CONTENT

No.	Title	Page
1	SPECIFICATION	2
2	CONSTRUCTION	2
3	OPERATION	3
4	INSTALLATION	3
5	ADJUSTMENT OF PRESSURE	4

	Prepared by	Reviewed by	Approved by
Name			
Signature			
Date			

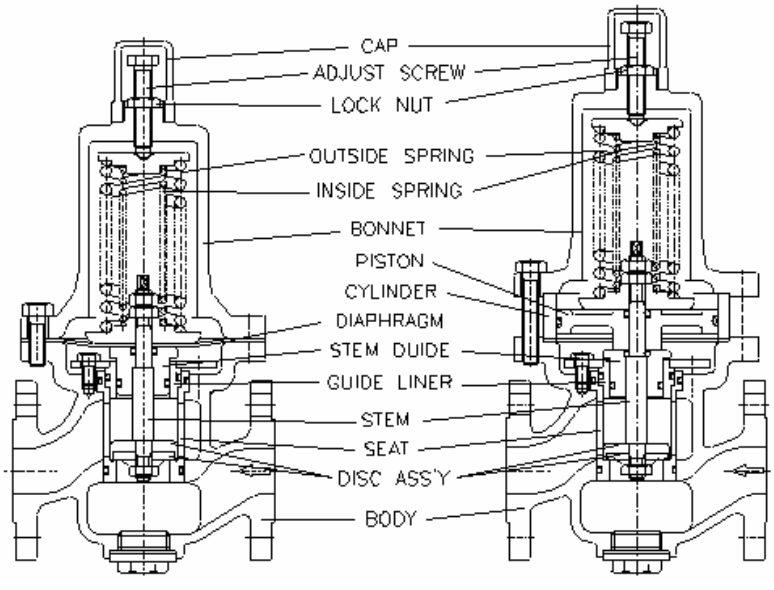
Item: Direct Type Primary Pressure Regulating Valve

This manual describes important points of how to secure operation of PR01 and PR02 primary pressure regulating valve. Customer should read this manual through carefully to ensure full performance.

1. SPECIFICATION

Mode / Item	PR01 (DIAPHRAGM)		PR02 (PISTON)
Applicable pressure	Water and air		Hot water, kerosene, H.F.O & M.D.O
Applicable temperature	5 ~ 80℃		5 ~ 150℃
Primary side adjustable pressure range	Size 80mm and smaller	0.5 ~ 5.0 kg f/㎠ g	Center Spring
		4.0 ~ 10.0 kg f/㎠ g	Inside + Outside Spring
	Size 100mm and larger	0.5 ~ 5.0 kg f/㎠ g	Outside Spring
		4.0 ~ 8.0 kg f/㎠ g	Inside + Outside Spring

2. CONSTRUCTION



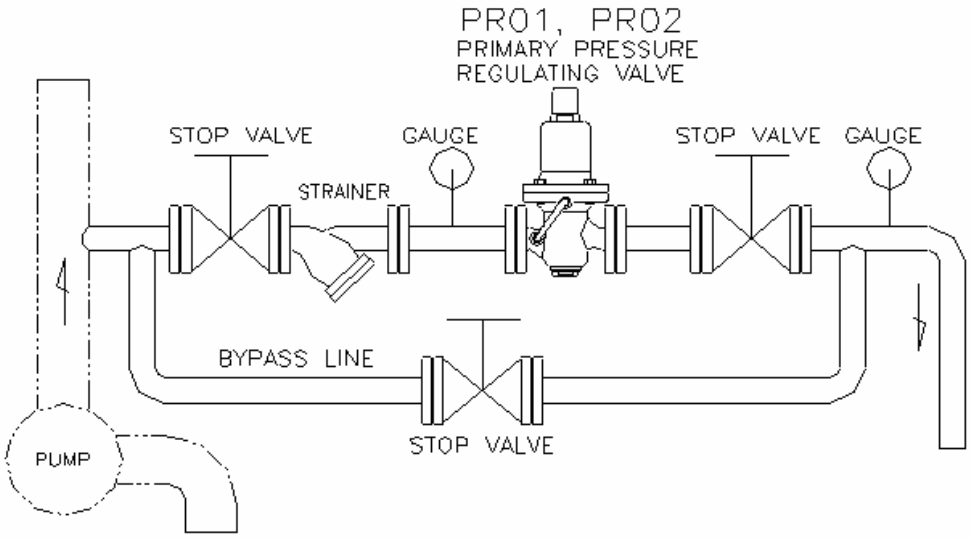
PR01 (Diaphragm) PR02 (Piston)

3. OPERATION

The disc is stuck on the seat ring by the load of the adjusting spring when the valve is pressure adjusted. The disc is kept stuck and the valve is in a closed condition if the fluid pressure at the inlet of the valve has not reached to relieving pressure.
When the fluid pressure exceeds the relieving pressure, the load of spring and the disc is off the seat ring to let the valve in open condition. Along with the increase of primary side pressure the opening degree of the disc gets larger and the disc is closed when the primary side pressure decreases. Thus, the primary side pressure can be regulated constantly.

4. INSTALLATION

4.1 Installation Example



4.2 Please install stop valves, a strainer and a bypass line as exampled above.

4.3 A space for disassembly inspection is necessary. More space than "h" in the Table below from the center of the piping should be reserved.

Size	20	25	32	40	50	65	80	100
h	500	500	600	600	600	700	700	800

4.4 Install the valve vertically on the horizontal pipe line.

4.5 Fixing and supporting of the pipe line are necessary not to have the weight of the piping directly on the valve.

4.6 Most of claims on the valve at new piping are caused by the foreign materials in the piping, and therefore, it is requested to remove foreign materials out of piping by flushing before introduction of fluid into the valve.

4.7 When hydraulic Pressure Test of piping, conduct it as closed stop valve at both side of the valve before the test.

5. ADJUSTMENT OF PRESSURE

All the valves are adjusted before shipment from the factory, however in case of readjustment being required at the job site, conduct it as follows:

Remove the cap and loosen the lock nut. To raise the pressure turn the adjusting screw clockwise to fasten and anti-clockwise to loosen to lower the pressure. After adjustment, fasten the adjusting screw with lock nut.

6. MAINTENANCE INSPECTION

To secure the proper function of the valve, it is necessary to periodically conduct inspection of operation and part condition to confirm no trouble.

(1) Daily inspection
Confirm if operation is proper.

(2) Periodical inspection
Disassemble and clean up the valve once a year. Inspect the working surface of disc and seat, O-ring, seal ring and diaphragm at disassembly and cleaning

※ NOTE

It is strongly recommend that install the Oil Separator on inlet (primary) valve line if the fluid is H.F.O.

