta P(P_1+P_2)}}}{2.94}$$

If $P_2 \leq P_1/2$,

$$Cv = \frac{Q\sqrt{(273+t)G}}{2.55P_1}$$

P_1 : Inlet pressure(kPa･A)　　Q : Max. gas flow rate (Nm^3/h)

P_2 : Reduced pressure(kPa･A)　　t : Gas temperature(℃)

ΔP : $P_1 - P_2$(kPa)　　G : Specific gravity (relative to air)

Cv : Cv value for a specific nominal size

Nominal Size	15A	20A	25A
Cv value	1.5	2.0	3.0

For selecting a nominal size in the case of inlet pressure is in a range 200 kPa up to 400 kPa, refer to Table 1.

6. Installation guideline

6.1 Diagram of piping example

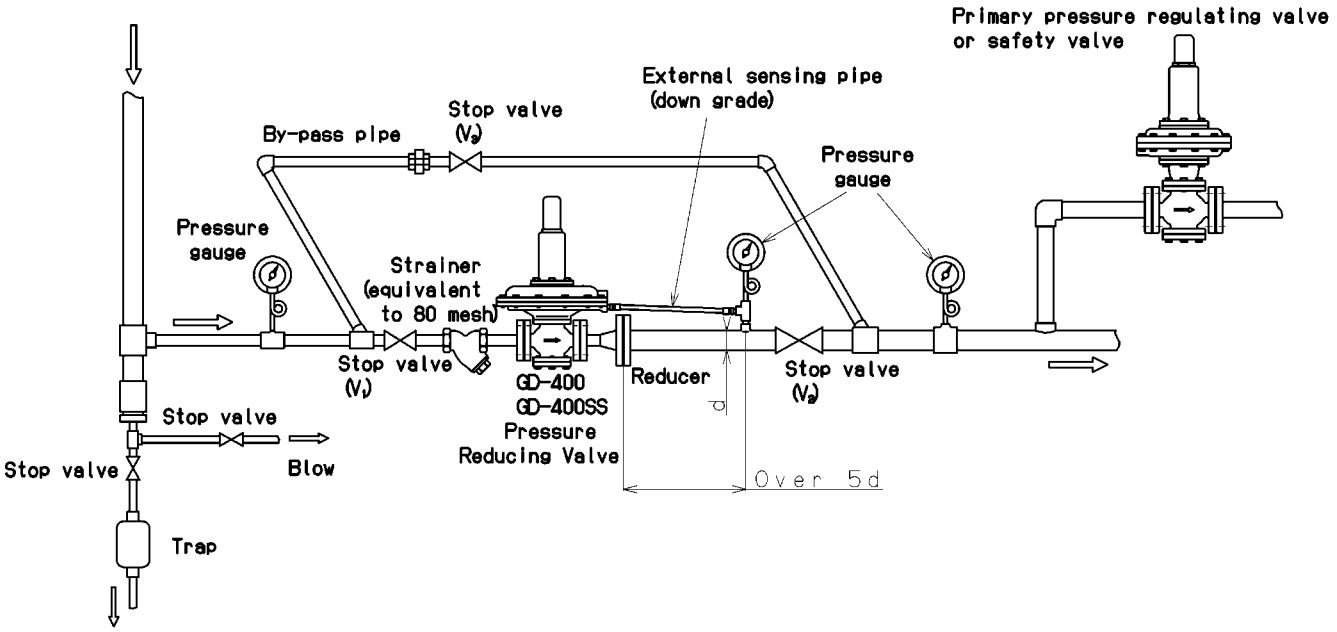


Fig.1

6.2 Warning and precaution on installation

⚠ WARNING

(1) The pressure reducing valve is heavy: check its weight by referring to the **"3. Dimensions and parts"**. Securely holding the valve with a lifting gear, attach and connect it to the piping.
※Unsteady valve may fall during assembly, causing bodily injury.

(2) If a primary pressure regulating valve or safety valve is installed to the outlet of the pressure reducing valve, connect a blow-off pipe to the outlet of the regulating (safety) valve to direct possible blowing fluid to a safety location.
※If the blowing fluid is hot, it will cause burn injury.

⚠ CAUTION

(1) Do not disassemble the pressure reducing valve unless it must be.
※Once incorrectly disassembled, the pressure reducing valve cannot function as it should, after reassembling.

(2) Before connecting the pressure reducing valve to the piping, remove the foreign materials from the piping.
※If foreign materials are introduced into the pressure reducing valve, it cannot operate at the proper performance and may be damaged.

(3) Install a strainer (equivalent to 80 mesh) to the inlet of the pressure reducing valve.
※If foreign materials are introduced into the pressure reducing valve, it cannot operate at the proper performance and may be damaged. (Refer to 6.1 Piping example, Fig.1.)

(4) Connect a primary pressure regulating valve or safety valve to the outlet side of the pressure reducing valve to protect it and outlet side equipment.
※Be sure to provide the protective valve to avoid system damage. (If the outlet pressure reaches 100 kPa or higher, internal parts will be damaged and need replacement. : Refer to Section 8.2 Troubleshooting.)

(5) Be sure to attach a pressure gauge to the inlet and outlet of the pressure reducing valve.
※Without pressure gauges, the pressure cannot be regulated correctly.

(6) Connect stop valve and bypass pipe to the pressure reducing valve.
※These are indispensable devices for maintenance and checking of the pressure reducing valve. (Refer to Fig. 1 of 6.1 Example of piping diagram.)

(7) The pressure reducing valve must be normal to the horizontal pipe, with the adjusting spring side facing up. (Refer to Fig. 2.)
※Otherwise, malfunction may occur and performance will be degraded.

