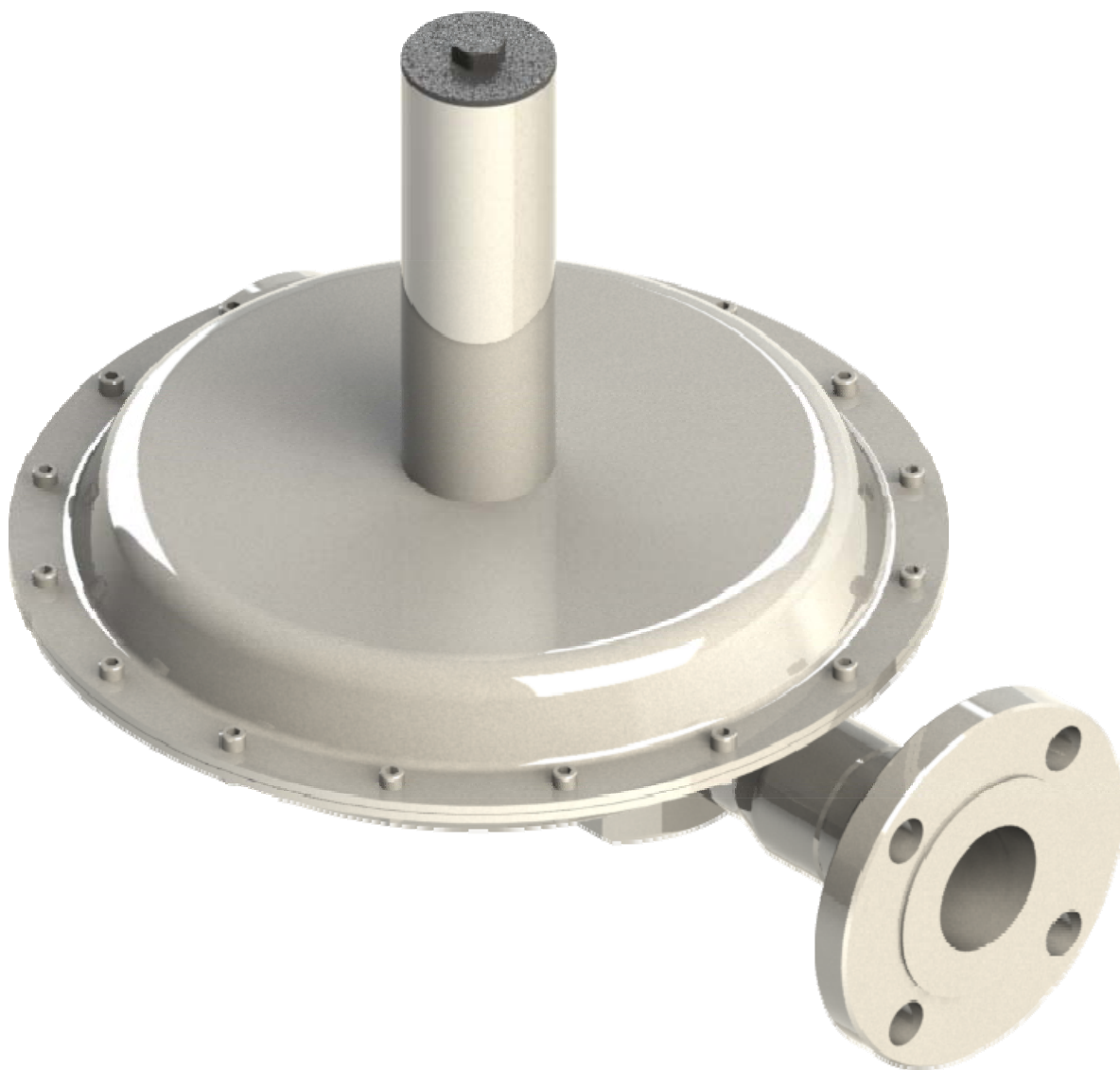


TBRS16 Pressure-Reducing Regulator User Manual

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.

