MERCER VALVE CO., INC.®
"AUTO SEAT TECHNOLOGY"®

ENG-515000

9500 SERIES SNAP PILOT OPERATED PRESSURE RELIEF VALVE

INSTALLATION, OPERATION, & MAINTENANCE MANUAL

MERCER VALVE

Before installation of a Mercer Valve Co., Inc. Pressure Relief Valve, all sections of this document and all regulatory authority codes must be read and understood. Failure to do so voids all warranties.

REV	ECN	DATE
F	3159	10/7/21

Table of Contents

I. Scope

This document is used for the installation, operation, and maintenance of a Mercer Valve 9500 Series snap pilot operated pressure relief valve. This document should be read and understood before the valve is installed, put into service, or maintained. Failure to do so can result in improper operation that could result in damage to equipment or affect the safety of individuals around the equipment. The recommendations in this document should be used in conjunction with all regulatory bodies and all end-user company policies.

All safety precautions should be adhered to and all appropriate personal protective equipment should be utilized during all procedures indicated in this document. Pressure relief valves contain and relieve impressive amounts of energy and forces, so safety measures should be used to prevent injury to personnel. This document does not cover safety precautions or safety equipment to be used in the procedures.

Some additional information on installation, operation, and maintenance can be found in the following specifications. These specifications should be used in addition to this document but are not limited to this list:

American Petroleum Institute:
API 510 – Pressure Vessel Inspection Code
API RP 520 Parts I & II – Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries
API RP 521 – Guide for Pressure-Relieving and Depressuring Systems
API STD 526 – Flanged Steel Pressure Relief Valves
API STD 527 – Seat Tightness of Pressure Relief Valves
API RP 576 – Inspection of Pressure-Relieving Devices
API STD 598 – Valve Inspection and Testing

American Society of Mechanical Engineers:
ASME PTC 25 – Pressure Relief Devices
ASME Boiler and Pressure Vessel Code Section VIII, Division I – Unfired Pressure Vessels
ASME Boiler and Pressure Vessel Code Section XIII – Rules for Overpressure Protection
ASME B16.5 – Pipe Flanges and Flanged Fittings

National Board of Boiler Inspectors:
NB-18 – Pressure Relief Valve Certifications
NB-23 – National Board Inspection Code

II. Definitions

Accumulation is the amount of pressure increase above the MAWP of the system that is allowed. Accumulation is set from the applicable codes.

Backpressure is the amount of pressure on the outlet side of the pressure relief valve. This is pressure downstream of the nozzle of the pressure relief valve. It is a combination of superimposed and built-up backpressures.

Blowdown is the reclosing point of the pressure relief valve. It can be expressed as a pressure but is most commonly expressed as a percentage of the set pressure.

Built-up Backpressure is pressure on the outlet of the pressure relief valve that is caused by the flow of the pressure relief valve. Piping size, length of outlet pipe, fittings, or other flow friction producing items all affect the built-up backpressure.

Capacity is the flow rate as required by the applicable code.

Cold Differential Test Pressure (CDTP) is the pressure at which the pressure relief valve is adjusted to open on the test stand. The CDTP includes corrections for the service conditions of backpressure and/ or temperature.

Conventional Pressure Relief Valve is a direct spring operated valve where the spring tension is used to hold the disk closed. The operational characteristics of the valve are directly affected by changes in the backpressure. These characteristics include opening pressure, closing pressure, relieving capacity, and valve function. This is also referred to as a spring operated pressure relief valve (SOPRV).

Inlet Size is the nominal pipe size (NPS) of the inlet of the pressure relief valve.

Leak Test Pressure is the pressure below the set pressure that the leak test is to be performed. This pressure is often calculated as a percentage of the set pressure.

Lift is the amount of travel of the disk from the fully closed to the fully open position when the valve is relieving.

Maximum Allowable Working Pressure (MAWP) is the pressure rating the system can withstand at a specific temperature. The MAWP is often used as the setting of the pressure relief valve.

Modulating Pilot is a gradual open pilot operated valve. The valve opens in response to the overpressure. The pilot will slowly drain the dome pressure to allow the main valve to open. On reclose, the dome pressure is slowly refilled to close the main valve piston.

Outlet Size is the nominal pipe size (NPS) of the outlet of the pressure relief valve.

Overpressure is the amount of pressure increase above the set pressure allowed for the pressure relief valve to achieve full lift and full flow. Set pressure plus overpressure should never exceed MAWP plus accumulation, but they will often be equal.

Pilot Operated Pressure Relief Valve (POPRV) is a pressure relief valve with two parts, a main valve and a pilot valve. The pilot valve controls the operation of the main valve. This is achieved by the pilot controlling the pressure in the dome area above the main valve piston. Backpressure does not affect the set pressure of a pilot operated valve.

Pressure Relief Valve (PRV) is a pressure relief device designed to open and relieve excess pressure and to reclose and prevent the further flow of fluid after normal conditions have been restored.

Set Pressure is the pressure on the inlet of the pressure relief valve that the valve is set to open. Each pressure relief valve manufacturer will define this setting based on how their valve is to act. Set pressure definitions for each manufacturer’s series can be found in NB-18.

Simmer or Warn is the audible or visual release of test fluid from between the disk and seat prior to the opening of the valve. This is caused by the force holding the disk closed and the inlet pressure force equalizing just before the valve begins to open at the set pressure.

Snap Pilot is a fast action pilot operated valve. The valve is either fully open or fully closed; it “snaps” open at set pressure and “snaps” closed on reseat. The snap pilot achieves this by fully venting the dome pressure at set point and fully refilling the dome pressure at reclose.

Superimposed Backpressure is the pressure on the outlet of the pressure relief valve that is caused by a closed discharge system. This type of backpressure is present before the valve begins to open. It can be constant or variable. Superimposed backpressure can affect the set pressure of a conventional spring operated PRV.

VR is an accreditation the National Board offers to organizations/ facilities that have been shown to independently operate and repair pressure relief valves sufficiently within codes and regulations.

III. Handling and Shipping

Mercer Valve produces a very durable pressure relief valve. Even though these valves are able to take some abuse, it is recommended that they are handled and shipped with care. This will help prevent damage prior to their installation. These PRVs are safety devices and are the last line of defense when a system overpressures. An impaired PRV could leave the system unprotected.

A PRV should be carried by a structural part, such as the body, flange, or eye bolts. If the valve is dropped, it should be checked to assure it is still functioning properly. Any damage to the connections (flanges, threads, etc.), such as denting and scratching, may cause a leak or inhibit proper installation. All precautions should be taken to ensure no valve damage occurs.

During shipping, all open ports of the PRV should be sealed to prevent the ingress of dirt and moisture. Proper precautions to prevent rust should be taken. All flanges and threads should be covered with protectors to prevent damage. The valve should be sealed in a plastic bag.

The valve may be placed in a shipping container upright or on its side, however, it should be packed so that it cannot move within. Upright shipment is preferred, especially for larger valves. Movement can cause the valve to become damaged during the shipping process. The proper shipping container should be chosen for the size and weight of the valve. After being packaged, the shipping container should be handled with care.

IV. Unpacking and Storing

A PRV should be installed immediately after being removed from the storage/ shipping box when possible. When the valve cannot immediately be installed, certain storage precautions should be taken to keep it functioning properly until it is installed. Following these recommendations will encourage proper function of the valve prior to installation. These recommendations only apply to Mercer Valve manufactured pressure relief valves. Other valve brands can have different requirements and their manufacturer should be contacted for information.

The PRV should be stored in a dry, indoor environment at temperatures between 50ºF (10ºC) and 90ºF (32ºC). The inlet and outlet of the valves should be protected from any possible damage. Threaded valves should have thread protectors installed. Flanged connections should be covered to protect their raised faces from scratches and dents. The protectors should also seal the openings so that foreign materials cannot ingress.

PRVs are usually stored vertically to keep parts aligned, however, this isn't required for Mercer's PRVs. Although vertical storage can help with initial startup in certain circumstances, these valves may be stored horizontally. If stored horizontally, it should be verified that the disk is down and sealed before installation.

Before installing a valve that has been stored, it should be visually inspected for any damage. It is recommended to test the valve before installation if it has been stored for more than one (1) year.

V. Installation

Proper installation of a PRV is mandatory to ensure safe and accurate operation. Incorrect installation can cause failures that result in damage or destruction to the equipment and also possible injuries or even death to anyone around the equipment.

Before installation, the valve should be visually inspected for any damage that occurred during shipping and storage. If any damage is found, do not install and immediately contact Mercer Valve.

Always remove all thread and flange protectors from the inlet and outlet before installing. These protectors can stop pressure from entering or exiting the PRV and this may result in malfunction. Make sure that a test gag is not engaged when the valve is in operation. Test gags are only used in controlled overpressures situations, such as hydrostatic testing of the system.

The set pressure should be tested before installation if the valve has been shipped great distances or has been in long term storage. This verification helps to confirm proper valve function and correct settings.

It is also important to check that the backpressure and temperature of the application are within the valve's ratings and limitations. There are two types of backpressure: superimposed and built-up. Each type of backpressure affects the valve differently. Superimposed backpressure can come in two forms, constant and variable. The correct form of backpressure must be considered during the sizing and selection of the valve. If the wrong type of backpressure is assumed, the valve may not operate properly.

The PRV's seat and o-rings have pressure-temperature limitations. Using these materials outside their limitations will cause issues. Contact Mercer Valve to find the limitations of the valve. Compatibility, in terms of reactivity and corrosion, between the system media and the materials used within the valve must be considered. Appropriate material selection is the responsibility of the end user/ purchaser of the valve.

The nameplate information should be verified for the service conditions of the application before the valve is installed. The fluid state, capacity, service temperature, set pressure, and backpressure can all be found on the PRV's nameplate, which is also called the tag. If the information indicates improper settings or the wrong service conditions, the valve should not be installed. The service temperature listed is not the temperature limit. It is important that the set pressure is examined against the system's MAWP. It should also be noted that the capacity on the tag is not specific to the application. A gas valve will have a tag capacity in SCFM (Nm^3/hr) of air at 60ºF (16ºC) and standard atmospheric conditions.

The PRV should be oriented in a vertical position with its inlet pointing downwards and its outlet pointing in a horizontal direction. Mercer Valve must be contacted to ensure proper operation if the valve cannot be installed in this orientation.

Use a suitable sealing mechanism (PTFE pipe tape, gasket, etc.) when installing a PRV on a system. Do not put a wrench on the PRV's body or bonnet during installation. Flanged valves require the correct amount, type, and size of bolts and the correct type of gasket to be used. Flange information can be found in ASME B16.5.