(8) The piping from the pressure reducing valve outlet must be of a size so that the current flow velocity in the tube is 5-15 m/s.
※Otherwise, malfunction may occur and performance will be degraded.

(9) Be sure to connect the external sensing port to the outlet of the pressure reducing valve.
※Otherwise, the outlet pressure is equal to that at the inlet.
Wrong connection may cause malfunction of the pressure reducing valve.

(10) When two-stage pressure reduction is employed, the distance between the pressure reducing valves must be 3 m or more.
※A shorter distance may cause malfunction and the designed performance cannot be obtained.

(11) Do not install a quick opening/closing device e.g. solenoid valve at the inlet and outlet.
※Fast open/close operation may cause malfunction and excessively shorten the valve life.

(12) Before installing the valve, verify the location of the inlet and outlet. The arrow on a side of the pressure reducing valve indicates the direction of flow. Observe the arrow.
※When installed in opposite direction, the pressure reducing valve cannot function as it should.

(13) Do not subject the pressure reducing valve to excessive load, deflection (bend), or vibration, through the connected piping.
※Any excessive physical disturbance may cause malfunction and excessively shorten the valve life.

(14) Secure the necessary maintenance space at the installation site of the pressure reducing valve.
※If the space is smaller than these values, the valve cannot be disassembled for maintenance. (Refer to Fig. 2)

○Space necessary for disassembly

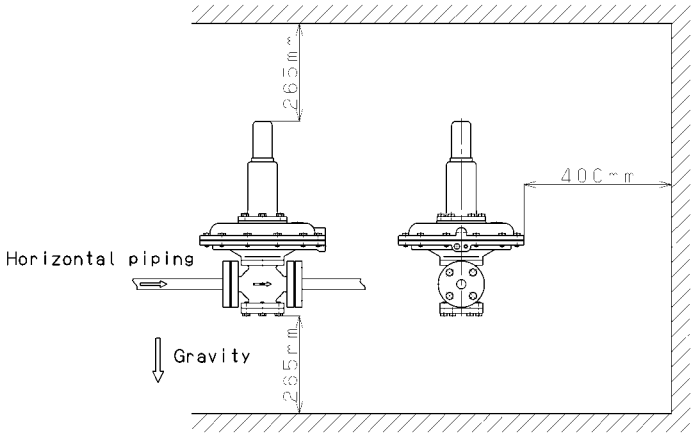


Fig.2

7. Operation guidelines

7.1 Warning and precaution on operation

⚠ WARNING

(1) Never touch the pressure reducing valve with bare hands while and after hot fluid flows.
※You may be suffered burns on hands.
(2) Before flowing hot fluid, make sure that the fluid will not cause risk at the end of the piping system and that the pipes are positively connected.
※Blowout of hot fluid will cause burn injury.

⚠ CAUTION

(1) Before flowing fluid, close the stop valve at upstream and downstream of the pressure reducing valve and completely remove the foreign matter through the bypass pipe.
※Foreign matter in the pressure reducing valve will degrade the valve performance.
(2) To deliver the fluid, open all stop valves gradually to avoid hunting.
※Hunting will damage the pressure reducing valve and equipment.
(3) When opening the bypass stop valve, ensure that the outlet pressure will not exceed the set pressure of the safety valve or the primary pressure regulating valve.
※If the outlet pressure exceeds the set pressure of the safety valve or the primary pressure regulating valve, the safety (regulating) valve operates and blows out fluid.
(4) Before discontinuing the operation for a long period, completely purge fluid from the pressure reducing valve and piping system and close the stop valves located upstream and downstream the pressure reducing valve.
※Foreign materials developed in the piping may cause malfunction of the pressure reducing valve.

7.2 Adjustment

Read again 6.1 Diagram of piping example and 7.1 Warning and precaution on operation.

7.2.1 Pressure setting is not preset (the user does not require pressure presetting)

(1) Verify that stop valves V_1, V_2 and V_3 are closed.

(2) Adjust the stop valve V_3 on the bypass pipe to an opening so that the primary pressure regulating valve (or safety valve) will not be activated. Keeping the regulating (safety) valve inactive, allow the fluid to pass through the piping to discharge foreign objects. After completely expelling foreign objects, be sure to close the bypass stop valve V_3.

(3) Remove the cap ㉟ and loosen the lock nut ㉝. Rotate the adjusting screw ㉞ (holding across flat) CCW until the spring ㉙ becomes free from the load.

(4) Fine tune the opening of the stop valve V_2 so that minimum amount of fluid is allowed to flow.

(5) Gradually open the inlet side stop valve V_1.

(6) Observing the outlet pressure gauge, gradually adjust the adjusting screw ㉞ (holding across flat) to obtain the desired pressure. (To increase the pressure, turn the screw clockwise; to reduce the pressure, counterclockwise.)

(7) Gradually open the stop valve V_2 and readjust outlet pressure to obtain the desired value.

(8) After completing the adjustment, tighten the lock nut ㉝ and fit the cap ㉟.

7.2.2 Pressure setting is preset (the user requires pressure presetting)

(1) Verify that stop valves V_1, V_2 and V_3 are closed.

(2) Adjust the stop valve V_3 on the bypass line to an opening so that the primary pressure regulating valve (or safety valve) will not be activated. Keeping the regulating (safety) valve inactive, allow the fluid to pass through the piping to blow out foreign objects.
After completely expelling foreign objects, be sure to close the bypass stop valve V_3.

