

Swagelok® Process Regulators

Pressure Reducing Ramp Regulator User Manual



SFRA with SEPC Installed



SFRA Air Driven

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.

Contents

Series Overview	4
Regulator Size	4
Standard Features.....	4
Additional Options	4
Oxygen Service	4
Installation.....	5
Points of Attention Before Installation.....	5
Installation	5
Operation	6
Points of Attention Before Operation	6
Adjusting the Set Pressure.....	6
Ratio Dome Pressure Control	6
Integral SEPC Assembly	7
Integral SEPC Control Schematic	7
External Dome Control Schematic.....	8
Maintenance	9
Required Tools for Maintenance	9
Points of Attention Before Servicing In Situ or Removal from the System	10
Servicing in situ	10
Removal from the System.....	10
Assembly Reference Data.....	11
Lubrication Chart	12
Ramp Regulator, Section View.....	13
Assembly and Disassembly.....	14
Points of Attention Before Reassembly	14
Instruction symbols.....	14
Step 1: Assemble Poppet	15
Step 2a: Assemble Ratio Dish	16
Step 2b: Assemble Ratio Dome Diaphragm	17
Step 2c: Assemble Ratio Dome Cap onto Body.....	18
Step 3: Assemble SEPC	19
Testing	20
Seat Leak Test.....	20
Shell Leak Test	20
Shell Leak Test Snoop® Locations	21
Troubleshooting.....	22

Series Overview

This user manual covers the Swagelok medium-pressure dome-loaded ratio regulator.

Regulator Size

This instruction manual covers the following sizes of regulators:

- 08 (1/2 in.)
- 09 (9/16 in.)

For pressure and temperature rating information refer to the *Process Pressure Regulators* catalog, [MS-02-492](#). 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

- Modular design
- Bolted construction
- Stainless steel as standard
- Fully serviceable
- Piston sensing
- Balanced poppet

Additional Options

Process regulators are available with the following options. Some options are only available on specific regulator series.

- Additional testing
- Maintenance kits

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 in accordance with Swagelok *Special Cleaning and Packaging (SC-11)* catalog, [MS-06-63](#), to ensure compliance with product cleanliness requirements stated in ASTM G93 Level C is available. Refer to the *Process Pressure Regulators* catalog, [MS-02-492](#), 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/dome facing upwards according to figure 1, page 7. 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. If the Regulator is to be serviced in system ensure it is secured with the M12 mounting holes and adequate clearance is provided above and below for part removal.
- The regulator is suitable for gases or liquids. 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 some auxiliary ports may be plugged. Remove these plugs and connect accessories if desired.
- If inlet/outlet fittings are being used, assemble them to the regulator, according to 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.
- Regulators should be securely mounted using the designated M12 mounting holes located adjacent to the main ports. This is especially important when in-situ servicing is anticipated. Ensure that both the tubing or pipework and the regulator are properly supported to prevent stress on the connections.
- If in-situ servicing is required, ensure there is adequate clearance of 80 mm above and 140 mm below the Regulator.
- Securely make the appropriate connections to the regulator in accordance with the procedures recommended by the connection manufacturer.
- Upstream and downstream shutoff valves should be installed in the system to facilitate servicing, maintenance, and troubleshooting of the regulator.

Operation

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. Reduce dome pressure to zero
 3. Steadily open the supply valve fully to allow inlet pressure to the regulator.
 4. To operate the regulator, increase the dome pressure to increase the set pressure. Reduce the dome pressure to reduce the set 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 necessary set pressure adjustments according to steps 4 and 5.

Ratio Dome Pressure Control

For ratio dome loaded regulators the dome pressure of the regulator controls the set pressure. There are several methods available for supplying and controlling the dome pressure.

- **Integral SEPC control.** In this setup the dome loaded regulator comes supplied with a SEPC (Electronic Proportional Controller) as part of the assembly (figure 1, page 7). The SEPC, fed from a customer supplied air/nitrogen source and electrical supply signal operates the control to the dome pressure (figure 2, page 7). This setup is suitable for hazardous locations subject to the product certification parameters.
- **External dome control.** External dome control. In this setup the dome pressure is supplied from an independent source, such as a cylinder or mains supply (figure 3, page 8).