One common cause of early PRV failure is debris trapped on the valve's seat, resulting in a leak. Weld slag and pipe tape are among the more common items that cause this. It is recommended that all piping and tank systems are cleaned prior to the initial installation of the PRV.

A pressure relief valve should be attached to the system with the shortest amount of piping possible. All piping leading to the PRV must be equal to or larger than the PRV's inlet pipe size; it must **never be smaller**. Any restriction within the inlet lines can cause valve chatter, which can result in serious damage to the valve. It is recommended that any pressure drop created from inlet piping is less than 3% of the set pressure. Piping restrictions can also reduce the relief capacity of the valve, which can leave the system under protected.

Outlet piping from the pressure relief valve should be a minimum length to keep built-up backpressure low. It is recommended that the built-up backpressure be kept below 30% for POPRVs for robust functionality. It is recommended that the outlet piping be less than 4 ft (1.2 m) in length. All outlet piping after the PRV must be equal to or larger than the PRV's outlet pipe size; it must **never be smaller**. Increasing the outlet piping size can help reduce the backpressure on the valve.

PRVs must be braced and supported for reaction forces, vibrations, weight, and other external forces applied during operation. These and all other loads must be considered when installing the valve and adding bracing.

See Figure 1 for an example installation of a pressure relief valve.

Excessive vibrations can cause a PRV to open below its intended set pressure. Vibrations apply acceleration to the internal movable parts and create an upward force. When this force is added to the force balance within the valve, the required pressure to open the valve is lowered. When the operating pressure is close to the set pressure and vibrations exist, premature relieving can occur.

In pilot operated pressure relief valves, the pilot valve may be removed from the main valve and remote mounted to prevent the pilot from being subjected to the vibrations. Since the pilot controls when the main valve operates, the main valve will not prematurely open due to these vibrations. Additionally, vibrations may produce stresses on sensing lines and brackets, which can cause cracking within components and could lead to failure of the PRV.

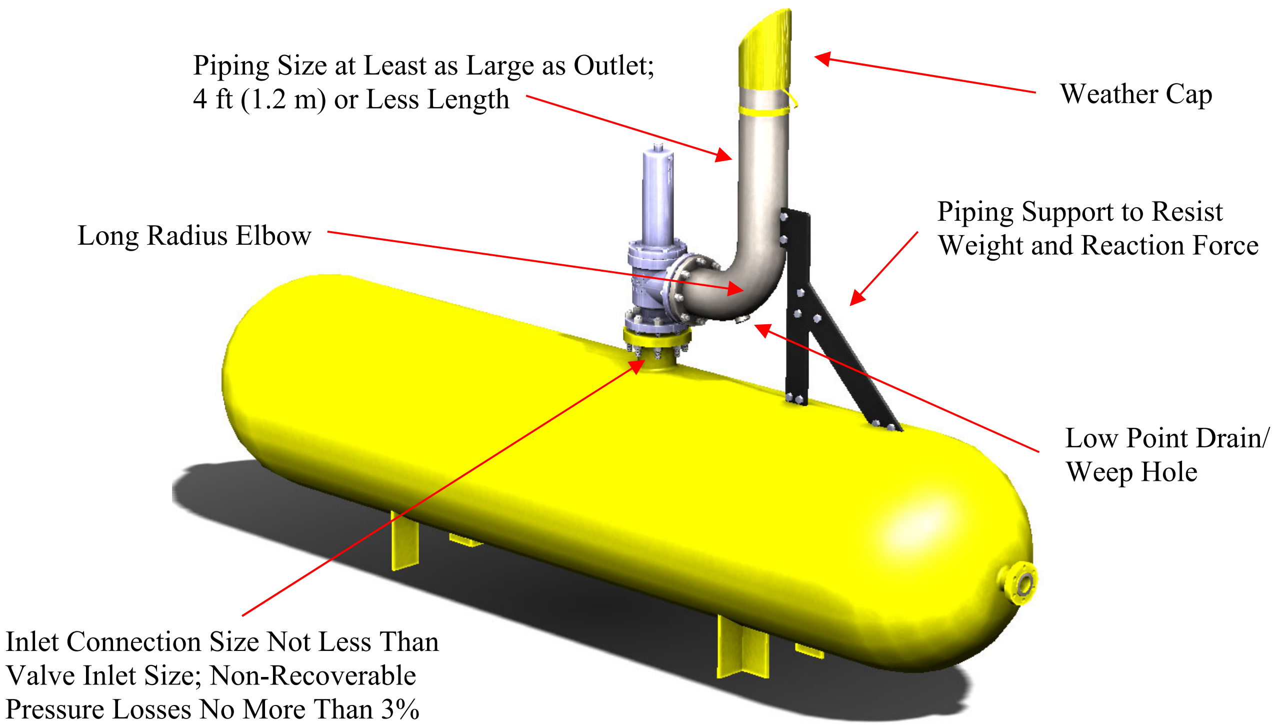


Figure 1: Typical Recommended Installation of a PRV

Discharge lines should be weather capped and provided with a drain hole to prevent liquid from collecting. It should be noted that snap pilots are not liquid certified and should never be used in any service where liquids are present and could enter the pilot. If these precautions are not taken, the valve may not be able to adequately protect the system.

POPRVs are especially susceptible to freezing temperatures and special consideration should be taken during the installation. A pilot valve has several tubing runs along the exterior of the main valve. Since these lines are directly exposed to the cold outside conditions, there is a possibility that the media passing inside of them will freeze and block the pressure. Insulation or other means need to be carried out to prevent freezing of the lines in order to maintain proper operation of the valve.

DO NOT BREAK THE SEAL WIRE. Breaking the seal wire invalidates the manufacturer's warranty to repair or replace the valve. If resetting is required in a field emergency situation, qualified personnel with calibrated instrumentation should perform it. A PRV with a broken seal wire is not considered to be an ASME coded valve until it has been repaired by a VR Certified repair shop.

Important installation information is contained in the ASME Boiler and Pressure Vessel Code and API RP 520 Part II. Other standards and codes may be applicable depending on the jurisdiction and area of use.

a) Remote Sensing Pilot Valve

At times, the pressure at the main valve inlet of a pilot operated valve may be a false pressure reading caused from pressure spikes or large pressure losses in the inlet piping. These variations from actual system pressure can affect the operation of the valve. They may cause premature valve pressure releases, rapid cycling, or chatter.

Remote sensing a pilot operated valve is when the sensing line for the pilot is removed from the main valve's inlet and is instead plumbed to somewhere else on the system. This allows the pilot to see a stable system pressure, which may not be present at the main valve's inlet. This will enable a consistent pressure reading and improve the operation of the valve.

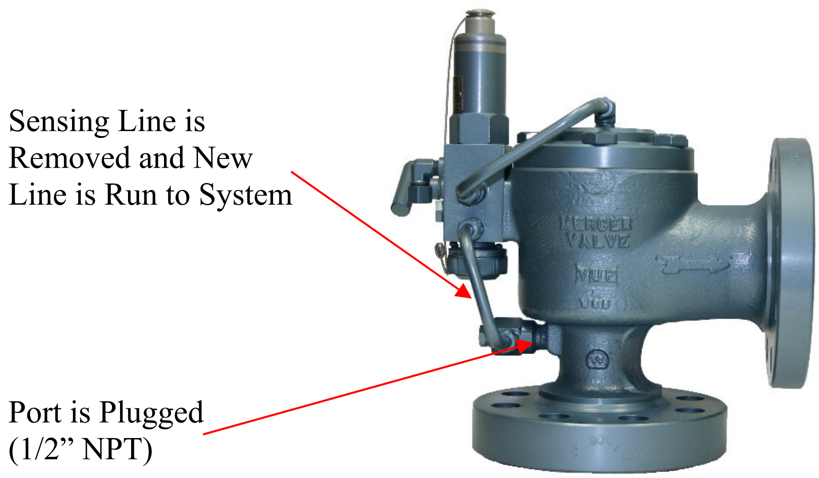


Figure 2: Direct Sensed POPRV

To remote sense a pilot valve, the sensing line and pressure probe assembly are removed from the inlet of the main valve and the port on the main valve is plugged. A location on the system is chosen for the pilot pressure to be sensed. This location will be somewhere the pressure is going to be more consistent and not affected by flow conditions. This location should never be able to be isolated from the pressure source that the main valve is connected to. This ensures that the pilot can also sense any pressure increase under the main valve. Often, the remote sense location is a larger volume piping where the pressure does not fluctuate as significantly. It could also be run to a section of piping where the inlet pressure losses are not as significant.

After the location is selected, a new inlet pressure line is run from the pilot valve back to the new sensing location. This line should never have a smaller ID than originally used on the valve. Mercer Valve uses 3/8" stainless steel seamless tubing for the sensing lines on the pilot operated valves. For straight runs, the remote sensing line can be 3/8" tubing up to 10 ft (3 m) distances. For distances further than 10 ft (3 m) but less than 25 ft (7 m), the tubing size should be increased to 1/2" stainless steel seamless tubing. Use Table 1 to pick tubing thickness for the appropriate inlet flange rating. Using the proper tubing size and wall thickness will reduce the probability of a delayed signal to the pilot valve.

Table 1: Sensing Line Tube Size

Inlet Flange Rating	Tube Size: 3/8" Tubing	Tube Size: 1/2" Tubing
150#, 300#, 600#, & 900#	0.035 in Wall Thickness	0.049in Wall Thickness
1500#	0.049 in Wall Thickness	0.065in Wall Thickness
2500#	0.049 in Wall Thickness	0.083in Wall Thickness

With a proper setup, remote sensing will help with valve operation by allowing the pilot valve to see a more accurate system pressure. When remote sensing a pilot operated valve, all precautions need to be taken to ensure the proper operation of the pilot operated valve. Mercer Valve accepts no responsibility for the modifications made to the original valve.

b) Remote Mounting Pilot Valve

Excessive vibrations can cause a pressure relief valve to open below the set pressure of the valve. The vibration applies acceleration to the moving parts in the valve that create an upward force. When this force is added to the force balance in the valve, the required pressure to open the valve is lowered. The vibration is offsetting part of the spring force.

This especially becomes a problem the closer the operating pressure is to the set pressure. When the operating pressure is close to the set pressure, any reduction in the closing force brings the valve that much closer to reaching the pressure it needs to open.

