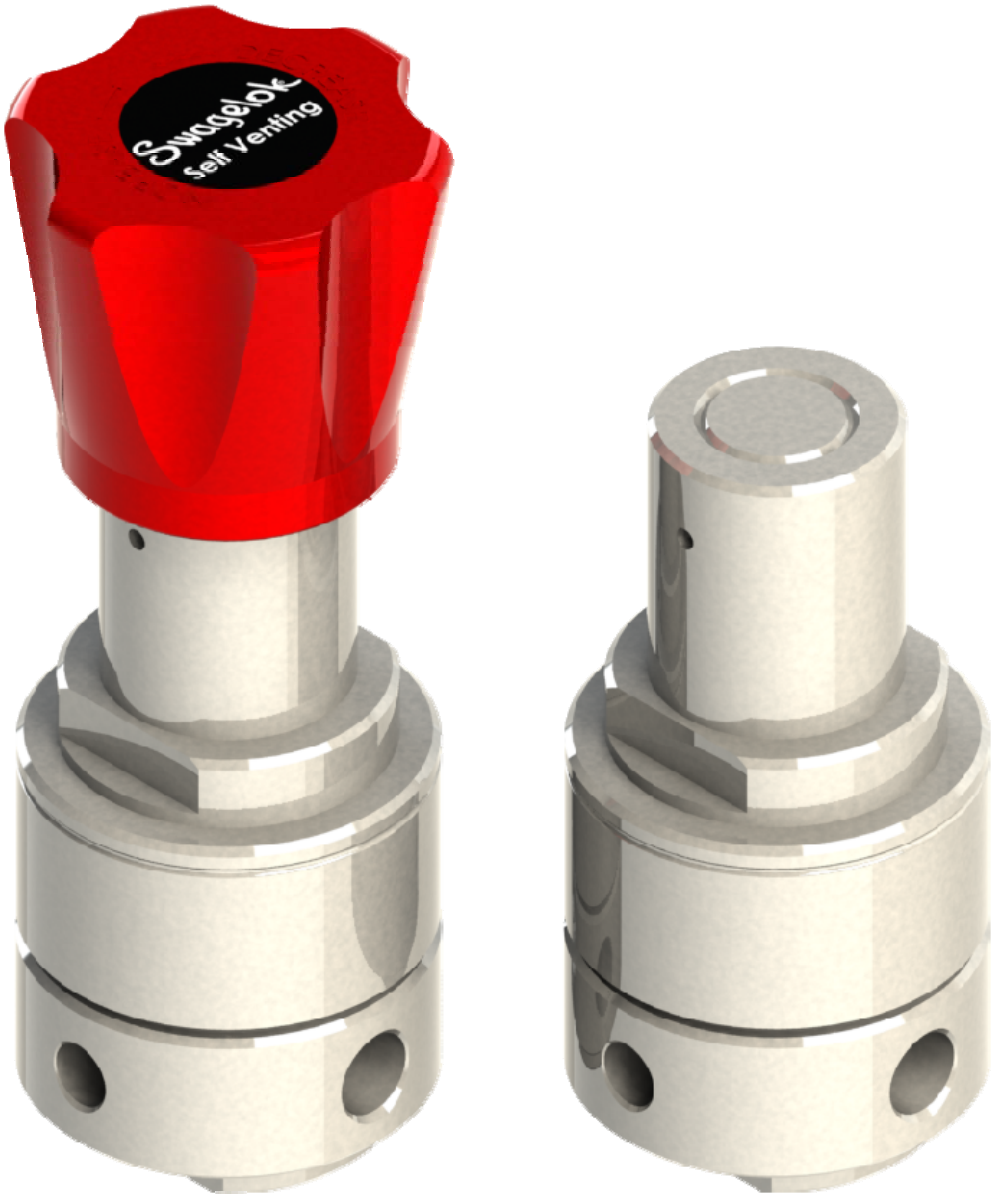
RS(H)2 and RD2 Pressure-Reducing Regulator User Manual



Read the complete manual before installing and using the regulator.

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

WARNING

- Users must be trained and equipped for the handling, use and servicing of pressure products and systems.
- Users must contact their gas or liquid supplier for specific safety precautions and instructions.
- Gaseous media should be free of excessive moisture to prevent icing at high flow.
- Always wear the appropriate protective clothing, including safety glasses, gloves, etc,. if required.
- Follow the applicable safety and maintenance procedures.
- Obey specific local regulations.
- Do not exceed the maximum inlet and outlet pressure rating of the product or its accessories.
- Operate within the temperature limits and any other conditions specified for the product.
- Do not drop or damage the product in any other way. This may negatively affect the performance of the product which can cause the product to malfunction.
- Venting fluids and gases can be dangerous. Vent to a safe environment away from people. Ensure adequate ventilation.

Contents

Introduction

Overview

- The RS(H)2 series are spring loaded pressure reducing regulators designed for the regulation of high pressure gases and liquids.
- The RD2 series are dome loaded pressure reducing regulators designed for the regulation of high pressure gases and liquids.
- For pressure and temperature rating information refer to the *Pressure Regulators, RHPS Series* catalog, MS-02-430. Note that seat seal material selection can limit the regulator operational pressure at elevated temperatures.

WARNING
Check that system pressures and temperatures do not exceed those stated on the regulator as this could result in product failure.

Standard Features

- Threaded construction
- Stainless steel as standard
- Fully serviceable
- Piston sensing
- Cartridge poppet assembly
- Bottom mounting
- Self-venting①

Additional Options

The regulator is available with the following options:

- Anti-tamper①
- Non-venting①
- No filter. For liquid applications.
- Panel mounting. Panel mounting kit sold separately. No disassembly required.

WARNING
The self-venting feature is for venting off excessive outlet pressure under zero flow conditions. It is not intended to be used as a safety relief valve.

Oxygen Service

- For more information about hazards and risks of oxygen enriched systems see the *Swagelok Oxygen System Safety* technical report (MS-06-13).
- Cleaning and packaging to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C is available. Refer to the *Pressure Regulators, RHPS Series* catalog, MS-02-430, for additional information.

① RS(H)2 series only

Installation

CAUTION
Do not use the regulator as a shutoff device. A level of leakage across the regulator seat can occur during normal operation.

Points of Attention Before Installation

This regulator can be equipped with a variety of different options. Before installing the regulator you should fully understand the functions of the supplied options and the suitability of your particular regulator for the intended application.