CONTENT

No.	Title	Page
1	Specification	2
2	Construction	2
3	Operation	3
4	Installation	3
5	Adjustment of Pressure	4
6	Maintenance and Inspection	5
7	Cause and Countermeasure of Trouble	6

	Prepared by	Reviewed by	Approved by
Name			
Signature			
Date			

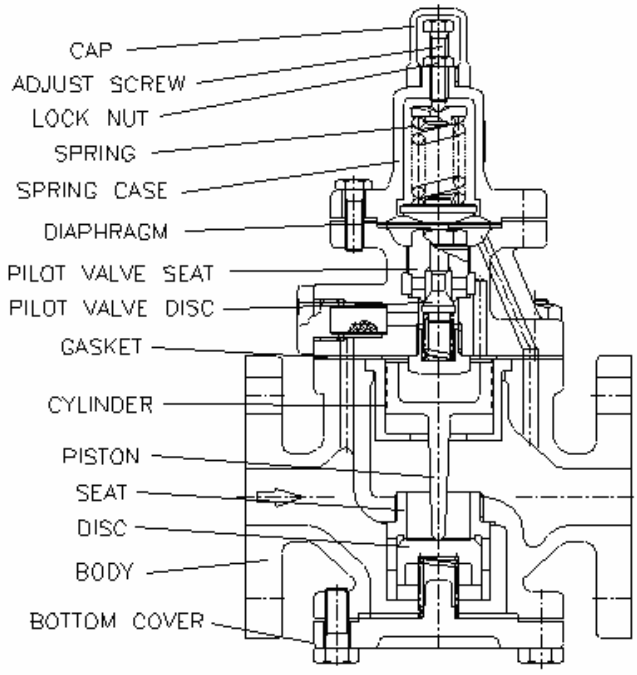
ITEM: Pilot Type Pressure Reducing Valve

This manual describes important points of how to secure proper operation of RV01 series Pilot type Pressure Reducing Valve, and therefore, it is required to read this manual through carefully to ensure full performance of subject valve.

1. SPECIFICATIONS

Item \ Model	RV01
APPLICABLE PRESSURE	Max. 16 kg f/㎠
ADJUSTABLE PRESSURE RANGE	0.35~8, 4~11 kg f/㎠
Max. REDUCING RATE	10 : 1
Min. PRESSURE DIFFERENTIAL ACROSS THE TEMPERATURE	0.7 kg f/㎠
APPLICABLE TEMPERATURE	Max. 220 ℃
APPLICABLE FLUID	Steam

2. CONSTRUCTION

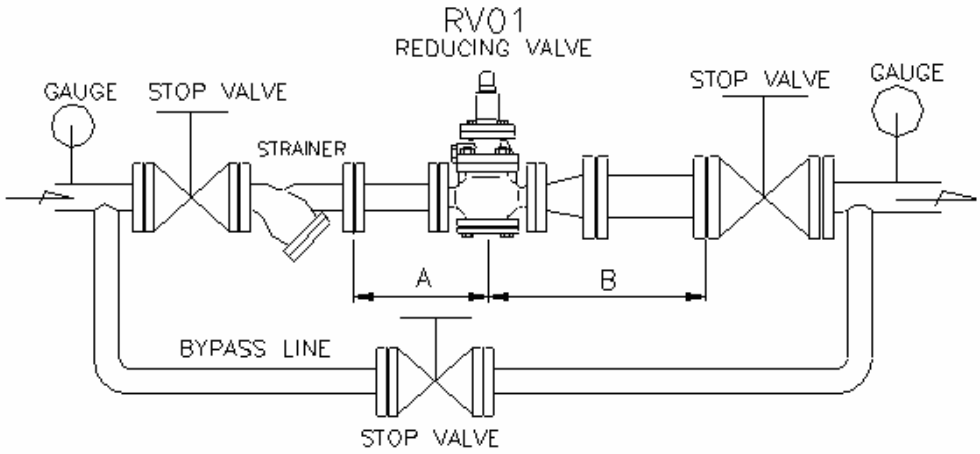


3. OPERATION

The disc and pilot disc are closed by the force of the adjustment spring while the adjust spring is in a free condition. When the steam reaches to the pressure reducing valve, the steam flows to pilot valve chamber through the primary side port and strainer. At moment, turned the adjustment screw until required setting pressure value for compressed the adjust spring, and therefore, the diaphragm gets bent and opens the pilot valve through the pilot stem. The steam in the pilot valve chamber oppressed the piston and the piston will be moved down by the force of the steam for open the disc and the steam will be released to the secondary side. The released steam in the secondary will pressure the diaphragm to push up the diaphragm through the secondary side port. RV01 series adjust the opening degrees of the disc for make a balance between the upward force of the secondary pressure on the diaphragm and the downward force of the adjusting spring on the diaphragm, and thus, constantly regulates secondary pressure.

4. INSTALLATION

4.1 Piping Example



Size of pressure Reducing Valve (mm)	Length of Straight Pipe (mm)	
	A	B
15 – 40	400	900
50 – 100	900	1500
125 – 200	1200	2500

4.2 As shown in the piping example, install straight pipe part before and after the pressure reducing valve, and install stop valves, strainer, safety valve, pressure gauges and a bypass line.
Use globe valves for the stop valves because gate valves allow leakage and complete shut-off of the steam can not be expected at maintenance.

4.3 Reserve enough space between pressure reducing valve and a solenoid valve when ON-OFF operation (like humidifying of air conditioner) with a solenoid valve at either primary or secondary side of the pressure reducing valve is conducted.

4.4 As the pressure reducing valve for steam service can not be shut off completely, install a steam trap at the secondary side when steam consumption gets zero.

4.5 A space for the disassembly inspection is necessary.
Reserve a space three times as much of H dimension shown on the right above the piping center and five times as much of G dimension underside.

4.6 Install the valve vertically on the horizontal pipe line. If laid down, friction at sliding part will be caused.

4.7 Fixing and supporting of pipe line are necessary not to have the weight of the piping and heat stress directly on the valve.

4.8 Most of claims on the valve at new piping are caused by the foreign materials in the piping and therefore it is requested to remove foreign materials out of piping by flushing before introduction of steam into the pressure reducing valve.

4.9 If drain is in the pressure reducing valve, it causes hunting or vibration. Piping without drain or discharge of drain should be conducted.

4.10 When hydraulic pressure test of piping is conducted close stop valves at both side of the valve before the test.

5. ADJUSTMENT OF PRESSURE

Pressure reducing valve shipped have not been pressure adjusted and therefore steam can not flow. Be sure to conduct the adjustment.
Adjustment Procedure

5.1 Leave the stop valve at primary and secondary side closed.

5.2 Open the stop valve on the bypass line and remove foreign matters completely. It is necessary to keep flushing for 10 minutes or more. Be careful at too much increase of secondary pressure at that time.

5.3 Close the stop valve at bypass line completely.

5.4 Take off the cap and confirm that the adjusting screw is free.

5.5 Open the stop valve at primary side gently.

5.6 Open the stop valve at secondary side slightly to allow light flow when the pressure reducing valve is set.

5.7 Turn the adjusting screw to the right and open the secondary side stop valve gradually when the steam starts flowing in.

5.8 Watching at the secondary side pressure gauge, turn the adjusting screw to the right slowly until the gauge indicates required adjusting pressure. Turning the adjusting screw to the right makes secondary pressure up and to the left makes it down.