In pilot operated pressure relief valves, the pilot can be removed from the main valve and remote mounted to stop the pilot from being subjected to the vibrations. Since the pilot controls when the main valve operates, when the pilot is not affected by the vibrations, the main valve does not prematurely open due to these vibrations.

There are several precautions that must be taken when remote mounting a pilot. If these precautions are not taken, improper operation of the valve can occur and the system may not be properly protected in an overpressure situation. Review the following:

1. All work should be performed when the valve/ system is not pressurized.
2. The pilot should be moved to a location that does not experience the vibrations that would exist if installed directly on the main valve. This can be accomplished by installing the pilot on a pole in the ground or attaching it to a rigid structural member of a building or piece of equipment. It is recommended that any accessories equipped be included with the remote mounting of the pilot valve.
   a) If there is an auxiliary filter or pressure snubber attached to the main valve, the sensing line will go to the option prior to it going to the pilot valve. In order, it would be plumbed as

follows: the sensing line to the auxiliary filter, then to the pressure snubber, then to the pilot valve, and then to the backflow preventer.

3. The pilot must be installed using the same type of mounting as is used to attach the pilot to the main valve. This includes the original orientation and mounting holes of the pilot valve. No modifications to the pilot shall occur.
4. New sensing tubing lines have to be run from the main valve inlet to the pilot and also from the pilot to the main valve dome. The proper size and pressure rating for the tubing must be used. When selecting the tubing size, the distance from the pilot to the main valve must be considered. Ideally, the tubing line should be sized so that there is no pressure loss across each tubing line during valve operations. The tubing lines should also not cause any change in the operation of the pressure relieve valve. This may mean using larger tubing than what was originally installed. Review the following recommendations:
   a) 3/8” tubing may be used when the pilot is mounted 10 ft (3 m) or less away from the main valve. Larger tubing should be considered otherwise. See Table 1 for proper tubing thickness.
   b) Flexible lines may be used to help reduce vibration induced stresses.
   c) Routing should be done in a safe manner to prevent accidental damage/ kinking to the sensing lines.
   d) Direct and simple routing should be done to prevent losses/ restrictions in the sensing lines. The shortest length possible is recommended.
   e) Lines should be free draining (no pockets) whenever possible.
   f) Temperature considerations should be made in order to prevent freezing of the lines.
5. Sensing tubing lines should be routed to ensure that the vibration does not cause breaks in the line due to fatigue or other stresses. With the pilot not vibrating at the same frequency and amplitude as the main valve body, the motion in the tubing lines will be inherent. It is important to make sure that the sensing lines are flexible enough to reduce these stresses.
6. The sensing lines need to be routed to the proper ports on the pilot and main valve. The valve will not be able to properly function otherwise, which will leave the system unprotected.
7. This work should only be done by competent individuals that have been trained and have experience with pressure relief valves.
8. After all installation and work has been performed, the valve should be tested for functionality, set pressure checked, and observed for any potential leaks.

VI. Operation

The Mercer Valve 9500 Series snap pilot operated pressure relief valve is designed and tested in accordance with ASME Boiler and Pressure Vessel Code for UV stamped pressure relief valves in gas/ vapor applications. This valve series has a set pressure definition for gas/ vapor valves of a “pop”. When the valve reaches set pressure, the disk will pop open, creating a “POP” sound. Before reaching set pressure, the valve may experience a small "warn”. This warn is not considered set pressure. At set pressure, the valve will open to full lift.

The 9500 Series snap pilot is a pilot operated PRV. The pilot controls the pressure above the main valve piston. This area, which is referred to as the dome area, is larger than the seating area in the main valve. This larger area allows for a tight seal of the main valve seat. The pilot pressurizes the dome area to hold the main valve closed and relieves the dome pressure to allow the main valve to open.

In a snap pilot, the pilot completely vents the dome pressure at set pressure. This allows the main valve to open completely, snapping open to full lift. On reclose, the snap pilot completely fills the dome area with pressure, allowing the main valve piston to snap closed again.

The pilot controls the operation of the main valve by filling and venting the main valve dome. This is achieved by opening and closing 2 seats in the snap pilot. While the system pressure is below set pressure, the lower seat is open and the upper seat is closed. When the lower seat is open, pressure from the main valve goes through the snap pilot, past the lower seat, and into the main valve dome. While the lower seat is open, the upper seat is being held closed by the snap pilot spring. With the upper seat closed, dome pressure is unable to vent.

When the valve reaches set pressure, the force on the upper seat exceeds the spring force that is holding it closed. This pushes the upper disk open, allowing the dome pressure to vent out. When the upper disk lifts, it allows the lower seat to close. This shuts off the pressure coming from the inlet of the main valve, stopping the continuous flow to the dome. With the vent open to the dome, all of the dome pressure is vented out, which allows the main valve piston to rise.

On reclose, the system pressure has dropped to the blowdown point of the valve. This lower pressure allows the lower seat to reopen and the upper seat to reclose. The dome pressure is then refilled, pushing the main valve piston closed. See Figure 3.

The PRV’s orifice should be sized so its capacity rating at the allowable overpressure exceeds the maximum flow capacity the system will produce. Sizing information can be found in the ASME Boiler and Pressure Vessel Code and API RP 520 Part I. Additional requirements by local authorities also need to be considered.

Since the PRV’s flow capacity will exceed the required capacity of the system, the system pressure will drop. The valve will reclose when the inlet pressure has dropped enough to allow the spring force to reclose the pilot valve. The disk of the main valve will then reseal against the seat and the relief valve will be ready for the next overpressure scenario.

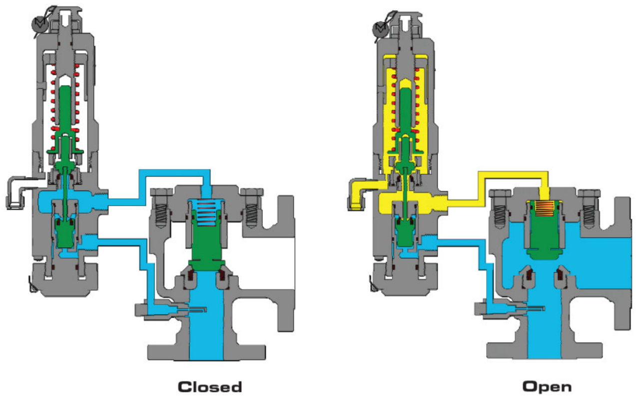


Figure 3: Operation of Snap Pilot Diagram

Best performance is usually obtained on a system where the operating pressure is at least 5% less than the valve's set pressure. Performance improves with a greater margin between operating and set pressure. A target margin of 7% below set pressure is more desirable. A larger margin helps with the reclosing of the PRV and reduces the chance of inadvertent opening from system characteristics such as pressure pulses, vibration, temperature, etc.

It should be noted that operating at extremely low pressures may make it more difficult for the main valve to get a good seal. This is because the system pressure is directed into the dome area above the seating area. The system pressure is used to get a good seal. So, if there is minimal operating pressure, the seal will not be as tight and leakage can occur. ASME's Boiler and Pressure Vessel Code and API's standards require that the set pressure does not exceed the MAWP of the system.

In addition to checking the set pressure versus the maximum allowable working pressure of the system, also check to ensure that backpressure and temperature limitations of the process are consistent with valve ratings. The fluid state, capacity, temperature, set pressure, and backpressure can all be found on the tag of the valve. Pressures and temperatures outside the normal ranges require special materials. Media considerations relative to corrosion or chemical reactions also need to be examined to ensure suitability of the valve in its service.

VII. Pilot Operated Valve Options

Pilot operated safety relief valves may be equipped with several options to enable serviceability or to ensure satisfactory operation. Listed are some of the common components which a pilot operated valve may be equipped with. Some equipment combinations of these components may not be available for some valves due to dimensional and suitability limitations.

a) Field Test Connection

A field test connection (FTC) makes in situ testing easier since the technician does not have to disassemble the pressure sense line to test the pilot. The technician can simply attach a controlled pressure supply to the field test connection to test the set pressure of the valve. This can make regular service on the pilot valve more expedient.

The field test connection operates the pilot and vents the dome. If there is any pressure in the system, the main valve will also open unless the inlet is blocked in. Highlighted in red in Figure 4 is a typical field test connection on a snap pilot.

There is an offshore field test connection option, which allows the user to pressurize both the pilot valve and the main valve. This type of option can be used to open the main valve along with actuating the pilot valve.

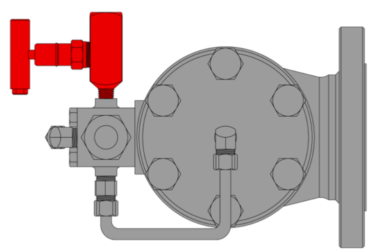


Figure 4: Field Test Connection on a Snap Pilot Operated Valve

b) Backflow Preventer

A backflow preventer (BFP) can be installed on a pilot valve in situations where the superimposed backpressure exceeds the system operating pressure. With this component equipped, the relief valve uses either the backpressure or the system pressure to hold the valve shut. It acts like a comparative switch, utilizing whichever pressure is greater to fill the dome and hold the valve shut. Highlighted in yellow and green in Figure 5 is a typical backflow preventer on a snap pilot.

A backflow preventer is intended to combat superimposed backpressure only; it will not do anything for built-up backpressure. It should also be noted that total backpressure should not exceed 30% of the set pressure when a backflow preventer is installed. Too much backpressure could affect the operation of the BFP and valve.

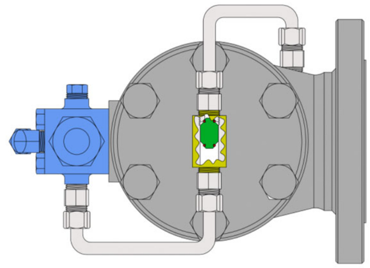


Figure 5: Backflow Preventer on a Snap Pilot Operated Valve

c) Pressure Snubber

A pressure snubber (PS) is a component that can be installed on a snap pilot operated valve where pressure spikes/ pulses exist in the system. The pressure snubber acts like a dampener on pressure pulses and evens out the pressure spikes. This component can prevent a pilot operated valve from prematurely relieving. A PS requires regular maintenance based on service conditions. Highlighted in yellow and dark blue in Figure 6 is a typical pressure snubber on a snap pilot.