- The preferred mounting position of the regulator is horizontal with the spring housing/dome facing upwards per Fig 3. Alternative mounting positions may increase the risk of component wear.
- It may be necessary to remove the regulator from the system during maintenance or service. Ensure that this is possible.
- The regulator is suitable for gases or liquids dependent on the options selected. Ensure compatibility between the regulator's materials of construction and the system media.
- Swagelok recommends the use of a non-venting regulator when the process media is hazardous or toxic.

Installation

- Verify that the regulator, its connections and any accessories are undamaged.
- Verify that the regulator and any accessories are suitable for the system operating pressure and temperature and have suitable connections.
- At the time of delivery any gauge ports may be plugged with blind fittings. Remove these and connect gauges if desired.
- If inlet/outlet fittings are being used, assemble them to the regulator, per the manufacturer's instructions, prior to installing the regulator in the system.

CAUTION
Ensure all upstream tubing/pipework is clean and free from debris. Any swarf, lint, wire, etc. may damage the regulator, resulting in a seat leak.

- Verify the flow direction of the system and mount the regulator accordingly.
- This regulator can be bottom mounted or panel mounted.
- Securely make the appropriate connections to the regulator in accordance with the procedures recommended by the connection manufacturer.
- Ensure that the tubing/pipework and the regulator are adequately supported and that there is no stress on the connections.
- Upstream and downstream shutoff valves should be installed in the system to facilitate servicing, maintenance and troubleshooting of the regulator.

CAUTION
Do not plug the vent port in the body if the regulator is self-venting. Vented pressure would become trapped in the spring housing. This would alter the regulator set pressure and could be released upon disassembly. The port must be open to atmosphere either directly or via a vent line.

Panel Mounting

RS2-P-02 and RSH2-P-02 Panel Mounting Kit installation

Item	Component Name	Qty
1	M5 button head screw	2
2	Panel mount ring	1
3	M5 set screw	3
4	3 mm hex key	1
5	2.5 mm hex key	1

Table 1

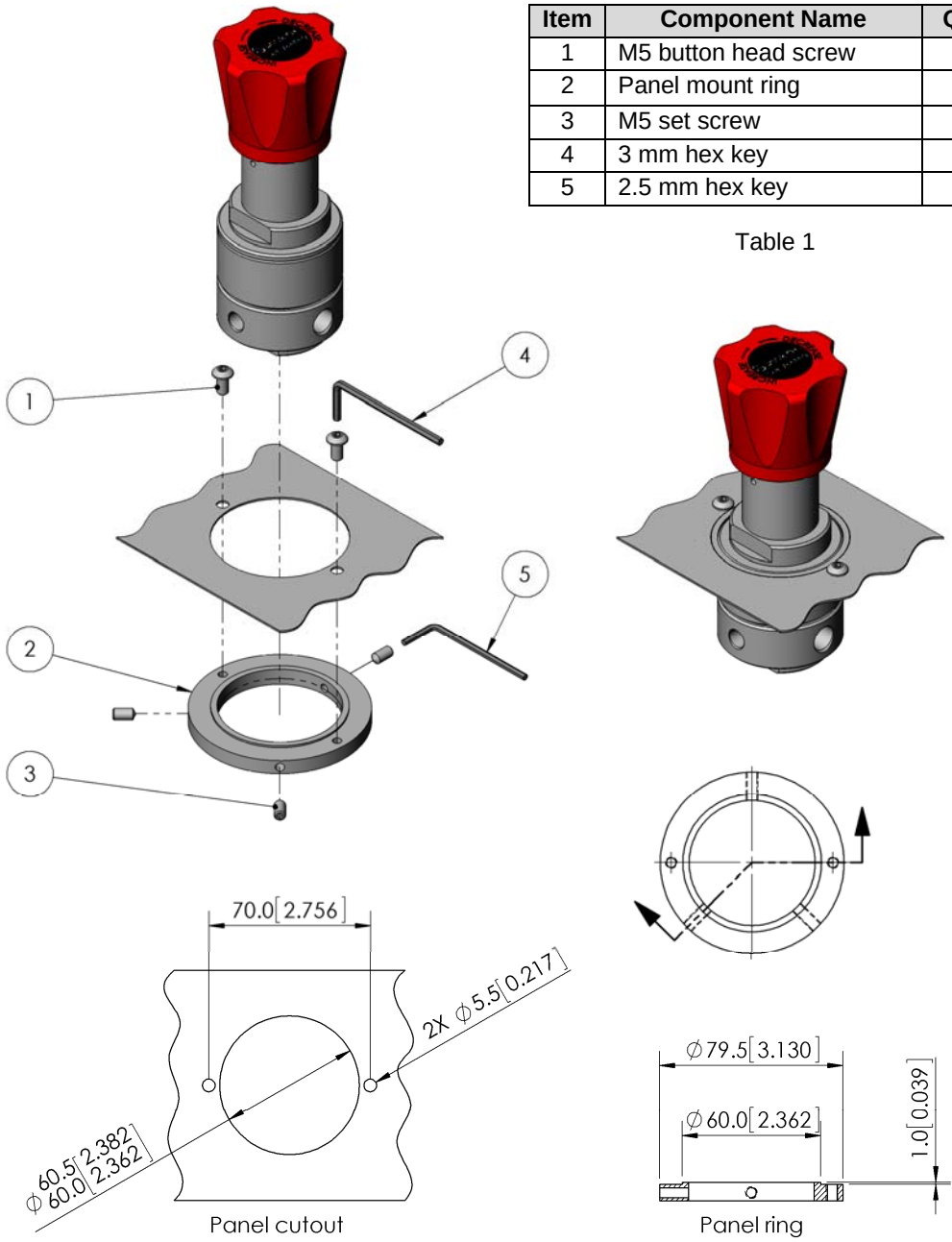


Fig 1

1. Cut the appropriate holes in the panel per the dimensions in Fig 1.
2. Affix the panel mount ring (2) to the regulator using the set screws (3). Take into consideration the desired orientation of the regulator ports relative to the mounting holes.
3. Insert the regulator though the panel and retain with the button head screws (1).

Operation

Required Tools for Operation

- No tools are required for changing the set pressure on a standard regulator.
- A 20 mm open-ended wrench and a 13 mm open-ended wrench or socket are required for anti-tamper regulators.

