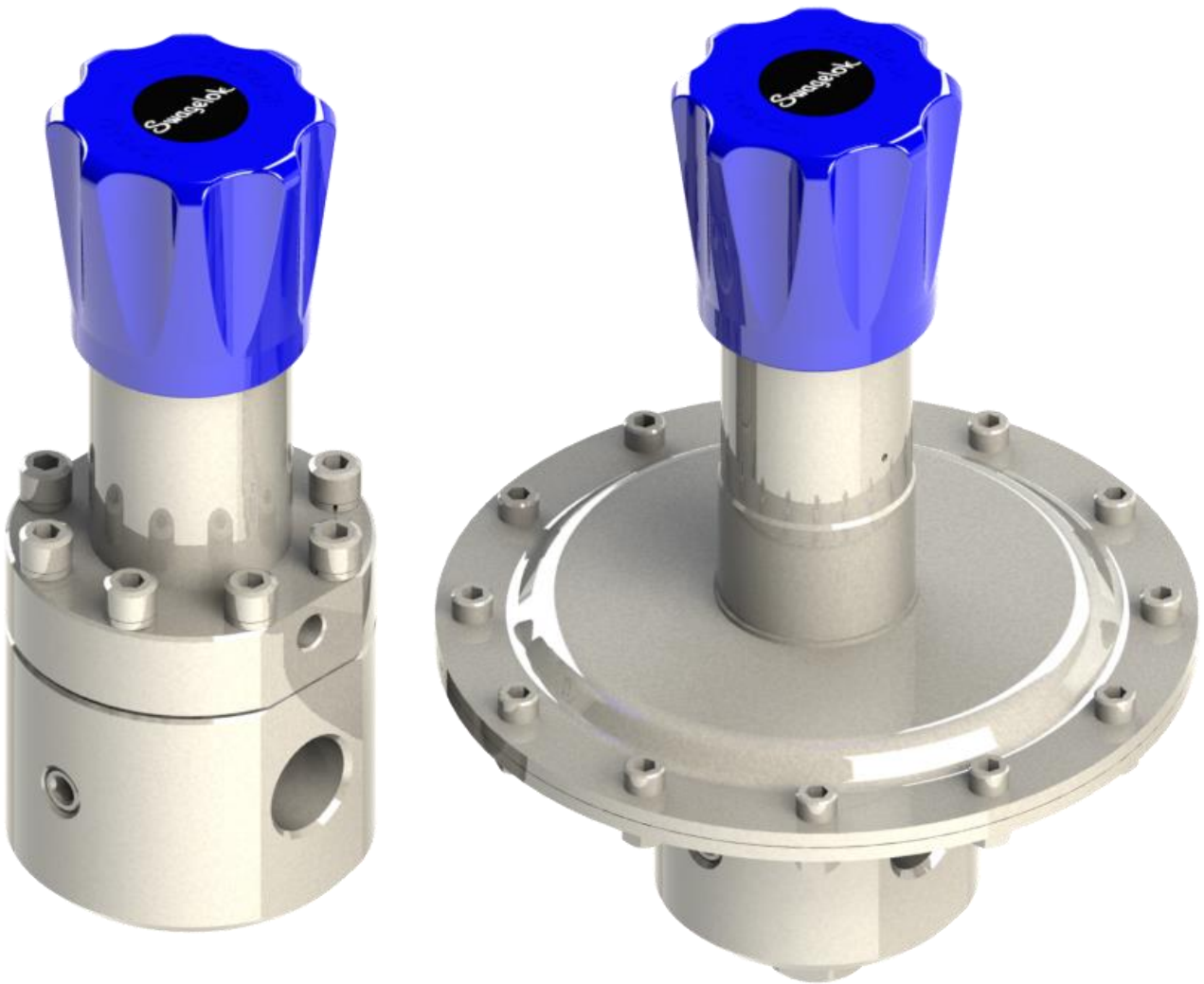


**(LP)BS(H)4/6/8 Back-Pressure Regulator
User Manual**

Swagelok



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..... 4**
 - Overview..... 4
 - Standard Features..... 4
 - Additional Options 4
 - Oxygen Service 4
- Installation..... 5**
 - Points of Attention Before Installation 5
 - Installation 5
- Operation..... 6**
 - Required Tools for Operation 6
 - Points of Attention Before Operation..... 6
 - Adjusting the Set Pressure..... 6
- Maintenance 7**
 - Required Tools for Maintenance 7
 - Points of Attention Before Removal from the System 8
 - Removal from the System 8
 - Assembly Reference Data..... 9
 - Disassembly 16
 - Points of Attention Before Reassembly..... 16
 - Reassembly..... 17
 - BS(H) Series: Diaphragm Sensing..... 17
 - BS(H) Series: Piston Sensing 17
 - LPBS Series 17
- Testing 18**
 - Seat Leak Test 18
 - Shell Leak Test..... 18
- Troubleshooting 19**

Introduction

Overview

- The BS(H)4, BS(H)6 and BS(H)8 series are spring loaded back pressure regulators designed for the regulation of high pressure gases and liquids.
- The LPBS4, LPBS6 and LPBS8 series are spring loaded back pressure regulators designed for high sensitivity regulation of 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

- Bolted construction
- Stainless steel as standard
- Fully serviceable
- Diaphragm or piston sensing

Additional Options

The regulator is available with the following options:

- Anti-tamper
- Gauge port configurations

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.