Integral SEPC Assembly



Figure 1

Integral SEPC Control Schematic

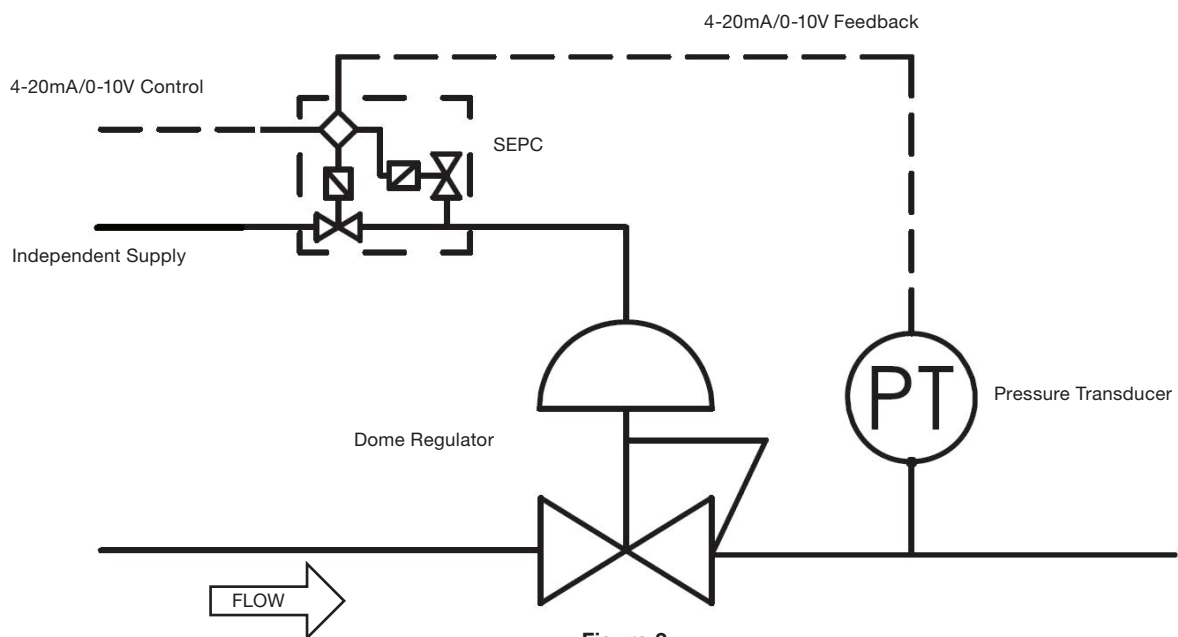
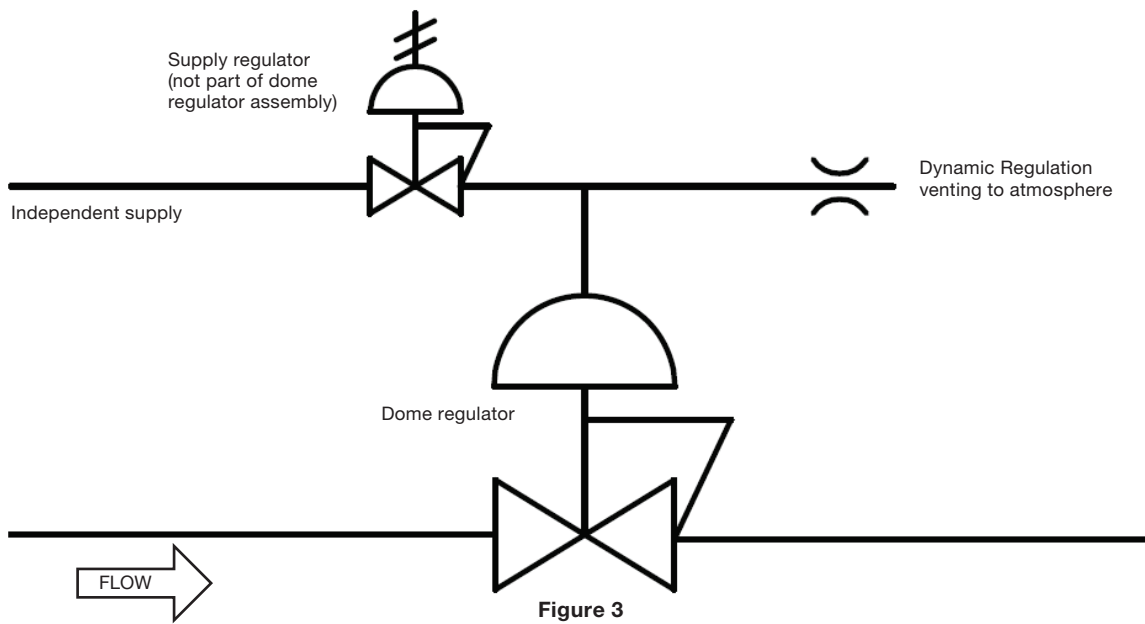


Figure 2

External Dome Control Schematic



Maintenance



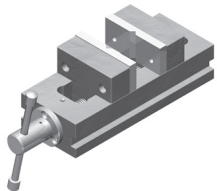
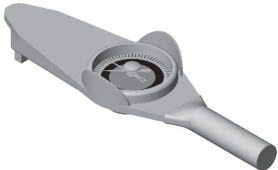
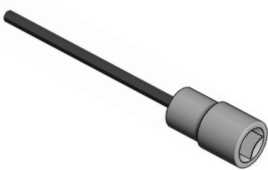
WARNING

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.

For more information on Swagelok process regulator maintenance kits, refer to the *Process Pressure Regulators* catalog, [MS-02-492](#).