Points of Attention Before Operation

CAUTION
The product can be hot or cold, depending on the environmental temperature and the process media temperature. Take the necessary precautions before operating or touching the product.

- Stopping flow through the regulator by closing a downstream shutoff valve may result in a rise in outlet pressure above the set pressure. This is usually referred to as "**lock-up**". This phenomenon does not indicate a problem with the regulator.
- A decrease of the flow rate may result in a rise of the outlet pressure. An increase of the flow rate may result in a fall of the outlet pressure. This is usually referred to as "**droop**". This phenomenon does not indicate a problem with the regulator.
- A decrease of the inlet pressure may result in a rise of the outlet pressure. An increase of the inlet pressure may result in a fall of the outlet pressure. This is usually referred to as "**inlet dependency**" or "**Supply Pressure Effect (SPE)**". This phenomenon does not indicate a problem with the regulator.

Adjusting the Set Pressure

- The set pressure is the desired outlet pressure of the regulator.
- To set the regulator, ensure that the supply pressure is greater than the required set pressure but does not exceed the maximum rating of the regulator.
- If the regulator is non-venting it must be able to flow in order for it to reduce the outlet pressure.

1. For non-venting regulators partially open any downstream valve. This will allow minimal flow through the regulator when adjusting the set pressure, reducing media consumption during this process.
2. Fully unwind the adjustment knob counterclockwise or have zero pressure in the dome.
3. Steadily open the supply valve to allow inlet pressure to the regulator.

4a. To operate RS(H)2 series regulators, turn the adjustment knob clockwise to increase the set pressure. Turn the knob counterclockwise to reduce the set pressure.

4b. To operate RD2 series regulators, increase the dome pressure to increase the set pressure. Reduce the dome pressure to reduce the set pressure. Note, due to forces within the regulator the dome pressure will differ slightly from the set pressure. Place a gauge in the outlet line to set or check the outlet pressure.

5. To obtain the most accurate set pressure, final adjustment must be made while **increasing** the set pressure. If the desired outlet pressure is exceeded, reduce the pressure below this value then increase up to it.
6. Fully open the downstream valve to allow full flow during operation.
7. Once under flow conditions make any final set pressure adjustments per steps 3 and 4 if required.

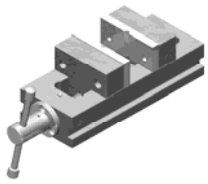
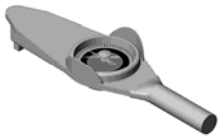
NOTICE
The RS(H)2 knob assembly is retained by a C-ring. When backing off the knob do not attempt to continue to unwind the knob once it has stopped. Doing so may damage the C-ring.

Maintenance

WARNING
Incorrect or improper repair or servicing of this product can cause serious personal injury and property damage.

- All repairs, servicing and testing of this product must be performed by competent personnel.
- Following any maintenance of the regulator, it is recommended that the product be tested for operation and leakage.
- The product should be checked periodically for proper and safe operation. It is the user's sole responsibility to determine the frequency of maintenance based on the application.
- To reduce maintenance related system downtime to a minimum, either during commissioning or normal operation, Swagelok recommends having maintenance kits readily available on site. The need for maintenance kits is particularly important during the commissioning phase of a system installation due to residual assembly debris remaining in the system. Such debris can cause a seat leak in the regulator, resulting in components needing to be replaced.

Required Tools for Maintenance

Smooth-jawed vise		Dome plug insertion tool②: RHPS-2-PLUG-TOOL	
17 mm socket		Calibrated torque wrench up to 52 lbf·ft (70 N·m)	
36 mm crows foot		Lubricant (included in kit): WL-8③ Krytox® 240 AC④ Adhesive (not included in kit): Loctite® 5045, 4052 or 243	
C-ring pliers①		Liquid leak detector	

① RS(H)2 series only
② RD2 series only
③ Standard cleaned assemblies
④ ASTM G93 or SC11 cleaned assemblies

Table 2

Points of Attention Before Removal from the System

- Swagelok recommends removing the regulator from the system for servicing and maintenance.
- Follow all local system safety and maintenance procedures when removing the regulator.

WARNING

Before removing a regulator from the system, to avoid personal injury, you must:

- **Depressurize the system.**
- **Purge the system to remove any residual system media left in the regulator.**
- **Always vent to a safe environment away from people and ensure there is adequate ventilation.**

CAUTION

Check if the process media is hazardous or toxic. If required, take the necessary safety precautions to ensure a safe workspace and your personal safety.

CAUTION

The product can be hot or cold, depending on the environmental temperature and the process media temperature. Take the necessary precautions before operating or touching the product.

Removal from the System

1. Isolate the regulator from all pressure sources by closing all appropriate upstream valves in the system.
2. With the regulator set, open all appropriate downstream valves to allow pressure to vent from the regulator.

WARNING

Ensure all pressure on the inlet, outlet and dome (RD2 series) has been fully vented. The accidental release of residual trapped pressure can cause serious personal injury.

3. Disconnect and remove the regulator from the system. For the RD2 series ensure the dome feed connection is removed.

Assembly Reference Data

Item	Component Name	Kit Type(s)	Torque lbf·ft (N·m)	Recommended Lubrication (included in kit per Table 2)
1	Body	N/A		
2	Poppet cartridge O-ring	A1, B1, B2, C1		
3	Poppet cartridge	A1, B1, C1	22 (30)	Lubricate threads
4	Piston plate outer O-ring	B1, B2, C1, C3		
5	Piston plate inner O-ring	B1, B2, C1, C3		
6	Piston plate	C1, C3		
7a	Relief seat	A1, A2, B1, B2, C1		
7b	Non-relieving plug	C1, C3	Hand Tight	Adhesive on threads
8	Relief seat/non-relieving plug O-ring	A1, A2, B1, B2, C1, C3①		
9	Piston	C1, C3		
10	Piston O-ring	B1, B2, C1, C3		Lubricate
11	Bottom spring guide	C1		
12	Set spring	C1, C4		
13a	Self-vent spring guide	C1		Lubricate central recess
13b	Top spring guide	C1		Lubricate central recess
14	Self-vent spring guide O-ring	B1, B2, C1		Lubricate
15	Spring housing/dome	N/A	52 (70)	Lubricate main threads
16	Spring housing cover	N/A	22 (30)	Adhesive on external threads
17	C-ring	D1		
18	Knob assembly	D1		Lubricate threads
19	Lock nut	D1		
20	Anti-tamper adjustment screw	D1		Lubricate threads
21	Anti-tamper cover	D1		Lubricate threads
22	NPT blind plug	N/A	15 (20)	Wrap threads in 2 laps of PTFE tape. Lubricate tape.
23	Piston backup ring	B1, B2, C1, C3		
24	Dome plug	N/A	22 (30)	Lubricate threads
25	Dome plug O-ring	B1, B2		Lubricate

① Non-relieving plug O-ring only

Table 3

For more information on RHPS series maintenance kits, refer to the *Pressure Regulators, RHPS Series* catalog, MS-02-430.

