MODEL GDK-2000
PRESSURE REDUCING VALVE
PRODUCT MANUAL

Thank you very much for choosing the Yoshitake's product. To ensure the correct and safe use of the product, please read this manual before use. This manual shall be kept with care for future references. The symbols used in this manual have the following meanings.

Warning	This symbol indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
Caution	This symbol indicates a hazardous situation that, if not avoided, may result in minor or moderate injury or may result in only property damage.

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YOSHITAKE

1. Specifications

Model		GDK-2000		
Connection		Screwed	Flanged	
		JIS Rc	JIS 20K RF	JIS 10K FF
Nominal size		15 ~ 50A	15 ~ 100A	
Application		Steam		
Inlet pressure		0.1 ~ 2.0 MPa		0.1 ~ 1.0 MPa
Reduced pressure (*)		0.05 ~ 1.4 MPa		0.05 ~ 0.9 MPa
		90% or less of Inlet pressure (gauge pressure)		
Min. differential pressure		0.05 MPa		
Max. pressure reducing ratio		10:1		
Max. temperature		220 °C		
Valve seat leakage		0.01% or less of rated flow		
Material	Body	Ductile Cast Iron		
	Main valve	Stainless Steel		
	Main valve seat	Stainless Steel		
	Main diaphragm	Stainless Steel		

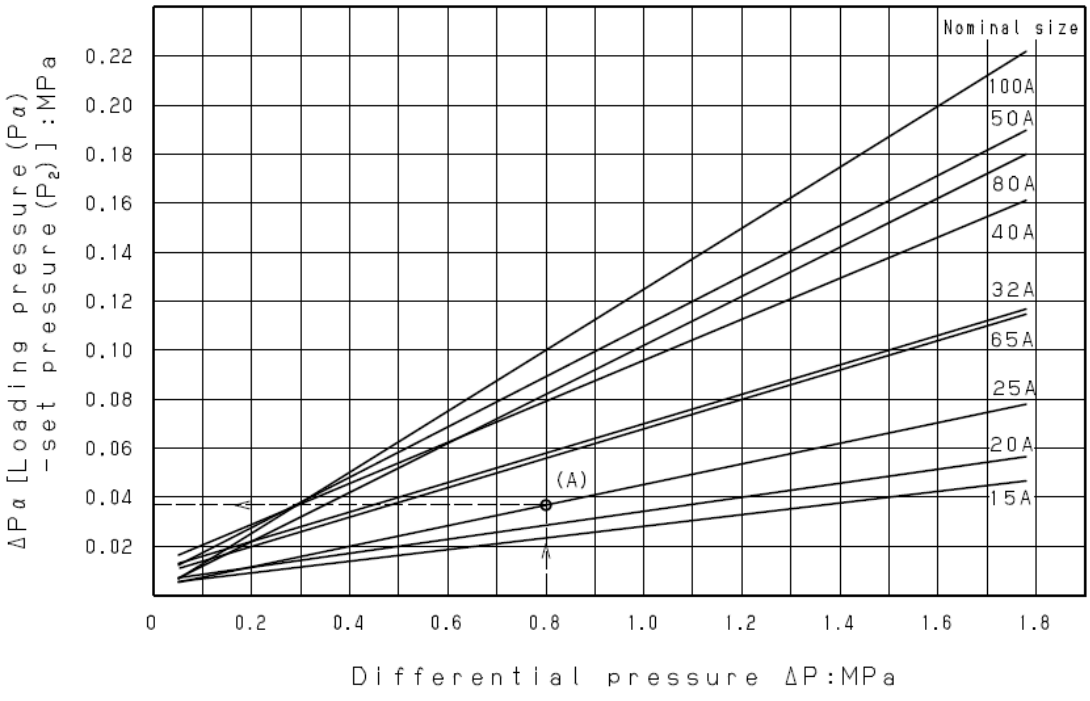
(*) Refer to “Standard Loading Pressure - Setting Pressure Chart Lines” for system air pressure.

Caution

Please confirm that the indications on the product correspond with the specifications of the ordered product model before use.
* If they are different, please contact us without using the product.

[Standard Loading Pressure - Setting Pressure Chart Lines]

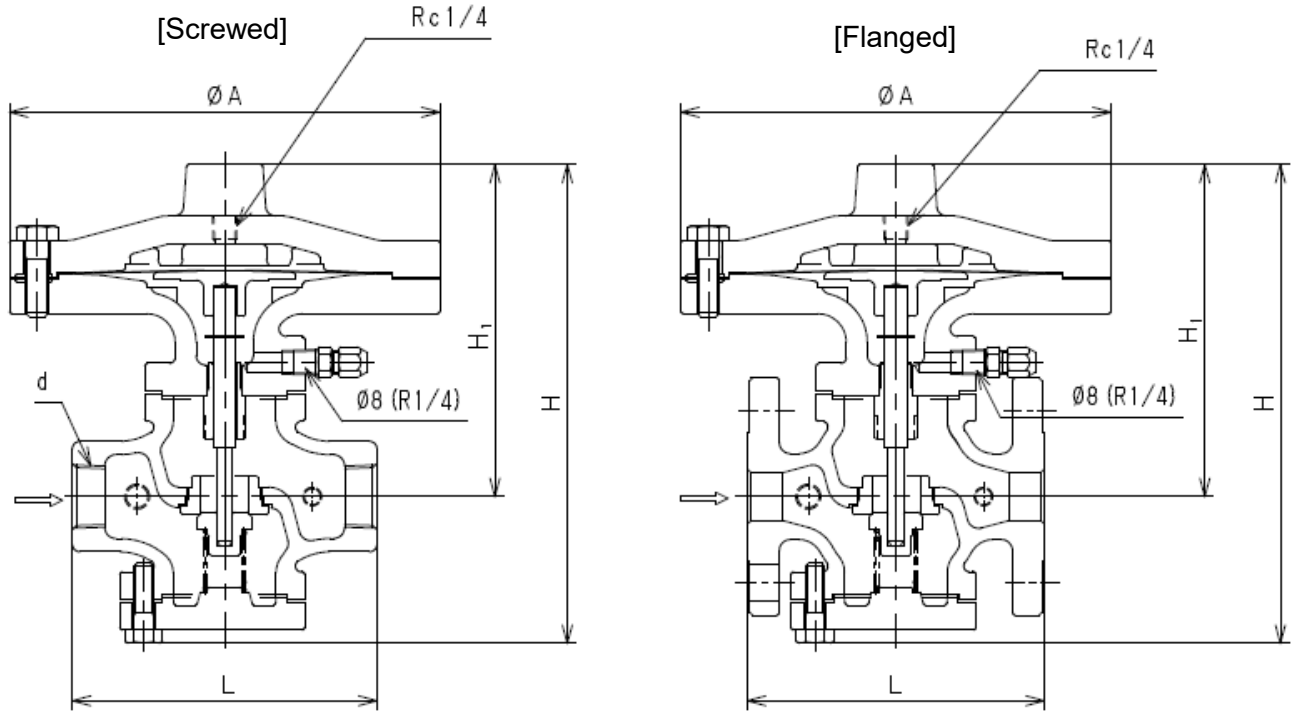
The setting pressures corresponding to the loading pressures are shown below. As slight deviations from the “loading pressure - setting pressure” chart lines shown below may occur depending on conditions such as the length of the air line, etc., a setting pressure which is high enough to cover such deviations should be selected.