(3) Adjust the opening of the stop valve V_2 so that minimum amount of fluid is allowed to flow.

(4) Observing the outlet pressure gauge, gradually increase the opening of the stop valve V_1 at the inlet.

(5) Gradually increase the opening of the stop valve V_2.

(6) If the reduced pressure is outside the desired value, remove the cap ㉟ and loosen the lock nut ㉝. Observing the outlet pressure gauge, gradually turn the adjusting screw ㉞ (holding across flat) to obtain the desired pressure. (To increase the pressure, turn the screw clockwise; to reduce the pressure, counterclockwise.)

(7) After completing the adjustment, tighten the lock nut ㉝ and attach the cap ㉟.

7.3 Adjustment of needle valve

⚠ WARNING

Do not adjust the needle valve without understanding its purpose and function.
※Never attempt to excessively open (turn CCW) the needle valve. Fluid will blow out. If the fluid is hot, you may suffer burns.

⚠ CAUTION

Never completely close the needle valve.
※The outlet pressure will increase, and the safety valve or the primary pressure-regulating valve may be actuated.

The needle valve has been set before shipment (one turn backward from the fully closed position).

8. Maintenance guideline

Be aware of foreign materials in the piping since many of faults in the pressure reducing valve are caused by existence of foreign objects. Faulty pressure gauge, clogged strainer and leaking stop valve of bypass pipe develop symptoms that look like those indicated by faulty pressure reducing valve. Note that a clogged strainer will decrease the outlet pressure, and a leaking bypass pipe will increase the outlet pressure. Before attempting to troubleshoot the pressure reducing valve, verify the cause of the trouble.

8.1 Warning and precaution on maintenance and inspection

⚠ WARNING

Before disassembling or inspection, completely release the pressure from the pressure reducing valve, piping and equipment and cool the pressure reducing valve if hot fluid has been processed. Never touch the pressure reducing valve with bare hands until it cools off.
※Residual pressure may cause bodily injury or burn injury or contaminate surrounding.

⚠ CAUTION

(1) To maintain the functions and performance of the pressure reducing valve, perform periodic inspection.
※User should refer such tasks to specialist, maintenance agency, or the manufacturer.
(2) Only properly trained, qualified individuals or service representatives should disassemble and check the valve.
※If problem is found, consult a repair shop or agency.
(3) Before flowing fluid, close the stop valve at upstream and downstream of the pressure reducing valve and completely remove the foreign objects through the bypass pipe.
※Foreign residues in the pressure reducing valve degrades the valve performance.

○Periodic replacement of consumable parts

Life expectancy of consumable parts depends on frequency and condition of use. Rough standard of life estimation is given below. (Part number shown in the table below refers to the number in Section 8.3, Fig.4 GD-400 exploded drawing.)

Parts	Part number	Replacement interval
Diaphragm	22	3 years
Balance diaphragm	7	3 years
Disc	10	3 years
O-ring	3、4、20、36	3 years

○Periodic inspection of pressure reducing valve

Check the items shown below at the specified interval.

Check item	Check interval
Check pressure setting	Once a year, or more
Check for external leakage	

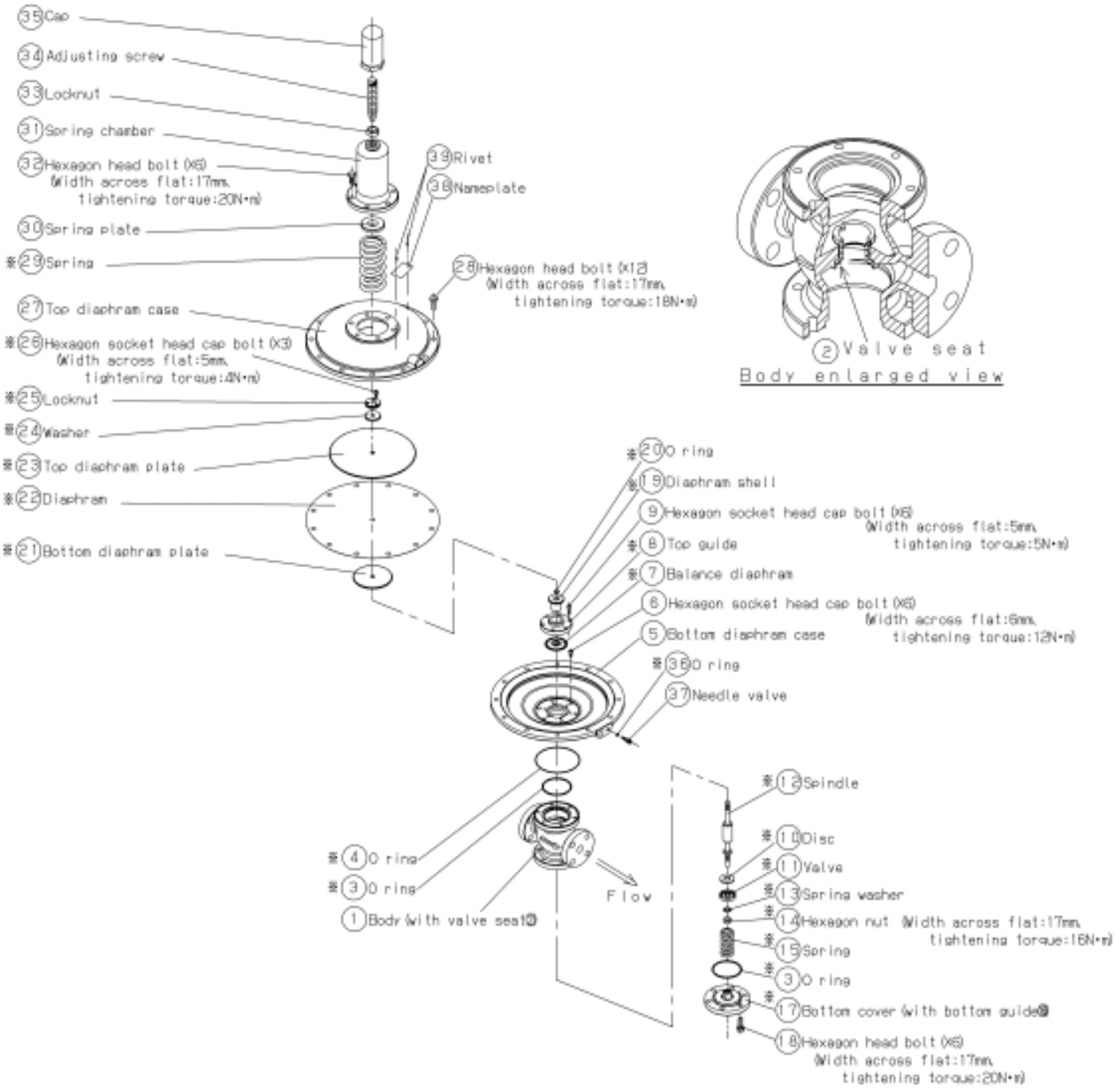
8.2 Troubleshooting (see 8.3 Exploded draiwing, Fig.3; 8.4 Troubleshooting procedure)