5.9 When the pressure adjustment has been completed, fix the adjusting screw with the adjusting nut.

6. MAINTENANCE AND INSPECTION

To secure the full function of the pressure reducing valve, it is necessary to have periodical inspection on the operation and condition of the parts to confirm no trouble.

6.1 Daily Inspection

Confirm if the valve is in normal operation.

6.2 Periodical Inspection

Disassemble and clean up the valve once a year. At that time, inspect working surfaces of pilot disc, pilot seat ring, disc and seat ring, piston cylinder, disc spring, strainer and gaskets.

If the valve is not in operation for a long time because of heating purpose and etc, discharged drain in the valve to avoid rusts or freezing. Take off the drain plug on the button flange for that purpose.

7. CAUSE AND COUNTERMEASURE OF TROUBLE

TROUBLES	CAUSES	COUNTERMEASURE
1. Secondary Pressure up.	a. Foreign matters between disc and seat ring or pilot disc	Remove the foreign matters
	b. Working surface of disc, seat or pilot disc and pilot seat have been damaged	Smoothen by lapping
	c. Friction of piston with seat or such pilot seat with pilot system	Use cloth-file and smoothen movement
	d. Friction of piston with cylinder Friction of piston ring with cylinder	Use cloth-file and smoothen movement File the slit of piston ring to reduce the tension
	e. Damaged diaphragm	Replace with new one
	f. Adjusting spring loses tension	Replace with new one
2. Secondary pressure does not come up to required pressure (Short of flow)	a. Friction of disc with seat or pilot disc with pilot system	Use cloth-file and smoothen movement
	b. Friction of piston with cylinder. Friction of piston ring with cylinder	Use cloth-file and smoothen movement File the slit of piston ring to reduce the tension
	c. Choked strainer	Remove foreign matters caused choking
	d. Wrong selection of size (too small size)	Recheck the specifications and replace with right size
	e. Too much resistance in the piping	Recheck the piping system
3. Improper operation	a. Wrong selection of size	Recheck the specifications and replace with right size
	b. Too much reducing rate	Apply two-stage reducing
	c. Affection of drain	Recheck the piping system and install a trap to stop drain to flow in the valve

CONTENT

No.	Title	Page
1	Specification	2
2	Construction	2
3	Operation	3
4	Installation	3
5	Adjustment of Pressure	4
6	Maintenance and Inspection	5
7	Cause and Countermeasure of Trouble	5

	Prepared by	Reviewed by	Approved by
Name			
Signature			
Date			

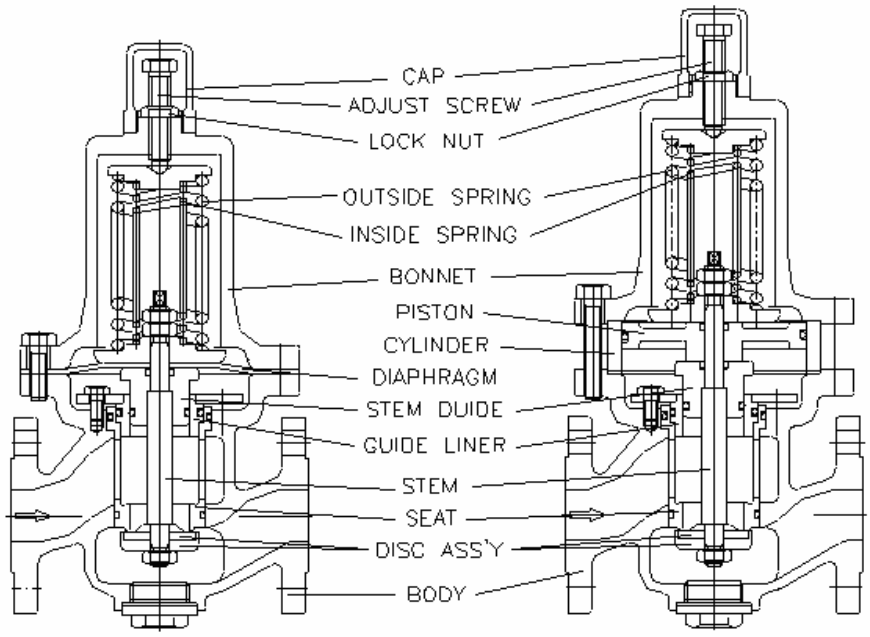
ITEM: Direct Pressure Reducing Valve

This manual describes important points of how to secure proper operation of RV02 series which is Direct type Pressure Reducing Valve, and also it require to read this manual through carefully to ensure full performance of subject valve.

1. SPECIFICATIONS

Item \ Model	RV02
Applicable Pressure	Max. 16 kg f/㎠
Adjustable Pressure Range	0.5~5, 4~11 kg f/㎠
Max. Reducing Rate	10 : 1
Min. Pressure Differential Across The Temperature	0.7 kg f/㎠
Applicable Temperature	Max. 100 ℃
Applicable Fluid	AIR, GAS & LIQUID

2. CONSTRUCTION



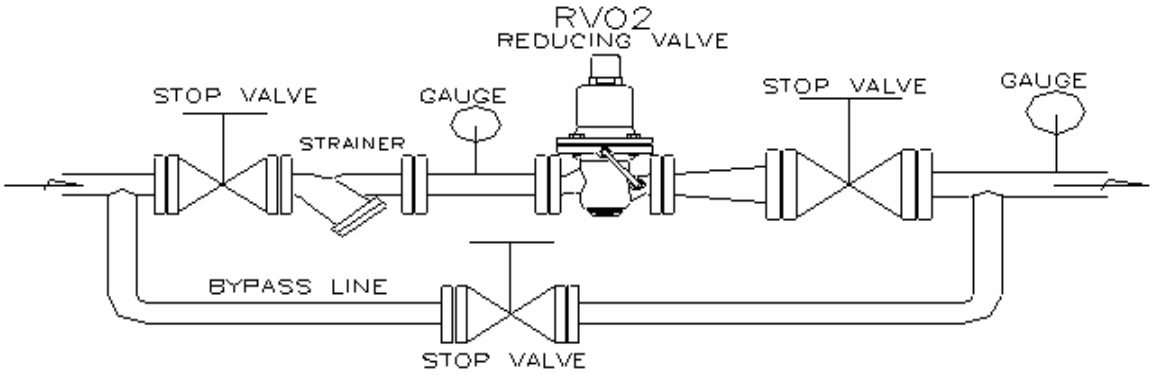
Diaphragm **Piston**

3. OPERATION

The disc are closed by the force of the adjustment spring while the adjust spring is in a free condition. When the air reaches to the pressure reducing valve, the air flows to valve chamber through the primary side port. At that moment turned adjustment screw until required setting pressure value for compressed adjust spring and the diaphragm (or piston) gets bent through the stem. The diaphragm (or piston) will be moved to down by the pressure of air for open the disc, and the air will be released to the secondary side. The released air in secondary side will pressure the diaphragm (or piston) to push up the piston. RV02 series are direct type and adjust the opening degrees of the disc for make a balance between the upward force of the secondary pressure on the diaphragm (or piston) and the downward force of the adjust spring on the diaphragm (or piston), and thus constantly regulates secondary pressure.