Required Tools for Maintenance

Smooth-jawed vise		Calibrated torque wrench up to 288 ft·lb (390 N·m)	
24 mm socket		Lubricant (included in kit) WL-8 ^①	
35 mm socket			
5 mm hex drive		Liquid leak detector	
6 mm hex drive			
10 mm hex drive			
14 mm hex drive			

① Standard cleaned assemblies

Points of Attention Before Servicing In Situ or Removal from the System

- Swagelok recommends removing the regulator from the system for servicing and maintenance.
- The Ramp Regulator can be serviced in situ if securely mounted and has adequate clearance above & below.
- Follow all local system safety and maintenance procedures when removing the regulator.



WARNING

Before servicing/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.

Servicing in situ

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. (i.e. The adjustment knob is rotated clockwise enough to allow flow through the regulator.)



WARNING

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

3. To remove/replace the Cartridge use [MS-CRD-0298](#).
4. To service the Cartridge use [MS-CRD-0290](#).
5. To service the Ratio Dome go to Steps 2a through 2c.

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. (i.e. The adjustment knob is rotated clockwise enough to allow flow through the regulator.)



WARNING

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

3. Ensure any appropriate lifting equipment is available to enable the regulator to be supported and handled once disconnected from the system.
4. Ensure that any external dome feed is disconnected.
5. Disconnect and remove the regulator from the system.

Assembly Reference Data

Bill of Material		
Item	Component Name	Torque
1	Flange	—
2	Body	—
3	Plug	—
4	Retainer	390Nm
5	Piston	—
6	Dome Dish	—
7	Diaphragm Screw	—
8	Diaphragm Plate	—
9	Diaphragm	—
10	Dome Cap	—
11	Diaphragm Upper Plate	—
12	Diaphragm Nut	40Nm
13	Cap Screw (12 off)	10Nm
14	Dish Screw (8 off)	50Nm
15	Flange Screw (8 off)	110Nm
16	Plug Screw (2 off)	15Nm
17a	Upper Piston BR (yellow)	—
17b	Lower Piston BR (yellow)	—
17c	Lower Piston BR (black)	—
17d	Lower Piston seal	—
18a	Retainer BR (yellow)	—
18b	Retainer seal	—
19a	Plug Upper BR (yellow)	—
19b	Plug Upper Seal	—
19c	Plug Upper BR (yellow)	—
20a	Plug Lower Seal	—
20b	Plug Lower BR (yellow)	—
21	Seat	—
22	Seat Support	—
23	Poppet (Assembly)	—
23a	Poppet Spring	—
23b	Poppet Circlip	—
23c	Poppet BR (yellow)	—

Lubrication Chart		
Item	Name	Application
2	Body	WL8, Plug and Retainer ID, Light Covering
3	Plug	WL8, Plug OD and Thread, Light Covering
4	Retainer	WL8, Plug OD and Thread, Light Covering
5	Piston	WL8, Piston OD, Light Covering
7	Diaphragm Screw	WL8, Thread
13	Screw	WL8, Thread
14		
15		
16		
17	Seal	WL8, Seal, Light Covering
18		
19		
20		
21		
23	Poppet	WL8, OD Seal Groove, Light Covering