RS(H)2 Series, Standard (Self-Venting), Exploded View

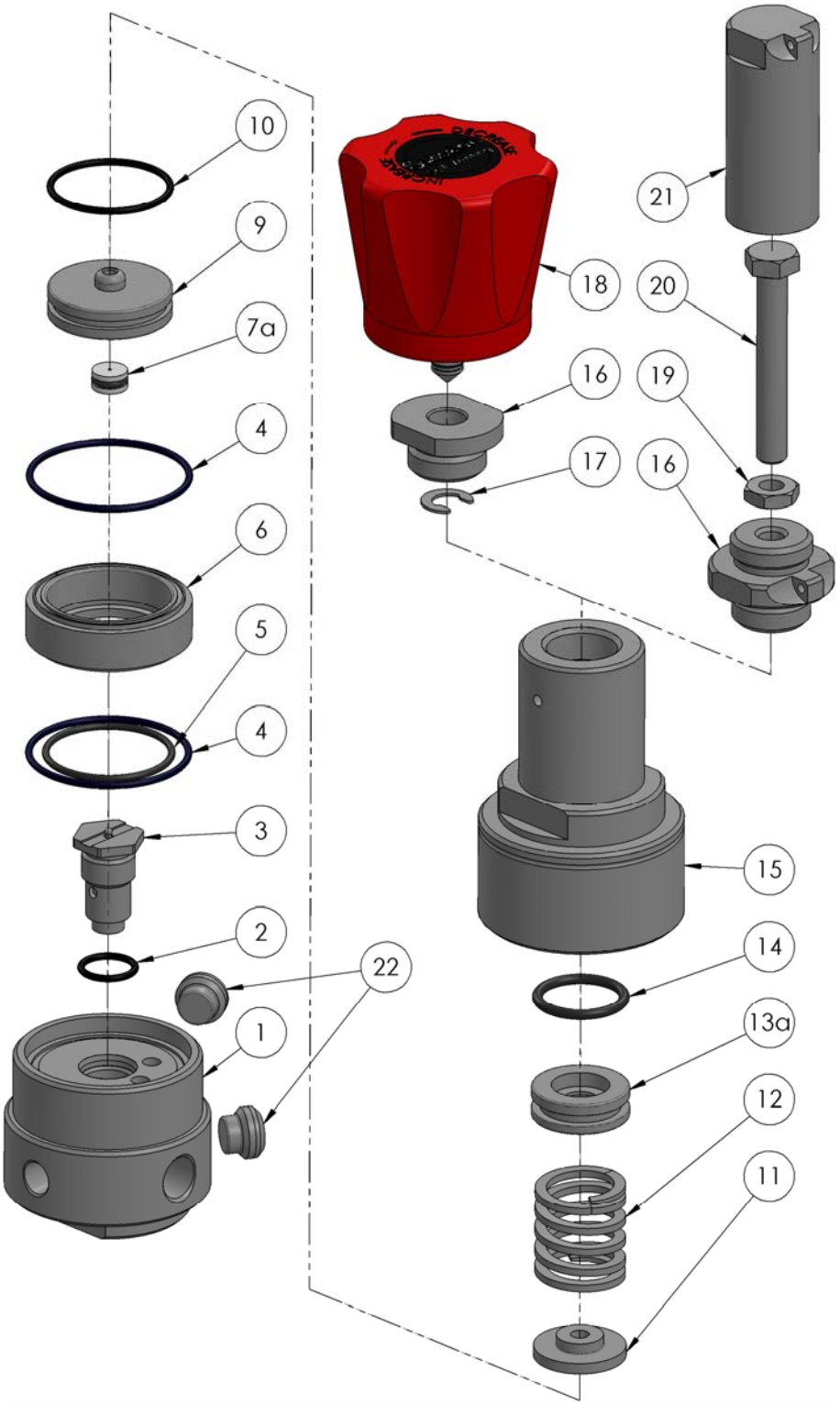


Fig 2

RS(H)2 Series, Standard (Self-Venting), Section View

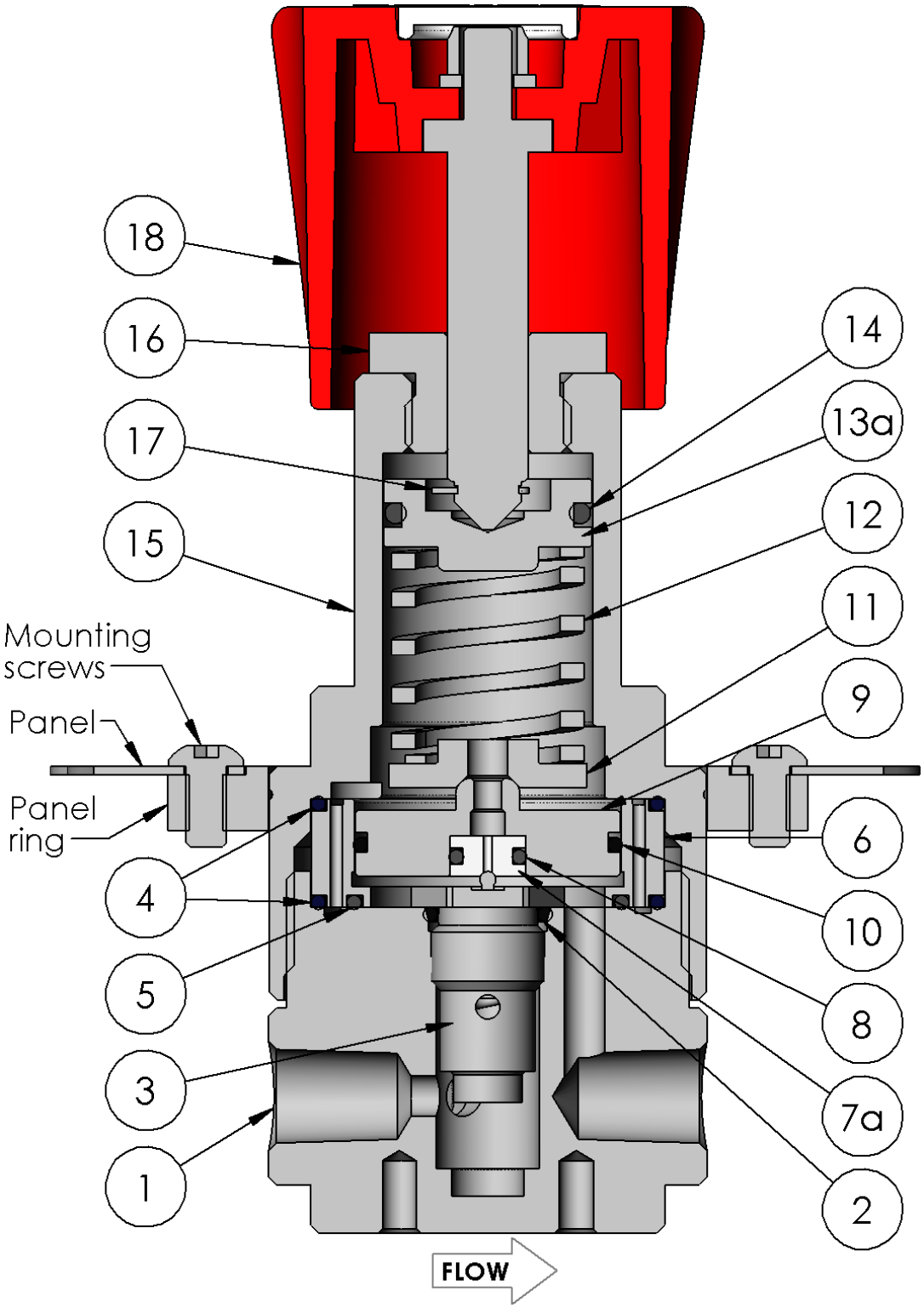


Fig 3

RS(H)2 Series, Non-venting; Control Ranges 1 and 2

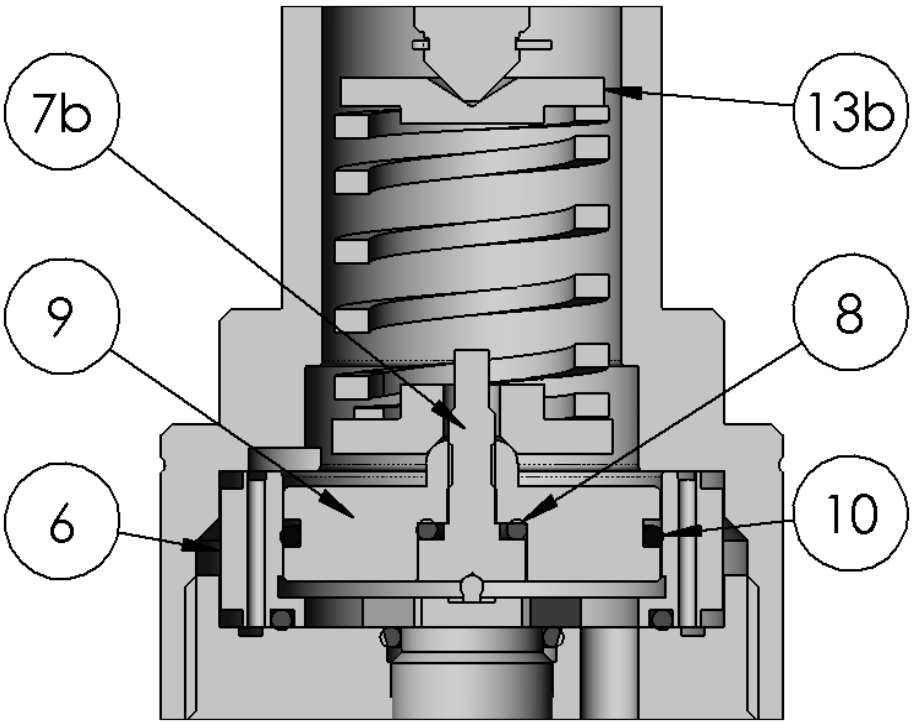


Fig 4

RS(H)2 Series, Alternative Configuration; Control Ranges 3 and 4

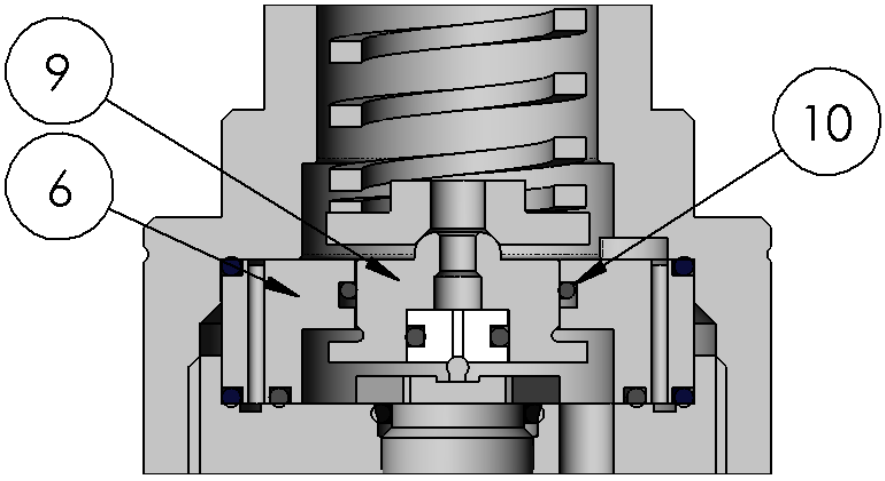


Fig 5

RS(H)2 Series, Alternative Configuration; Control Range 5

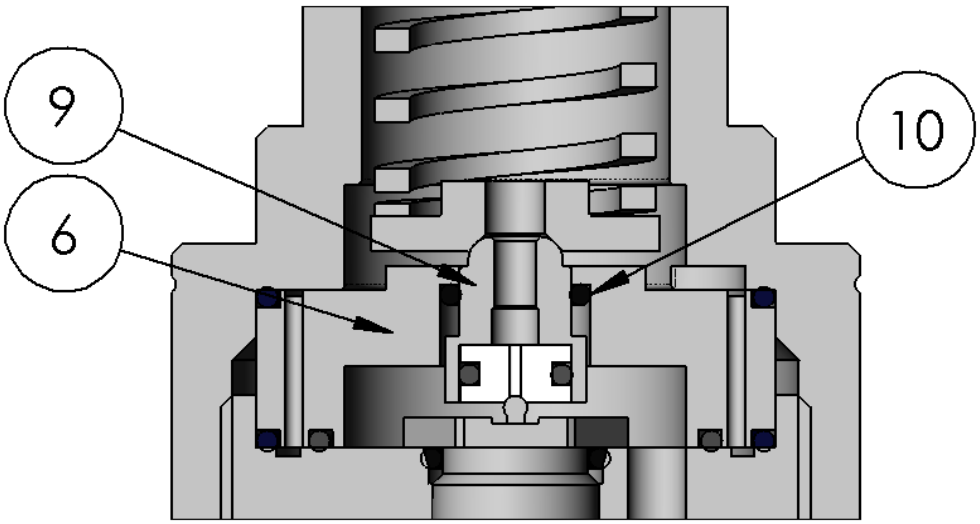


Fig 6

RS(H)2 Series, Alternative Configuration; Control Ranges 5 and 6

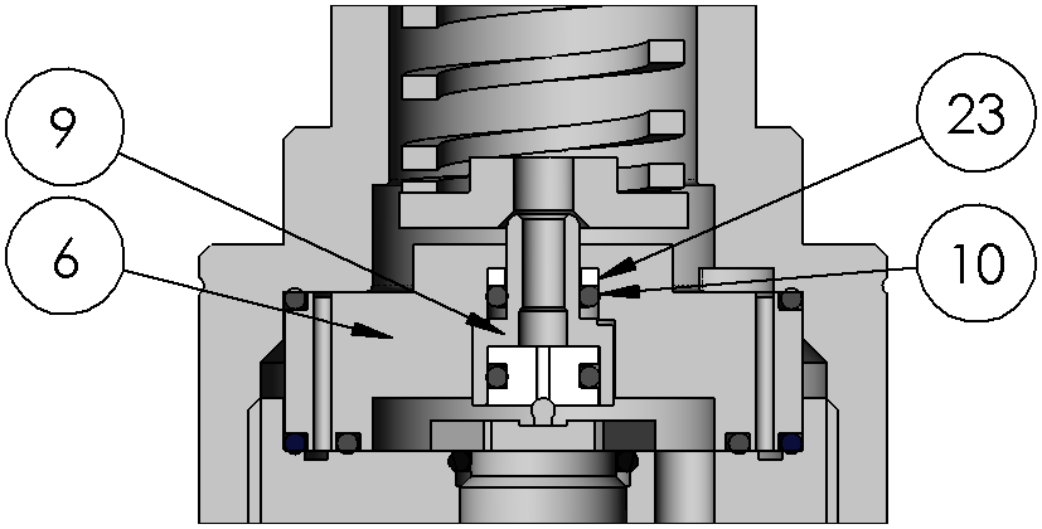


Fig 7

RD2 Series, Exploded View