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 and connections. 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 facing upwards per Fig 2. 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 and liquids. Ensure compatibility between the regulator's materials of construction and the system media.

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.
- The BS4 series regulator can be 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.



NOTICE

Do not plug the vent port in the spring housing. This would alter the regulator set pressure. This must be open to atmosphere either directly or via a vent line.

Operation

Required Tools for Operation

- For changing the set pressure on a standard regulator no tools are required.
- For anti-tamper regulators a 12 mm open-ended wrench and a 4 mm hex drive are required.

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.

- Once the regulator closes, after being open to flow, the inlet pressure may fall a little under the set pressure. This is usually referred to as “**reseat pressure**”. This phenomenon does not indicate a problem with the regulator.
- An increase in the flow may result in a rise of the set pressure. A decrease in the flow may result in a fall of the set pressure. This is usually referred to as “**accumulation**”. This phenomenon does not indicate a problem with the regulator.
- An increase of the outlet pressure may result in a fall of the set pressure. A decrease of the outlet pressure may result in a rise of the set pressure. This is usually referred to as “**dependency**”. This phenomenon does not indicate a problem with the regulator.

Adjusting the Set Pressure

- The set pressure is the desired upstream 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.
 - The regulator must be able to flow in order to adjust the set pressure.
1. Open any downstream valve.
 2. To operate the regulator, turn the adjustment knob clockwise to increase the set pressure. Turn the knob counterclockwise to reduce the set pressure.
 3. Partially open the supply valve to allow the regulator to sense the inlet pressure with minimal flow.
 4. Close the supply valve and verify the set pressure by measuring the regulator inlet pressure.
 5. Make adjustments to the set pressure as required and repeat steps 3 and 4.
 6. To obtain the most accurate set pressure, final adjustment must be made while **increasing** the set pressure. If the desired set pressure is exceeded, reduce the pressure below this value then increase up to it.
 7. Once the regulator is set, the supply pressure can be adjusted to its normal working value.
 8. Open the supply valve fully to allow full flow during operation.
 9. When in operation make any final set pressure adjustments if required.

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		Calibrated torque wrench up to 37 lbf-ft (50 N·m)	
24 mm socket		Lubricant (included in kit): WL-8 ^⑤ Krytox® 240 AC ^⑥	
17 mm socket			
16 mm wrench ^①		Liquid leak detector	
17 mm wrench ^②			
10 mm wrench ^③			
6 mm hex drive ^④			
5 mm hex drive ^③			

① BS(H) series, control ranges 7/9/11 only

② BS(H) series, control range 6 only

③ LPBS series only

④ BS(H) series only

⑤ Standard cleaned assemblies

⑥ ASTM G93 or SC11 cleaned assemblies

Table 1

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, 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 to the open position (i.e. knob backed off fully counterclockwise) , open all appropriate downstream valves to allow pressure to vent from the regulator.



WARNING

Ensure all pressure on the inlet and outlet 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.

Assembly Reference Data

Item	Component Name	Kit Designator	Torque lbf-ft (N·m)	Recommended Lubrication (included in kit per table 1)
1	Body plug	C1, C2	37 (50)	Krytox® GPL 207 on threads
2	Body plug backup ring	B1, B2, C1, C2		
3	Body plug O-ring	B1, B2, C1, C2		
4	Seat	C1		
5	Seat seal	A1, A2, B1, C1		
6	Body	N/A		
7	Diaphragm/piston screw	C1	13 (18)	Krytox GPL 207 on threads
8	Poppet O-ring	A1, B1, B2, C1		Molykote® 55
9	Poppet backup ring	A1, B1, B2, C1		
10	Poppet	A1, B1, C1		
11	Overtravel spring	C1, C5		
12	Diaphragm	B1, B2, C1, C3		
13	Diaphragm plate	C1		
14	Piston	C1, C3		
15	Piston plate O-ring	B1, B2, C1, C3		
16	Piston plate	C1, C3		
17	Piston O-ring	B1, B2, C1, C3		Molykote 55
18	Piston guide ring	B1, B2, C1, C3		
19	Set spring	C1, C4		
20	Spring guide	C1		Krytox GPL 207 in recess
21	Ball	C1		Krytox GPL 207
22	Spring housing	N/A		
23	Washer	E1		
24	Cap screw	E1	BS: 20 (27)	Krytox GPL 207 on threads
			LPBS: 11 (15)	
25	Anti-tamper adjusting screw	D1		Krytox GPL 207 on threads
26	Anti-tamper O-ring	D1		
27	Anti-tamper cover	D1		Krytox GPL 207 on threads
28	Knob assembly	D1		Krytox GPL 207 on threads
29	Blind plug	N/A	NPT: 15 (20)	Wrap threads in 2 layers of PTFE tape. Krytox GPL 207 on tape
			BSP: 26 (35)	Krytox GPL 207 on threads
30	BSP blind plug O-ring	B1, B2, C1		
31	Piston backup ring	B1, B2, C1, C3		
32	LPBS diaphragm screw	C1		Krytox GPL 207 on threads
33	Diaphragm washer	C1		
34	Diaphragm nut	C1	7 (10)	
35	Spring housing nut	E1		