Problem	Presumable cause	Corrective action
Ⅰ. Reduced pressure exceeds prescribed value. (※1)	1. Leakage from the stop valve on bypass pipe.	1. Close the stop valve. If leakage continues, replace the stop valve.
	2. External sensing pipe tube is not connected.	2. Connect the external sensing pipe.
	3. Needle valve ㊲ is clogged by foreign materials.	3. Purge the foreign materials from needle valve ㊲.
	4. Foreign object pinched between disc ⑩ and valve seat ②. Damage to disc and/or valve seat.	4. Remove the foreign object from disc ⑩ and valve seat ②. Replace the disc ⑩ if damaged. If the seat of valve is damaged, consult us.
	5. Loosened hexagon socket head cap bolt ㉖ and/or locknut ㉕	5. Tighten hexagon socket head bolt ㉖ and locknut ㉕.
	6. Damaged diaphragm ㉓	6. Replace diaphragm ㉓.
	7. Foreign object pinched between diaphragm shell ⑲ and slide of top guide ⑧.	7. Remove foreign object from diaphragm shell ⑲ and slide of top guide ⑧.
	8. Foreign object pinched between spindle ⑫ and slide of bottom guide ⑯.	8. Remove foreign object from spindle ⑫ and slide of bottom guide ⑯.
	9. Loosened hexagon head nut ⑭ of valve	9. Tighten hexagon head bolt ⑭ on valve .
	10. Loosened hexagon socket head cap bolt ⑨ of top guide	10. Tighten hexagon socket head cap screw ⑨ on top guide.
	11. Damaged balance diaphragm ⑦	11. Replace balance diaphragm ⑦.
Ⅱ. Reduced pressure does not reach prescribed value. Or, fluid fails to flow.	12. Strainer at inlet is clogged	12. Clean the screen of the strainer.
	13. Needle valve ㊲ is clogged by foreign materials.	13. Remove foreign material from needle valve ㊲.
	14. Foreign object pinched between diaphragm shell ⑲ and slide of top guide ⑧.	14. Remove foreign objects from diaphragm shell ⑲ and slide of top guide ⑧.
	15. Foreign object pinched between spindle ⑫ and slide of bottom guide ⑯.	15. Remove foreign matters from spindle ⑫ and slide of bottom guide ⑯.
Ⅲ. External leakage	16. Needle valve ㊲ is clogged by foreign materials.	16. Remove foreign material from needle valve ㊲.
	17. Loosened hexagon head bolt ⑱ of bottom cover, or damaged O-ring ③	17. Tighten hexagon head bolt ⑱ on bottom cover or replace O-ring ③.
	18. Loosened hexagon head bolt ㉘ on top diaphragm case	18. Tighten hexagon head bolt ㉘ on top diaphragm case
	19. Loosened hexagon socket head cap bolt ㉖ and locknut ㉕	19. Tighten hexagon socket head cap bolt ㉖ and locknut ㉕.
	20. Damaged diaphragm ㉓	20. Replace diaphragm ㉓.
	21. Loosened hexagon socket head cap bolt ⑥ on the bottom diaphragm case is loosened or O-rings ③ and ④ are damaged	21. Tighten lower hexagon socket head cap bolt ⑥ on the bottom diaphragm case; or replace O-rings ③ and ④.

※1 : 100 kPa or higher outlet pressure exceeding will lead to damage of internal components. Replace the following parts

Hexagon socket head cap bolt ㉖, locknut ㉕, washer ㉔, top diaphragm plate ㉑, diaphragm ㉓, bottom diaphragm plate ㉒, O-ring ⑳, diaphragm shell ⑲, balance diaphragm ⑦, spindle ⑫, disc ⑩, valve ⑪, spring washer ⑬, hexagon nut ⑭

8.3 Exploded view



※Available as consumable part

Fig. 3　Exploded drawing

8.4 Troubleshooting procedure

Disassembling warning

⚠ WARNING

Before beginning disassembling or inspection, completely release all pressure from the pressure reducing valve, piping and equipment. If the fluid used is hot, wait until the valve cools down. Never touch valve with bare hands while they are still warm.
※Residual pressure in the pressure reducing valve, piping or equipment may cause injury or burning; or may contaminate work area.