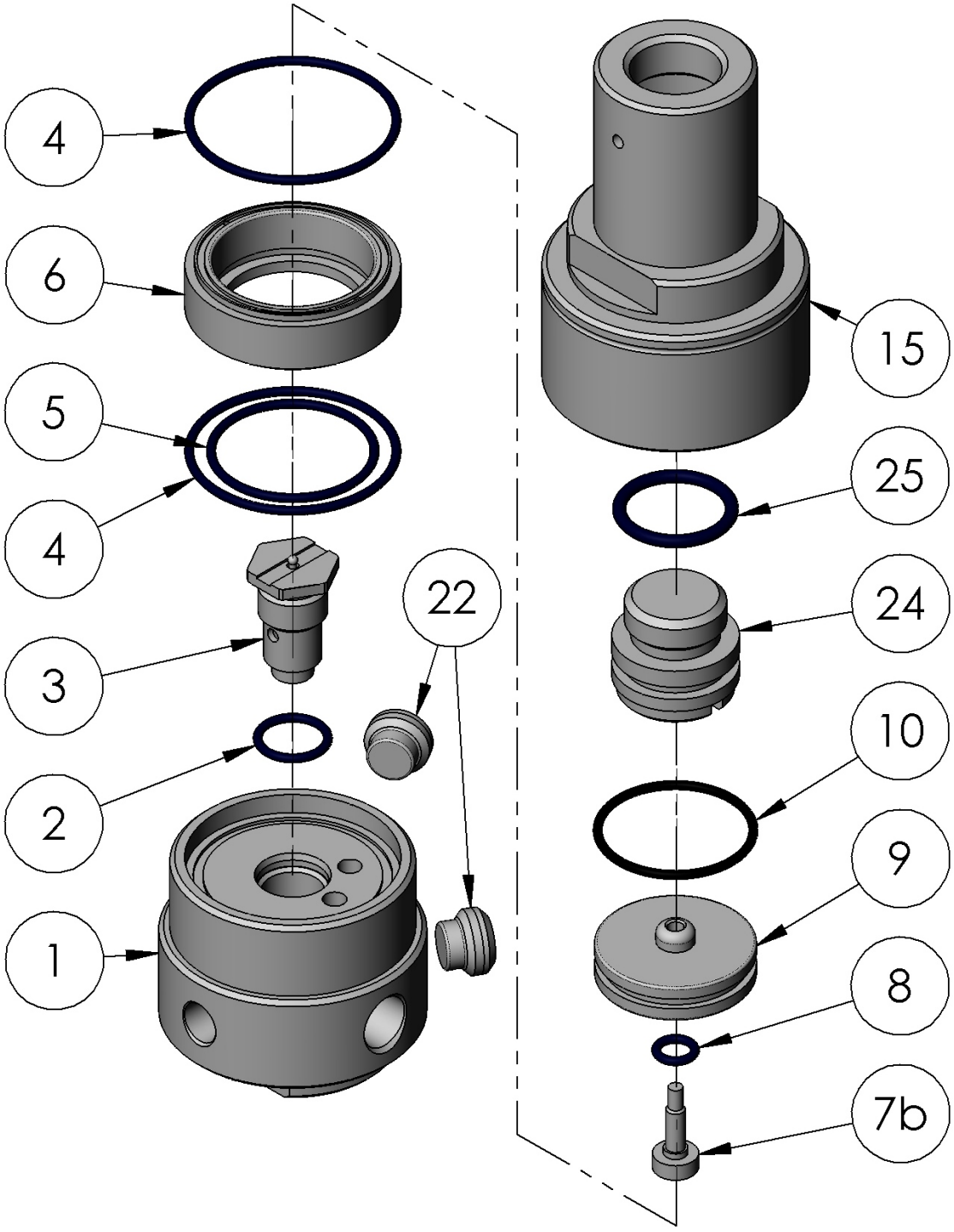


Fig 8

RD2 Series, Section View

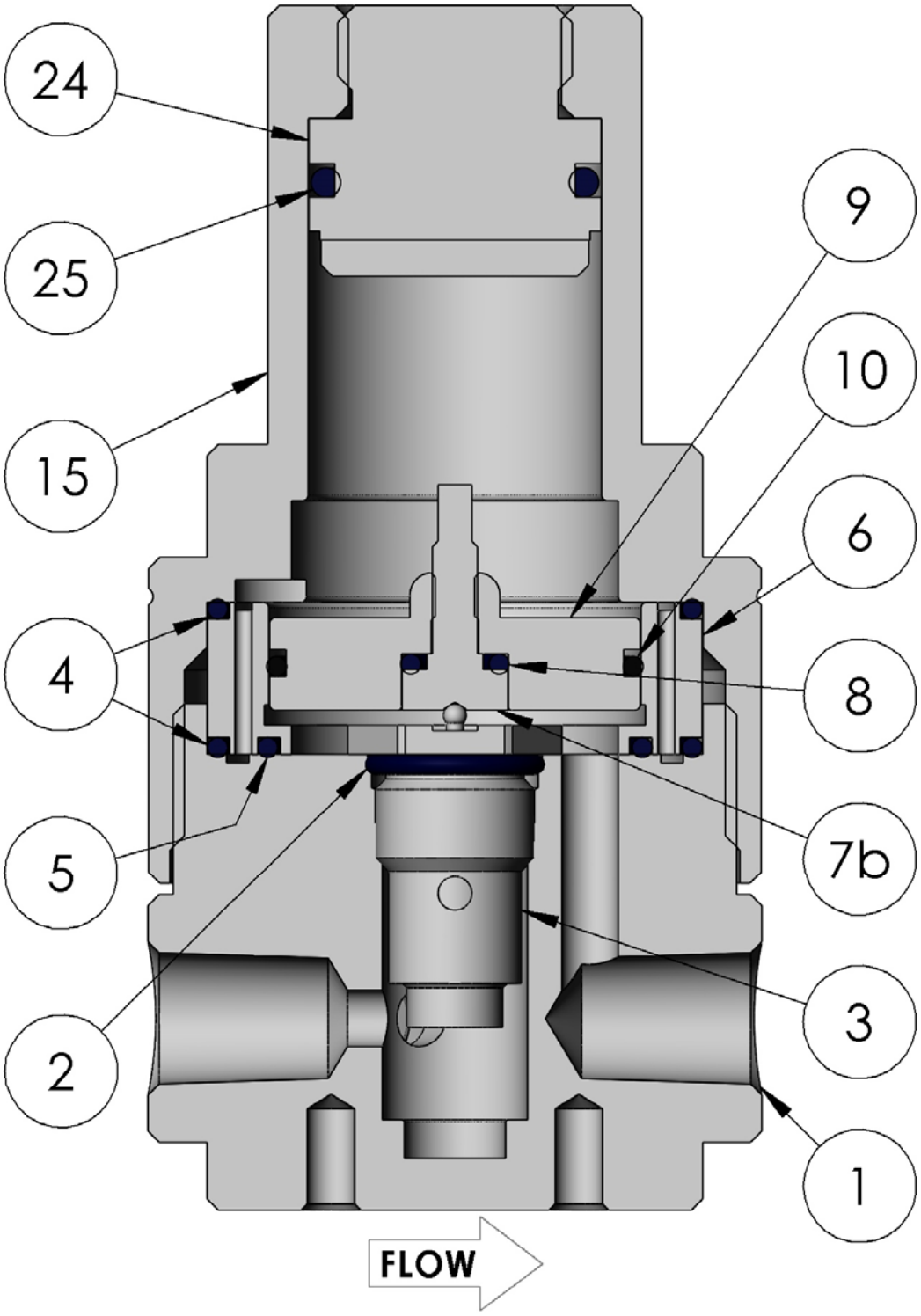


Fig 9

Disassembly

- The following instructions describe how to fully disassemble the regulator for the purposes of maintenance and repair.
- Note that not all components listed appear in all regulator configurations.
- Only disassemble the regulator as far as is required to replace the components supplied in the maintenance kit.
- Discard all components being replaced.

1. Ensure the knob assembly (18) is backed off and not acting on the set spring (12).
2. Unscrew the spring housing or dome (15) from the body (1).