* Explanation of Chart Lines

For a nominal size of 25A, the loading pressure for an inlet pressure [P_1] of 1.0MPa and a reduced pressure[P_2] of 0.2MPa can be obtained as follows: Find point[A] where a vertical line drawn upward from the valve's inlet/reduced pressure differential (ΔP) (1.0 - 0.2 = 0.8MPa) intersects the 25A nominal size line. Next draw a horizontal line from point[A] to the left border of the chart to obtain the ΔPα (loading pressure[Pα] - set pressure[P_2]) = 0.037MPa value. The loading pressure can then be calculated as follows: Loading pressure[Pα] = ΔPα+ P_2 = 0.037 + 0.2 = 0.237MPa.

2. Dimensions and Weights



The structure differs for nominal sizes 65A to 100A.

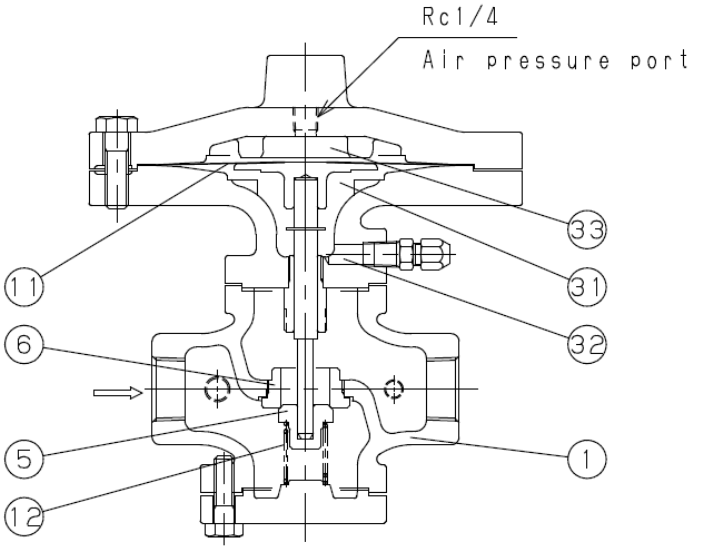
(mm)

Nominal size	Screwed (JIS Rc)						Flanged (JIS 20K RF)				
	d	L	H_1	H	A	Weight (kg)	L	H_1	H	A	Weight (kg)
15A	Rc 1/2	150	74	244	200	12.4	146	74	244	200	13.9
20A	Rc 3/4	150	74	244	200	12.4	146	74	244	200	14.4
25A	Rc 1	160	76	251	226	16.4	156	76	251	226	19.2
32A	Rc 1-1/4	180	90	282	226	19.9	176	90	282	226	22.4
40A	Rc 1-1/2	180	90	282	226	19.9	196	90	282	226	22.9
50A	Rc 2	230	103	319	276	30.5	222	103	319	276	33.5
65A	------	-----	-----	-----	-----	-----	282	122	373	352	61.8
80A	------	-----	-----	-----	-----	-----	302	135	399	352	69.1
100A	------	-----	-----	-----	-----	-----	342	167	488	401	108.6

- Different Length(L) and Weight values apply for JIS 10K FF.
- Other standard connections are available upon request.

3. Operation

The pressure reducing valve reduces pressure by the throttling the valve. The valve is composed of the main valve, main valve seat, a pressure adjusting air chamber, and a main diaphragm for pressure sensing and activation.



No.	Parts name
1	Body
5	Main valve
6	Main valve seat
11	Main diaphragm
12	Main valve spring
31	Main diaphragm chamber
32	Reduced pressure sensing port
33	Air pressure control space

(1) When the pressure reducing valve is mounted correctly, the main valve [5] should be closed by the main valve spring [12] when a no-pressure condition is made by a standard control unit, etc. When the inlet gate valve is gradually opened, allowing the high-pressure fluid to flow in, the inlet pressure will be applied to the back side of the main valve. (Fig. 1)

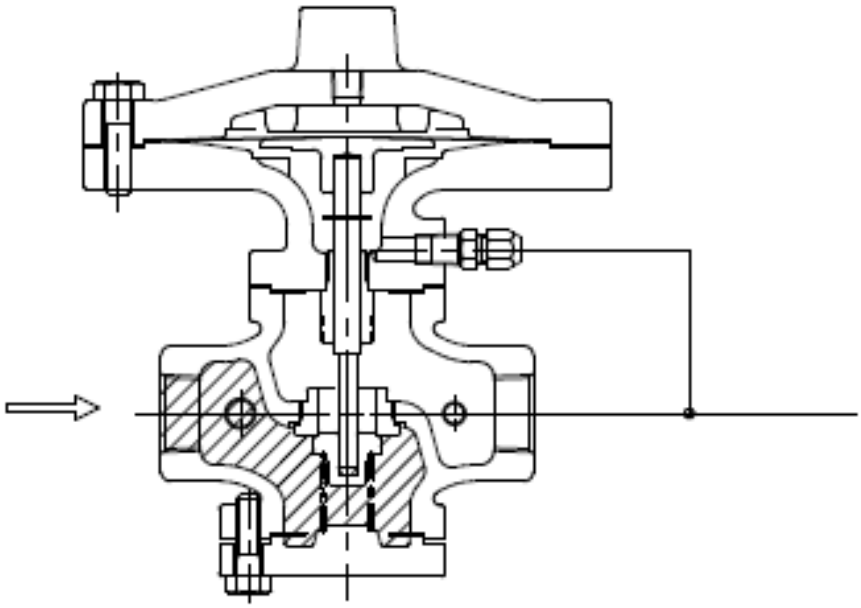


Fig.1

(2) When air pressure is introduced into the air pressure control space [33] by a standard control unit, etc., main diaphragm [11] will bend and when it overcomes both the pressure against the back of the main valve, and the load of the main valve spring, thereby pushing the main valve open. The fluid then begins to flow from the inlet side to the reduced pressure side. (Fig. 2)

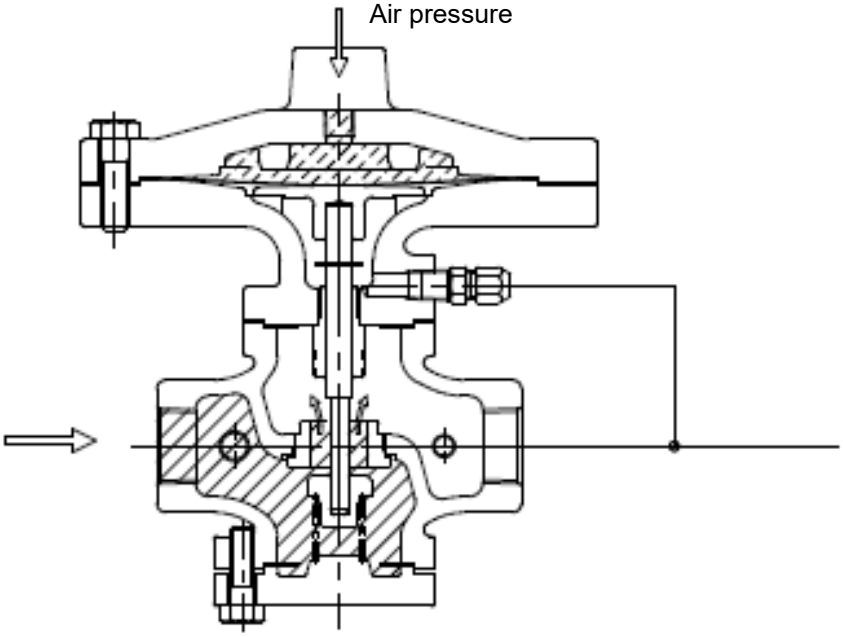


Fig.2

(3) The flow of pressure proceeds from the reduced pressure sensing pipe through the reduced pressure sensing port [32], and into the main diaphragm chamber [31]. The diaphragm then balances the operating pressure with the reduced pressure. The amount of reduced pressure applied to the diaphragm and operating pressure act on each other to maintain an appropriate reduced pressure by controlling the main valve's opening. (Fig. 3)