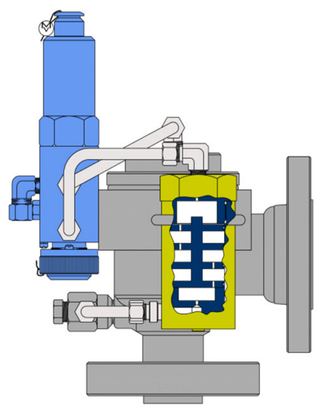


Figure 6: Pressure Snubber on a Snap Pilot Operated Valve

d) Auxiliary Inlet Supply Filter

An auxiliary inlet supply filter may be installed on a pilot operated valve to prevent debris from entering the pilot valve. This may be necessary for dirtier services. Since snap pilots are not liquid certified, the auxiliary filter should never be used to filter liquids. Since there are small ports and tight passageways between the internal components of the pilot valve, dirt and debris may clog ports and galleries within the pilot valve.

Though Mercer Valve's pilot operated valves have smaller filters that come standard on all pilot assemblies, an auxiliary inlet supply filter, which is much larger, can provide additional filtering to improve functionality and prolong the life of the pilot valve. An auxiliary filter requires regular maintenance based on service conditions. Highlighted in yellow in Figure 7 is a typical auxiliary inlet supply filter on a snap pilot.

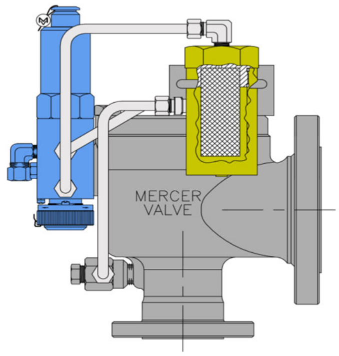


Figure 7: Auxiliary Inlet Supply Filter on a Snap Pilot Operated Valve

e) Remote and Manual Blowdown

Remote and manual blowdown is a component that can be equipped on a pilot operated valve to empty the dome pressure and open the main valve without reaching set pressure. This is used to easily and quickly empty or reduce the pressure of a system. The dome pressure is vented to the outlet of the valve.

The manual blowdown uses a ball valve to vent the dome pressure, whereas the remote blowdown uses a pneumatic or electric actuator that can be remotely activated to vent the dome pressure. Highlighted in red in Figure 8 is a manual blowdown option on a snap pilot.

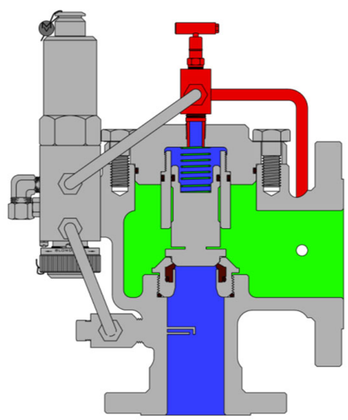


Figure 8: Manual Blowdown on a Snap Pilot Operated Valve

VIII. Maintenance

For dependable performance, PRVs must be maintained regularly. **Mercer Valve recommends its PRVs are inspected and tested annually**. After the valve has been installed and a service history has been established, the testing and inspection frequency may be adjusted. Some guidelines for testing frequencies can be found in NB-23, API 576, and API 598. Additionally, government jurisdiction should be reviewed.

When maintenance is performed, only qualified repair personnel should complete it. Qualified repair personnel conducting the annual inspection and testing may alter the maintenance schedule based on the service conditions.

Before performing maintenance, it should be ensured there is no pressure within the main valve or pilot valve. During the inspection, a visual inspection, set pressure verification, and leak check should be completed. These tests can be performed while the PRV is installed on its system or when it is on a testing bench. The PRV can only be tested while on its application if there is a method and procedure to apply a controlled pressure to the PRV's inlet without exceeding any limits of the system.

A visual inspection is used to identify if the PRV is installed properly, is correct for the application, and doesn't have any apparent problems. Check the nameplate information to verify that the valve is installed on the proper service. A missing nameplate requires immediate addressing. If the valve is installed on gas/ vapor service, the nameplate's capacity will indicate an air capacity in SCFM (Nm^3/hr) at 60ºF (16ºC) and standard atmospheric conditions.

Check the seal wire. A broken seal wire indicates that an unqualified person may have adjusted the set pressure; this also voids any warranty the valve may have had. The valve should be inspected for damages. If there is damage to the valve, it may not operate properly.

Look for potential issues that would keep the valve from opening or would inhibit flow. Rust or dirt accumulation, insect or animal nests, and pooled water are just some of the things that can restrict the flow or stop the valve from opening. If any problems are found during the visual inspection, the valve must be repaired by a qualified person or replaced with an equal.

When verifying the set pressure, the appropriate fluid should be used. Gas/ vapor PRVs should only be tested with a gas, usually air or nitrogen. Testing a pressure relief valve with the incorrect fluid will likely cause inaccurate readings.

The set pressure of UV stamped pressure relief valves, in accordance with the ASME Boiler and Pressure Vessel Code, has a tolerance of ±3% of the specified set pressure or ±2 psi (±15 kPa), whichever is greater. If the examined set pressure is not within this tolerance, the PRV should be reset or possibly repaired by qualified repair personnel. A PRV's set pressure definition will depend upon its manufacturer and will be listed in NB-18 if it is ASME certified. NB-18 can be found at http://www.nationalboard.org/.

After the set pressure has been verified, the valve is leak checked for any leaks coming from its seat. Leak checks are usually performed at 90% of the set pressure or 5 psi (34.5 kPa) below set pressure, whichever is greater. The valve must be actuated and reseated to perform this test. The pressure is then brought up to and held at the leak check pressure. If the valve does not pass a leak check, it will need to be repaired by a qualified person or replaced with an equal.

For POPRVs, a common maintenance routine includes inspecting all the filters within the pilot and draining the auxiliary filter and pressure snubber accessories, if equipped. This action will help reduce the tendency for the pilot valve to become fouled and improve the overall reliability of the valve.

Start of Service Period

In many codes and standards, there is ambiguity about when the PRV's inspection interval begins for newly constructed equipment. When a governing code or standard has defined this start date specifically, then it should be followed. When the start date is not specified, the following is what Mercer Valve recommends for its products, which will clarify this ambiguity should the user/ owner of the PRV adopt it to their standards. This recommendation is irrespective of the warranty Mercer Valve has for its goods.

Contingent that proper storage and transportation of the PRV was utilized, the start time for the inspection interval (otherwise known as the service life) is the PRV's commissioning date not exceeding one year after it was manufactured; the manufactured date is listed on the PRV's nameplate. Commissioning is defined as the first time the equipment is operated with the PRV installed.

This recommendation is based on Mercer Valve's storage policy. Mercer Valve recommends testing a valve only if it has been in storage for more than a year. Testing of the valve should be in accordance with NB-23 standards and with a clean, inert media. The testing must not excessively exercise the valve. The valve should not have any wear or damage prior to the commissioning date.

Additional maintenance instructions can be found in API RP 576, the ASME Boiler and Pressure Vessel Code, and the National Board Inspection Code.

IX. Inspections

Pressure relief valves are used to help with safe operation of the system that they are installed on. They are designed to stop excessive overpressure scenarios. More information on causes of overpressure can be found in API 521. If a PRV fails during an overpressure scenario, the system can increase to an unsafe pressure.

These overpressure situations can exceed the MAWP and result in failures. These failures can be catastrophic in nature and result in damages to the system or even destruction of the equipment. The safety of people around the system will be affected as well. Because of the gravity of these types of failures, keeping pressure relief valves in proper working order is essential. Regular inspections must be conducted to assure a properly functioning PRV.

These inspections are used to verify if the PRV is suitable for the service conditions it is installed in. If the PRV is not correct for the conditions, it may not be able to protect the system properly and this could result in a failure.

The inspection of the PRV can be done while in place, in the field, or offsite within a repair shop. During the inspection, three tests should be performed: a visual inspection, set pressure test, and leak test. Using these three inspections can help determine the functionality of the valve or if repair or replacement is necessary.

Relief valves can generate an enormous amount of noise and pose other hazards to personnel during its operation. Appropriate personal protective equipment must be worn and other safety standards must be followed when working with pressure relief valves.

a) Visual Inspection

During the visual inspection, the pressure relief valve is checked for any potential issues that may restrict the operation of the valve. This inspection will be performed with the valve still assembled but the valve should not be pressurized for the safety of the person performing the inspection. Corrosion and damage to the valve are some of the common problems found in the visual inspection. Some of the items that should be checked in the visual inspection are as follows:

- <u>Cap and Seal Wire</u> – The valve cap and seal wire should be checked first on all inspections. These parts prevent adjustment tampering. On the seal wire, there is a pressed security seal that has an impression on it to indicate the certified company that last adjusted the set point of the valve. When this seal wire is cut or removed, it indicates that someone may have adjusted the set point or altered the valve. This voids any warranty the valve may have had. See Figure 9.
- <u>Flanged Connections</u> – The flanges should be checked for wear, such as pitting or reduction in width, which could cause the flange to not seal properly or could reduce the pressure rating of the flange. Flanged connections should also be checked for proper fasteners.

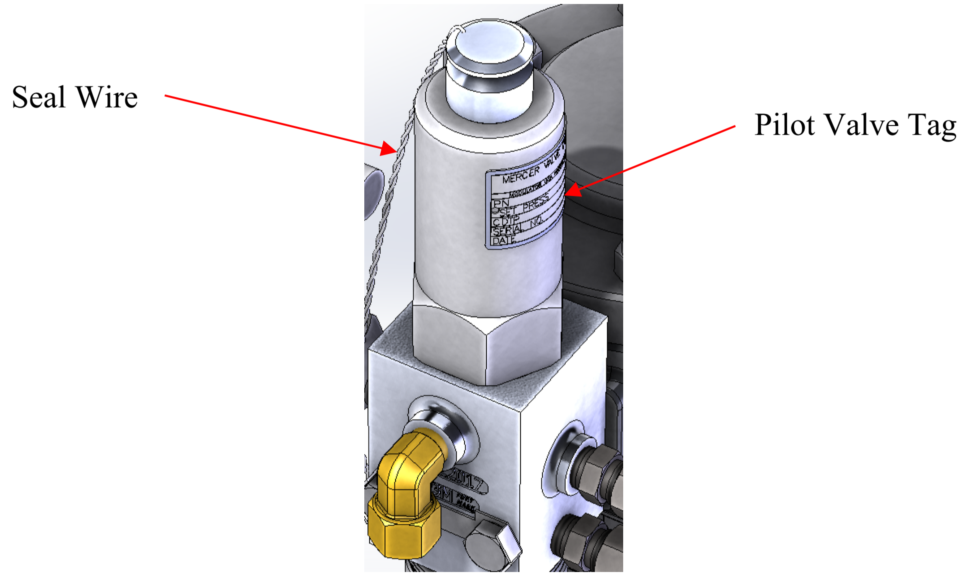


Figure 9: Typical Cap and Seal Wire on a Snap Pilot Valve

- Outlet – The valve's outlet should be inspected to make sure there is not any corrosion or other debris accumulation within that could inhibit the operation of the valve.
- External Surface – The valve should be checked for any damage that has occurred that could restrict or impair the operation of the valve. Tubing lines, bent piping, and other external attachments are commonly damaged and can cause malfunction.
- Valve Tag – The tag information should be inspected and verified to the service conditions. Some of the items on the tag that are to be verified are the set pressure, CDTP, and capacity in appropriate unit of measure for the service fluid. If any of the tag information is found to not correspond to the conditions of the system, the valve should be removed and replaced with an appropriate valve. A missing tag also warrants further inspections. There are two tags on 9500 Series valves: one is located on the main valve while the other is on the pilot valve.