4. INSTALLATION

4.1 Piping Example



4.2 As shown in the piping example, install straight pipe part before and after the pressure reducing valve, and install stop valves, strainer, safety valve, pressure gauges and a bypass line.
Use globe valves for the stop valves because gate valves allow leakage and complete shut-off of the air can not be expected at maintenance.

4.3 Reserve enough space between pressure reducing valve and a solenoid valve when ON-OFF operation (like humidifying of air conditioner) with a solenoid valve at either primary or secondary side of the pressure reducing valve is conducted

4.4 A space for the disassembly inspection is necessary.
Reserve a space three times as much of H dimension shown on the right above the piping center and five times as much of G dimension underside.

4.5 Install the valve vertically on the horizontal pipe line. If laid down, friction at sliding part will be caused.

4.6 Fixing and supporting of pipe line are necessary not to have the weight of the piping on the valve.

4.7 Most of claims on the valve at new piping are caused by the foreign materials in the piping and therefore it is requested to remove foreign materials out of piping by flushing before introduction of air into the pressure reducing valve.

4.8 When hydraulic pressure test of piping is conducted close stop valves at both side of the valve before the test.

5. ADJUSTMENT OF PRESSURE

Pressure reducing valve shipped have not been pressure adjusted and therefore air can not flow. Be sure to conduct the adjustment.

5.1 Leave the stop valve at primary and secondary side closed.

5.2 Open the stop valve on the bypass line and remove foreign matters completely. It is necessary to keep flushing for 10 minutes or more. Be careful at too much increase of secondary pressure at that time.

5.3 Close the stop valve at bypass line completely.

5.4 Take off the cap and confirm that the adjusting screw is free.

5.5 Open the stop valve at primary side gently.

5.6 Open the stop valve at secondary side slightly to allow light flow when the pressure reducing valve is set.

5.7 Turn the adjusting screw to the right and open the secondary side stop valve gradually when the air starts flowing in.

5.8 Watching at the secondary side pressure gauge, turn the adjusting screw to the right slowly until the gauge indicates required adjusting pressure. Turning the adjusting screw to the right makes secondary pressure up and to the left makes it down.

5.9 When the pressure adjustment has been completed, fix the adjusting screw with the lock nut.

6. MAINTENANCE AND INSPECTION

To secure the full function of the pressure reducing valve, it is necessary to have periodical inspection on the operation and condition of the parts to confirm no trouble.

6.1 Daily Inspection

Confirm if the valve is in normal operation.

6.2 Periodical Inspection

Disassemble and clean up the valve once a year. At that time, inspect working surfaces of disc, seat, piston, cylinder, disc spring, and gaskets.

7. CAUSE AND COUNTERMEASURE OF TROUBLE

TROUBLES	CAUSES	COUNTERMEASURE
1. Secondary Pressure up.	a. Foreign matters between disc and seat	Remove the foreign matters.
	b. Working surface of disc been damaged.	Replace with new one.
	c. Friction of piston with cylinder. Friction of o-ring with cylinder.	Replace with new one.
	d. Adjusting spring loses tension.	Replace with new one.
2. Secondary pressure does not come up to required pressure (Short of flow)	a. Friction of disc with seat	Replace with new one.
	b. Friction of piston with cylinder. Friction of o-ring with cylinder.	Use cloth file and smoothen movement file the slit of o-ring.
	c. Wrong selection of size. (too small size)	Recheck the specifications and replace with right size
	d. Too much resistance in the piping.	Recheck the piping systems
3. Improper operation	a. Wrong selection of size	Recheck the specifications and replace with right size.
	b. Too much reducing rate	Apply two-stage reducing.

CONTENT

No.	Title	Page
1	SPECIFICATION	2
2	CONSTRUCTION	2
3	OPERATION	3
4	INSTALLATION	3
5	ADJUSTMENT OF PRESSURE	4
6	MAINTENANCE AND INSPECTION	5
7	CAUSE AND COUNTERMEASURE OF TROUBLE	5

	Prepared by	Reviewed by	Approved by
Name			
Signature			
Date			

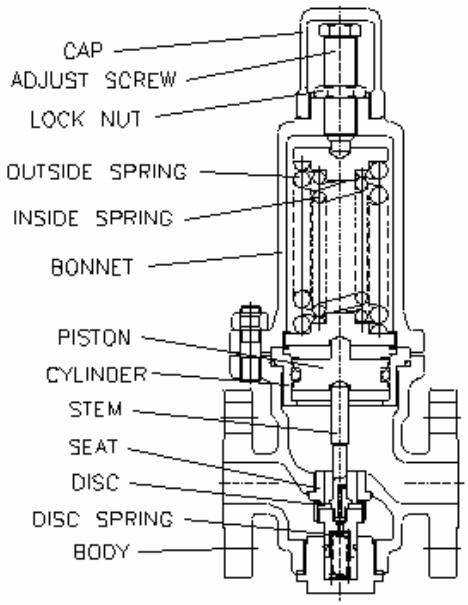
Item: Direct Piston Type Pressure Reducing Valve

This manual describes important points of how to secure proper operation of RV03 series Direct type Pressure Reducing Valve and therefore it is requested to read this manual through carefully to ensure full performance of subject valve.

1. SPECIFICATION

Item \ Model	RV 03
Applicable Pressure	Max. 40 kgf/cm^2
Adjustable Pressure Range	0.5~5, 4~11 kgf/cm^2
Max. Reducing Rate	10 : 1
Min. Pressure differential across the temperature	0.5 kgf/cm^2
Applicable Temperature	Max. 100℃
Applicable Fluid	Air, Gas

2. CONSTRUCTION

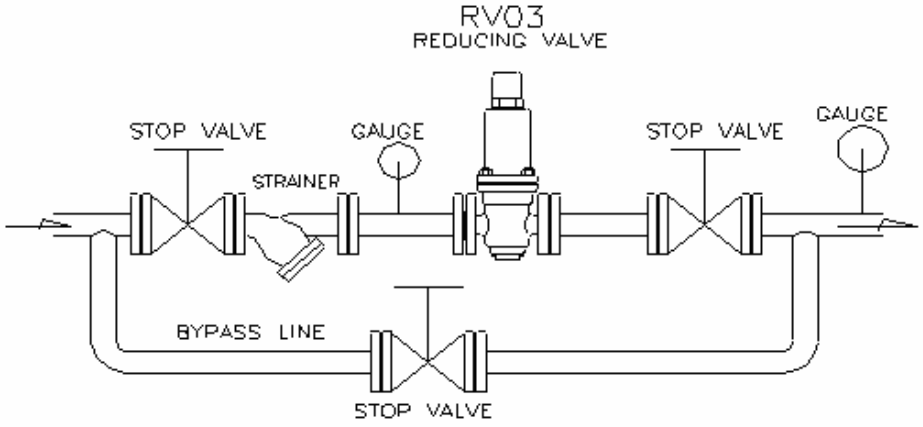


3. OPERATION

The disc are closed by the force of the adjustment spring while the adjust spring is in a free condition. When the air reaches to the pressure reducing valve, the air flows to valve chamber through the primary side port. At that moment turned the adjustment screw until required setting pressure value for compressed the adjust spring and the piston gets bent through the stem. The piston will be moved to down by the air pressure for open the disc, and the air will be released to secondary side. The released air in secondary side will pressure the piston to push up and the disc will move to up for closing. RV03 series are direct type and adjust the opening degrees of the disc for make a balance between the upward force of the secondary pressure on the piston and the downward force of the adjustment spring on the piston and thus constantly regulates the secondary pressure.