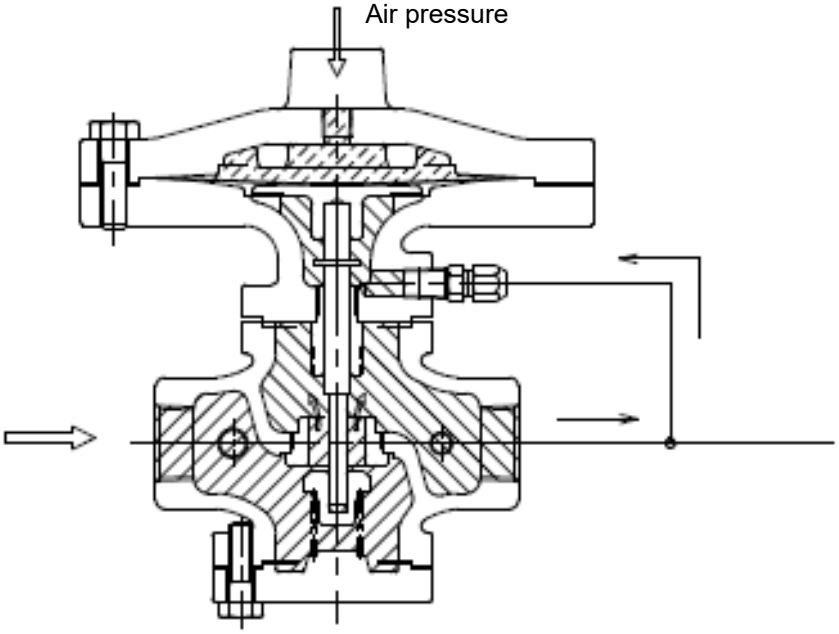


Fig.3

(4) In the absence of a reduced pressure load, the pressure in the diaphragm chamber increases, thereby pushing the main valve spring to close the valve. (Fig. 4)

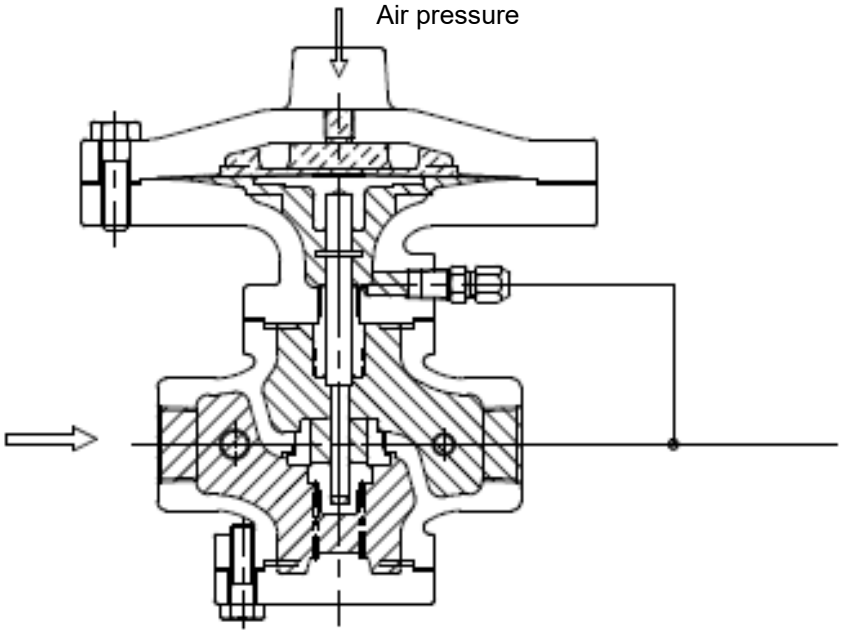
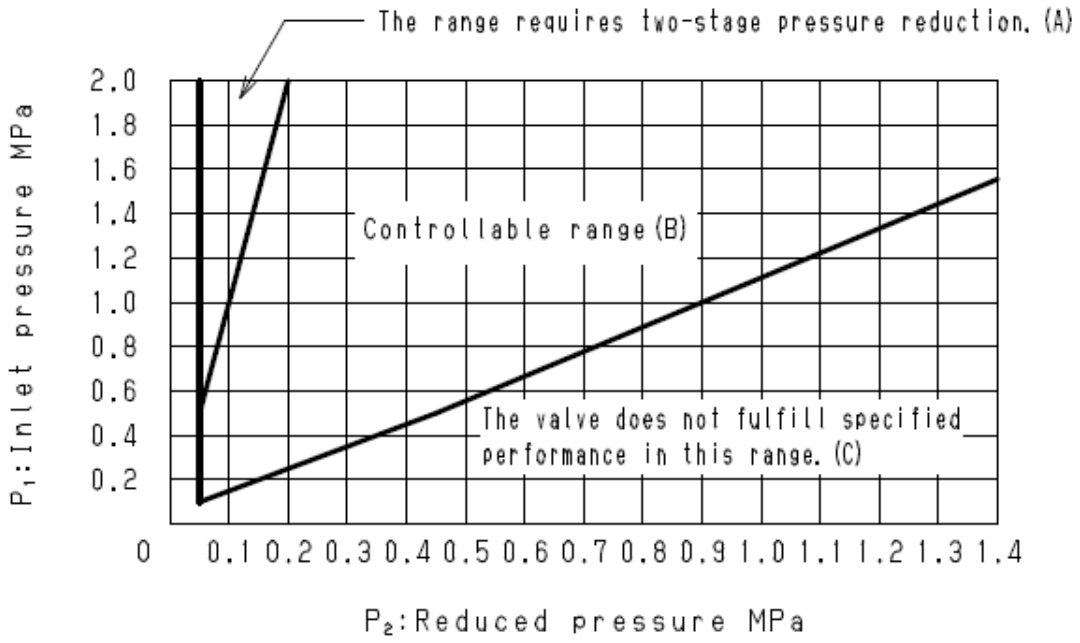


Fig.4

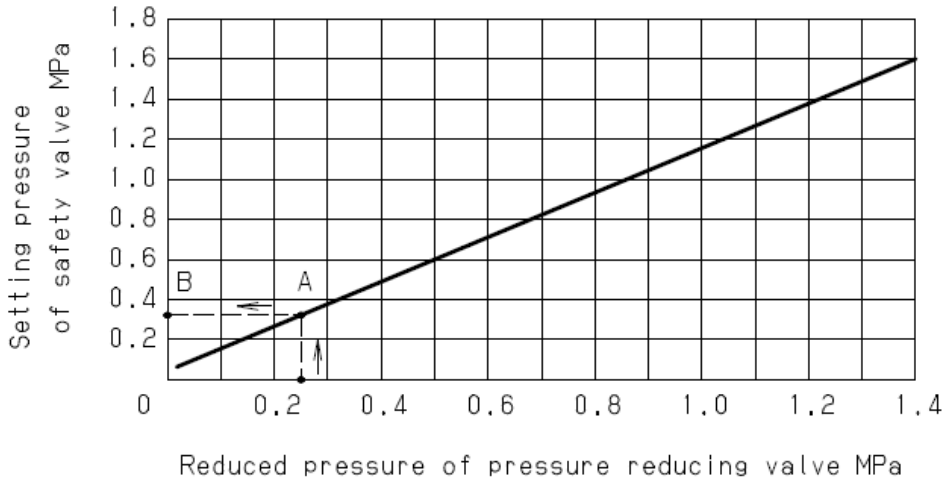
4. Nominal size selection method

4.1 Pressure reducing valve specification selection chart



To select the most appropriate pressure reducing valve, refer to the above selection chart. Find the intersection point of the inlet pressure (P_1) and the reduced pressure (P_2). If the intersection point is within the range (A), two-stage pressure reduction is required. In this case, maximize the distance between the valves (at least 3 meters). The valve does not fulfill specified performance in the range (C).