Table 2

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

BS(H) Series, Exploded View

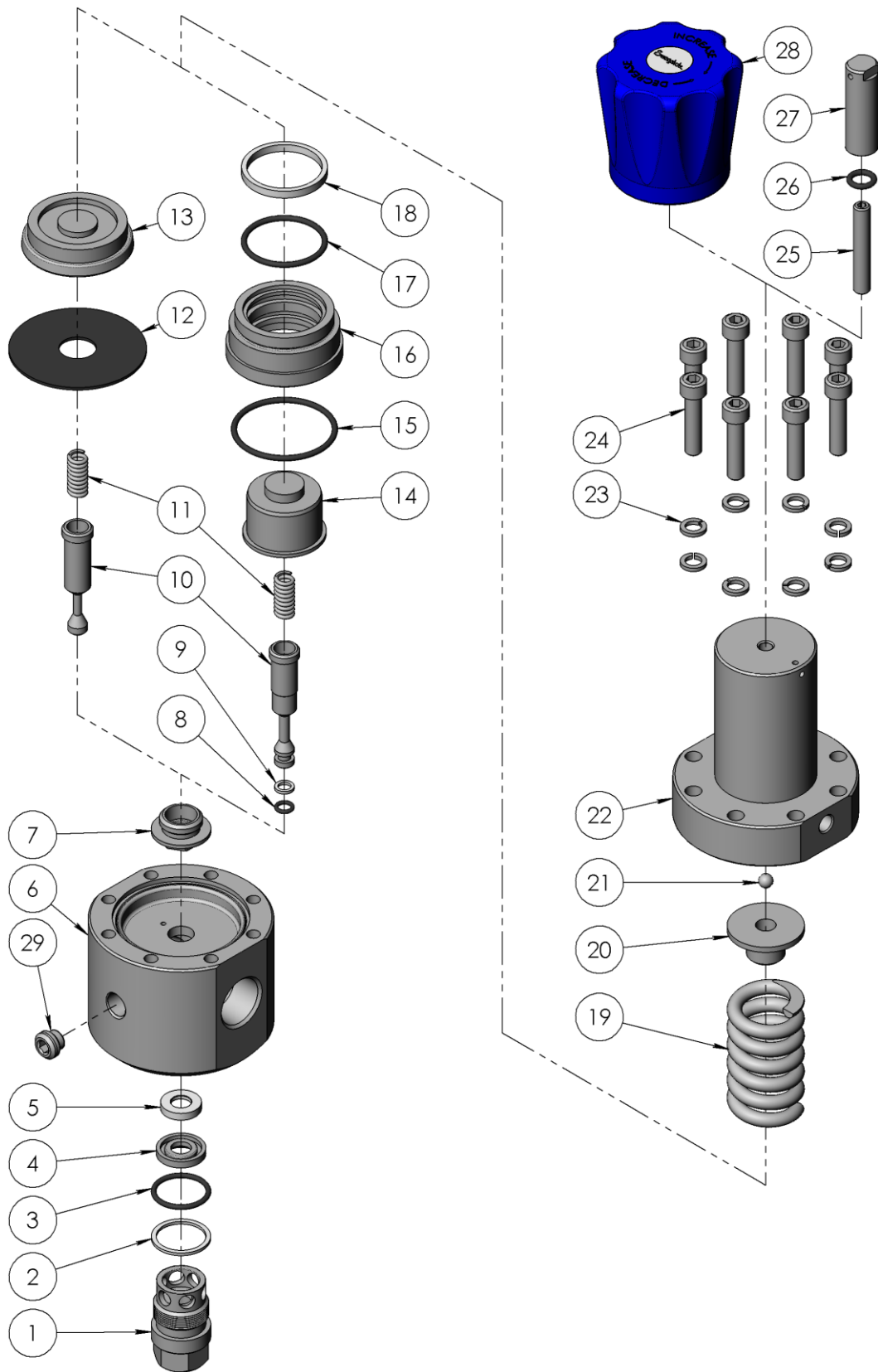


Fig 1

BS Series, Diaphragm Sensing, Section View

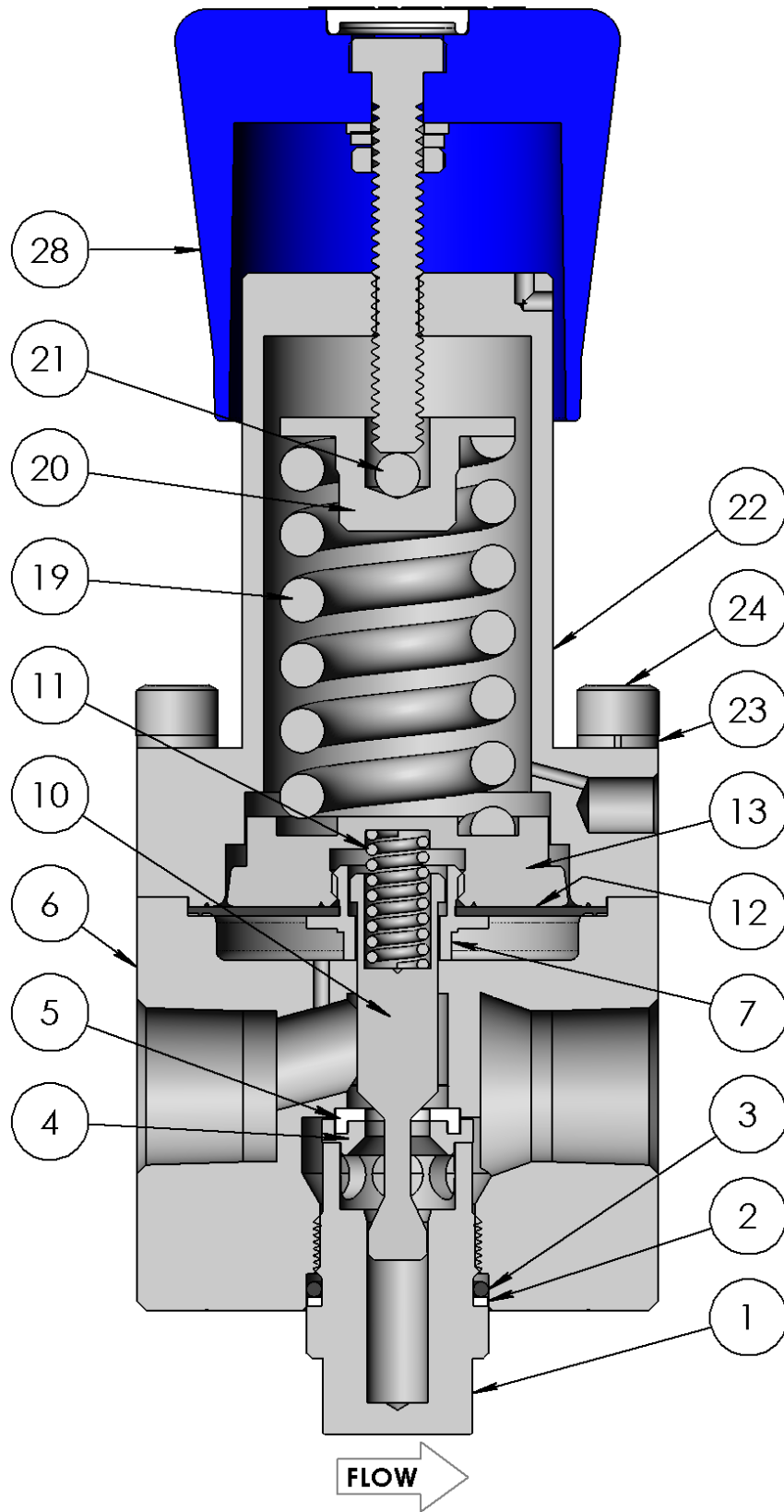


Fig 2

BSH Series, Piston Sensing with Anti-Tamper, Section View

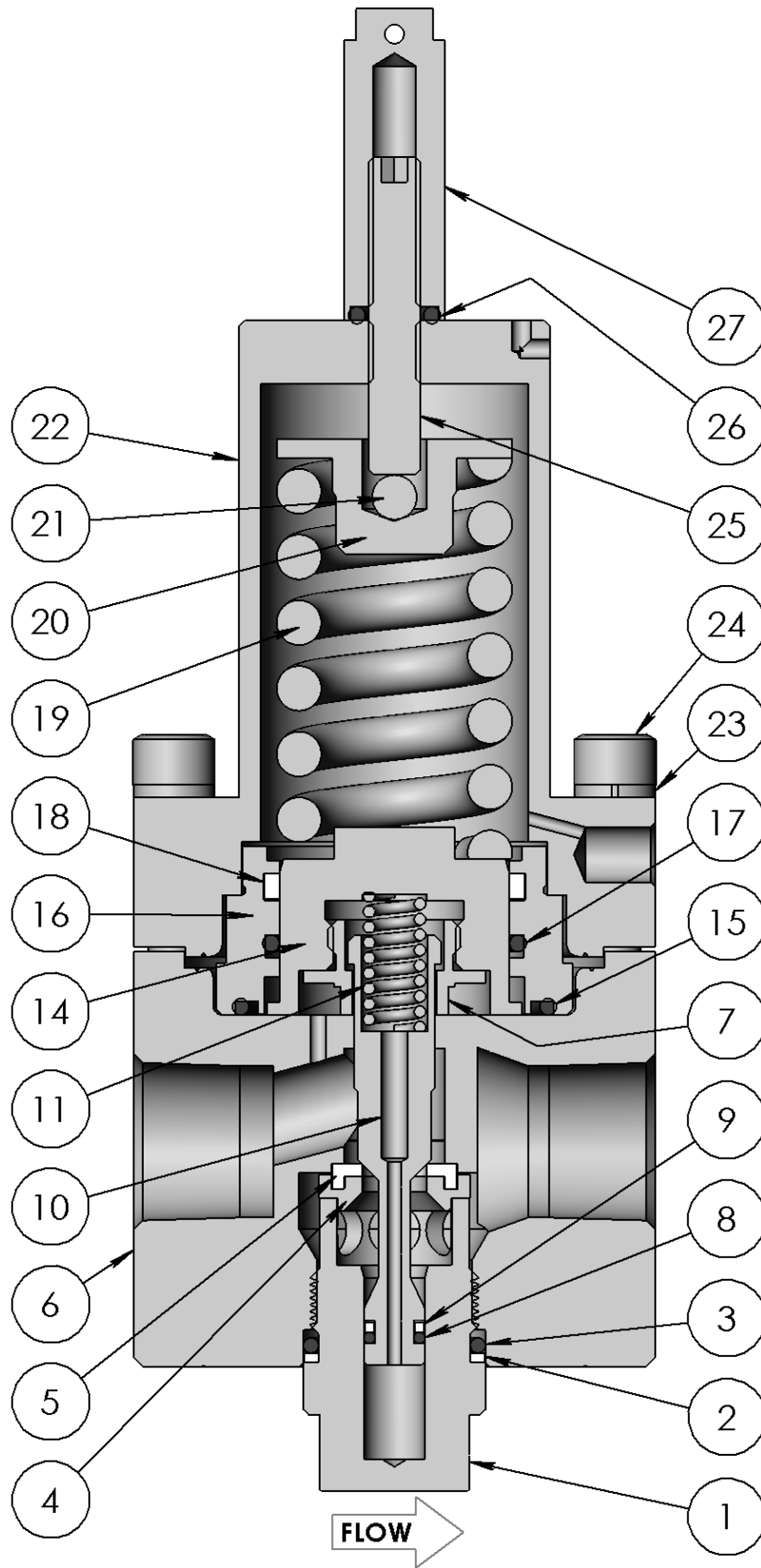


Fig 3

BSH Series, Alternative Configuration Example; Control Ranges 7, 9 and 11