Reassembling precautions

⚠ CAUTION

(1) Visually inspect the disc and valve seat for no development of flaw, dirt and dent.
※Otherwise, the reduced pressure will increase: clean the dirty surface and replace damaged parts.
(2) Verify smooth up/down movement of the valve stem.
※Jerky movement will cause malfuction.
(3) Verify that the seat, diaphragm, balance diaphragm and O-ring are clean.
※Dirty components will cause malfunction and leakage.
(4) Apply silicone grease to the O-ring and balance diaphragm to be assembled. (Recommended silicone grease: G501, Shin-Etsu Chemical Co., Ltd.)

Problem I : Reduced pressure exceeds prescribed value.

Presumable cause I.1: Leakage from stop valve connected on bypass pipe.

Action (1) : Close the stop valve connected to the bypass pipe.

Action (2) : If problem persists, replace the stop valve.

Presumable cause I.2: External sensing pipe is not connected.

Action (3) : Connect the external sensing pipe. (See 6.1, Fig.2 Diagram of piping example.)

Presumable cause I.3: Needle valve ㊲ is clogged by foreign materials.

Action (4) : Using a flat head screwdriver, remove the needle valve.

Action (5) : Clean the needle valve and hole of lower diaphragm casing.

Action (6) : Turn the needle valve to full close and then open by turning one turn in reverse direction with a flat head screwdriver.

Presumable cause I.4: Foreign object is pinched between valve disc and valve seat; or these parts are damaged.

Action (7) : Remove the cap ㉟.

Action (8) : Loosen locknut ㉝. Loosen bifacial adjusting screw ㉞ by turning it CCW to relieve the spring load.

Action (9) : Unscrew 6 hexagon head bolts ㉜. Remove spring chamber ㉛, spring plate ㉚ and spring ㉙.

→

Action (10) : Loosen 12 hexagon head bolts ㉘ and remove top diaphragm case ㉗.

Note: Remove top diaphragm case ㉗ in close relation to diaphragm ㉓.

(Do not attempt to twist casing any further. This may damage balance diaphragm ⑦.)

→

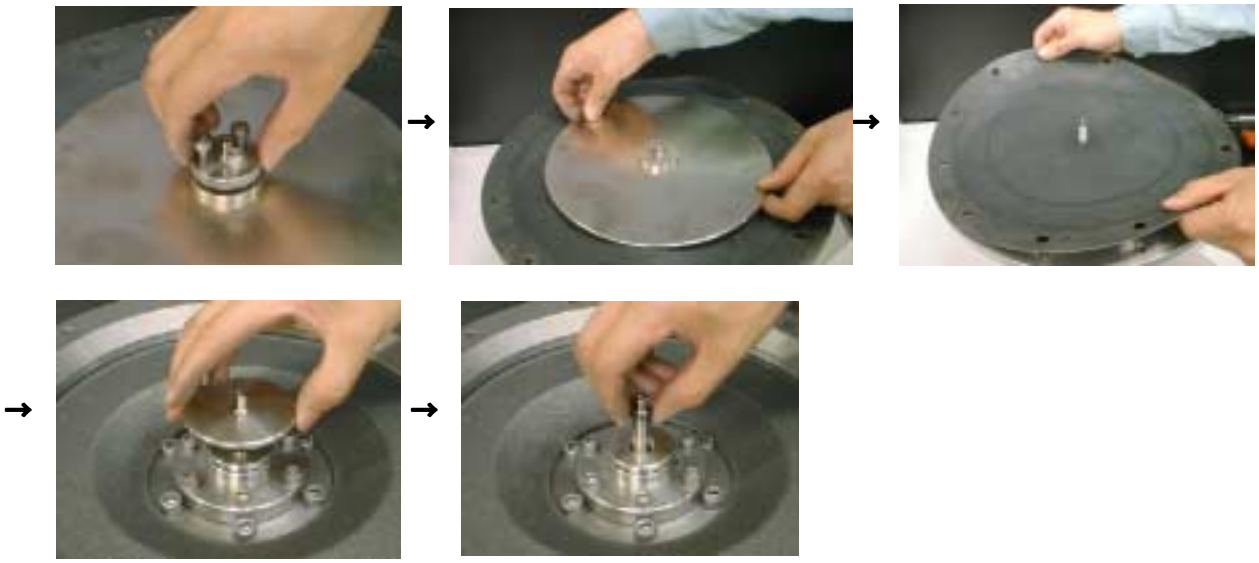
Action (11) : While securely holding top diaphragm plate ㉑ with hand, unscrew 3 hexagon socket head cap bolts ㉖.

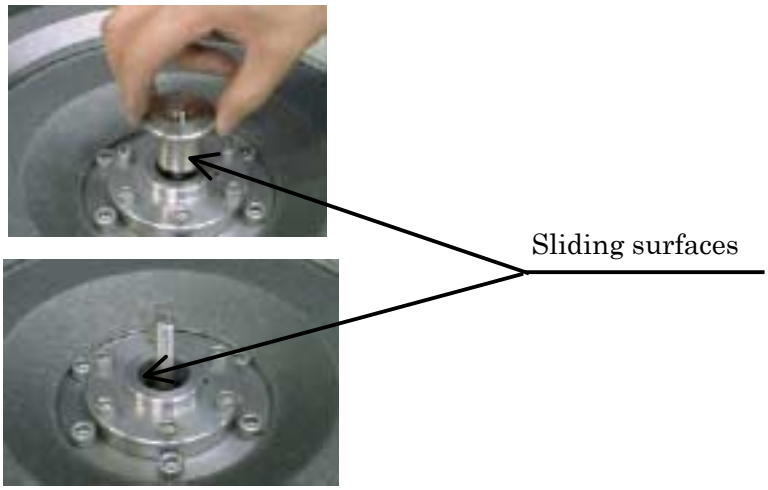
(Hexagon socket head cap bolt ㉖ and locknut ㉕ will be checked for looseness in Presumable cause I.5.)