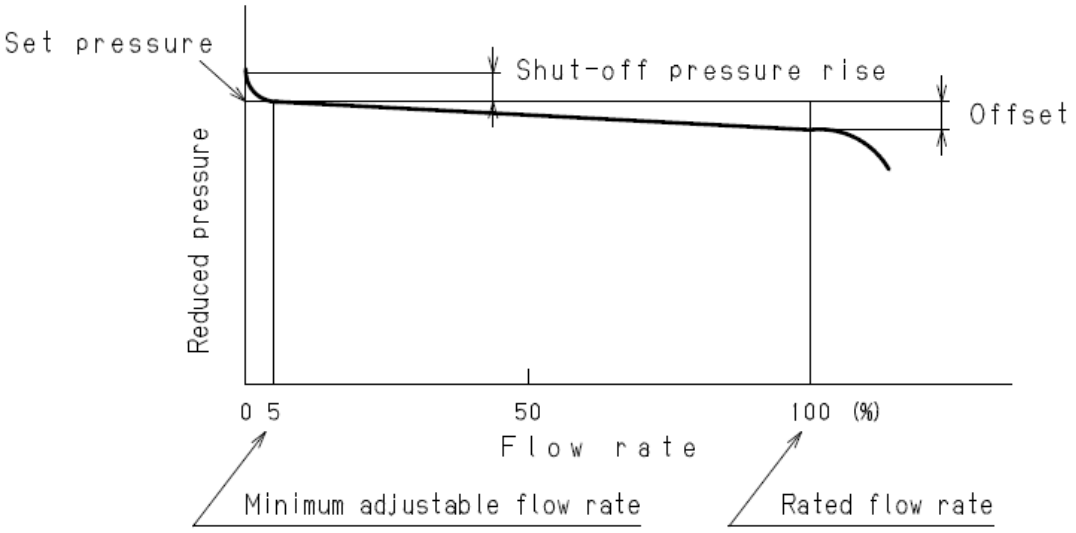
4.2 Safety valve setting pressure chart



Determine the reduced pressure of pressure reducing valve. Find the intersection point (A) with the chart curve. Next, find point (B) by proceeds horizontally from point (A) to the left until the 'Setting pressure of safety valve' axis. The setting pressure of the safety valve should be higher than the pressure of the point (B).