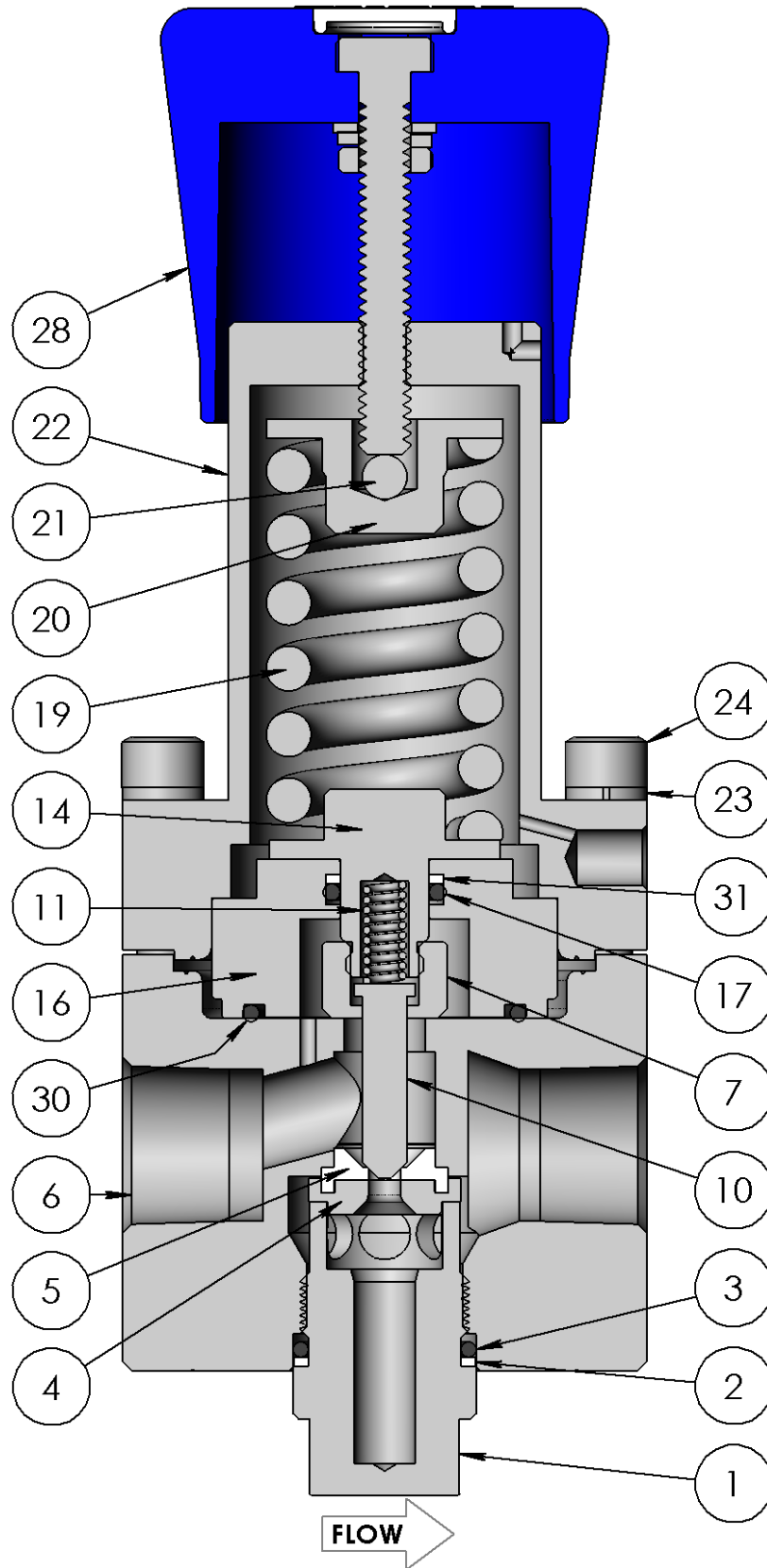


Fig 4

LPBS Series, Exploded View

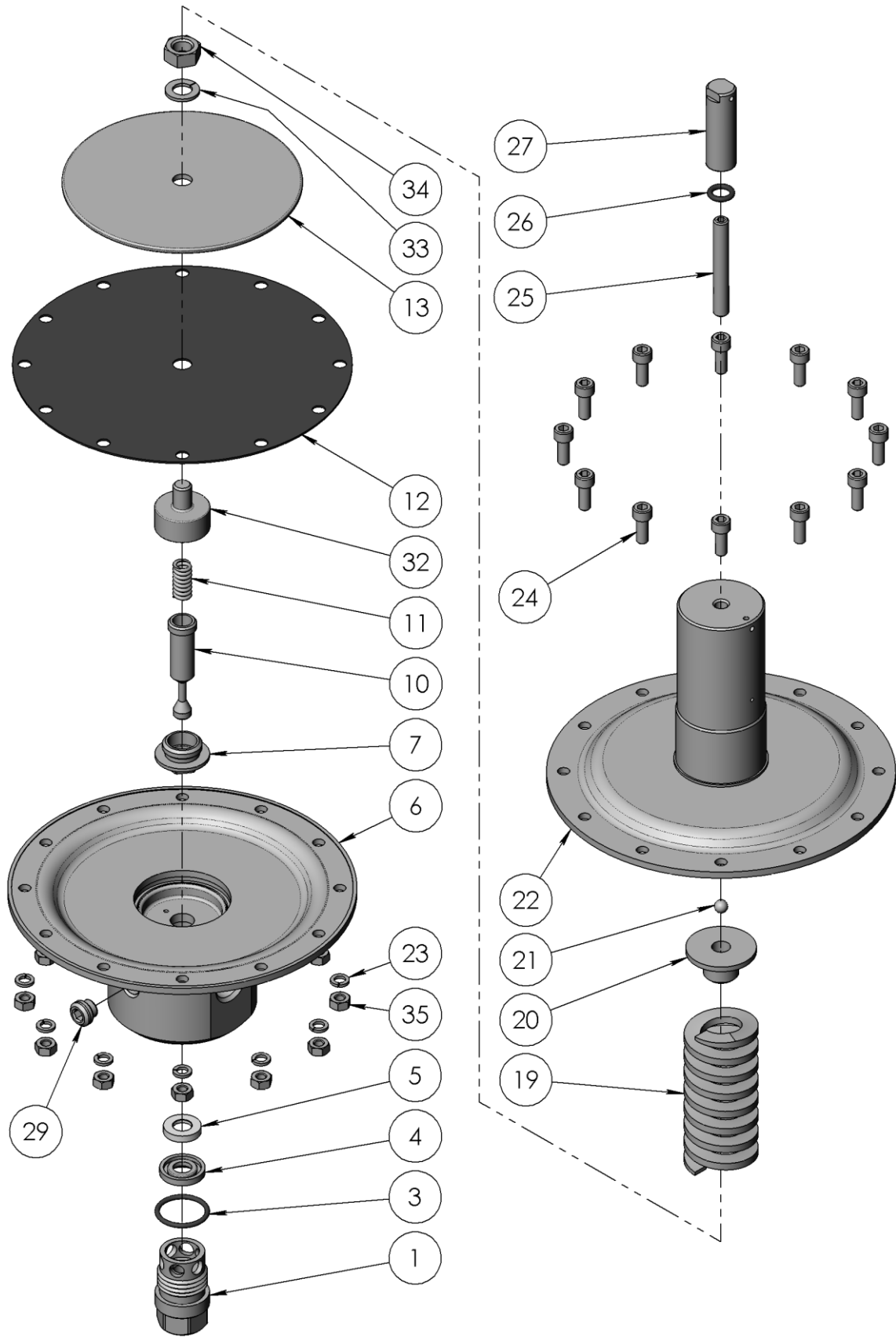


Fig 5

LPBS Series, Anti-Tamper, Section View

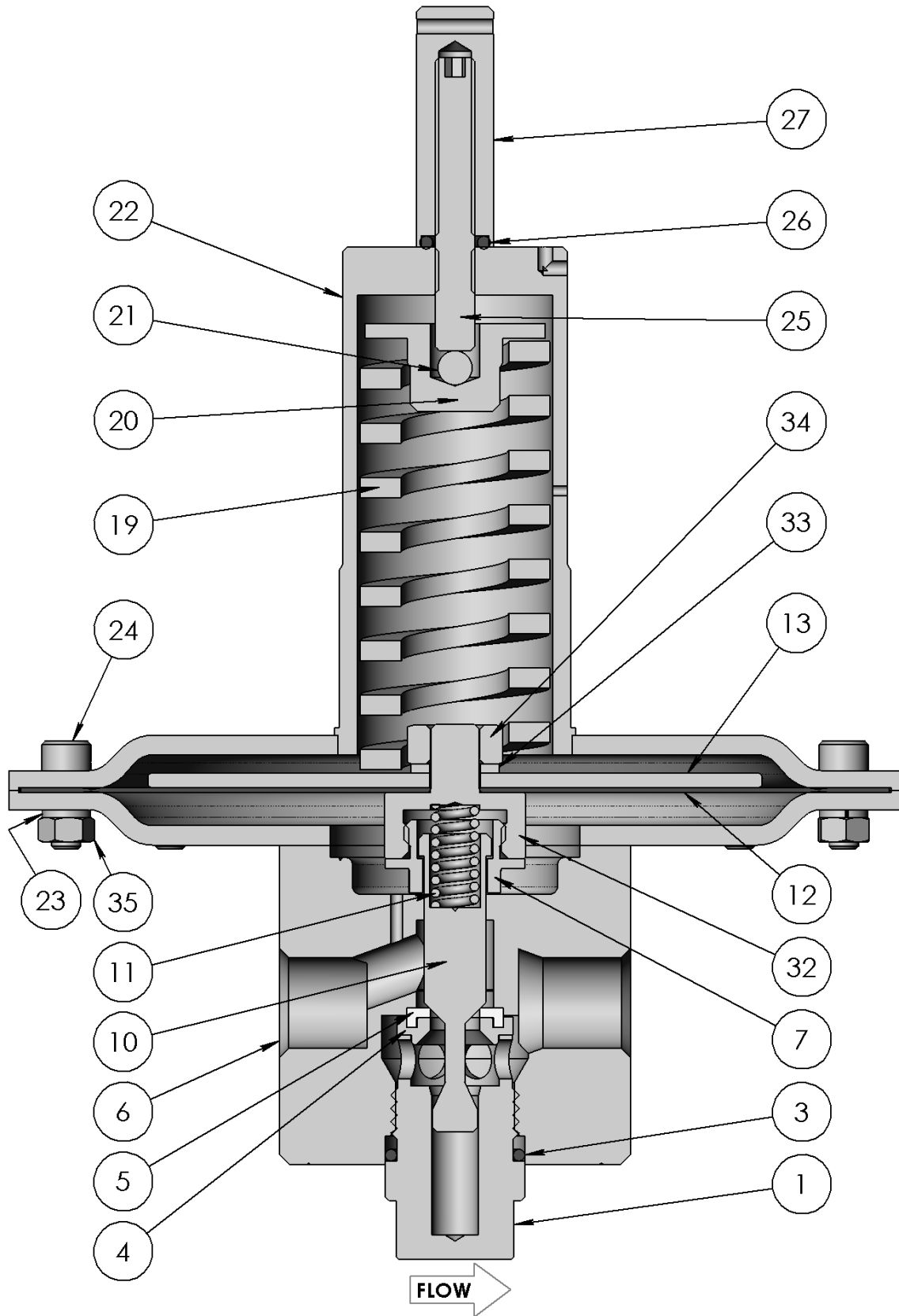


Fig 6

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 (28) is backed out and not acting on the set spring (19). It can be fully removed, if required, by unwinding counterclockwise until it detaches from the spring housing (22).
 2. Loosen the cap screws (24) and remove the spring housing (22).
 3. Remove the spring guide (20) including the ball (21) and the set spring (19).
 4. Remove the sensing assembly.
 - 5a. For a diaphragm sensor, remove the diaphragm screw (7) from the diaphragm plate (13) to release the diaphragm (12), poppet (10), and overtravel spring (11).
 - 5b. For a piston sensor, remove the piston (14) from the piston plate (16) then remove the piston screw (7) from the piston (14) to release the poppet (10) and overtravel spring (11).
 6. Remove the O-ring (8) and backup ring (9) from the poppet (10).
 7. Remove the O-rings (15 and 17), backup ring (31) and guide ring (18) from the piston plate (16).
 8. Remove the body plug (1), seat (4), and seat seal (5).
 9. Remove the O-ring (3) and backup ring (2) from the body plug (1).

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.
- Swagelok recommends replacing all O-rings removed during disassembly.
- Swagelok recommends that dynamic O-rings should be lightly lubricated with Molykote 55 per Table 2.



NOTICE

All threaded components must be lightly lubricated with Krytox GPL 207 per Table 2 before reassembly to avoid galling of threads.