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Introduction

Overview

- The TBR516 series are spring loaded pressure reducing regulators designed for low pressure, high sensitivity regulation of gases and liquids.
- For pressure and temperature rating information refer to the *Tank Blanketing Pressure Regulators, RHPS Series* catalog, MS-02-431.



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 sensing
- Millibar control
- External feedback

Additional Options

The regulator is available with the following options:

Factory set (FS) and locked

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 *Tank Blanketing Pressure Regulators, RHPS Series* catalog, MS-02-431, 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. 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 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. 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.
- 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.



WARNING

When using the regulator with an inlet pressure higher than 10 psig (700 mbar) a safety valve must be installed in the outlet line to ensure the outlet pressure does not exceed 10 psig (700 mbar), which could result in product failure.

External Feedback

The purpose of external feedback is to provide a more accurate and stable regulation of the outlet pressure. This is achieved by sensing the outlet pressure downstream of the regulator and feeding it back to the regulator's sensing element.

- The external feedback line is to be connected in a turbulence-free zone in the downstream piping, at a maximum distance of 5x the outside diameter of the downstream tubing/piping (Fig 1).
- The tube size of the external feedback should be $\frac{3}{8}$ in. or $\frac{1}{2}$ in. or the metric equivalent.



CAUTION

When using a regulator with external feedback, ensure that the outlet line is connected to the external feedback port before applying pressure to the regulator. Failing to do so may lead to damage and non-functioning of the regulator and no pressure regulation will occur.



CAUTION

Never connect the external feedback line downstream of a shut-off valve. Doing so may lead to damage and non-functioning of the regulator and no pressure regulation will occur.

External Feedback Schematic

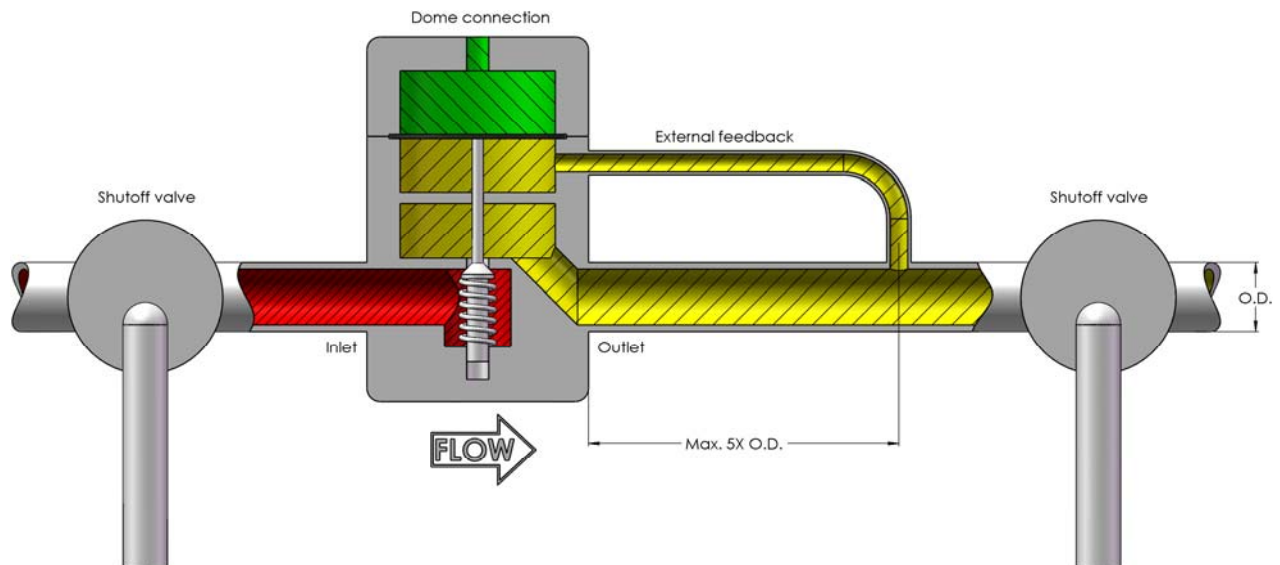


Fig 1

Operation

Required Tools for Operation

A 19 mm socket wrench is required for changing the set pressure on a standard regulator.