4. INSTALLATION

4.1 PIPING EXAMPLE



4.2 As shown in the piping example, install straight pipe part before and after the pressure reducing valve and also install stop valves, strainer, safety valve, pressure gauges and a bypass line.
Use globe valves for the stop valves because gate valves allow leakage and complete shut-off of the air can not be expected at maintenance.

4.3 Reserve enough space between pressure reducing valve and a solenoid valve when ON-OFF operation (like humidifying of air conditioner) with a solenoid valve at either primary or secondary side of the pressure reducing valve is conducted.

4.4 A space for the disassembly inspection is necessary.
Reserve a space three times as much of H dimension shown on the right above the piping center and five times as much of G dimension underside.

4.5 Install the valve vertically on the horizontal pipe line. If laid down, friction at sliding part will be caused.

4.6 Fixing and supporting of pipe line are necessary not to have the weight of the piping and heat stress directly on the valve.

4.7 Most of claims on the valve at new piping are caused by the foreign materials in the piping and therefore it is requested to remove foreign materials out of piping by flushing before introduction of air into the pressure reducing valve.

4.8 When hydraulic pressure test of piping is conducted close stop valves at both side of the valve before the test.

5. ADJUSTMENT OF PRESSURE

Pressure reducing valve shipped have not been pressure adjusted and therefore air can not flow. Be sure to conduct the adjustment.

Adjustment Procedure

5.1 Leave the stop valve at primary and secondary side closed.

5.2 Open the stop valve on the bypass line and remove foreign matters completely. It is necessary to keep flushing for 10 minutes or more. Be careful at too much increase of secondary pressure at that time.

5.3 Close the stop valve at bypass line completely.

5.4 Take off the cap and confirm that the adjusting screw is free.

5.5 Open the stop valve at primary side gently.

5.6 Open the stop valve at secondary side slightly to allow light flow when the pressure reducing valve is set.

5.7 Turn the adjusting screw to the right and open the secondary side stop valve gradually when the air starts flowing in.

5.8 Watching at the secondary side pressure gauge, turn the adjusting screw to the right slowly until the gauge indicates required adjusting pressure. Turning the adjusting screw to the right makes secondary pressure up and to the left makes it down.

5.9 When the pressure adjustment has been completed, fix the adjusting screw with the lock nut.

6. MAINTENANCE AND INSPECTION

To secure the full function of the pressure reducing valve, it is necessary to have periodical inspection on the operation and condition of the parts to confirm no trouble.

6.1 Daily Inspection

Confirm if the valve is in normal operation.

6.2 Periodical Inspection

Disassemble and clean up the valve once a year. At that time, inspect working surfaces of disc, seat, piston, cylinder, disc spring, and gaskets.

7. CAUSE AND COUNTERMEASURE OF TROUBLE

TROUBLES	CAUSES	COUNTERMEASURE
1. Secondary Pressure up.	a. Foreign matters between disc and seat	Remove the foreign matters.
	b. Working surface of disc been damaged.	Replace with new one.
	c. Friction of piston with cylinder. Friction of o-ring with cylinder.	Replace with new one.
	d. Adjusting spring loses tension.	Replace with new one.
2. Secondary pressure does not come up to required pressure (Short of flow)	a. Friction of disc with seat	Replace with new one.
	b. Friction of piston with cylinder. Friction of o-ring with cylinder.	Use cloth file and smoothen movement file the slit of o-ring.
	c. Wrong selection of size. (too small size)	Recheck the specifications and replace with right size
	d. Too much resistance in the piping.	Recheck the piping systems
3. Improper operation	a. Wrong selection of size	Recheck the specifications and replace with right size.
	b. Too much reducing rate	Apply two-stage reducing.

CONTENT

No.	Title	Page
1	Design & Construction	2
2	Operating Cycle	5
3	Installation	7
4	Caution or Hydraulic Test	8
5	Adjustment	9
6	Troubleshooting	12
7	Disassembly	13
8	Repair & Lapping	14
9	Reassembly	15

	Prepared by	Reviewed by	Approved by
Name			
Signature			
Date			

1. DESIGN / CONSTRUCTION

The maintenance guide includes BY Controls' Model No. **SV01** and **SV02** Full Bore Type Safety-Relief Valves.

Full Bore Type will provide that Seat Opening Diameter (SOD) is not less than 1.15 times the throat Opening (TDO), provided that the steam passage area at the seat opening when opened is not less than 1.05 times at the throat opening area and the connection nozzle are not less valve inlet and the connection nozzle are not less than 1.7 times the area of throat opening.

Those valves have a unique **Nozzle Seat** which provides maximum capacity obtainable. The discharge through this nozzle enters a body chamber which is carefully proportioned in the connection nozzle are not less than 1.7 times the area of throat opening.

Especially for the positive proper adjustment of operating characteristic on fluid, **Two Rings** are adopted to obtain substantial adjustment of both blowdown and pop action.

For easy access to resume normal seating face. if need due to failure of its trueness, the most important characteristic of BY Control **Flat Seat Nozzle Valve** is the ease with which seating surface can be reconditioned when it is necessary unlike a slight deviation from he specific angles can lead leakage and faulty operation.

All important part are thermally balanced and precisely machined, thus assuring accurate alignment regardless of temperature variation.

1.1 Valve trim

Trim parts in BY Controls safety relief valve include disc and nozzle seat only.

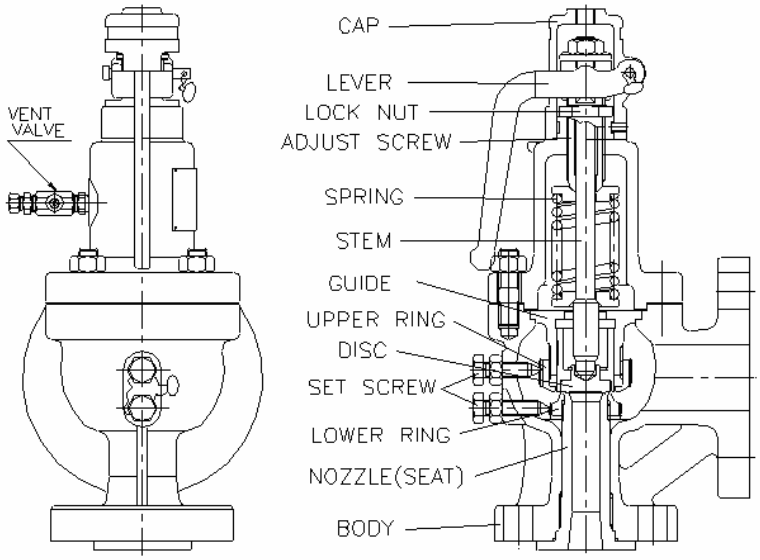
(1) **Disc**

A disc acts as the top guide and is guided by a cylindrical valve guide, BY Controls' standard construction of safety relief valves includes metal-to-metal seats in a view of tightness which provide commercial tightness acceptable for most applications or special bubble tightness under certain conditions.