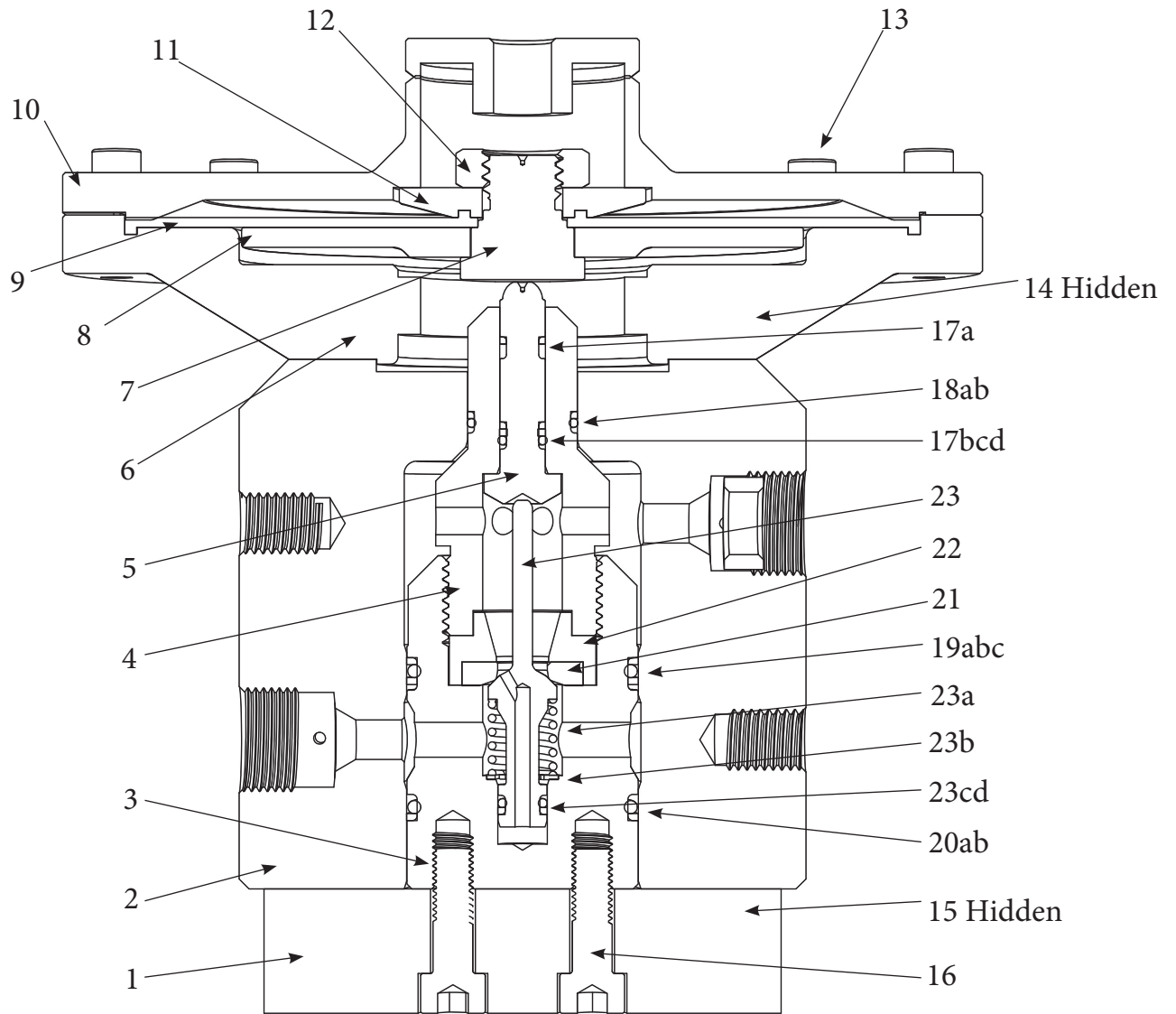


Figure 4

Assembly and Disassembly

- For the purposes of maintenance and repair the following instructions describe how to fully assemble a pressure reducing regulator. For disassembly follow the instructions in reverse order.
- Note that the components shown in this instruction manual may differ visually to those in the regulator.
- Note that not all components shown 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.

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 according to **Assembly Reference Data** table on page 11.



NOTICE

All threaded components must be lightly lubricated according to the Assembly Reference Data table on page 11 before reassembly to avoid galling of threads.

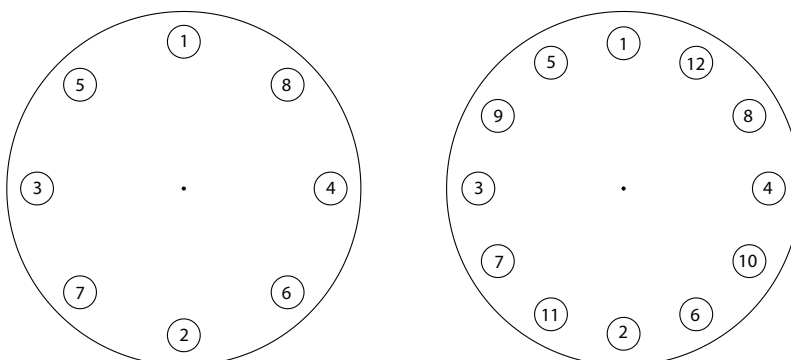
Instruction symbols

Lubricate component = 

Torque = 

WT = PTFE based grease, Swagelok WL-8 or comparable

Where multiple bolts require torquing, a crisscross sequence should be used as shown below.



Step 1: Assemble Poppet

See Figure 5.

Pressure reducing poppets are provided pre-assembled by the factory. This step can be skipped if fitting a pre-assembled poppet (23).

1. Slide the poppet spring (23a) over the poppet (23).
2. Compress the poppet spring (23s) and fit the poppet E-clip (23b) onto the poppet (23).
3. Fit the poppet O-ring (23c) and poppet back up ring (23d) onto the poppet (23). Ensure that they are ordered correctly.