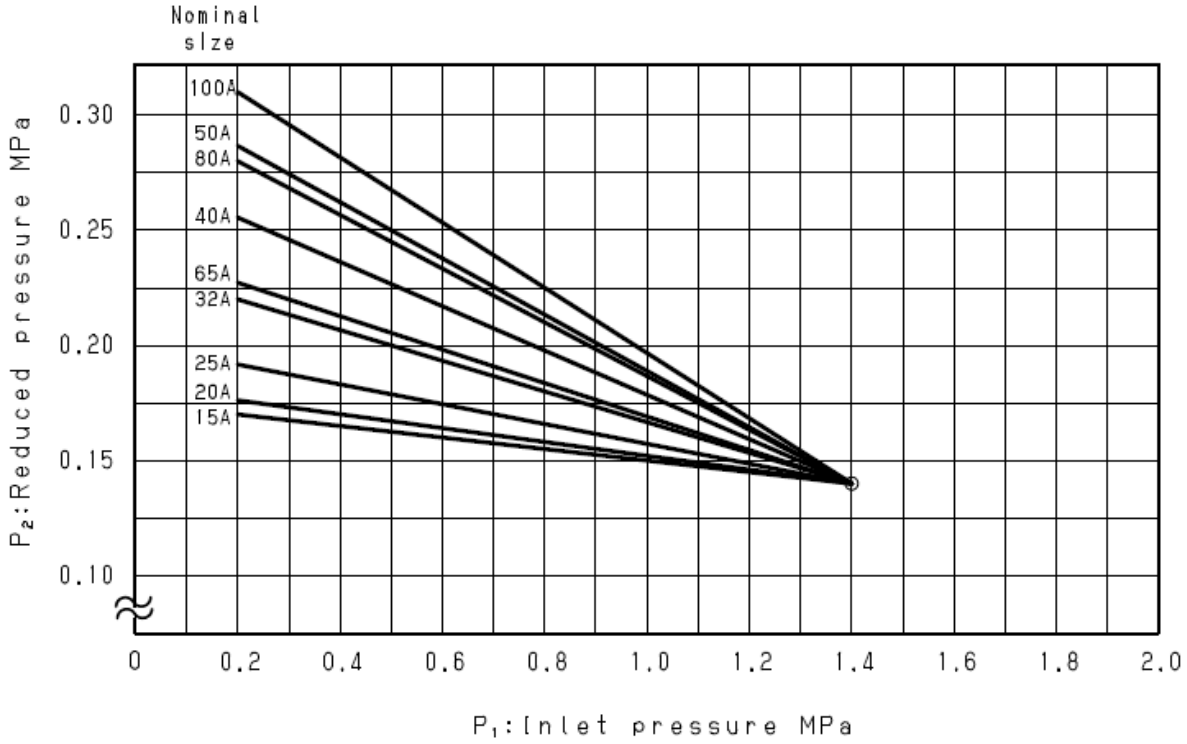
4.3 Characteristic chart

(1) Flow rate characteristics chart



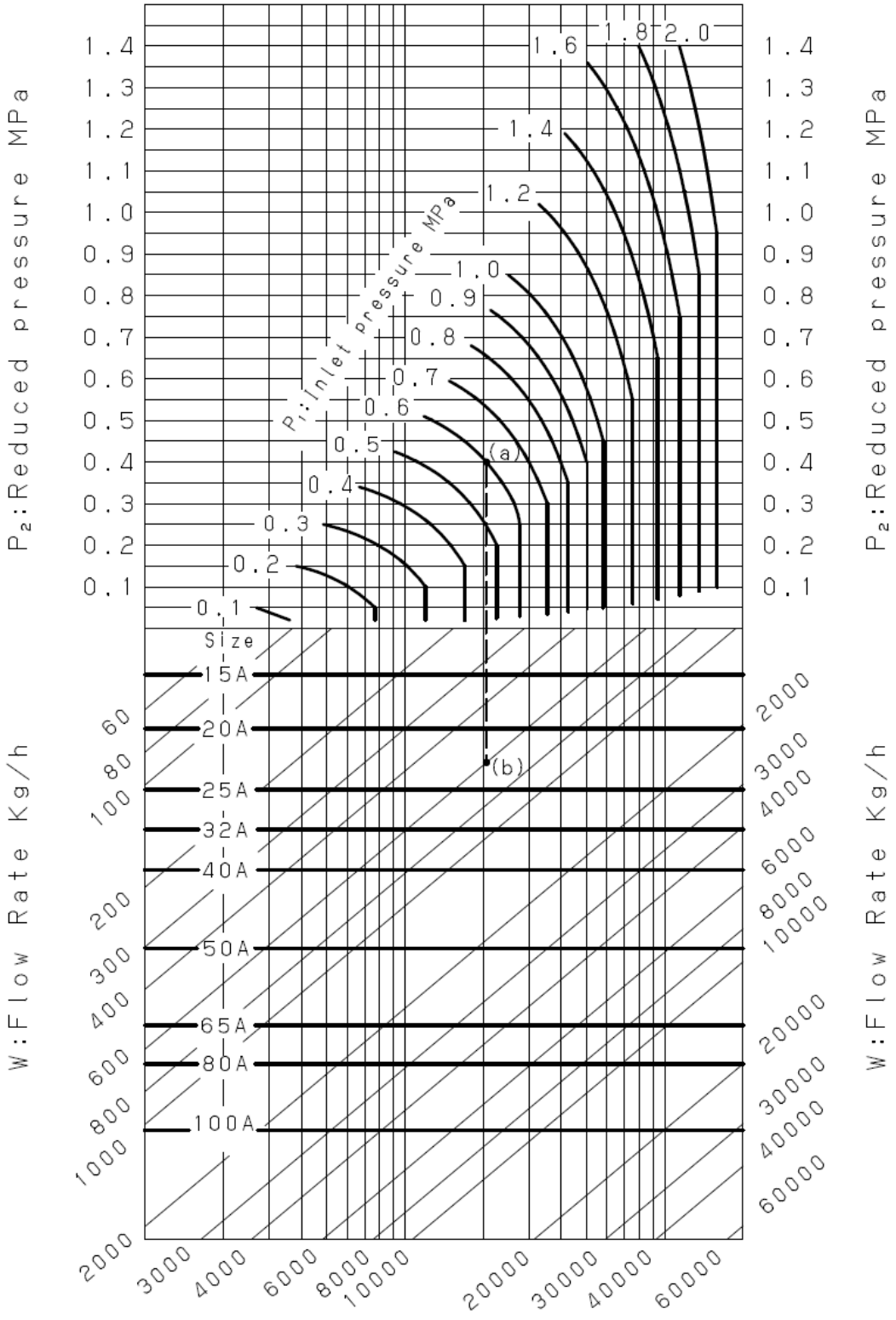
- Shut-off pressure rise: 0.02 MPa or less
- Offset: 10% or less of set pressure at outlet side (Minimum value: 0.05MPa)

(2) Pressure characteristics chart



This chart shows variation in reduced pressure when the inlet pressure of 1.4 MPa is changed between 0.2 MPa and 1.4 MPa while the reduced pressure is set at 0.14 MPa.

4.4 Nominal size selection chart



[Example]

When selecting the nominal size of a pressure reducing valve with its inlet pressure (P_1) is 0.6 MPa, its reduced pressure (P_2) is 0.4 MPa and its steam flow rate is 600 kg/h, first find the intersection point (a) of inlet pressure 0.6 MPa and reduced pressure 0.4 MPa. Trace down vertically from this intersection point (a) to find intersection point (b) with the flow rate of 600 kg/h. Since the intersection point (b) is between nominal sizes 20A and 25A, select the larger one, 25A.

4.5 Nominal size selection calculation formula

An appropriate nominal size can be calculated by obtaining Cv value for the operating conditions in question, as shown below.

• Calculation formula for Cv value

$P_2 > \frac{P_1}{2}$

$$Cv = \frac{Wk}{138\sqrt{\Delta P(P_1 + P_2)}}$$

$P_2 \leqq \frac{P_1}{2}$

$$Cv = \frac{Wk}{120P_1}$$

W: Max. steam flow rate [kg/h]
P_1: Inlet pressure [MPa・A]
P_2: Reduced pressure [MPa・A]
ΔP: P_1 - P_2 [MPa]
k: 1+0.0013× {superheated steam temp.[°C] - saturated steam temp. [°C]}

● Rated Cv value table

Nominal size	15A	20A	25A	32A	40A	50A	65A	80A	100A
Cv value	5.0	7.2	10.9	14.3	18.8	32	54	70	108

[Example]

The flow rate of the pressure reducing valve is calculated under the following conditions: Nominal size 15A, saturated steam, Inlet pressure of 0.6 MPa = 0.7 [MPa A], Reduced pressure of 0.4 MPa = 0.5 [MPa A], you can find that Cv value of 15A is 5.0 from the chart. The following formula is established.

$$P_2(=0.5) > \frac{P_1(=0.7)}{2}$$

$$W = \frac{138Cv\sqrt{\Delta P(P_1 + P_2)}}{k} = \frac{138 \times 5.0 \times \sqrt{0.2 \times (0.7 + 0.5)}}{1} = 338kg/h$$

* Use a safety factor of 80 to 90% for nominal size selection in view of friction losses in piping.

5. Installation

5.1 Precaution for installation

⚠ Warning

1. Since the product is heavy, securely support it using lifting devices or the like when installing. See the product weight specified in “2. Dimensions and Weights”.
   * Failure to follow this notice may cause falling accident of the product, resulting in bodily injury.

⚠ Caution

1. Do not disassemble the product unless it is necessary.
   * Failure to follow this notice may prevent the product from functioning properly.
2. Before installing the product, remove foreign substances and scale from the piping.
   * Failure to follow this notice may prevent the product from achieving its intended performance due to the ingress of foreign substances and scale into the product.
3. Install the valve so that the arrow on the valve body coincides with the direction of the fluid flow.
   * Failure to do so may prevent the valve from functioning.
4. Install the valve perpendicularly to horizontal lines with the diaphragm chamber located at the top.
   * Failure to do so may prevent the valve from functioning.
5. Do not connect the sensing pipe close to valves and elbows. Choose the position with the least vibration. (Recommended straight length: 10 times the line pipe diameter)
   * Failure to do so may cause inconsistent reduced pressure, which hampers correct pressure control.
6. Do not apply excessive load, torque or vibration to the valve.
   * Doing so may result in malfunction or drastically shortened service life.

5.2 Installing accessories

⚠ Warning

1. When installing the pressure reducing valve, be sure to connect the provided sensing pipe and joint.
   * Unless the sensing pipe is connected, the valve will not operate. Further, steam may blow off, resulting burns.

[Sensing pipe connection method]

Connect the provided sensing pipe (φ8-2m) and joint (φ8-R1/4) as shown in the illustration on Fig.5.

1. Wind sealing tapes around the joint and insert the joint into the pressure sensing side.
2. Fully insert the sensing pipe into the valve and the pressure sensing side joint. Tighten the cap nut until it can no longer be rotated manually, and then turn the cap nut about one and quarter times with a tool.
3. Note that the sensing pipe must be connected so that the valve side is higher than the pressure sensing side.