For reinforcement of seating faces both on disc and nozzle seat to insure their trueness from violent and rapid shout down force during operating, surfaces are carefully settled and precisely lapped.

Maintain the necessary operating clearance between disc and its guide assures free movement under a certain temperature ranges given.

Please refer to limiting service conditions for keeping them from exposing thermal expansion trouble as specified in catalog.



SV01 and SV02

(2) **Nozzle seat**

As the nozzle seat is fully and tightly screwed up into the main body keeping seating face same contour parallel, it will not come out of the position and any deviation from disc contacting center.

Also, with a view to avoid any malfunction, leaks, or other problems which may be caused by stress from the outlet piping or by thermal strains, the seat surface is designed to occupy a position at the center of the body cylinder and separated as far as possible from the contact position with body.

Since the fluid channel from the throat the throat to the valve seat is the most important part determining the performance of the valve, a logical shape is provided so that there will be no interruption in the fluid expansion.

On Model SV01 and SV02 with full nozzle Sharpe which is screwed up from inlet bottom of body.

1.2 Tow Rings

(1) **Upper ring**

The fluid coming out of the nozzle seat strikes against the upper ring and reverses its direction producing a reaction strength by which the valve is lifted. The upper ring is screwed onto the circumference of valve guide.

- Upper ring is called Blow down Ring or Guide Ring.

(2) **Lowing ring**

The lower ring screwed onto the circumference of nozzle seat,

The area expansion due to a small amount of fluid leakage just before the blow-off produces pressure enough to lift the disc. This force causes a quick popping action of the valve. The lower ring adjusts the simmer of the fluid.

The other names are (popping) Control Ring or Nozzle Ring. For details of adjustment guide about two ring mechanism are described in 5.2 Adjustment of blow down through 6.3.3 Hunting.

1.3 Body

The body maintains tightness with its precise finishing and its stout construction ensures safety against thermal stress due to the rapid variation in the temperature of the fluid to be blown off as well as securing it against the reaction strength resulting for a large amount of fluid blown off.

1.4 Bonnet

Standard construction of bonnet includes closed one to protect the internal spring and support the adjusting screw.

On model SV01 and SV02 open and yoke bonnet can be provided to sure safety against thermal stress due to rapid variation in the temperature of the discharging flow during blowing off.

1.5 Cap construction and Lever

Standard caps for BY Controls pressure relief valve are screwed or Bolted Top and Open Lever Top to provide periodical test, for usage of which hermetic

sealing is not required (with most uses for steam and air) Adopted Test Gag on two kinds of top cap, when required, is handy for use in hydraulic test.
On standard open lever, Fork lever are adopted to large size valve.

1.6 Adjust cock (or needle)

When the safety valve is blowing off fluid, back pressure is applied to the back of disc and the guide. The back pressure interferes with the valve when it is being lifted but assists it when the valve is being closed.
To apply the back pressure most effectively, on additional cock which can be handled from the outside, can be provided. BY Controls' safety valve can with adjust needle on construction of open bonnet to prevent any trouble in the operation of it even if the throttle should close too much.

2. OPERATING CYCLE

All of safety-relief valves are of the direct spring loaded construction. The operating mechanism of each type is as follows:
The pressure upstream of the valve should rise abnormally and reach near to the set pressure, it cause the balanced spring to push upward and the valve disc be slightly lifted up to make an initial opening. Steam or gas gushing out of this initial opening will be guided by the properly adjusted lower ring to exert dynamic pressures on the valve disc and the valve disc will be lifted quickly, the valve will start to discharge.

In case of the Full Bore Type Valve operating characteristic of which is controlled by the two rings, fluid discharged by the initial blowing-out will be deflected in a downward direction through upper ring and this deflection as well as pressure generated between two ring are exerted on the face of the valve disc to lift it to a higher position.

As the Low-Lift Type Valve is not provided with an upper ring, the fluid is deflected through a chamber formed by the lower face of the valve disc and the lower ring. The valve disc is lifted by static and dynamic pressure.

2.1 Close

When inner pressure is lower than set pressure, the valve disc keeps the condition of full close due to differential power between the fluid pressure and thee condition of

full close due to differential power between the fluid pressure and the counter-pressure by the adjusted spring.

2.2 Initial open (Commence-to-blowout)

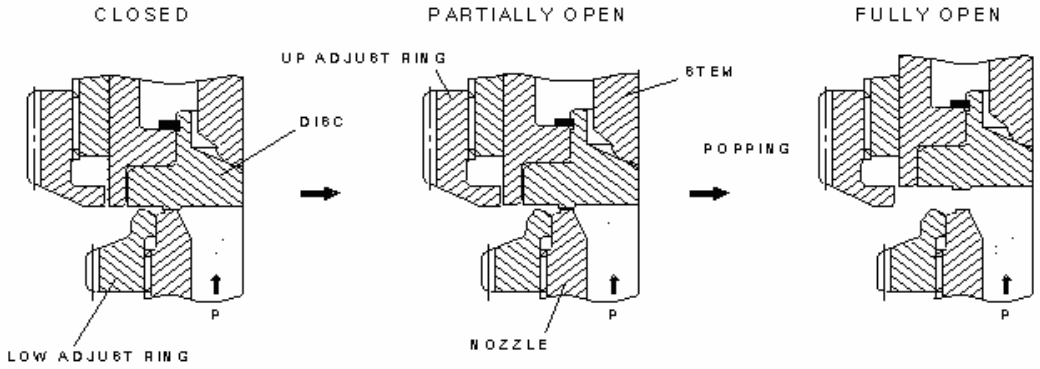
In case of inner fluid pressure near reaching set pressure, the power retaining valve closed by the spring will be gradually overcome by the inner pressure allowing a little fluid leakage into accumulating chamber which is formed between the lower and upper rings.

2.3 Full open

The pressure condensed in the accumulating chamber maker's greater force to lift the disc upward against spring force. This pressure leads popping action to lift up the disc quickly; in this case, the full open can be easily attained at the given overpressure above the set pressure.

2.4 Re-seating

Re-seating will be duly obtained at the adjusted ring mechanism after enhancement of blow-off.