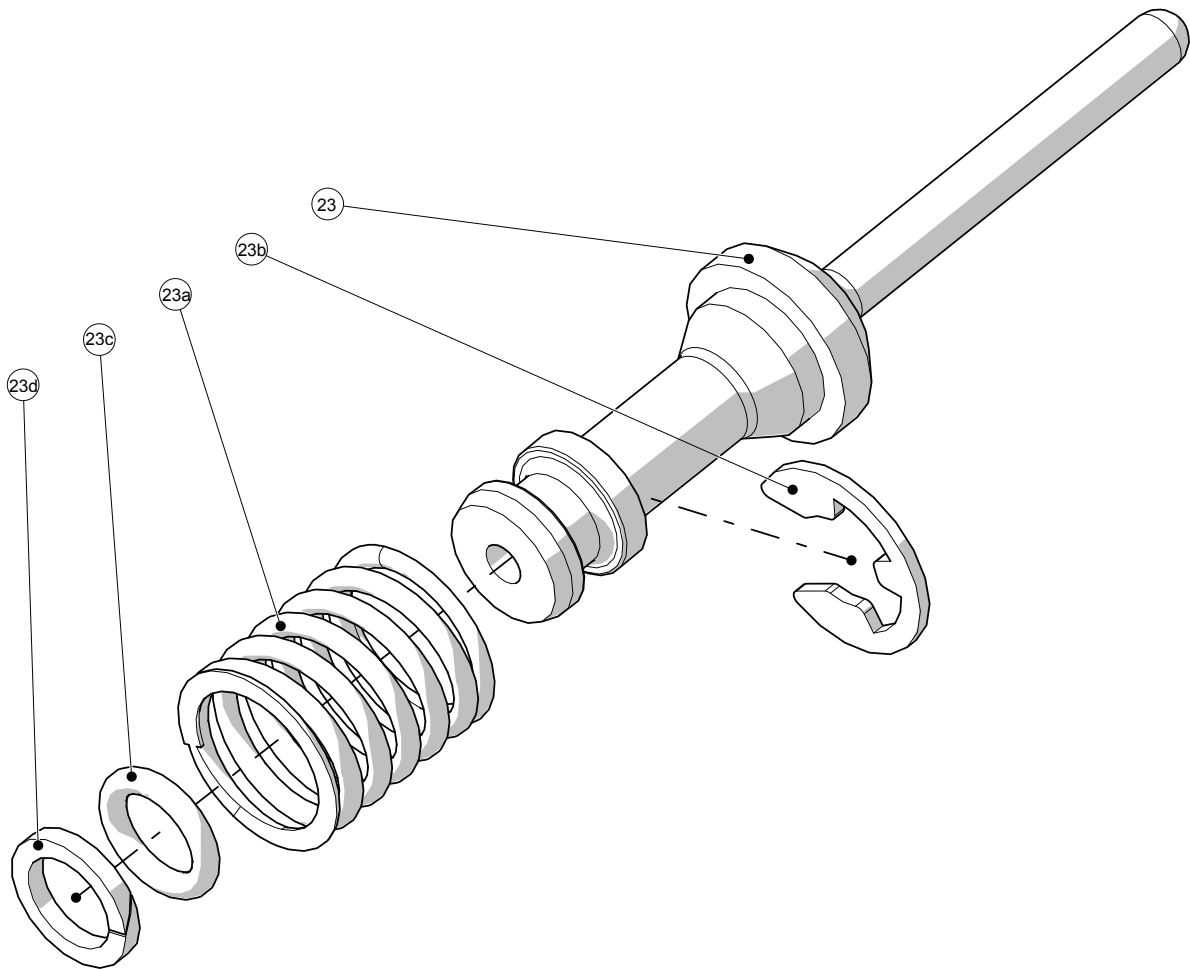


Figure 5

Step 2a: Assemble Ratio Dish

See Figure 6.

Image is representative. Depending on the regulator type, the number of plates may vary.

1. Fit the ratio dish (6) on top of the assembly.
2. Lightly lubricate the first three threads of each screw (14).
3. Fit all screws (14) into the body (2) and torque, using a crisscross sequence, according to the table below.
4. Assemble and fit the diaphragm assembly according to Step 2b on page 17.

Item	Component Name	Nominal torque by product size, ft·lb (N·m)
Tool	Hex drive	10 mm
46	Screws – cap	37 (50)