If, for any reason, the valve has failed the visual inspection and the valve is deemed to be dangerous to test, the set pressure inspection and the leak inspection should not be carried out. Valves that fail visual inspection should be replaced or repaired immediately.

b) Set Pressure Inspection

During the set pressure inspection, the set pressure is verified in accordance with the ASME Boiler and Pressure Vessel Code. For all valves set 70 psi (500 kPa) and above, the set pressure has a tolerance of ±3% of the nameplate set pressure. For all set pressure below 70 psi (500 kPa), the tolerance is ±2 psi (±15 kPa) of the nameplate set pressure. If the valve has a CDTP associated with it due to temperature and/ or backpressure, the test pressure is checked to the CDTP. Even with a CDTP, the set pressure tolerance is calculated based on the actual nameplate set pressure.

The set pressure test should be performed before (if it passes the visual inspection) and after any repairs.

The set pressure is inspected to the definition listed in NB-18, a publication by the National Board of Pressure Vessel Inspectors, which is found at http://www.nationalboard.org/. This publication lists all ASME Boiler and Pressure Vessel Code certified pressure relief valves. It indicates the correct set pressure definition and other characteristics of a valve. The set pressure has been defined to achieve particular operational characteristics. If the wrong set pressure definition is used in the inspection test, the valve's set pressure will not be accurate and it may not operate appropriately.

The correct fluid for testing has to be used to achieve accurate results. For gas/ vapor service, nitrogen or compressed air is used as the test fluid. All snap pilots will be gas/ vapor service valves. If the incorrect fluid is used during the testing, the test's results will be inaccurate. Depending on the size of the valve and its set pressure, the set pressure discrepancy can vary outside of ASME tolerances.

Setting procedures should be in accordance with ASME PTC 25. The rate of the system pressure increase should be slow when the pressure is within 15% of the set pressure. Within this range, the rate should never be more than 2 psi/ sec (15 kPa/ sec). Ideally, each pressure increment on the pressure gauge should be clearly read as the pressure is increased. Slow pressure increase helps to accurately read the pressure gauge.

The procedures for testing set pressure are as follows:

1. Check the set pressure definition from NB-18. For Mercer 9500 Series snap pilot operated pressure relief valves, the set pressure definition for a gas/ vapor valve is the first audible discharge from the main valve, or a "pop".
2. Rigidly connect the valve to a test fixture.
3. Slowly increase the pressure on the inlet side until the main valve opens. This will be the set pressure of the valve. If the pressure reaches more than 1.5 times the expected set pressure and hasn't opened, do not proceed with the test. The valve is to be considered stuck closed and has failed.
4. Verify the set pressure 2-3 more times. Verification relief should be no more than ±1% or ±0.5 psi (3.5 kPa), whichever is greater, from the average of all verifying set pressures.

If the test equipment is not adequate, the results can produce a false reading. Refer to Section X on proper test equipment.

<u>Common Set Pressure Definitions</u>

-POP – A crisp "pop" sound from the valve. The "pop" sound is made from the rapid increase in the lift of the disk, allowing more flow out of the valve.

-1st Audible Sound – The 1st sound heard from the outlet of the valve. This definition is usually for gas service.
-1st Steady Stream – A continuous stream from the outlet of the valve. This stream should flow out from the outlet and not dribble down the outlet. This definition is usually for liquid service.

c) Leak Inspection

After the set pressure is verified, the valve undergoes a leak inspection. This is performed to verify the disk and seat are sealed to a degree appropriate for the type of pressure relief valve being tested. Leak tests are always performed below the set pressure of the valve, usually at a certain percentage of the set pressure. The leak check is usually performed at 90% of the set pressure or 5 psi (34.5 kPa) below the set pressure, whichever is greater.

If the valve has a CDTP, the leak test pressure will be below the CDTP in lieu of the set pressure. Mercer Valve should be contacted for proper leak pressure and specification for the valve. In the tests, the pressure is held steady for a length of time and the valve is observed for any leakage. Before this test is performed, the valve must have had its set pressure examined.

There are several methods used in testing for leakage. All of the tests can indicate a leak at the seat but some of the tests are more sensitive to leakage than others.

One common test for gas valves is listed in API STD 527. In this test, the outlet is blocked with a tube coming out of it into a cup of water. The tube and water are observed for any bubbles developing in the water from the tube's end. This test has specific requirements for its apparatus, pressure, and duration of observation. This specification should be reviewed before testing the valve. For soft seated valves, such as the 9500 Series, zero bubbles must be observed for one minute to pass leak inspection per API 527.

Flow gauges can also be used to check for leakage. These tests are similar to the API 527 test except a flow gauge is attached to the outlet instead of a cup of water.

Soap film test is another common method for leak testing. In this test, the valve's seat and disk are sprayed with a soap and water mixture. The mixture is then observed for any growth of bubbles.

Another simple test is to apply a membrane, a wet paper towel for example, onto the outlet. This membrane seals the outlet. If there is any leakage, the pressure will push the membrane out, causing it to bulge.

Sometimes, there is not a way to access the outlet due to outlet piping when a valve is left on the unit. In these cases, the valve cannot be leak checked by normal means. One method of checking for a seat leak is by maintaining a blocked-in pressure in the valve's inlet. In this test, a block valve must be installed below the pressure relief valve and it must be closed during the test. It is important to make sure that the gas used to pressurize the valve does not react with the system fluid in these tests.

If the pressure remains stable during the test, there are no leaks present. If the pressure is not stable, there is a potential leak and the valve should be removed for further testing. Even though the test indicates a leak, it doesn't guarantee that it's from the valve. It could be in the connections on the inlet or the block valve. This is why the valve should be removed and rechecked on a test stand using normal leak check methods if it fails using this method.

Backpressure Testing

The purpose of backpressure testing is to check for leaks in the secondary pressure zone (the outlet side of the pressure relief valve). This includes the body, bonnet, outlet flange, and all parts included in the upper valve assembly. Backpressure testing is not required by ASME for field repair. If this is conducted, it should be performed before the valve's seal wire has been attached.

The backpressure test is performed after the valve has been assembled and set to the correct set pressure. The test is performed by attaching a sealed and controlled pressure to the outlet and then entirely submerging the valve in a solution of water treated with rust inhibitor. The pressure in the secondary pressure zone is brought to 30 psig (200 kPa) at a minimum.

For PRVs installed on systems with backpressure, this test should be performed at the backpressure of the system. This is the pressure required by the ASME Boiler and Pressure Vessel Code. The valve is then visually inspected for any leaks by checking for bubbles coming from any part of the valve.

X. Test Equipment

Testing and inspections can be performed in multiple locations. They can be performed onsite in place (in situ testing), onsite on a mobile test unit, or offsite in a shop or test facility. Each environment offers its own advantages and disadvantages.

a) In Situ Testing

Testing and inspecting in place eliminates the laborious task of removing and handling the valve. This is especially desirable with large PRVs. Additionally, not disturbing the existing connections reduces the chance of compromising the existing seals. This type of testing is very useful when a system cannot be shut down for long lengths of time.

There are disadvantages to this type of testing. The inspection process is more difficult because the accessibility of the valve is reduced. The outlet pipe is often still attached and the internal parts are not observable for the visual inspection. This can also make it difficult to leak check. Different methods for leak checking are required. In addition, the set pressure testing process is difficult. Block valves are mandatory to be able to properly test the set pressure. Even with a block valve under the valve, the volume under the valve may not be sufficient to accurately test the set pressure. A heavy warn or simmer can cause false readings as a result of insufficient test volume.

Gauge placement is critical to get an accurate pressure reading. If the gauge is placed too far away from the valve or the line has too many restrictions, there will be pressure losses. When this happens, the pressure gauge will indicate a pressure that includes the pressure losses. This is an inaccurate reading compared to the actual pressure at the valve's inlet.

The supply pressure can also be a factor. Usually, the pressure source in these types of tests is far away from the actual valve. Compressed air or nitrogen bottles are heavy and usually a line is run from the bottles to the valve. The length of this line can create a pressure drop. This will usually mean that additional pressure in the bottles will be required to properly test the set pressure of the valves. Typical testing apparatus can be seen in Figures 10 and 11.

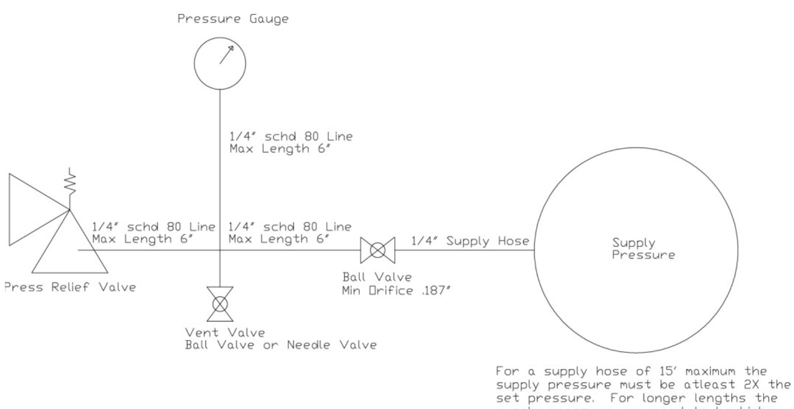


Figure 10: Diagram of Proper In Situ Testing Apparatus

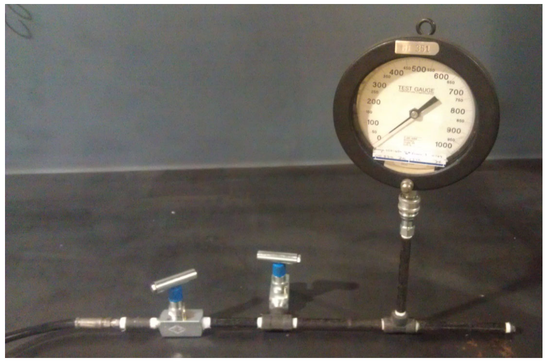


Figure 11: Picture of Typical In Situ Testing Apparatus

b) Using a Field Test Connection

A field test connection enables a set pressure verification and leak test to be performed while the valve remains installed in its application. A field test connection is an option for pilot operated valves. The main valve will open if there is pressure within its inlet, so there should be a block valve at the main valve's inlet connection when using the field test connection.