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.
 - The regulator must be able to flow in order for it to reduce the outlet pressure.
1. 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. Remove the cover and fully unwind the adjusting screw counterclockwise.
 3. Steadily open the supply valve to allow inlet pressure to the regulator.
 4. To operate, turn the adjusting screw clockwise to increase the set pressure. Turn the adjusting screw counterclockwise to reduce the set pressure.
 5. To obtain the most accurate set pressure, final adjustment must be made while **increasing** the 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.

Maintenance

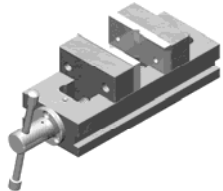









WARNING

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		Seat mounting tool: RHPS-15-SEAT-TOOL	
8 mm open-ended wrench		Calibrated torque wrench up to 37 lbf·ft (50 N·m)	
10 mm open-ended wrench			
3 mm hex drive ^①		Lubricant (included in kit): WL-8 ^② Krytox® 240 AC ^③	
5 mm hex drive			
6 mm hex drive			
8 mm socket		Liquid leak detector	
17 mm socket			
19 mm socket			
36 mm socket			

① Factory set option only

② Standard cleaned assemblies

③ 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, 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 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 Type(s)	Torque lbf-ft (N·m)	Recommended Lubrication (included in kit per Table 1)
1	Body plug	C1, C2	37 (50)	Lubricate threads
2	Body plug O-ring	B1, B2, C1, C2		
3	Poppet O-ring	B1, B2, C1, C2		Lubricate
4	Seat	A1, B1, C1	11 (15)	Lubricate threads
5	Seat seal	A1, B1, B2, C1		
6	Nut	E1		
7	Lock washer	E1		
8	Blind plug	N/A	NPT: 15 (20)	Wrap threads in 2 layers of PTFE tape. Lubricate tape.
			BSP: 26 (35)	Lubricate threads
9	BSP blind plug O-ring	B1, B2, C1		
10	Body assembly	N/A		
11	Poppet	A1, A2, B1, C1		
12	Poppet spring	C1, C5		
13	Holder O-ring	B1, B2, C1		
14	Guide bushing	B1, B2, C1		
15	Valve holder	C1		
16	Hex head screw	N/A	22 (30)	Lubricate threads
17	Lock washer	N/A		
18	Socket head cap screw	N/A	18 (25)	Lubricate threads
19	Hex head screw	C1		Lubricate threads
20	Bushing	C1		
21	Lever	C1		
22	Diaphragm screw	C1		Lubricate threads
23	Nut	C1	4 (6)	
24	Diaphragm	B1, B2, C1, C3		
25	Diaphragm plate	C1		
26	Lock nut	C1	7 (10)	
27	Set spring	C1, C4		
28	Spring guide	C1		Lubricate central recess
29	Spring housing assembly	N/A		
30	Socket head cap screw	E1	11 (15)	Lubricate threads
31	Adjusting screw	D1		Lubricate threads
32	FS locking ring [Ⓢ]	D1		
33	FS locking screw [Ⓢ]	D1	3.7 (5)	
34	Cover	D1		

Ⓢ Factory set option only

Table 2

For more information on RHPS series maintenance kits, refer to the *Tank Blanketing Pressure Regulators, RHPS Series* catalog, MS-02-431.