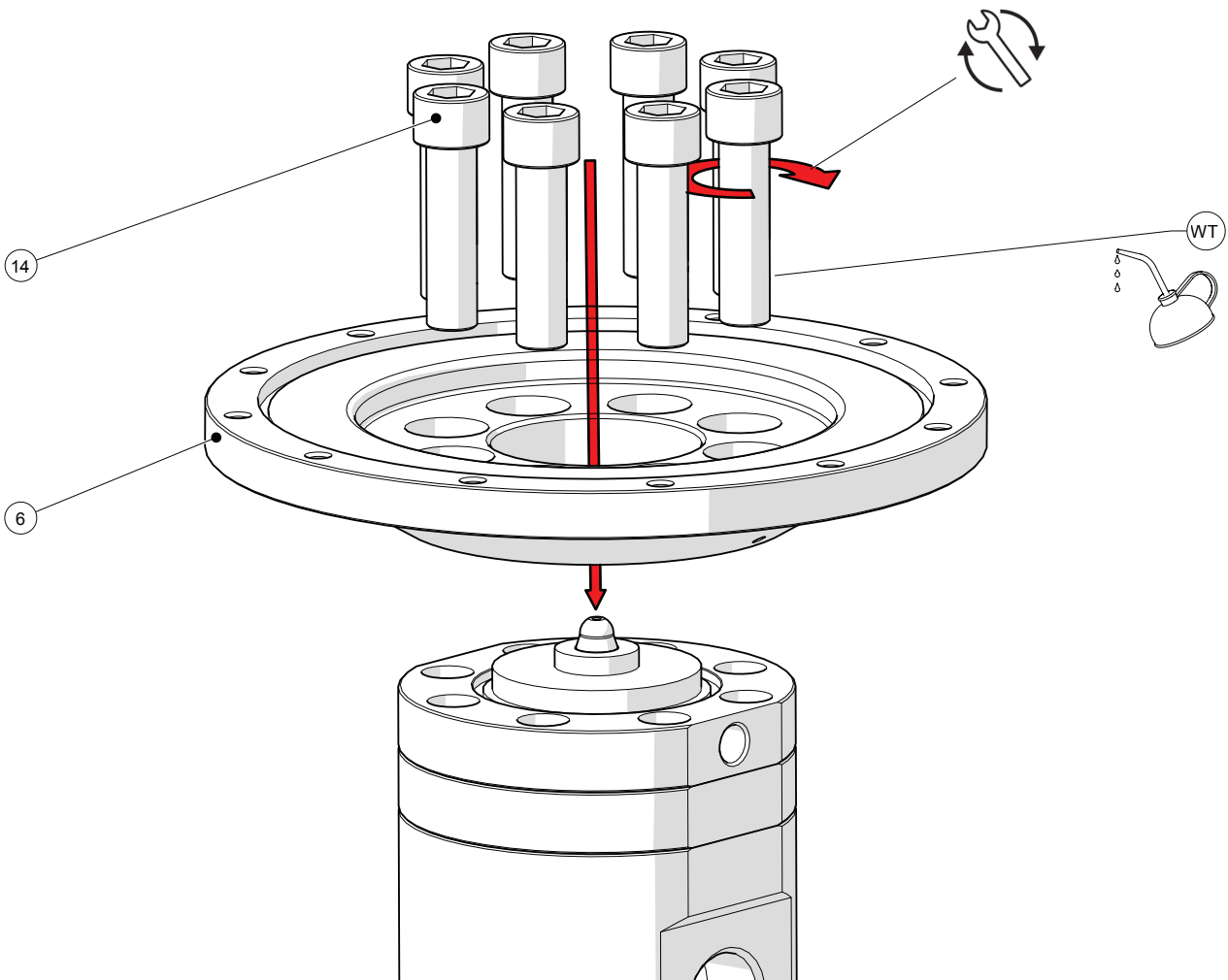


Figure 6

Step 2b: Assemble Ratio Dome Diaphragm

See Figure 7.

Image is representative, the size of the diaphragm and plates may vary.

1. Fit the lower diaphragm plate (8), diaphragm (8) then upper diaphragm plate (11) onto the diaphragm screw (7). Ensure that the diaphragm (9) fully seats into the upper diaphragm plate groove (11).
2. Lightly lubricate the threads of the diaphragm screw (7).
3. Screw on the diaphragm nut (12) and torque according to the table below.
4. Insert the diaphragm assembly into the Dome Dish (6), ensuring that the outside of the diaphragm (9) seats fully into the Dome Dish (6).

Item	Component Name	Nominal torque by product size, ft·lb (N·m)
Tool	Socket	24 mm
29	Diaphragm nut	30 (40)