To use a field test connection, an external pressure source is attached. This pressure source is typically a nitrogen bottle. It is important that the pressure source's media is chemically compatible with the application. Some fluids can react when mixed and could cause corrosion, an explosion, or other undesirable effects.

The pressure source will need to have a metering valve leading to a pressure gauge and a vent valve. See Figure 11. The pressure source must be greater than the set pressure of the valve but it should not exceed the pressure rating of the valve; it must be regulated to be below the rating of the valve.

With the pressure source attached and the field test valve closed, increase the pressure equal to the current pressure within the PRV. This ensures that when the field test is opened so the pressure in the dome does not drop and cause the main valve to open. Once the pressures are equal, the field test connection can be opened. The gauge after the metering valve will show the pressure in the valve.

The metering valve may now be opened slowly to increase the pressure up to the set point. This test will operate the pilot valve only. During this test, the main valve dome will be pressurized and vented.

c) Offsite Testing

Offsite testing allows for the most thorough and accurate testing and inspection. The valves are removed from their units and brought to a shop. In the shop, a valve can be completely tested and inspected. The shop environment gives the technician the most advantages because more tools are available, there is adequate space to work, and test benches enable accurate results.

All of the same concerns in testing are still present in offsite testing as in situ testing. The volume of pressure, valve simmer, pressure losses to the gauges, and supply line pressure are all factors in getting an accurate result. Proper assembly of a test bench is crucial in limiting these effects.

The main disadvantage in offsite testing is time. A valve must be removed from the unit and then transported to the shop. After testing, it is transported back to the field to be reinstalled. This time frame can be long and cause delays.

For gas/ vapor valves, there should be approximately 1/4 ft^3 (7 liters) or more capacity below the valve when setting. This volume is sufficient to accurately test the set pressure for most 4 x 6 M orifices and smaller valves. To see other valve characteristics (e.g. blowdown), a larger vessel is required. If excessive warn is observed during the test, a larger volume is required. See Figure 12 for an example.

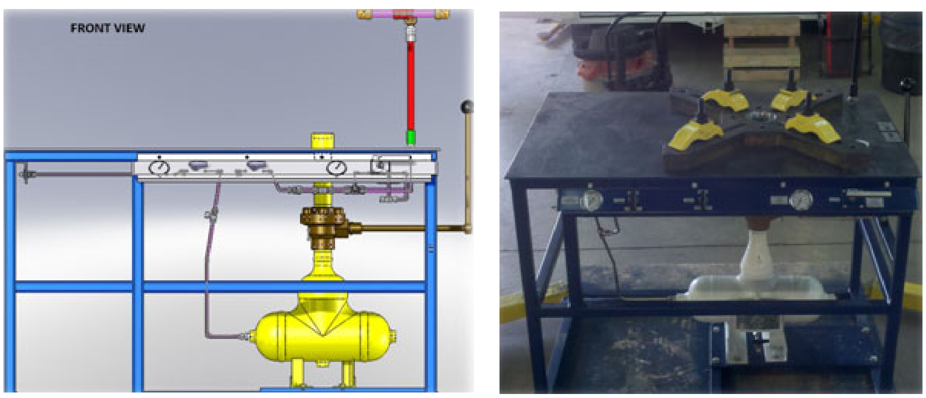


Figure 12: Typical Gas/ Vapor Test Stand Setups

d) Mobile Test Units

Mobile testing units are similar to offsite testing. The valve is removed from the application, which enables a more thorough inspection. Mobile testing units can save time because transporting the valve offsite isn't necessary. Mobile test units do have their disadvantages though.

Mobile test units are often not setup to test all valve types and sizes. The testing equipment on a mobile test unit can vary. Some mobile test units have test stands similar to an offsite test stand, allowing for larger valves to be tested accurately. Other mobile test units are setup only for smaller valves. In each case, the limitations of the test stand should be documented and the test stand should only be used for the sizes and pressure that it is designed for. See Figure 13 for an example.

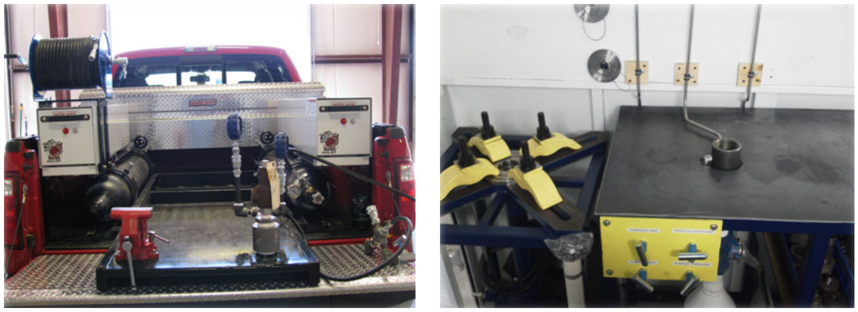


Figure 13: Typical Mobile Test Stand Setups

e) Test Stand for Snap Pilot

A snap pilot's set pressure can be adjusted while either attached to the main valve or not. When the pilot valve is not attached to the main valve, a special test stand can be used. See Figure 14. Two gauges should be used: one to measure the dome pressure and one to measure the system pressure. The dome area should have a volume similar to the size of the actual dome of the main valve of the pilot.

Lines should all be 3/8" tubing or larger and kept to minimal distances to reduce the chance of creating flow losses. All components used must be rated for the pressures being tested. This test stand can be used for adjusting the set pressure of the snap pilot valve, but ultimately the pilot valve should be installed with the main valve and then tested on a full-sized test stand for accurate setting.

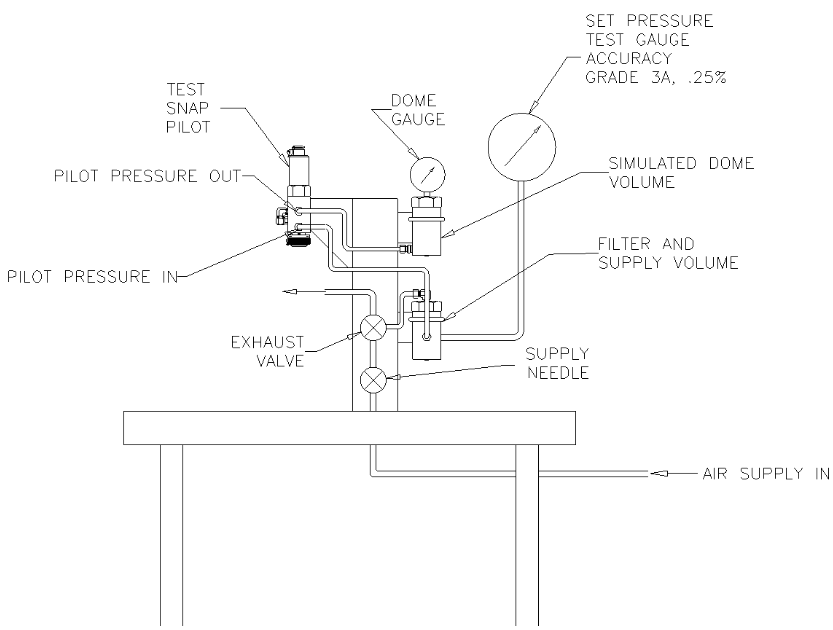


Figure 14: Recommended Test Stand for a Snap Pilot

f) Test Gauges

When testing the set pressure or leak checking, it is recommended that two pressure gauges are used. This enables quick identification if they are reading incorrectly. If the gauges are not reading identical values within their respective tolerances, it is an indication that at least one gauge is inaccurate and both should be checked to make sure they are calibrated correctly.

The test gauges should have at least 0.25% accuracy over their full scale. The portion of the gauge used should be selected so that the tolerance of it is more stringent than the set pressure's tolerance. For analog gauges, only the middle 1/3 or less of the gauge should be used; it is the most accurate portion of the gauge. Each gauge should be calibrated using a dead weight tester. Monthly calibrations of the gauges are recommended.

g) Lift Checking

The lift of the valve is checked by seeing how much the disk subassembly moves. See Figure 15 for a typical lift checking apparatus. The lift is the measurement of the movement of the disk from the closed position to the mechanical stops at the fully open position. The minimum lift for certified PRVs can be found in the NB-18 publication, which is located on the National Board website www.nationalboard.org.

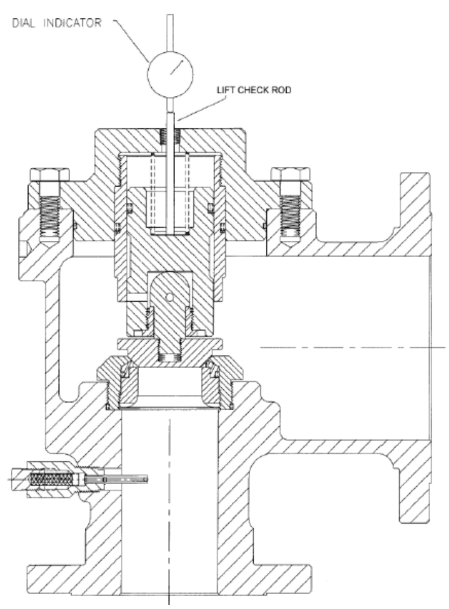


Figure 15: Typical Lift Check Setup

XI. Tester Qualifications

Only qualified individuals should perform PRV tests and repairs. They should be trained to test and calibrate pressure relief valves. They should understand how to properly operate the equipment and know the hazards involved. They should be familiar with the specific PRV being tested and know how it functions and operates. It is recommended that the individual attend factory approved training class for each type of valve worked on.

The end user's company may have additional requirements for the individual conducting the PRV inspection. These requirements should be checked before any PRV work is carried out. Government authorities can also have requirements for the individual. For every PRV installment, regional specifications that apply should be reviewed.

It is recommended that the individual be qualified in a program similar to US DOT OPS Operator Qualification. This is a qualification program for pipeline operators. Operator Qualification (OQ) Rules can be found in 49 CFR Part 192, Subpart N and 49 CFR Part 195, Subpart G.