3. RS(H)2 series only - Remove the top spring guide (13a/13b), set spring (12), and bottom spring guide (11). If present remove the O-ring (14) from the self-vent spring guide (13a).
4. Remove the piston plate (6) then remove all piston plate O-rings (4, 5) from the plate.
5. Push the piston (9) out of the piston plate (6) and remove the piston O-ring (10) and backup ring (23).
6. Remove the poppet cartridge (3) then remove the O-ring (2) from the cartridge.
7. RS(H)2 series only - To remove the knob assembly (18) remove the C-ring (17) then fully unwind the handle from the spring housing (15).
8. RD2 series only - To remove the dome plug (24) unscrew it from the dome (15) using the dome plug insertion tool. The dome plug O-ring (25) can then be removed from the plug.

Points of Attention Before Reassembly

- Visually inspect all components for abnormal wear or damage. Replace components in case of doubt.
- All parts must remain clean and undamaged before starting assembly.
- Maintenance kit components will be supplied preassembled where practicable to aid reassembly.
- Spare poppet valve cartridges are supplied as a pre-assembled and tested unit. Individual cartridge components are not available for purchase.
- Swagelok recommends replacing all O-rings removed during disassembly.
- Swagelok recommends that dynamic O-rings should be lightly lubricated per Table 3.