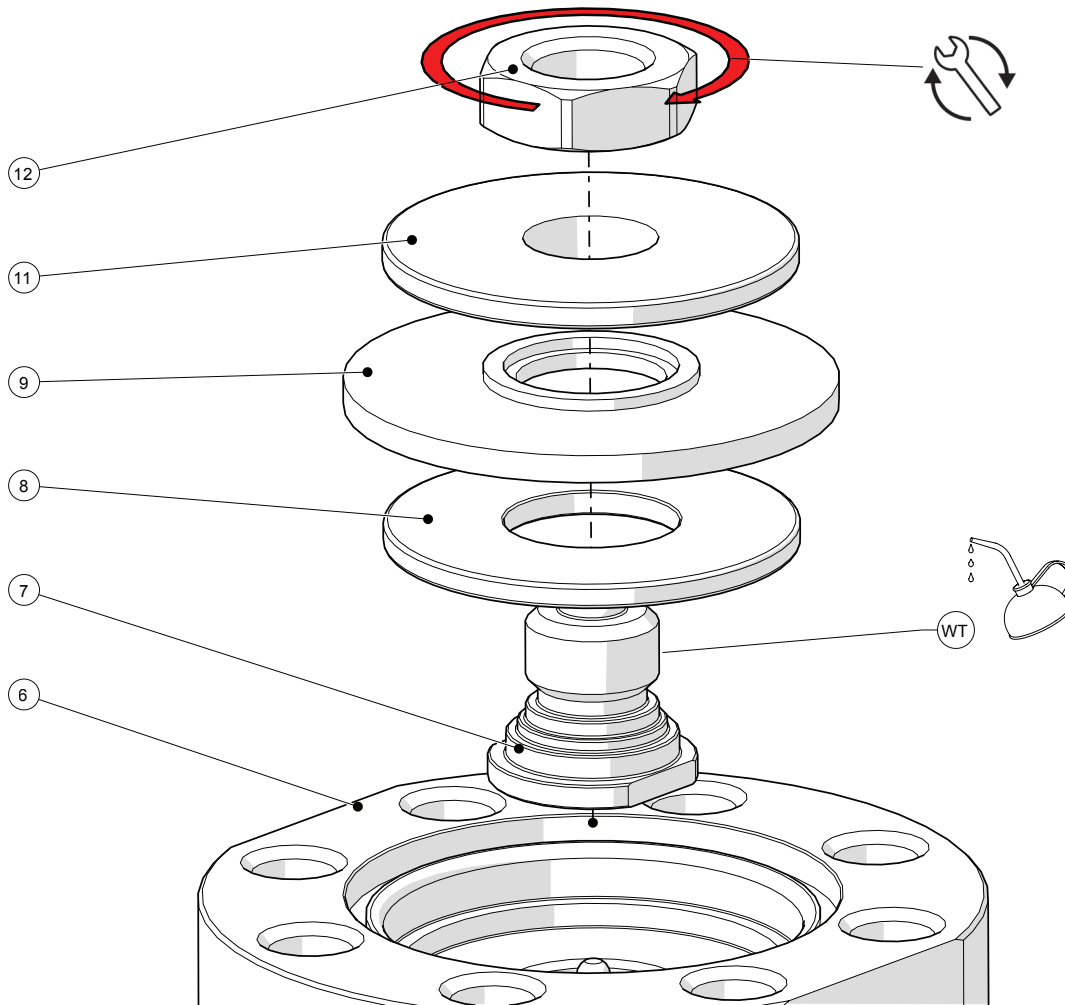


Figure 7

Step 2c: Assemble Ratio Dome Cap onto Body

See Figure 4.

1. Fit the Dome Cap (10) onto the Dome Dish aligning the weep hole if required.
2. Lightly lubricate the first three threads of each screw (13).
3. Fit all screws into the body and torque, using a criss cross sequence, according to the table below.

Item	Component Name	Nominal torque by product size, ft·lb (N·m)
Tool	Hex drive	5 mm
13	Screws - high sensitive cap	3.7 (5)

Step 3: Assemble SEPC

See Figure 8.

1. Install tube fitting (27) and fitting seal (28) into the auxiliary port according to the manufacturer's instructions.
2. Connect tube (37) following tube fitting manufacturer's instructions.

Item	Component Name	Nominal torque by product size, ft·lb (N·m)
Tool	Crows foot	1 1/16 in. (27 mm)
27	BSP fittings	26 (35)

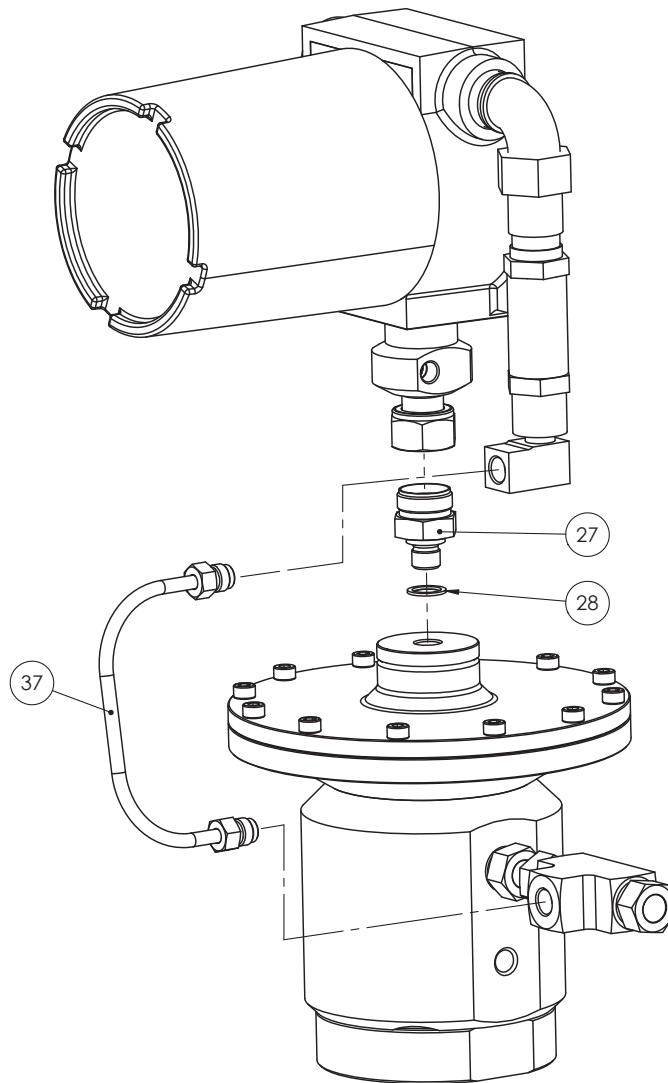


Figure 8

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 addressed. 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 handle is screwed fully counterclockwise or that there is zero pressure on 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 weep hole, vent plate weep hole and body plug to body interface according to figure 9, page 21.
4. Repeat the procedure with the highest inlet and outlet pressure applicable for the regulator and system.