It is also recommended that any company that repairs PRVs is VR certified through ASME and The National Board of Boiler and Pressure Vessel Inspectors. VR is an accreditation program administered by the National Board for the repair of pressure relief valves. A PRV repair is any process or operation that affects the valve's flow passage, capacity, function, or pressure-retaining integrity; this includes cleaning. VR companies are certified to work on all types of pressure relief valves.

XII. Tool List

The following tool list shows the recommended tools used with a respective valve component. This list is not exhaustive and more tools, such as typical shop tools, may be required.

a) Main Valve

Table 2: Tools Used on Main Valve

Tool	Where it is Used
1-1/2" Hex Socket	D, E, & F Nozzles
2-1/2" Hex Socket*	G, H, & J Nozzles in 2x3 Bodies and 1-1/2" FB Nozzles
3" Hex Socket*	2" FB Nozzles
3-1/2" Hex Socket*	J, K, & L Nozzles in 3x4 Bodies
4" Hex Socket*	L & M Nozzles
4-1/8" Oct Socket*	3" FB Nozzles
4-13/16" Oct Socket*	N & P Nozzles
3/4" Hex Socket	Q & R Nozzles (Valves After 2004)
Q & R Nozzle Tool (Available Through Mercer)	Q & R Nozzles (Valves Prior to 2005)
5/16" Allen Key	4" FB Nozzles
3/8" Allen Key	6" FB Nozzles
5/16" Allen Key	T Nozzles

**Large sized hex sockets, which can be used for nozzle removal/ installation, are similar to "Truck Wheel Bearing Lock Nut Sockets".*

b) Snap Pilot Valve

Table 3: Tools Used on Pilot Valve

Tool	Where it is Used
Cutter Dikes	Seal Wire
9/16" Open End Wrench	Mounting Bolts
5/8" Open End Wrench	Pipe Plug and Fittings
11/16" Open End Wrench	Tube Fittings and Lock Nut
1-3/4" Open End Wrench	Bonnet
7/32" Allen Key	Adjustment Screw
1" Hex Socket	Retention Nut
3/4" Open End Wrench	Stationary Seat
5/64" Allen Key	Blowdown Set Screws
Pick	O-Ring Removal

c) Miscellaneous

Table 4: Miscellaneous Items Used

Nickel Based Anti-Seize (similar to Loctite® LB 771™)
Low Strength Thread Retainer (similar to Purple Loctite® 222)
Medium Strength Thread Retainer (similar to Blue Loctite® 242)
High Strength Thread Retainer (similar to Red Loctite® 271)
Fine Grade Abrasive Hand Pad (similar to Scotch-Brite™ 7447®)
Phenyl-Methyl Silicone Grease (similar to Molykote® 33)
Water Resistant NLGI #2 Grease (similar to Aqua Lube Marine Grease)
PTFE Thread Sealant Tape (or similar)

XIII. Disassembly

The following general procedure is recommended for disassembling a snap POPRV. The disassembly is separated into sections and only some of them will apply, depending on what is being done. For example, if only the set pressure needs to be changed, the snap pilot bonnet may be the only item that needs to be addressed. Consult Figures 69 and 70 for component identifications and locations. See Figure 16 for an example of a snap POPRV with accessories.

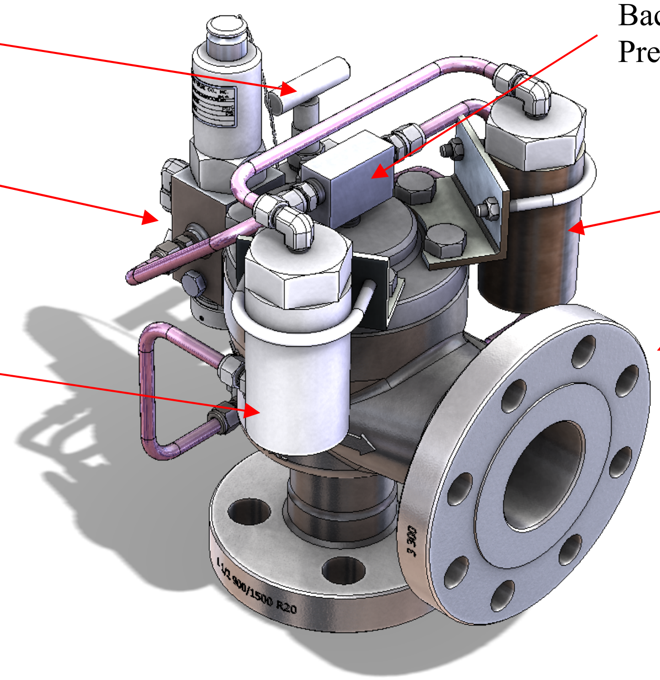


Figure 16: Snap POPRV with Accessories

a) Filter Inspection

A common maintenance routine for POPRVs is inspection of the filters. The filters can be replaced regularly to prevent dirt and debris from entering or clogging the pilot valve, which helps ensure proper function. If any of the filters appears congested with debris, the entire pilot should be disassembled and inspected for other debris accumulations. The following describes the filter disassembly process:

1. Make sure there is not pressure within the main and pilot valves.
2. Remove the probe filter from the pressure probe subassembly. See Figure 17.
   a) The pressure probe should remain with the main valve body.

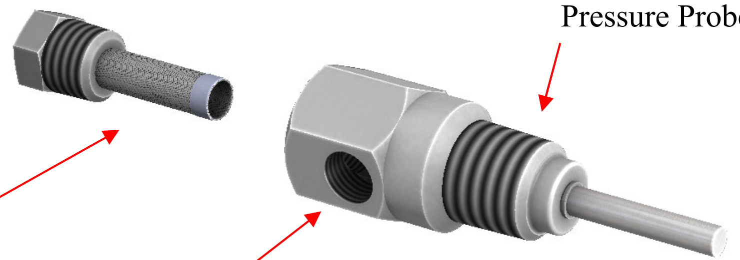


Figure 17: Typical Filter and Pressure Probe from a Pilot Operated Relief Valve

3. Inspect the filter for debris, which may have accumulated in the bore of the filter.
    i) A replacement filter is included in the repair kit.
4. Inspect the inside of the pressure probe for any debris and make sure that it is clean.
    a) Only remove the pressure probe if debris has clogged the inside and the debris is difficult to remove.
    b) Note the orientation of the sense line port (in reference to the sensing tubing) and then remove the pressure probe, if required. This notation will be needed for reassembly. The pressure probe tube hole must always face towards the main valve's inlet and down into the flow path.
5. Remove the pilot valve from the main valve by removing the mounting bolts and disconnecting the attached tubing. See Figures 18 and 19. Carefully remove the pilot valve from the main valve bonnet.

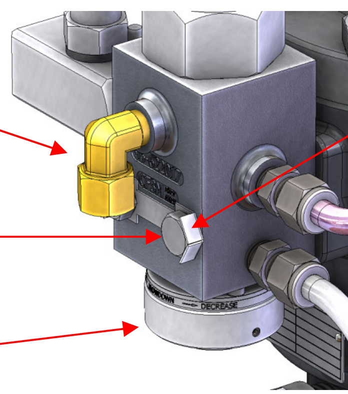


Figure 18: Pilot Valve Detail Mounting

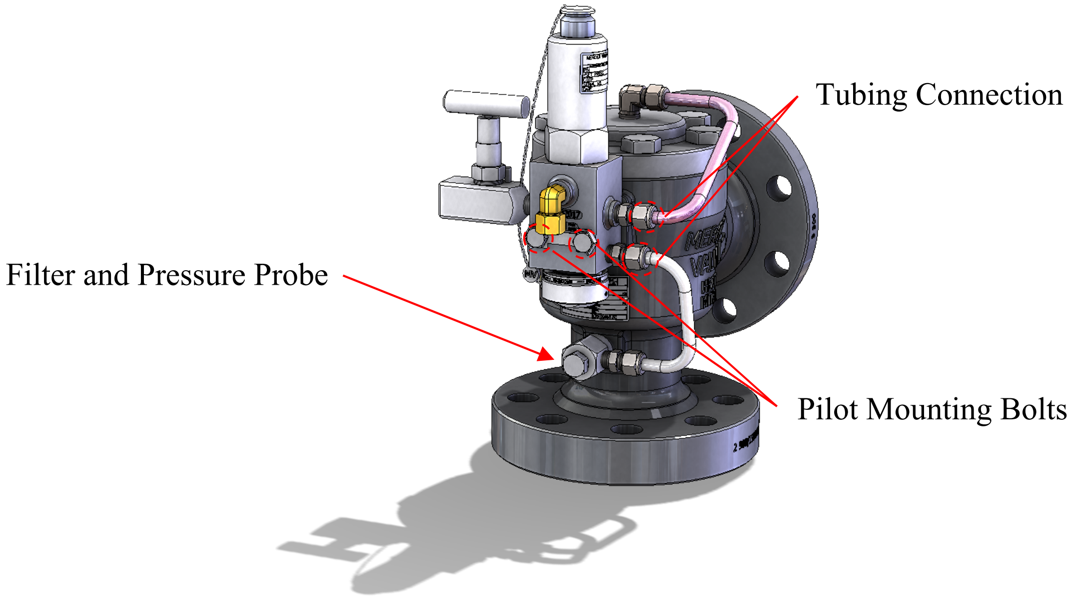


Figure 19: Typical Snap POPRV (Actual Valve May Vary in Appearance)

6. Remove the tube-to-pipe fitting. See Figure 20.
   a) There will be one filter screen in the pilot body behind this connection.

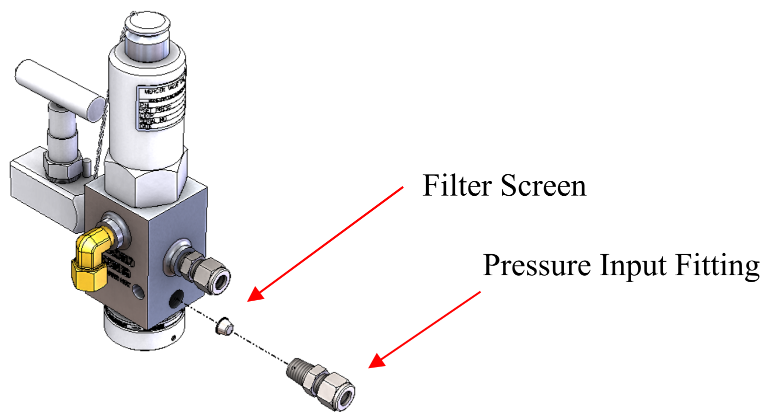


Figure 20: Exploded View of Typical Filter Screen Location on a Snap Pilot Valve

7. All filter screens and ports should be inspected for debris.
   i) Replacement filter screens are included in the repair kit.

b) Main Valve Disassembly

1. Make sure there is not pressure within the main and pilot valves.
2. Remove the tubing connecting the main valve to the pilot valve.
3. Remove the pilot mounting bolts and carefully remove the pilot valve from the main valve. See Figures 18 and 19.