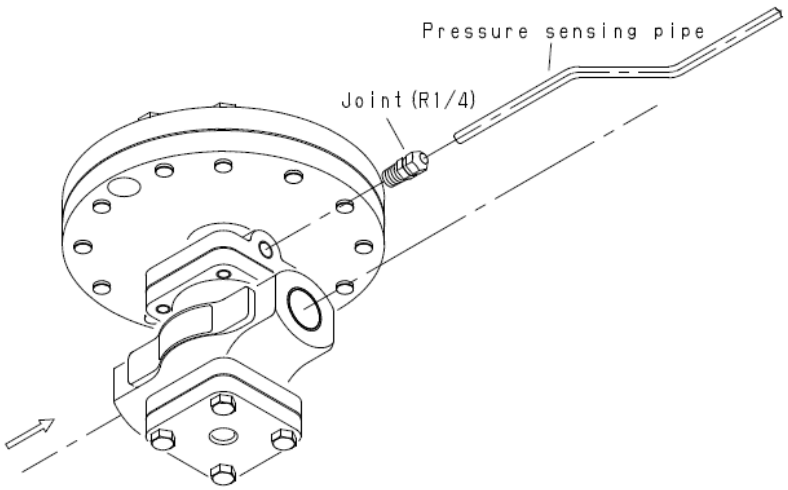


Fig.5

5.3 Piping before and after the pressure reducing valve

⚠ Warning

1. Be sure to install a non-return valve in the air line system.
   * Failure to do so could pose a risk of burns caused by steam flowing back through the air line in the event of the main diaphragm rupture.
2. When installing a safety valve for equipment protection at the outlet side of the product, connect a blow-off pipe to the outlet side of the safety valve, and lead it to a place where there is no risk of physical damage even if fluid blows out.
   * Failure to follow this notice may result in injury and scalds in case of fluid blow out.

⚠ Caution

1. Install a strainer (80 mesh) at the pressure reducing valve inlet side. Also, match the nominal diameter of the strainer to the diameter of the piping on the inlet side of the pressure reducing valve.
   * Failure to do so may hamper correct pressure control, which affects the original performance.
2. Install a safety valve for equipment protection at the outlet side of the product.
   * Failure to follow this notice may prevent the product from achieving its intended performance due to the ingress of foreign substances and scale into the product.
3. Install a pressure gauge at both the inlet and outlet sides of the valve.
   * Failure to do so may hamper correct pressure adjustment.
4. Install a steam trap to the inlet sides of the valve to prevent drainage problems.
   * Failure to do so may result in drainage problem, affecting the original performance.
5. When installing quick open and close valves, such as a solenoid valve, install it at inlet side as much as possible, and secure at least 3 m from the valve.
   * Failure to do so may result in malfunction or drastically shortened service life.
6. When pressure reducing in two stages, secure at least 3 m between the valves.
   * Failure to do so may result in malfunction, affecting the original performance.
7. When the pressure reducing ratio is large, install a reducer to keep the flow velocity in the pipe below 30 m/s or less.
   * An excessively high flow velocity may cause erosion, resulting in drastically shortened service.
8. Install a bypass pipe around the pressure reducing valve. (Refer to 5.4 Piping example)
   * Without a bypass pipe, it would be necessary to stop operation during maintenance and inspection.
9. Space is required above and below the center of the piping and on the conduit side for overhaul inspection, so secure the space shown in Fig. 6 when piping.

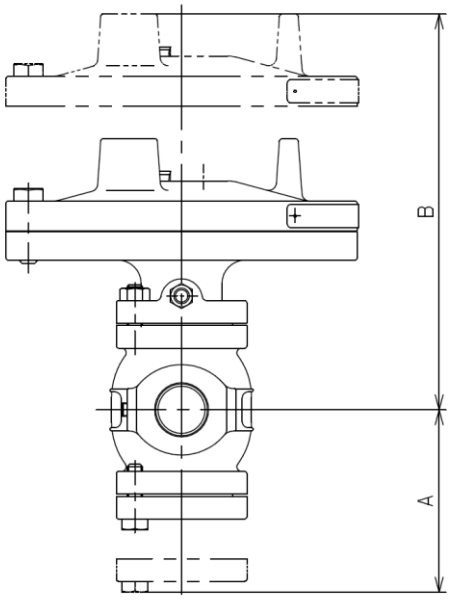


Fig.6

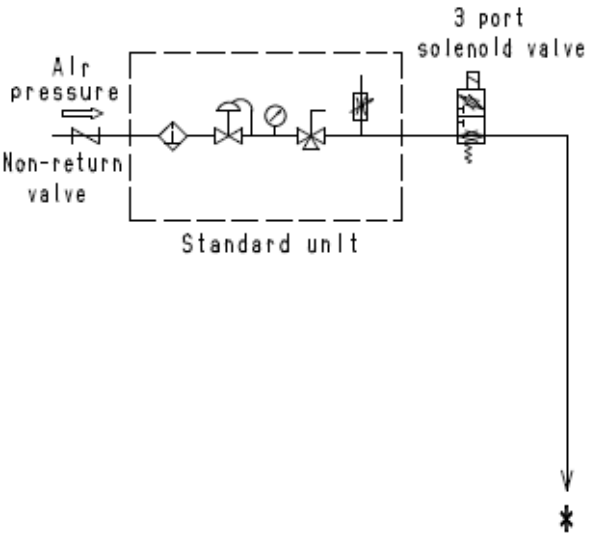
(mm)

Nominal size	A	B
15A	160	230
20A		
25A		240
32A	185	255
40A		
50A	210	280
65A	275	325
80A	300	340
100A	380	400

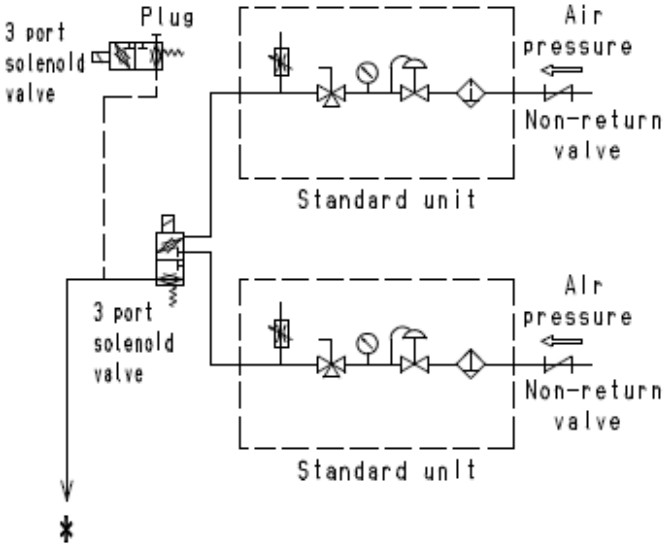
5.4 Piping example

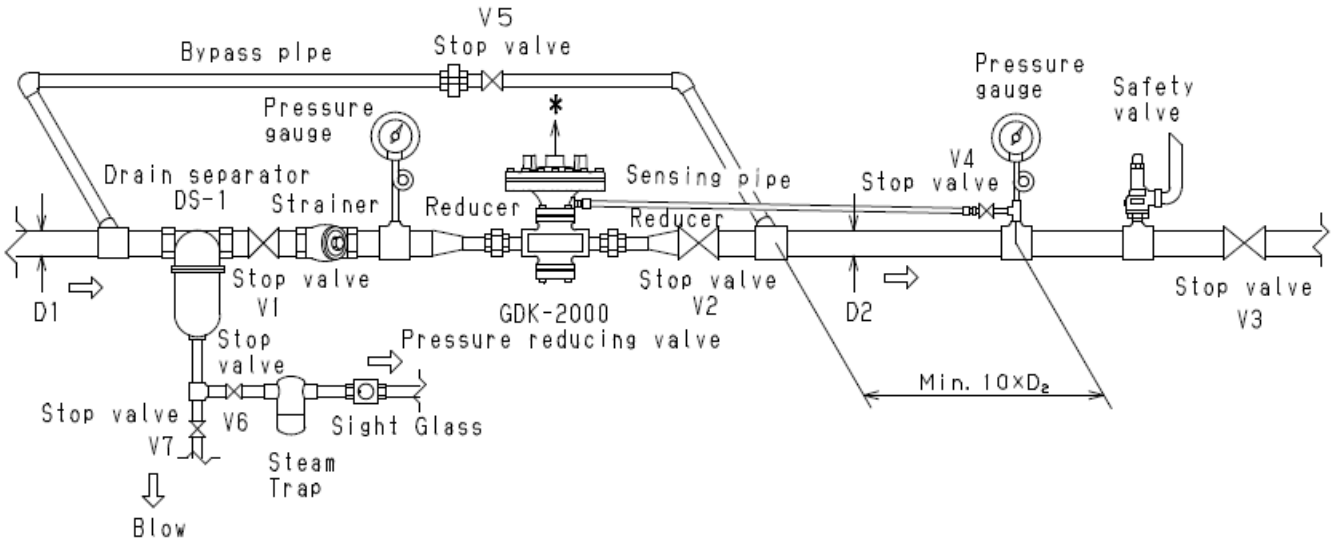
The remote pressure reducing valve can set several levels of pressure with a single pressure reducing valve depending on how the pneumatic circuit for operation is constructed, and automatic control is possible with a solenoid valve.