3. INSTALLATION

3.1 Storage and Conversance

Safety-relief valve are often off hand at the job site months before they are actually installed unless they are properly stores and protected their performance may be affected deadly. Roughness in handling may damage valve appearance sharp, worst to crack, or cause alignment of the valve part. Furthermore carrying

by pulling up the lever may cause change of the spring set pressure and alignment of the stem.

3.2 Inlet side piping

It is the best practice to directly mount the safety and safety-relief valve in vertical position on a nozzle of pressure vessel or a short connection which allows smooth flow of fluid.

Where rounded or beveled approaches can not be provided ahead of the safety-relief valve, it is recommended that one size larger riser or fitting be used. The pressure drop in the valve inlet piping should not exceed 3% of the set pressure.

Valves are sometimes badly damaged just as they go into service because of failure to clean the connections.

It is essential that the boiler, pressure vessel, valve inlet, and all connections should be cleaned thoroughly before the valve is mounted.

(1) Caution at inlet piping

Most of leak on valve performance are caused from failure to clean. Many valves are damaged when first placed in service or even hydraulic pressure test under undue preparation due to failure to properly clean the connections and piping when installed.

3.3 Outlet side piping

When arranging the discharge piping, pay due attention to the following points talking into consideration that discharge piping should be simple and direct

(1) Minimize the length and the number of bends of discharge piping so as to reduce the back pressure of the valve to a minimum. Especially, when a silencer is used, note that the discharge pipe tends to be long and gives a large pressure drop due to discharge exceed 10% of the set pressure.

(2) Discharge piping should be so designed that the weight of the piping will at no time be taken up by the valve body.

A sufficient flexibility to the discharge piping is also essential to avoid strain on the valve caused by thermal pipe expansion.

※ Where either of the above conditions are unacceptable the use of balanced bellows valves is reconvention.

Conventional valve with vented bonnet are not suitable for continuous back pressure. Therefore never try to arrange discharge pipe from two or more valves into a common header.

4. CAUTION ON HYDRAULIC TEST

When hydraulic pressure test on the pressure vessel is conducted without removing the safety valve installed on it. increase inner pressure of the vessel to 80 too 90% of the set pressure of the valve, then mount the test gag to hold the end of the stem lightly in order to protect the valve from damage caused by undue load.
Removal of the gag shall also be conducted at 80 to 90% of the set pressure.
When several valves are installed on a vessel or pipe line and one of the valves is being on adjustment. The same caution should be taken at the mounting of the test gag or gags on the other valve or valves to prevent it or them from blowing off.

4.1 Cautions

The test gag can not be mounted on the ordinary type caps. Therefore, the caps should be replaced with those made for the purpose.

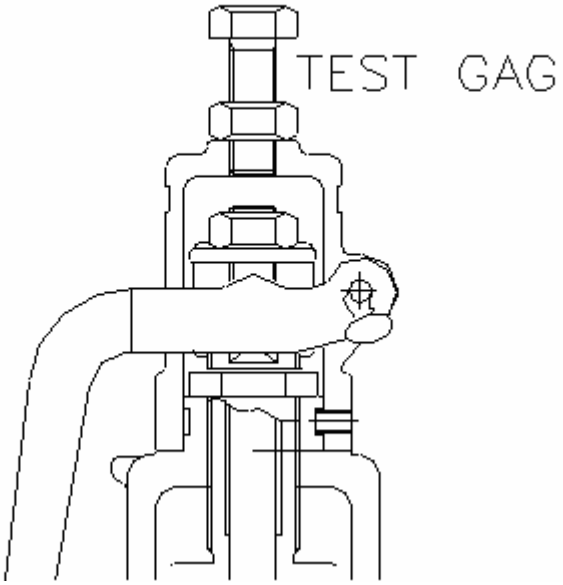
In case of pressure test for pressure vessels without using test gag, test them without the safety valves for safety of it.

Removed valve should be covered at the flange parts against intrusion of dusts, etc.

Replace with a plug and gasket in case of closed top (or take off when open top) after the test, otherwise the valve will not operate thereby creating a dangerous situation.

4.2 Test gag

- Test gag should be used only when hydrostatic testing is performed at field
- Safety valve & safety relief valve are usually shipped with this gag
- The test gag should be furnished in accordance with following

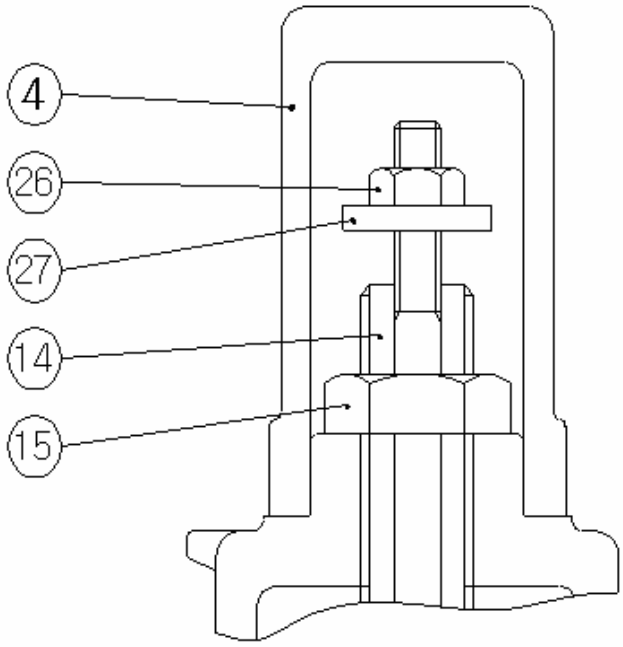


5. ADJUSTMENT

Consideration of service pressure characteristic
(Differential between operating and set pressure)
In order to avoid unsatisfactory operation of safety relief valves in normal processing service. The operating pressure of the system should not exceed 90% of the set pressure. In the pump and compressor delivery line, however, the difference between the set pressure and the operating pressure should be made large on account of the pulsation attributable to the pump delivery pressure is a better method. Before re-adjustment, remove a Pb seal to cap and set screws which is sealed to prevent arbitrary adjustment by an incompetent and visual check of any external changes of set pressure of set pressure or blow-down pressure.

5.1 Adjustment of set pressure

The set pressure of each safety valve has precisely been adjusted and sealed at our factory before the shipment, however in case that it is necessary to readjust at the job-site to the state of the exhaust pipe, the amount of blowing capacity, and other factors, readjustment can be done in the following procedure :



Take off cap(4), loosen lock nut(15) and turn down the adjusting screw(14) to the right(clockwise viewing from above) to raise set pressure and turn up the left (anti-clockwise viewing from above) to lower the set pressure.

At the readjustment, be sure to lower the pressure of the system at below 90% of the set pressure and hold the stem nut (26) with a spanner not to allow the disc (3) going along with by turning of the adjusting screw (14).