Reassembly

BS(H) Series: Diaphragm Sensing

1. Fit the body plug O-ring (3) and, if present, body plug backup ring (2) onto the body plug (1). Ensure their orientation is correct. Reference Figs 1-4.
2. Lightly lubricate the body plug (1) threads with Krytox GPL 207. Stack the seat (4) and seat seal (5) onto the body plug (1) then fit the body plug (1) into the body (6). Ensure the body plug O-ring (3) is not pinched while being inserted. Torque to 37 lbf·ft (50 N·m).
3. Fit the diaphragm (12) onto the diaphragm screw (7). Insert the poppet (10) and overtravel spring (11) through the diaphragm screw (7). Lightly lubricate the diaphragm plate threads (13) with Krytox GPL 207 then fit onto the diaphragm screw (7). Torque to 13 lbf·ft (18 N·m).
4. Insert the sensing assembly into the body (6). Take care when inserting the poppet (10) through the seat seal (5) not to cause any damage to either component.
5. Fit the ball (21) into the spring guide (20) and retain in place with a liberal amount of Krytox GPL 207.
6. Stack the set spring (19) and spring guide (20) onto the sensing assembly.
7. Fit the spring housing (22) over the stack and secure with the cap screws (24) and washers (23). Lightly lubricate the cap screws (24) with Krytox GPL 207 and torque to 20 lbf·ft (27 N·m).
8. Lightly lubricate the knob assembly stem (28) with Krytox GPL 207 then insert it into the spring housing (22).

BS(H) Series: Piston Sensing

1. Follow steps 1 and 2 of the BS(H) series diaphragm sensing reassembly procedure.
2. If present, fit the poppet O-ring (8) and backup ring (9) onto the poppet (10). Ensure their orientation is correct. Reference Fig 3.
3. Fit the piston O-ring (17), piston plate O-ring (15) and, if present, piston backup ring (31) and piston guide ring (18) into the piston plate (16).
4. Insert the poppet (10) and overtravel spring (11) through the piston screw (7). Lightly lubricate the piston screw threads (7) with Krytox GPL 207 then fit into/onto the piston (14). Torque to 13 lbf·ft (18 N·m).
Note if the regulator is of the design shown in Fig 4 the piston (14) needs to be inserted through the piston plate (16) before fitting the piston screw (7). Lightly lubricate the piston O-ring (17) with Molykote 55 before inserting the piston (14).
5. Lightly lubricate the piston O-ring (17) with Molykote 55 then insert the piston (14) into the piston plate (16).
6. Follow steps 4 through 8 of the BS(H) series diaphragm sensing reassembly procedure.

LPBS Series

1. Follow steps 1 and 2 of the BS(H) series diaphragm sensing reassembly procedure.
2. Insert the poppet (10) and overtravel spring (11) through the diaphragm screw (7). Lightly lubricate the diaphragm screw threads (7) with Krytox GPL 207 then fit this into the LPBS diaphragm screw (32). Torque to 13 lbf·ft (18 N·m).
3. Place the diaphragm (12) onto the diaphragm plate (13). Insert the LPBS diaphragm screw (32) through the plate per Fig 6. Lightly lubricate the diaphragm screw (32) thread with Krytox GPL 207.
4. Secure the assembly with the diaphragm nut (34) and washer (33). Torque to 7 lbf·ft (10 N·m).
5. Follow steps 4 through 8 of the BS(H) series diaphragm sensing reassembly procedure, with the inclusion of the cap nuts (35) at step 7.

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 any downstream shutoff valves are open.
3. Set the regulator to 14.5 psig (1 bar) then open and close the supply shutoff valve.
4. Monitor the inlet pressure and/or use liquid leak detector on the outlet port. A drop in inlet pressure over time or bubbles in the leak detector indicates a seat leak.
5. Repeat the procedure with the highest set pressure suitable for the regulator and system.

Shell Leak Test

1. Set the regulator to the open position (i.e. ensure the knob is fully backed off counterclockwise).
2. Close the downstream shutoff valve.
3. Maintain an inlet pressure of approximately 14.5 psig (1 bar) on the regulator. Measure the outlet pressure to ensure this also reads the same value.
4. Using liquid leak detector, check for bubbles at the spring housing to body interface, body plug to body interface and the spring housing weep hole.
5. Repeat the procedure with the highest inlet and outlet pressure applicable for the regulator and system.

Troubleshooting

Symptom	Cause	Remedy
Constant leakage from the outlet before the set pressure is reached.	A damaged seat seal and/or poppet.	Replace the seat seal and/or poppet.
Leakage around the body plug.	A damaged O-ring.	Replace the O-ring.
Leakage between the body and the spring housing or through the spring housing weep hole.	A damaged diaphragm or piston O-ring.	Replace the diaphragm or O-ring.
	Insufficient torque on the cap screws.	Tighten the cap screws per Table 2.
The required set 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 inlet 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 local Swagelok distributor.
The regulator will not relieve at the set point.	The poppet is sticking.	Replace the poppet.
	The set point has been accidentally altered.	Readjust the set point.
The set pressure has changed without adjusting the knob.	Changes to the outlet pressure may result in changes to the set pressure.	Maintain a constant outlet pressure on the regulator. See “ Points of Attention Before Operation ” about dependency .
	Changes to the flow may result in changes to the set pressure.	Maintain a constant flow through the regulator. See “ Points of Attention Before Operation ” about accumulation .

Table 3

Warranty Information

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

Swagelok, Snoop - TM Swagelok Company
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