Note: Do not attempt to twist top diaphragm plate ㉑ any further. This may damage the balance diaphragm ⑦.

Action (12) : Loosen locknut ㉕ and remove washer ㉔, top diaphragm plate ㉑, diaphragm ㉓, bottom diaphragm plate ㉒ and O-ring ⑳.

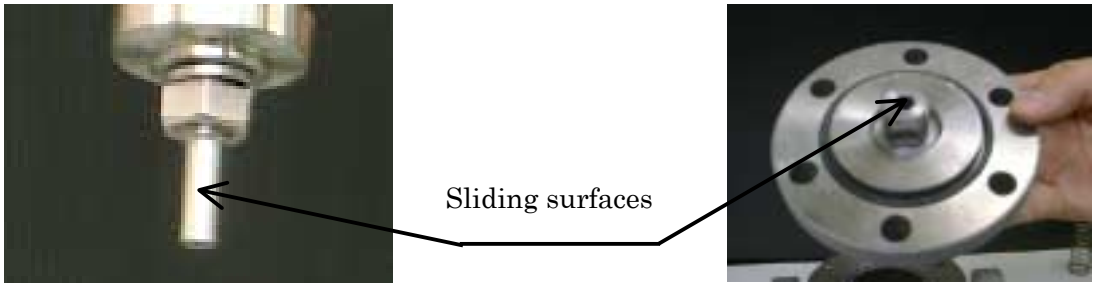
(Presumable cause I.6: Diaphragm ㉓ is damaged; and Presumable cause I.7: Foreign material is pinched between diaphragm shell ⑲ and slide of top guide ⑧, and take appropriate Action(s) as necessary.)



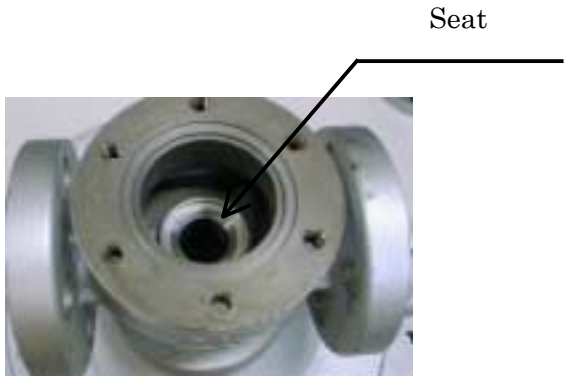


Action (13) : Remove 6 hexagon head bolts ⑱ from the lower cover. Remove spring ⑮, spindle ⑫, disc ⑩, valve ⑪, spring washer ⑬, and hexagonal nuts ⑭.

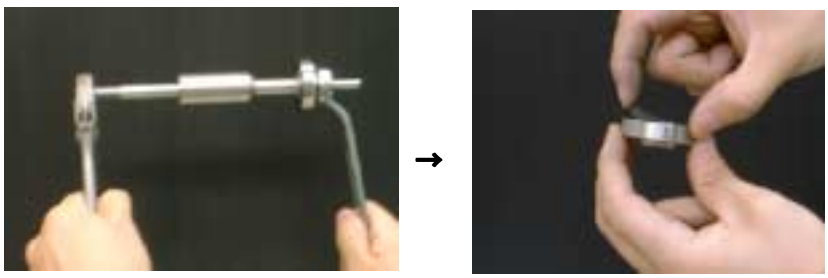
(Presumable cause I.8: Foreign object is pinched between spindle ⑫ and slide of bottom guide ⑯; Probable cause I.9: Hexagon nut ⑭ on the valve is loosened; and take appropriate Action(s) as necessary.)



Action (14) : Check disc ⑩ and valve seat ② for pinched foreign materials and damage. Remove pinched materials, if any.



Action (15) : If the valve seat ② is damaged, consult us. If disc ⑩ is damaged, loosen hexagon nut ⑭ and remove spring washer ⑬ and valve ⑪. Remove the disc ⑩ from recess on the valve ⑪.