Shell Leak Test Snoop® Locations

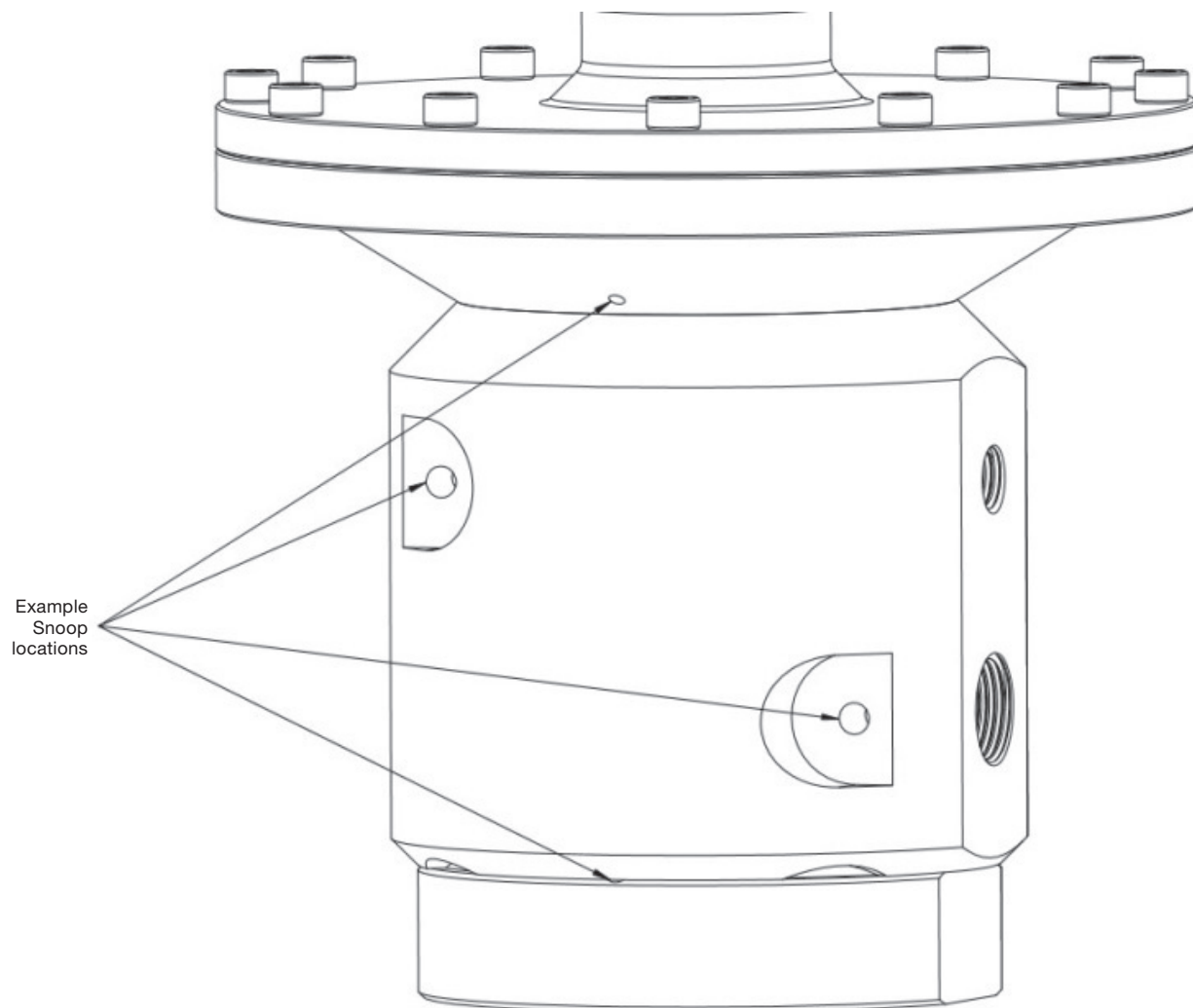


Figure 9

Troubleshooting

Symptom	Cause	Remedy
The outlet pressure creeps up, without adjusting the regulator.	A damaged poppet and/or seat.	Replace the poppet and/or seat.
Leakage around the lower flange.	A damaged O-ring.	Replace the O-ring.
Leakage at a weep hole.	A damaged diaphragm or O-ring.	Replace the diaphragm or O-ring.
	Insufficient torque on the cap screws.	Tighten the cap screws according to table on page 18 .
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 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 local authorized sales and service center.
The outlet pressure does not drop when the knob is adjusted counterclockwise or dome pressure is reduced	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 regulator.	Changes to the inlet pressure may result in changes to the outlet pressure.	Maintain a constant inlet pressure to the regulator. See <i>Points of Attention Before Operation</i> on page 6 about dependency .
	Changes to the flow may result in changes to the outlet pressure.	Maintain a constant flow through the regulator. See <i>Points of Attention Before Operation</i> on page 6 about droop .

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

Do not mix/interchange Swagelok products or components not governed by industrial design standards, including Swagelok tube fitting end connections, with those of other manufacturers.

Warranty Information

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