NOTICE

All threaded components must be lightly lubricated per Table 3 before reassembly to avoid galling of threads.

Reassembly

RS(H)2 Series: Standard (Self-venting)

1. Secure the body (1) in a vise, holding on the flats.
2. Fit the poppet cartridge O-ring (2) onto the poppet cartridge (3). Lightly lubricate the cartridge threads then insert the cartridge (3) into the body (1) and torque to 22 lbf·ft (30 N·m).
3. Fit the self-vent seat O-ring (8) onto the self-vent seat (7a) then insert the seat into the piston (9). Ensure the chamfered edge of the seat is facing out.
4. Fit the piston O-ring (10) and, if present, piston back up ring (23) either onto the piston (9) or into the piston plate (6). Reference Fig 4-7.
5. Lightly lubricate the piston O-ring (10) then insert the piston (9) into the piston plate (6) ensuring it is oriented correctly. Reference Fig 4-7.
6. Fit the piston plate inner O-ring (5) into the O-ring groove on the bottom of the piston plate (6).
7. Fit the piston plate outer O-ring (4) into the body (1).
8. Fit the piston plate (6) into the body (1) ensuring it is oriented correctly with the face containing two O-ring grooves facing towards the body.
9. Lightly lubricate the knob assembly stem (18) then insert it into the spring housing cover (16).
10. Secure the C-ring (17) onto the groove at the end of the stem (18).
11. Fit the self-vent spring guide O-ring (14) onto the self-vent spring guide (13a) and lightly lubricate it.
12. Fully coat the recess of the top spring guide (13a/13b) with lubricant.
13. Insert the self-vent spring guide (13a) into the spring housing (15) with the recessed side facing into the housing.
14. Insert the remaining piston plate outer O-Ring (4) into the spring housing (15).
15. Stack the bottom spring guide (11) and set spring (12) onto the piston (9).
16. Lightly lubricate the spring housing thread (15) then fit it onto the body (1). Torque to 52 lbf·ft (70 N·m).

RS(H)2 Series: Non-venting

1. Follow steps 1 and 2 of the RS(H)2 series standard reassembly procedure.
2. Fit the piston plug (7b) and piston plug O-ring (8) into the piston (9). Use thread locking compound on the plug threads, taking care not to contaminate the O-ring (8). Allow 30 minutes minimum for the thread locking compound to cure.
3. Follow steps 4 through 6, 8 through 10, 12 and 15 of the RS(H)2 series standard reassembly procedure.
4. Stack the top spring guide (13b) onto the set spring (12).
5. Follow step 16 of the RS(H)2 series standard reassembly procedure.

RD2 Series:

1. Follow steps 1 and 2 of the RS(H)2 series standard reassembly procedure.
2. Fit the piston plug (7b) and piston plug O-ring (8) into the piston (9). Use thread locking compound on the plug threads, taking care not to contaminate the O-ring (8). Allow 30 minutes minimum for the thread locking compound to cure.
3. Follow steps 4 through 8 of the RS(H)2 series standard reassembly procedure.
4. Fit the dome plug O-ring (25) onto the dome plug (24) then lightly lubricate it.
5. Lightly lubricate the dome plug threads (24) then insert it into the dome (15). Push it down until the threads meet.
6. Screw the dome plug (24) into the dome (15). Torque to 22 lbf·ft (30 N·m) using the dome plug insertion tool.
7. Follow steps 14 and 16 of the RS(H)2 series standard reassembly procedure.

Testing

Swagelok recommends that the regulator be tested for seat and shell leakage to atmosphere. A well performing regulator will not show any indication of leaking. If any evidence of a leak is identified this must be rectified. Any damaged components must be replaced.

Seat Leak Test

1. Ensure there is sufficient supply pressure to the regulator to be able to perform the tests.
2. Ensure the knob is screwed fully counterclockwise or that there is zero pressure in the dome.
3. Maintain an inlet pressure of approximately 14.5 psig (1 bar) on the regulator and close the downstream shutoff valve.
4. Monitor the outlet pressure. An increase in pressure over time indicates a seat leak.
5. Repeat the procedure with the highest inlet pressure applicable for the regulator and system.

Shell Leak Test

1. Maintain an inlet pressure of approximately 29 psig (2 bar) on the regulator and close the downstream shutoff valve.
2. Increase the outlet pressure to approximately 14.5 psig (1 bar).
3. Using liquid leak detector, check for bubbles at the spring housing/dome to body interface and the spring housing weep hole.
4. Repeat the procedure with the highest inlet and outlet pressure applicable for the regulator and system.

Troubleshooting

Symptom	Cause	Remedy
The outlet pressure creeps up, without adjusting the spring or dome pressure.	A damaged cartridge seat.	Replace the cartridge.
Leakage between the body and the spring housing/dome.	A damaged O-ring.	Replace the O-ring.
	Insufficient torque on the spring housing/dome.	Tighten the spring housing/dome per Table 3.
Controlled pressure drops off sharply even when the flow is within regulator capabilities.	The cartridge filter element is clogged.	Replace the poppet cartridge.
	The system filter element is clogged.	Replace the system filter.
The required outlet pressure cannot be reached.	The inlet pressure to the regulator is not high enough.	Ensure that the inlet pressure to the regulator is equal to or greater than the desired set pressure.
The outlet pressure rises too much when going from a dynamic to a static situation.	There is too much flow in the dynamic situation.	A larger regulator or parallel regulator is required. Review application flow capacity and contact your authorized sales and service center.
The outlet pressure does not drop when the knob is adjusted counterclockwise or pressure in the dome is lowered.	The regulator is non-venting.	A shutoff valve in the outlet line must be opened to reduce the outlet pressure.
The outlet pressure has changed without adjusting the knob or dome pressure.	Changes to the inlet pressure may result in changes to the outlet pressure.	Maintain a constant inlet pressure to the regulator. See "**Points of Attention Before Operation**" about **dependency**.
	Changes to the flow may result in changes to the outlet pressure.	Maintain a constant flow through the regulator. See "**Points of Attention Before Operation**" about **droop**.

Table 4

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty.
For a copy, visit swagelok.com or contact your authorized Swagelok representative.

March 2018, Rev B
MS-CRD-0185