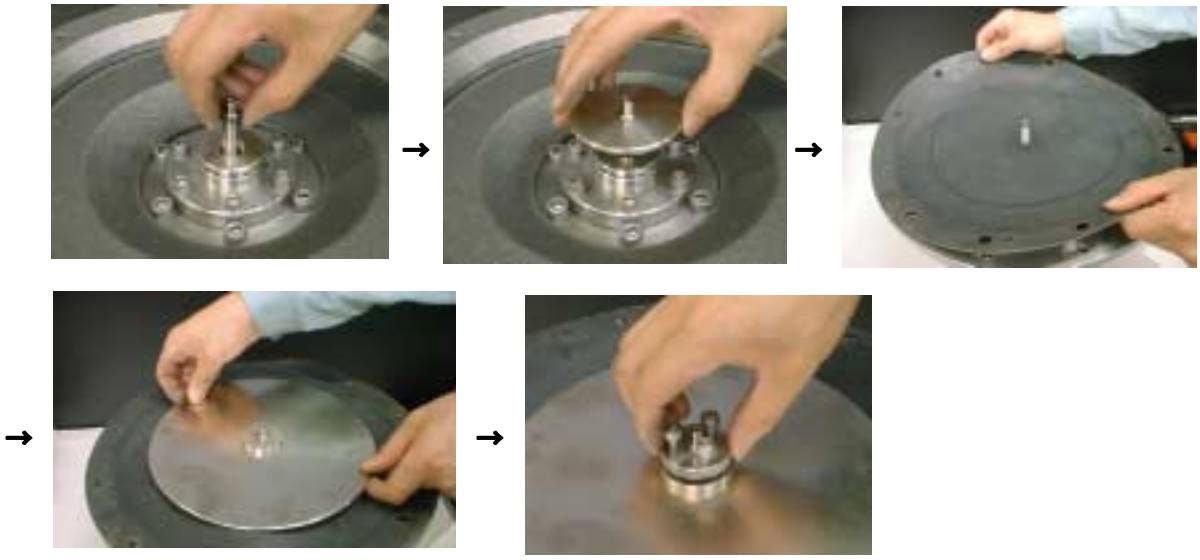
Action (16) : Place a new disc ⑩ in recess on the valve ⑪.

Action (17) : Attach disc ⑩, valve ⑪, spring washer ⑬ into spindle ⑫ and secure with hexagon nut ⑭. **(Tightening torque:16 N・m)**

Action (18) : Attach spindle ⑫, disc ⑩, valve ⑪, spring washer ⑬, a set of hexagon nuts ⑭ and spring ⑮. Secure bottom cover ⑰ with 6 hexagon head bolts ⑱.

(Tightening torque: 20 N・m)

Action (19) : Attach O-ring ⑳, bottom diaphragm plate ㉒, diaphragm ㉓, top diaphragm plate ㉑ and washer ㉔. Position the holes of diaphragm ㉓. Tight locknut ㉕ manually.



Action (20) : While securely holding top diaphragm plate ㉑ with hand, tighten 3 hexagon socket head cap bolts ㉖. **(Tightening torque: 4 N･m)**

Note: Do not attempt to twist top diaphragm plate ㉑ any further. This may damage the balance diaphragm ⑦.

Action (21) : Place top diaphragm case ㉗. Align the holes of both components and secure the casing with 12 hexagon bolts ㉘. **(Tightening torque: 18 N･m)**


Action (22) : Attach spring ㉙ and spring plate ㉚. Secure spring chamber ㉛ with 6 hexagon head bolts ㉜.


Action (23) : Follow the procedure described in 7.2 Adjustment.

Presumable cause I.5: Hexagon socket head cap bolt ㉖ or/and locknut ㉕ is loosened

Action (24) : Follow steps in Actions (7) to (11) and then go to Action (20) through (23).

Presumable cause I.6: Diaphragm ㉓ is damaged.

Action (25) : Follow steps in Actions (7) to (12); replace diaphragm ㉓. After replacement, go to Actions (19) to (23).

Presumable cause I.7: Foreign material is pinched between diaphragm shell ⑲ and slide of top guide ⑧.

Action (26) : Follow steps in Actions (7) to (12). After removing the object, go to Actions (19) to (23).

Presumable cause I.8: Foreign object is pinched between spindle ⑫ and slide of bottom guide ⑯.

Action (27) : Follow steps in Actions (7) to (13). After removing the object, go to Actions (18) to (23).

Presumable cause I.9: Hexagon nut ⑭ on the valve is loosened.

Action (28) : Follow steps in Actions (7) through (13). And then go to Actions (17) to (23).

Presumable cause I.10: Hexagon socket head cap bolt ⑨ on upper guide is loosened.

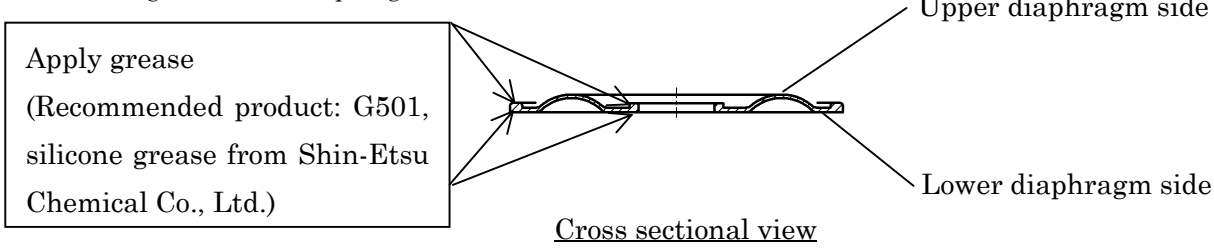
Action (29) : Follow steps in Actions (7) to (12). Tighten hexagon socket head cap bolt ⑨. **(Tightening torque: 5 N・m)** Go to Actions (19) to (23).

Presumable cause I.11: Balance diaphragm ⑦ is damaged.

Action (30) : Perform Actions (7) to (12). Unscrew hexagon socket head cap bolt ⑨ and remove top guide ⑧.

Action (31) : Replace balance diaphragm ⑦. Place top guide ⑧ and secure it with hexagon socket head cap bolt ⑨. **(Tightening torque: 5 N・m)**

○Assembling the balance diaphragm



Action (32) : Complete Actions (19) to (23).

Problem II: Reduced pressure does not reach the prescribed value. Or, fluid fails to flow.

Presumable cause II.12: The strainer at the inlet is clogged.

Action (33) : Clean the strainer screen.

Presumable cause II.13: Needle valve ㊲ is clogged by foreign materials.