TBR516 Series, Exploded View

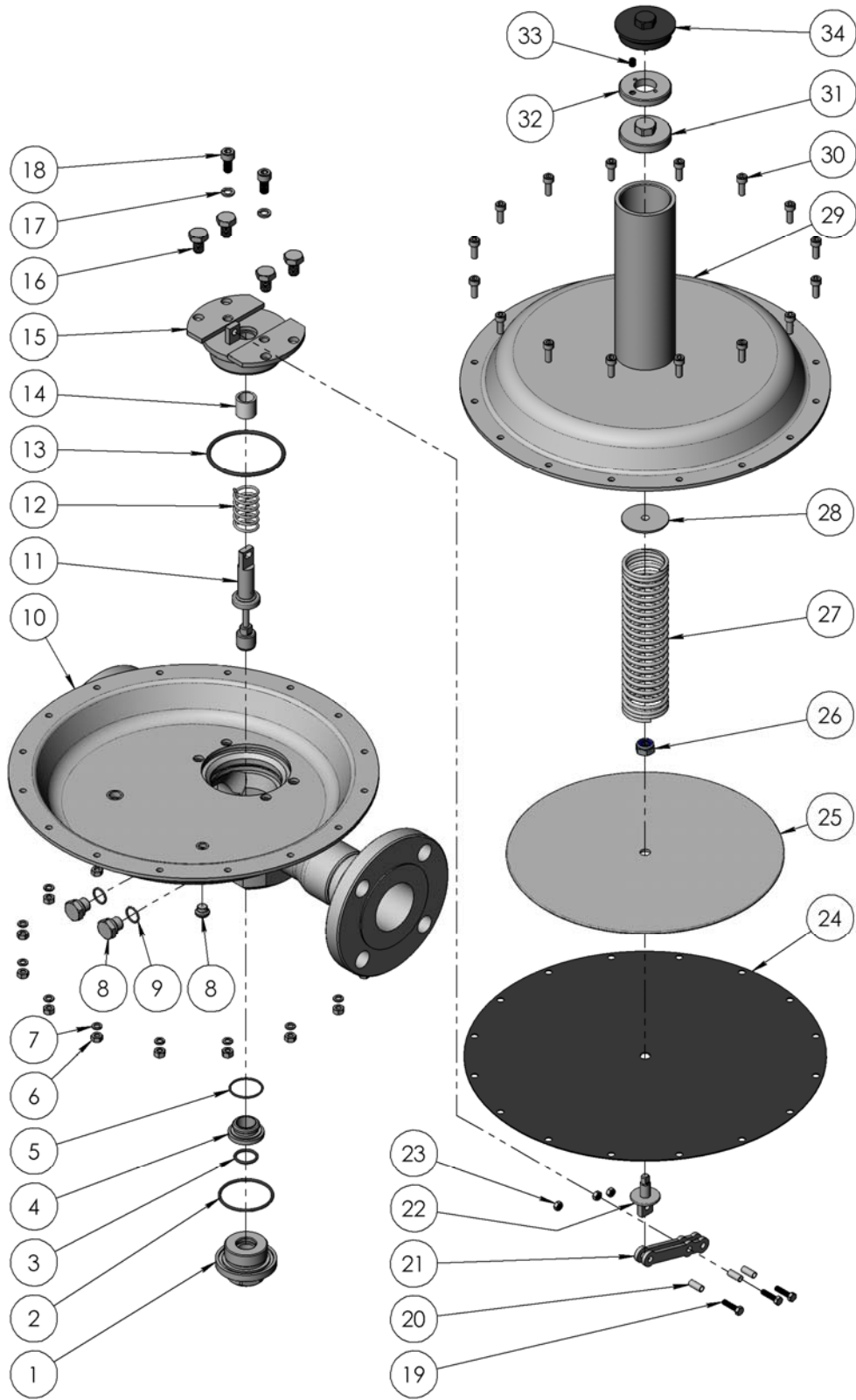


Fig 2

TBR516 Series, Section View

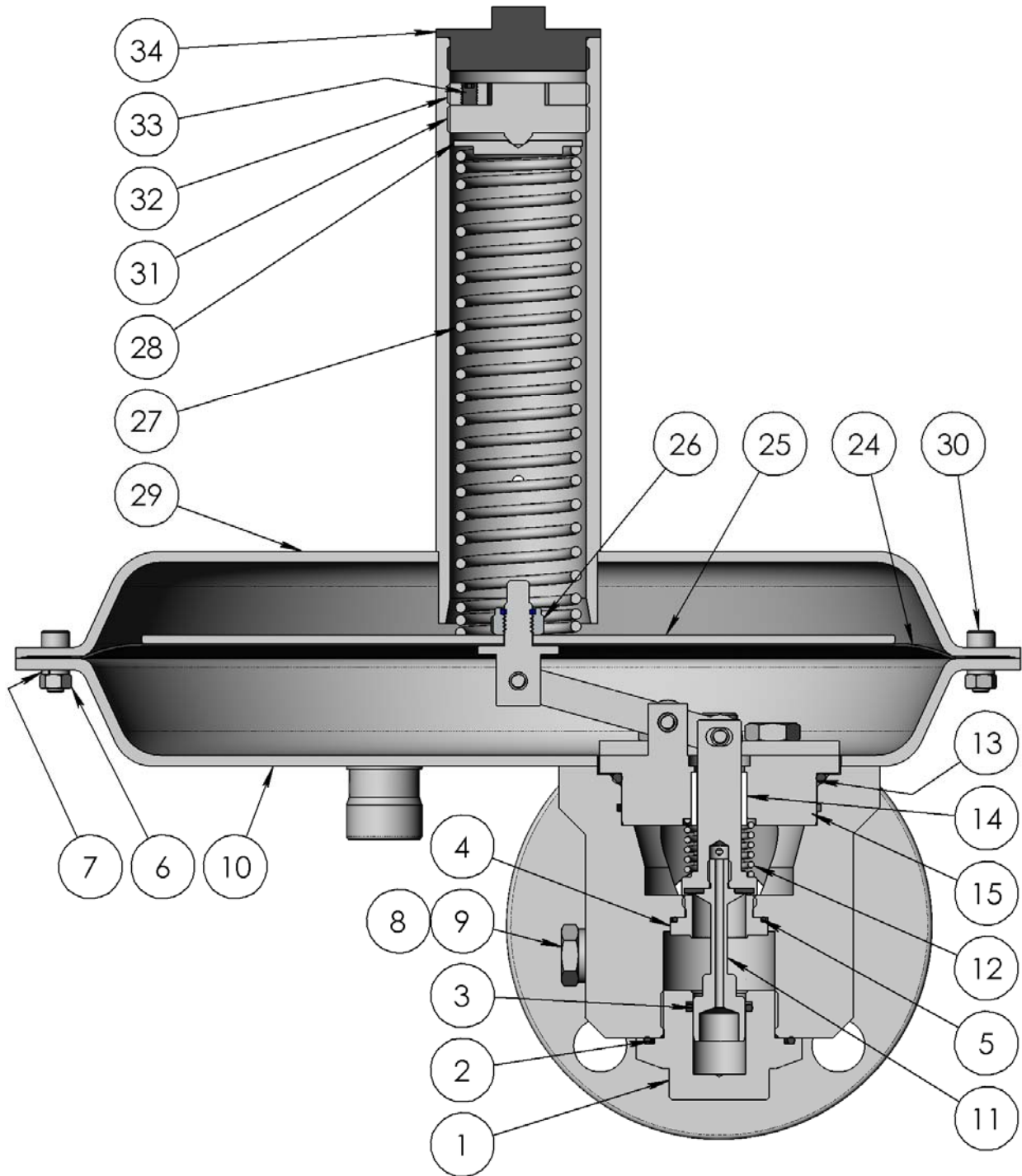


Fig 3

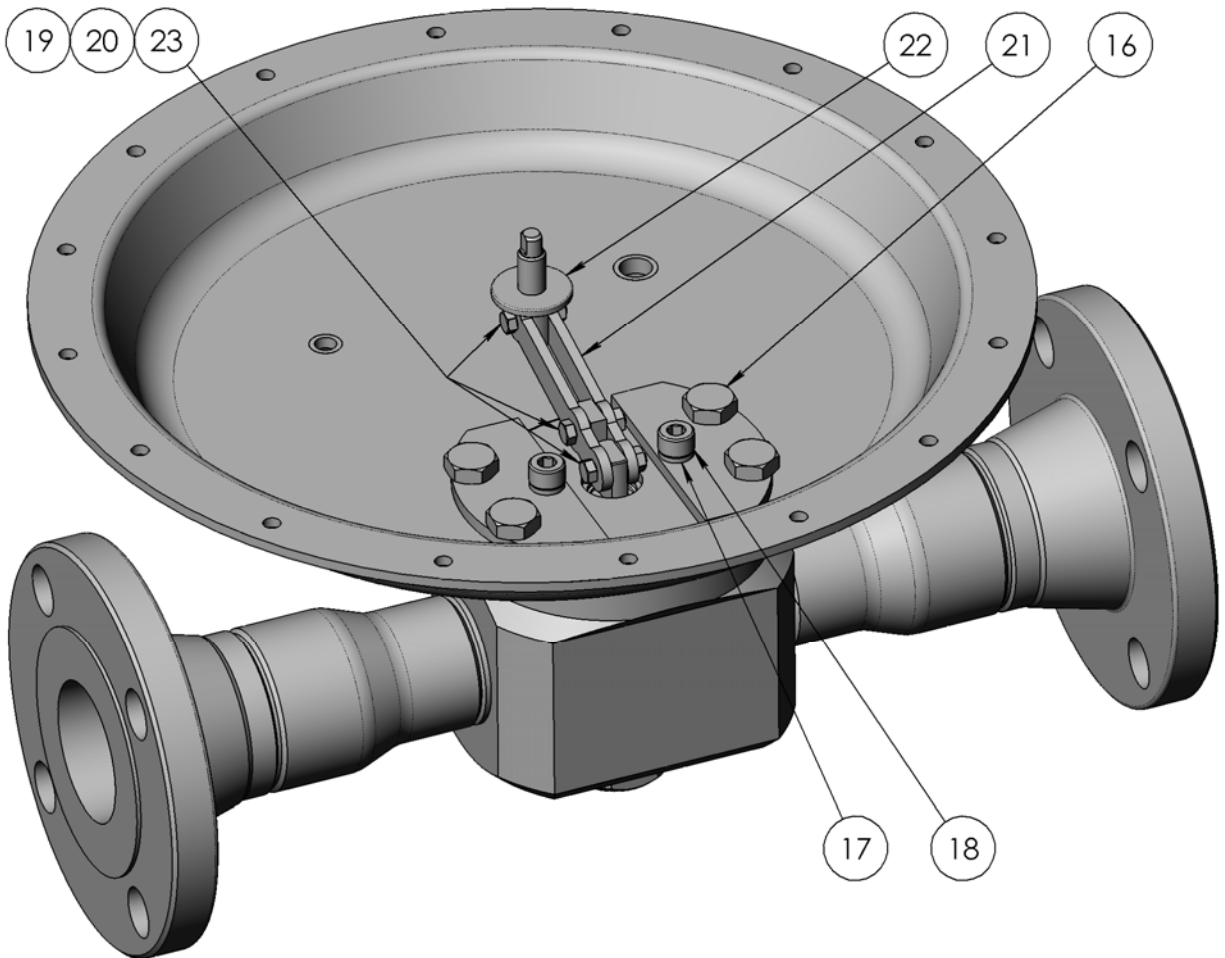
TBR516 Series, Lever Mechanism

Fig 4

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. Remove the cover (34) and ensure that the adjusting screw (31) is backed out and not acting on the set spring (27). It can be fully removed, if required, by unwinding counterclockwise until it detaches from the spring housing (29).
 2. Loosen the cap screws (30) and remove the spring housing assembly (29), spring guide (28), and set spring (27).
 3. Loosen the lock nut (26) then remove the diaphragm plate (25) and diaphragm (24).
 4. Loosen and remove the two cap head screws (18) from the valve holder (15).
 5. Remove the 3 nuts (23) from the hex head screws (19). Remove the screws (19), bushings (20), levers (21), and diaphragm screw (22).
 6. Loosen the hex head screws (16) and remove the valve holder (15).
 7. Remove the O-ring (13) and bushing (14) from the valve holder (15).
 8. Remove the poppet (11) and poppet spring (12) from the body assembly (10).
 9. Remove the body plug (1) from the body assembly (10) then remove the body plug O-ring (2) and poppet O-ring (3) from the body plug (1).
 10. Remove the seat (4) and seat seal (5) from the body assembly (10) using the seat insertion tool.