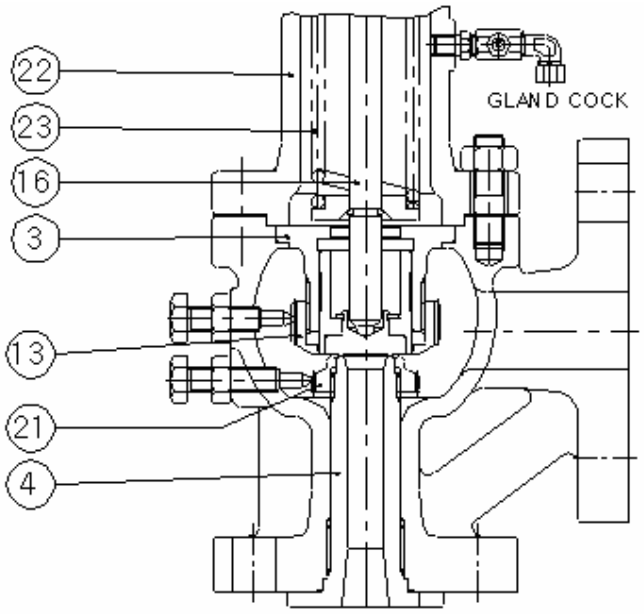
After completion of re-adjustment, screw up the adjusting screw with lock nut.

Tolerance of set pressure Unit: kg/cm^2

SET Pressure	TOLERANCE
5 excel. and under	± 0.14
Over 5 and 23 excel.	± 3% (of set pressure)

5.2 Adjustment of Blow down Pressure

As the blow down pressure is related with the relieving capacity of valve and piping resistance or pressure loss of equipments or drain pipe, it may be necessary to readjust after the installation at the job-site. In that case, readjust in the following in the following procedures :



(1) In case the valve has either gland cock or needle valve
Readjustment can be done by adjusting the opening degree of them.
Turning the gland cock or needle valve toward the closing direction makes blow down pressure lesser and toward the opening direction makes blow down pressure more.

If adjustment with the above procedure is not satisfactory, it is required to adjust with blow down ring (13) or control ring (21) in the procedure shown below together with the above procedure:

(2) When the blow down ring (13) gradually to the right (while viewing in front of notch but never keeping an eye on it).

The adjustment of blow down pressure can be done easily as stated above, however sometimes slight adjustment may effect too much to cause unstable operation depending on factors of equipments or drain pipe.

After completion of re-adjustment, screw up the ring with set screw.

(3) When the blow down pressure is too little

To the contrary to the procedure for too much blow down pressure, turn down the blow downing (13) to the left (white viewing in front of notch but keeping an eye on it.)

In case of, hunting condition (disc makes drastic up and down movement repeatedly when the safety valve is in a blowing off condition) turn down the blow down ring (13) to the left and if still in the same condition turn up the control ring to the ring.

In case of chattering, same as above, turn down the blow down ring. In this case turning degree is smaller than that for hunting.

For cure of these unstable operations, please refer to simmer, chattering and hunting of 7.3 unstable operations.

Adjustable blow down range

Reliving Pressure	Adjustable blowdown
4 and under	0.3 and under
4 excel. and over	less 10% than reliving pressure

6. TROUBLESHOOTING

6.1 Leakage

The most frequent causes of leakage are from damages on the valve seat and catching of foreign matters on it. In these cases, pull the lever to blow off the dirt sticking to the seat. If the leakage does not stop, the seat must have been damaged.

To avoid seating surfaces damaged by foreign matters. Care should be taken thoroughly from storage to installation which is the best practice after completely flushing out.

Refer to, when need, the repair and lapping procedures for reconditioning on the other page.

6.2 Incorrect popping pressure

If a safety valve does not operate at specified pressure, a major cause is accumulation of dirt or scale between the disc and the guild or occurrence of change in the spring load due to bent of stem. In either case, cleaning or dismounting for servicing is required.

6.3 Unstable operation

Unstable operation often results from miss-adjustment. The following are the state of unstable operation and its remedy.

(1) Simmer

When a simmer is present raise the lower ring (push the notches to the right while in front of notch) by one at a time. (Never set the lower ring in contact with the valve disc)

This is of the slightly weakening dynamic power to lower accumulation not enough to lift up the disc.

(2) Chattering

This is a rapid reciprocating variations in valve lift during which the disc repeatedly contacts the seat. It is because popping power is weak. In this case, bring up the lower ring (closer to the bottom face of the disc but never contact each other)

(3) Hunting

This is the states where the disc repeats violent vertical motion during operation as if it beat the seat violently. This is often caused when there is much flow restriction in the popping connected with inlet and discharge side of the safety valve or when blowdown is excessively too short, in this case, open the gland cock or needle valve or bring down the upper ring to increase blowdown.

If hunting is not ceased despite the above adjustment, rechecking of the piping is necessary.

7. DISASSEMBLY

Before disassembling the safety, make sure that no pressure is left in the pressure vessel. For this purpose, slightly loosen the nuts connecting the bonnet to the valve body, and lift the upper assembly a little. The gas remaining in the vessel will gush out of the valve seat. After confirming the stoppage of the gush, dismantle the valve.

As for the order of disassemble of components, follow the arrow of the drawing of an order of disassembly.

8. REPAIR AND LAPPING

In practice, the main necessary repair work will be lapping on the sealing surfaces of disc and nozzle seat. Its procedure is as follows:

8.1 Kind of lapping compound

No. 1 Lapping compound;

Pasty mixture of compound No. 200 kneaded with rape oil into a cream form.

No. 2 Lapping compound:

Pasty mixture of compound No. 800 kneaded with rape oil into a form between cream and liquid,

No. 3 Lapping compound:

Pasty mixture of compound No. 3000 kneaded with rape oil into a form between cream and liquid,

8.2 Lapping procedure

(1) Thinly coat a surface of lapping block with No.1 lapping compound. Elliptically move the lapping block to remove large scratches.

(2) Use No.2 lapping compound and make lapping in the same manner as procedure 1 to reduce scratches in size.

(3) Finish with No.3 lapping compound. The lapping manner is the same as procedure 1.

(4) Finally, use No.3 lapping compounds and make mutual lapping of the valve disc and the valve seat to finish them.

Mutual lapping is effected by lightly turning and reversing the valve disc on the valve seat. The turning and reversing motion 5 to 10mm, and mutual lapping should not be continued too long. If it is continued too long, the outer side of the seating surface will become dull. When the lapping is felt heavy to hand, stop doing it.

8.3 Washing

Carefully wash the valve seat and valve disc with cleaning oil or liquid after lapping to make them completely free of lapping compound.

8.4 Inspection of lapped surfaces

Inspection of lapped surface is extremely difficult. Try the following method: Lighten the lapped surface. If the brightness is even all over the surface, the lapping is complete. If any shady portion is present, the lapping is incomplete.

9. REASSEMBLY

Reassembly will be made following the reverse order of disassembly.
Especially the following attention should be paid:

(1) Pay extra care not to damage or soil the lapped surfaces of valve disc and valve seat.
(2) Properly center the tip end of the valve spindle on the valve disc.
(3) Evenly and alternately lock up nuts to tighten the bonnet or yoke bolts.