Action (34) : Follow steps described in Actions (4) to (6).

Presumable cause II.14: Foreign material is pinched between diaphragm shell ⑲ and slide of top guide ⑧.

Action (35) : Follow steps described in Actions (26).

Presumable cause II.15: Foreign object is pinched between spindle ⑫ and slide of bottom guide ⑯.

Action (36) : Follow steps described in Actions (27).

Problem III: External leakage

Presumable cause III.16: Needle valve ㊲ is clogged by foreign materials.

Action (37) : Follow steps described in Actions (4) to (6).

Presumable cause III.17: Hexagon head bolt ⑱ of bottom cover is loosened. Or, O-ring is damaged.

Action (38) : Retighten hexagon head bolt ⑱ of bottom cover.

Action (39) : In the case the O-ring is damaged, unscrew hexagon head bolt ⑱ on the bottom cover. Remove the cover and replace the O-ring with new one.

Action (40): Attach the bottom cover and secure it with hexagon head bolt ⑱.

(Tightening torque: 20N･m)

Presumable cause III.18: Hexagon head bolt ㉘ on top diaphragm case becomes loose.

Action (41) : Retighten hexagon head bolt ㉘ of top diaphragm case.

Presumable cause III.19: Hexagon socket head cap bolt ㉖ and locknut ㉕ are loosened.

Action (42) : Follow steps described in Actions (7) to (11) and then perform Actions (20) to (23).

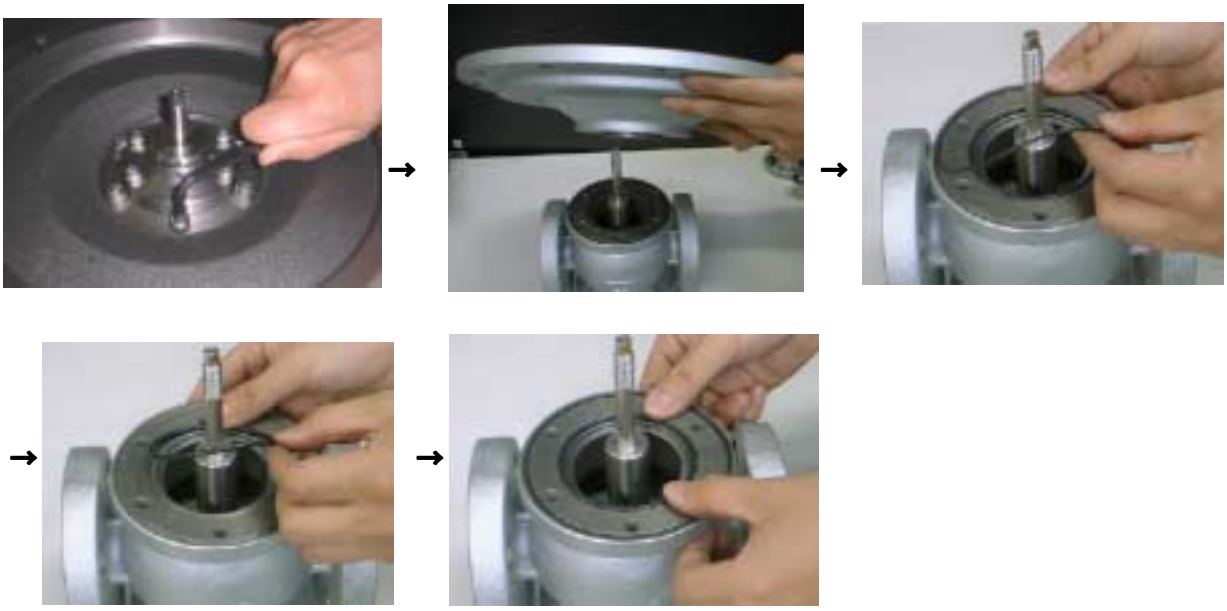
Presumable cause III.20: Diaphragm ㉓ is damaged.

Action (43) : Follow steps described in Actions (7) to (12); replace diaphragm ㉓. After replacement, perform steps in Actions (19) to (23).

Presumable cause III.21: Hexagon socket head cap bolt ⑥ on the bottom diaphragm case is loosened or O-rings ③ and ④ are damaged

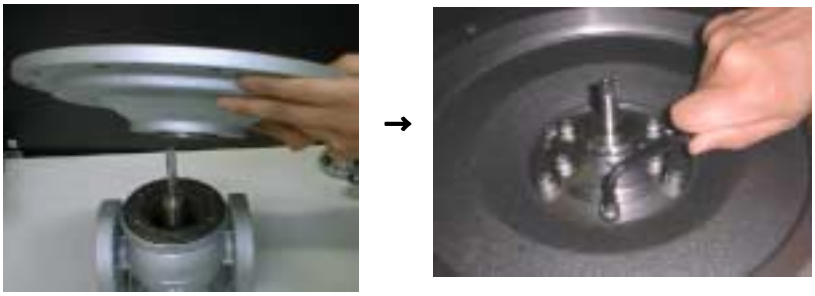
Action (44) : In case of loosened bolt: follow steps described in Actions (7) to (12). Retighten the hexagon head bolt ⑥. And then perform steps in Actions (19) to (23).

Action (45) : In the case O-ring is damaged, follow steps described in Actions (7) to (12). Unscrew hexagon head bolt ⑥. Remove the bottom diaphragm case and replace the O-ring.



Action (46): Place the bottom diaphragm case and secure it with hexagon socket head cap bolt ⑥.

(Tightening torque: 12N・m)



Action (47): Follow steps described in Actions (19) to (23).