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 per Table 2.



NOTICE

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

Reassembly

TBRS16 Series: Standard

1. Secure the body assembly (10) in a vise.
2. Fit the seat seal (5) into the body assembly (10) and ensure that it is seated all the way round.
3. Lightly lubricate the seat threads (4) then insert the seat (4) into the body assembly (10) using the seat insertion tool. Torque to 11 lbf·ft (15 N·m). Take care not to pinch the seat seal (5).
4. Fit the body plug O-ring (2) and poppet O-ring (3) onto the body plug (1) and lightly lubricate the body plug threads.
5. Lightly lubricate the poppet O-ring (3).
6. Screw the body plug (1) into the body (10). Torque to 37 lbf·ft (50 N·m).
7. Insert the poppet (11) into the bodyplug (1) though the seat (4).
8. Install the poppet spring (12) over the poppet (11).
9. Press the guide bush (14) in to the valve holder (15) until flush.
10. Fit the holder O-ring (13) over the valve holder (15) then insert the valve holder (15) into the body assembly (10) over the poppet (11).
11. Orient the valve holder (15) so that the raised boss is towards the centre of the dish and orient the poppet (11) to be in line with the boss, per Fig 4.
12. Lightly lubricate the hex head screw threads (16). Secure the valve holder (15) using the hex head screws (16). Torque to 22 lbf·ft (30 N·m).
13. Lightly lubricate the smaller hex head screw threads (19).
14. Insert the screws (19) and bushings (20) through one lever (21) and through the poppet (11), valve holder (15) and diaphragm screw (22) per Fig 4.
15. Fit the second lever (21) onto the screws (19) and retain with the nuts (23). Torque to 4 lbf·ft (6 N·m).
16. Lightly lubricate the socket head cap screw threads (18) then install them and the lock washers (17) into valve holder (15). Torque to 18 lbf·ft (25 N·m).
17. Place the diaphragm (24) and diaphragm plate (25) on to the diaphragm screw (22).
18. Lubricate the diaphragm screw thread (22) then fit the lock nut (26). Torque to 7 lbf·ft (10 N·m).
19. Lubricate the recess of the spring guide (28).
20. Place the set spring (27) and spring guide (28) onto the diaphragm plate (25).
21. Cover the spring with the spring housing (29).
22. Lightly lubricate the cap screws (30). Secure the spring housing (29) to the body (10) using the cap screws (30), washers (7) and nuts (6). Torque to 11 lbf·ft (15 N·m).
23. Lubricate the adjusting screw thread (31) and install into the top of the spring housing (29).
24. Fit the cover (34) into the top of the spring housing (29).

TBRS16 Series: Factory Set Option

1. Follow steps 1 through 23 of the TBRS16 series standard reassembly procedure.
2. Screw the FS locking ring (32) into the spring housing (29) until it contacts the adjusting screw (31).
3. Insert the FS locking screw (33) into the FS locking ring (32) and torque to 3.5 lbf·ft (5 N·m).
4. Follow step 24 of the TBRS16 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 set screw is screwed fully counter clockwise.
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 the maximum inlet pressure on the regulator and close the downstream shutoff valve.
2. Increase the outlet pressure to the maximum set pressure.
3. 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.

Troubleshooting

Symptom	Cause	Remedy
The outlet pressure creeps up, without adjusting the spring.	A damaged poppet and/or seat.	Replace the poppet and/or seat.
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.	Replace the diaphragm.
	Insufficient torque on the cap screws.	Tighten the cap screws per Table 2.
Controlled pressure drops off sharply even when the flow is within regulator capabilities.	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 sufficient.
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 local authorized sales and service center.
The outlet pressure does not drop when the adjustment screw is adjusted counterclockwise.	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 adjustment screw.	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 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.

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