[Standard operating circuit]
The standard unit's air pressure reducing valve inputs air pressure to the remote pressure reducing valve to input the desired pressure. Use the manual three-way switching valve to turn the air pressure ON/OFF. Also, by using a three-way solenoid valve as shown in Fig. 7, automatic ON-OFF control is possible.



[Combination operation circuit]
Two sets of units are used, each of which is pre-adjusted to an arbitrary air pressure, and the pressure corresponding to each air pressure is output from the remote pressure reducing valve by switching the solenoid valve.





[Note]

The needle valve of the standard unit prevents pressure fluctuations due to volumetric expansion of air heated by steam above the remote pressure reducing valve and the effects of volumetric changes in the operating air pressure chamber. If the operating air pressure circuit is long, the operating pressure - set pressure basic diagram will deviate slightly. In such cases, change the operating pressure to achieve the required set pressure.

6. Operation procedure

6.1 Precaution for operation

⚠ Warning

1. Do not touch the product with bare hands directly.
   * Failure to follow this notice may result in scalds.
2. Before applying steam to the product, confirm that there is no risk when steam flows into the piping end and that piping joints are securely connected.
   * Failure to follow this notice may result in scalds in case of steam blow out.

⚠ Caution

1. Before leading fluid into the product, close the stop valves at the inlet and outlet of the product and remove foreign substances and scale from the piping completely by using a bypass line.
   * Failure to follow this notice may prevent the product from functioning properly due to the ingress of foreign substances and scale into the product.
2. Adjust pressure of the bypass stop valve manually to prevent the outlet pressure from going over the set pressure of the safety valve.
   * If going over, the safety valve blows out.
3. Before stopping operation of the product for an extended period, completely discharge fluid from the product and close the stop valves at the inlet and outlet sides of the product.
   * Failure to follow this notice may cause malfunction due to rusting inside the product and the pipes.

6.2 Adjusting procedure

Taking a wrong adjusting procedure may cause hunting, scale problems or water hammer, and can heavily damage the main parts of the valve. Be sure to follow the procedure below (see also “5.4 Piping example”).

1. Confirm that all stop valve (V_1-V_7) is closed.
2. Open the stop valve for trap before the product.
3. Open the stop valve (V_3) and adjust the opening of the bypass stop valve (V_6) so as not to blow the safety valve. Then completely discharge foreign substances by allowing fluid pass through the piping. After discharging, be sure to close the bypass stop valve.
4. Set the operating air pressure to no pressure.
5. Open the stop valve (V_4) of sensing pipe and the stop valve (V_2) at the outlet side of the product. Open the stop valve (V_3) so that a little fluid can flow through.
6. Slowly open the stop valve (V_1) at the inlet side after checking that condensate in the inlet side of the product is discharged from the trap.
7. While watching the pressure gauge on the secondary side, increase the operating air pressure with a standard unit, etc., and adjust to the desired pressure. Be sure to release a small amount of operating air pressure with a needle valve. (For the needle valve of the standard unit, open the valve opening by 1/2 to 1 turn.)
8. Slowly open the stop valve (V_3) and make fine adjustments so that the secondary pressure is the desired pressure.
9. After completing the adjustment, fix the handle of the pressure reducing valve of the operating air pressure unit.

7. Maintenance Procedure

7.1 Troubleshooting (Refer to “7.5 Exploded drawing”)

Trouble	Cause	Remedy
Reduced pressure of desired level is not obtained.	1. Working pressure is improper.	1. Correct the working pressure.
	2. Insufficient operating air pressure.	2. Increase the operating air pressure to the desired set pressure.
	3. The main diaphragm [11] is damaged.	3. Disassemble and replace it.
	4. The sensing pipe is clogged.	4. Disassemble and clean it.
	5. The nominal size of the product is too small for the specifications of the system.	5. Replace the product of proper nominal size.
	6. Incorrect pressure adjustment.	6. Set correctly (refer to “6.2 Adjusting procedure”).
	7. The strainer on the inlet side of the product is clogged.	7. Disassemble and clean it.
	8. Trouble with the pressure gauge.	8. Replace the pressure gauge.
Abnormal pressure rises at the outlet.	1. Operating air pressure too high.	1. Decrease the operating air pressure.
	2. Foreign substances stuck between the main valve [5] and the main valve seat [6], or scratches on them.	2. Disassemble the product and remove the foreign substances. Conduct lapping if scratches are found. If the scratches still exist, please contact us.
	3. Incorrect pressure adjustment.	3. Set correctly (refer to “6.2 Adjusting procedure”).
	4. Foreign substances stuck between the spindle [8] and the guide [9].	4. Disassemble the product and remove the foreign substances.
	5. Trap is not provided on a dead-end line.	5. Install a trap device.
	6. Bypass valve is leaking.	6. Repair or replace it.
Abnormal sound. Unstable operation.	1. Nominal size is too large for the specifications.	1. Change the nominal size appropriately.
	2. Too much high-pressure reduction ratio.	2. Use a two-stage pressure reduction.
	3. Condensate-induced problem.	3. Install a trap device.
	4. A quick operating valve installed near the product.	4. Place the quick operating valve more than 3 meters away from the product.
	5. Outlet pipe diameter is too small.	5. Select a pipe size so that flow velocity can be 30 m/s or less.
	6. No or too much operating air pressure relief.	6. Set correctly. (refer to “6.2 Adjusting procedure”).

- Most of problems at pressure reducing valve is caused by foreign matter and scales in the piping. Be careful sufficiently.
- Phenomenon like valve trouble happens by pressure gauge failure, bypass valve leakage, forgetting to close bypass valve or strainer clog. Check the above troubleshooting and take a proper remedy or prevention.
- Please contact us if you cannot judge whether damaged parts need to be replaced or not.

7.2 Precaution for maintenance and inspection

⚠ Warning

1. Completely discharge the pressure inside of the product, piping and equipment prior to disassembly and inspection. When fluid is hot, cool down the product to the condition that it can be touched with bare hands. Avoid touching the product with bare hands till it is cooled down enough.
   * Failure to follow this notice may result in scalds, injury or contamination on the surroundings due to the residual pressure.

⚠ Caution

1. Disassembly and maintenance must be conducted by professional.
   * In the event of product failure, ask a professional to take measures.
2. When disassembling, put a container under the product to collect condensate flowing out from it. Disassemble the product after condensate is completely discharged from the product.
   * Failure to follow this notice may result in making the surroundings dirty.
3. Before applying steam to the product, close the stop valves at the inlet and outlet sides of the product and remove foreign substances and scale from the piping completely.
   * Failure to follow this notice may prevent the product from functioning properly due to the ingress of foreign substances and scale into the product.
4. Before stopping operation of the product for an extended period, completely discharge the fluid from the product and close the stop valves at the inlet and outlet sides of the product.
   * Failure to follow this notice may cause malfunction due to rusting inside of the product and the pipes.
5. After stopping operation of the product for an extended period, conduct operational check of the product.
   * In the event of product failure, ask a professional to take measures.

7.3 Disassembly

Before disassembly, be sure that the stop valves at the inlet and outlet sides of pressure reducing valve are closed. Be careful that all internal pressure and condensate are discharged.

(1) Disassembly of the main valve

1. Remove the bolt [15] from the cover [4] to dismount the cover from the body [1]. At the same time, remove the main valve spring [12] and main valve [5].

(2) Disassembly of the main diaphragm

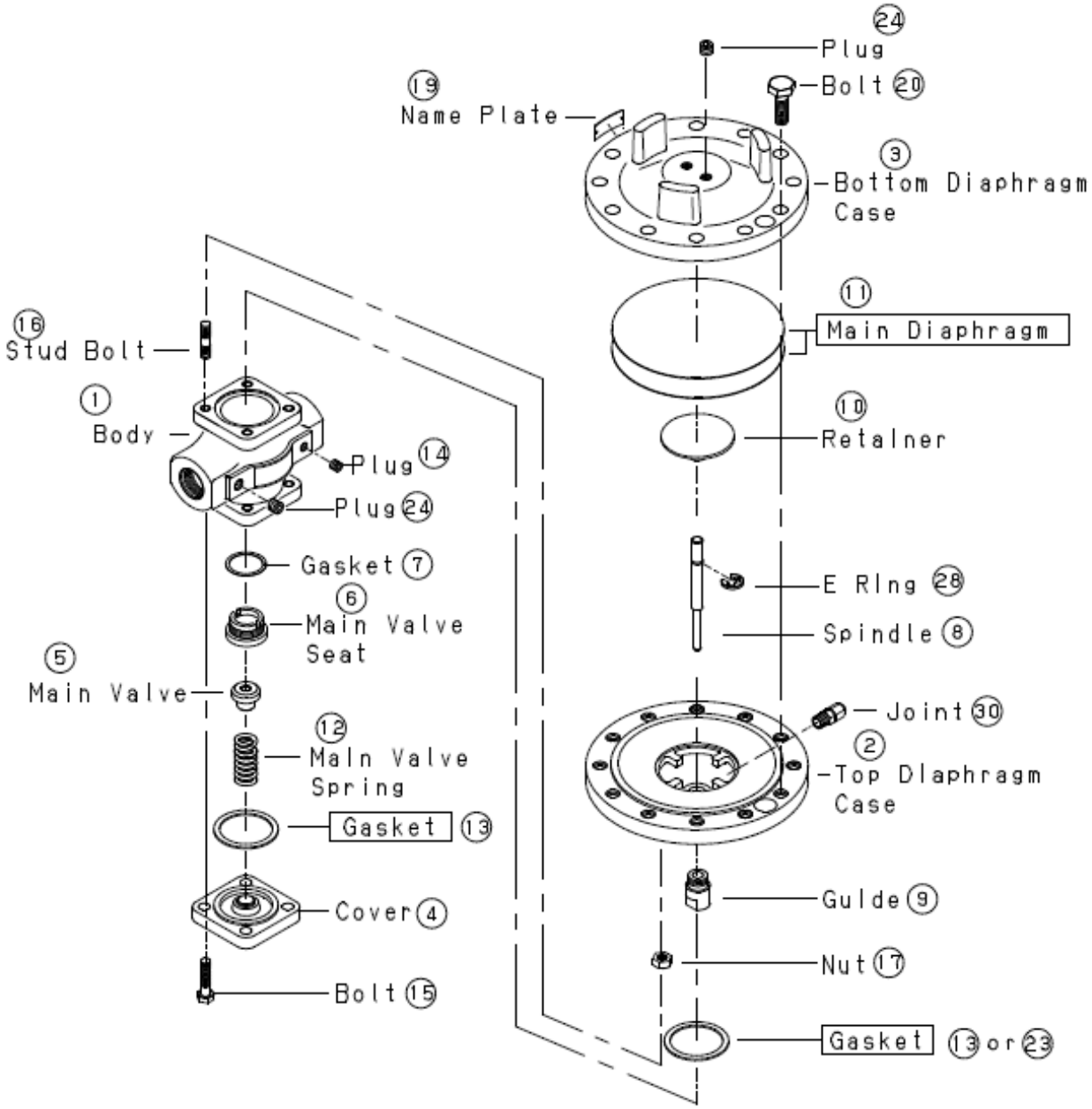
1. Remove the bolt [20] from the bottom diaphragm case [3]. Dismount the bottom diaphragm case, at the same time, remove the main diaphragm [11] and retainer [10].

7.4 Precautions for reassembly

⚠ Caution

1. Check that there are no scratches on the main valve and main valve seat.
   * Any scratches at sealing surface lead to increase in secondary pressure. When any scratches are identified on the main valve or main valve seat, make lapping of them. Please contact us if scratches still exist after lapping.
2. Confirm that the sliding parts (the spindle) moves smoothly.
   * If the sliding parts do not move smoothly, it may cause failure problems.
3. Replace gaskets with new ones when reassembling.
   * If the old gasket is used again, it may cause steam leakage problem.
4. Assemble the parts in reverse order from disassembly. Tighten the bolts uniformly.
   * Wrong order keeps the product from being assembled correctly. If the hexagon bolts are not tightened uniformly, it may cause steam leakage problem.

7.6 Exploded drawing



The structure differs for nominal sizes 65A to 100A.
The parts name shown in the rectangle boxes are available as consumable supply.

* Apply lubricant agent for heat/steam resistance (recommendation: SOLVEST No.110 paste, STT Inc.) to the top and bottom seal area of the main diaphragm.

Warranty Information

1. Limited warranty

   This product has been manufactured using highly-advanced techniques and subjected to strict quality control. Please be sure to use the product in accordance with instructions on the manual and the label attached to it.

   Yoshitake warrants the product to be free from any defects in material and workmanship under normal usage for a period of one year from the date of receipt by the original user, but no longer than 24 months from the date of shipment from Yoshitake's factory.

2. Parts supply after product discontinuation

   This product may be subject to discontinuation or change for improvement without any prior notice. After the discontinuation of the product, Yoshitake supplies the repair parts for 5 years otherwise individually agreed.

3. This warranty does not cover the damage due to any of below:
   (1) Valve seat leakage or malfunction caused by foreign substances inside piping.
   (2) Improper handling or misuse.
   (3) Improper supply conditions such as abnormal water pressure/quality.
   (4) Water scale or freezing.
   (5) Trouble with power/air supply.
   (6) Any alteration made by other than Yoshitake.
   (7) Use under severe conditions deviating from the design specifications
   (e.g. in case of corrosion due to outdoor use).
   (8) Fire, flood, earthquake, thunder and other natural disasters.
   (9) Consumable parts such as O-ring, gasket, diaphragm and etc.

   Yoshitake is not liable for any damage or loss caused by malfunction or defect of the product.

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