4. Remove the main valve bonnet.
   a) Main valve bodies which are 1" x 2" or 1-1/2" x 2" will have threaded bonnets, while larger sizes will have bolted bonnets.
      i) The bonnet will have an o-ring that can be replaced, which is included in the repair kit. See Figure 21.

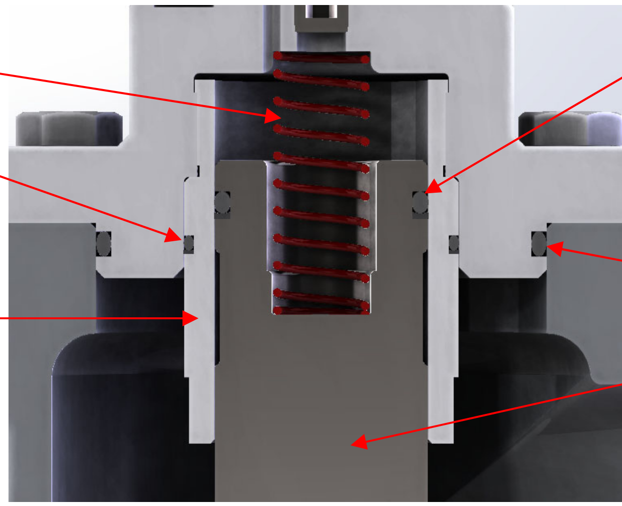


Figure 21: Typical Piston/ Dome Section

5. Remove the piston subassembly, along with the return spring, from the bonnet.
6. Remove piston o-rings. See Figure 21.
   i) Replacement o-rings are included in the repair kit.

Piston Subassembly

The disk can be disassembled from the piston subassembly, if deemed necessary. If the disk is damaged beyond repair, it should be replaced.

i) The disk is not included in the repair kit and needs to be specially ordered.
ii) The whole piston subassembly is not included in the repair kit and needs to be specially ordered.

7. Radially fix the inner stem by inserting a rigid steel pin into the outer hole of the piston sleeve. See Figure 22.

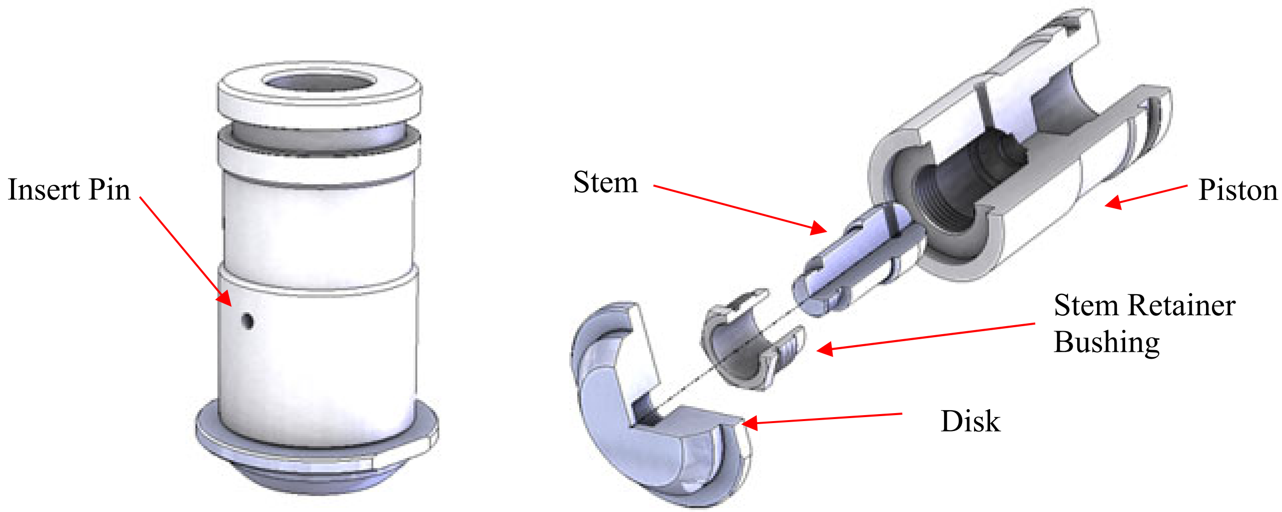


Figure 22: Piston Subassembly

8. Gently fix the outer portion of the piston and use a square wrench to unscrew the disk in a counterclockwise direction.
   a) Be careful not to scratch or ruin the piston.
   b) The stem's threads will have thread retainer applied.
9. If the stem needs removal, keep the piston and inserted pin gently fixed and use a hex socket to unscrew the stem retainer bushing. See Figure 22.
   a) The stem retainer bushing will have thread retainer applied.
10. The stem can now be removed.

<u>Piston Sleeve</u>

The piston sleeve should be checked for wear or damage and needs to be removed in order to replace the o-ring behind it. The piston sleeve should be handled with extreme care, as it can be deformed and damaged. Any deformation, damage, or wear will require a replacement, which must be specially ordered.

11. Rigidly support the main valve bonnet to prevent rotation.
12. Using the flats on the piston sleeve, unscrew it carefully. See Figure 23.
    a) The piston sleeve is securely installed into the main valve bonnet and can be difficult to remove due to the limited area on the wrenching flats and the use of thread retainer on the threads. Special care and consideration should be taken upon removal because if the piston sleeve gets misshapen during removal, it will need to be replaced.

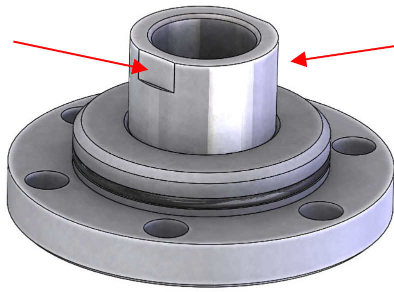


Figure 23: Piston Sleeve and Bonnet (Shown Upside-Down)

13. Remove the piston sleeve o-rings.
    i) Replacement o-rings are included in the repair kit.

Correction Sleeve

Some D, E, and F configurations have a correction sleeve installed. See Figure 24. The correction sleeve should only be removed if the correction sleeve o-ring is leaking.

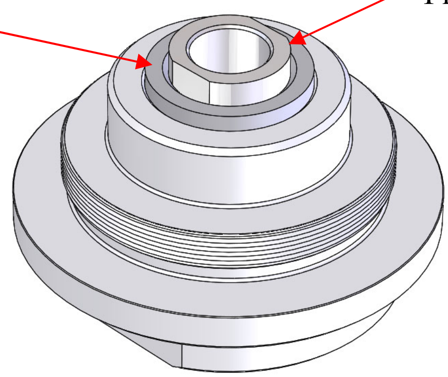


Figure 24: Correction Sleeve

Nozzle Subassembly

14. Unscrew and remove the nozzle subassembly.
    a) It is removed by going through the top of the main valve.
    b) Some of the nozzles require large sockets for removal, while others are bolted in. Review the tool list to determine the appropriate tool.
        i) A replacement nozzle is included in the repair kit.
15. Pull the o-ring out of the nozzle pocket.
    i) A replacement o-ring is included in the repair kit.

c) Snap Pilot Valve Disassembly

The snap pilot may be separated into two sections: the top portion, which includes the bonnet and upper seat components; and the lower portion, which includes the lower cage and stationary seat.

1. Make sure there is not pressure within the main and pilot valves.
2. Remove the tubing connecting the snap pilot valve to the main valve and any accessories.
3. Bend the back-off clip tabs away from the mounting bolts. See Figure 18.
    i) A replacement back-off clip is provided in the repair kit.
4. Remove the pilot mounting bolts and carefully remove the pilot valve from the main valve. See Figures 18 and 19.
5. Cut and remove the pilot valve seal wire and remove the cap from the pilot bonnet. See Figures 9 and 65.
    a) The seal wire is located on the cap and runs to the blowdown ring of the pilot valve.
    b) Go to Section XIII e) if the valve is a lift lever configuration.

<u>Top Portion of Snap Pilot Valve</u>

Disassembling of the snap pilot valve should begin with the bonnet.

6. Loosen the lock nut from the adjustment screw. See Figure 25.

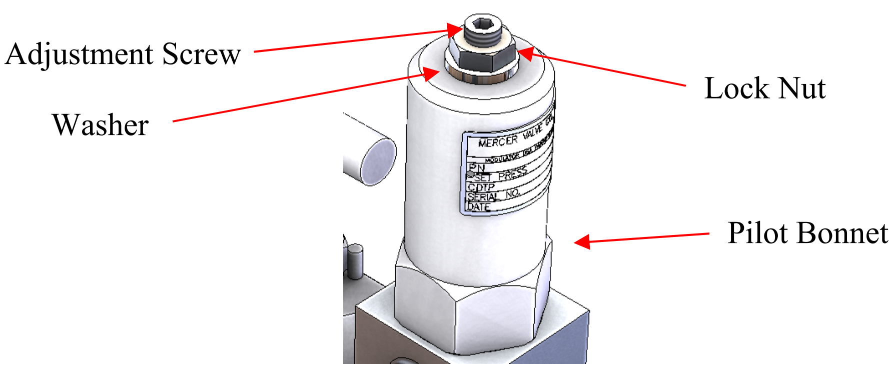


Figure 25: Pilot Bonnet

7. Relieve the spring tension by turning the adjustment screw <u>counter clockwise</u>.
    a) This is important so that components will not spring out and pose a hazard.
    b) If the adjustment screw begins to recede back into the bonnet during the relieving of the preload, then the spring compression has been completely removed.
8. Remove the spring guide and set spring.
9. Remove the lock nut and washer from the top of the pilot bonnet.
10. Push down on the adjustment screw from the snap pilot bonnet.
    a) This will remove the adjustment screw and adjustment bushing.
11. Unscrew the adjustment bushing from the adjustment screw.

a) These have left handed threads.

12. Remove the o-ring from the adjustment screw. See Figure 26.
    i) A replacement o-ring is included in the repair kit.

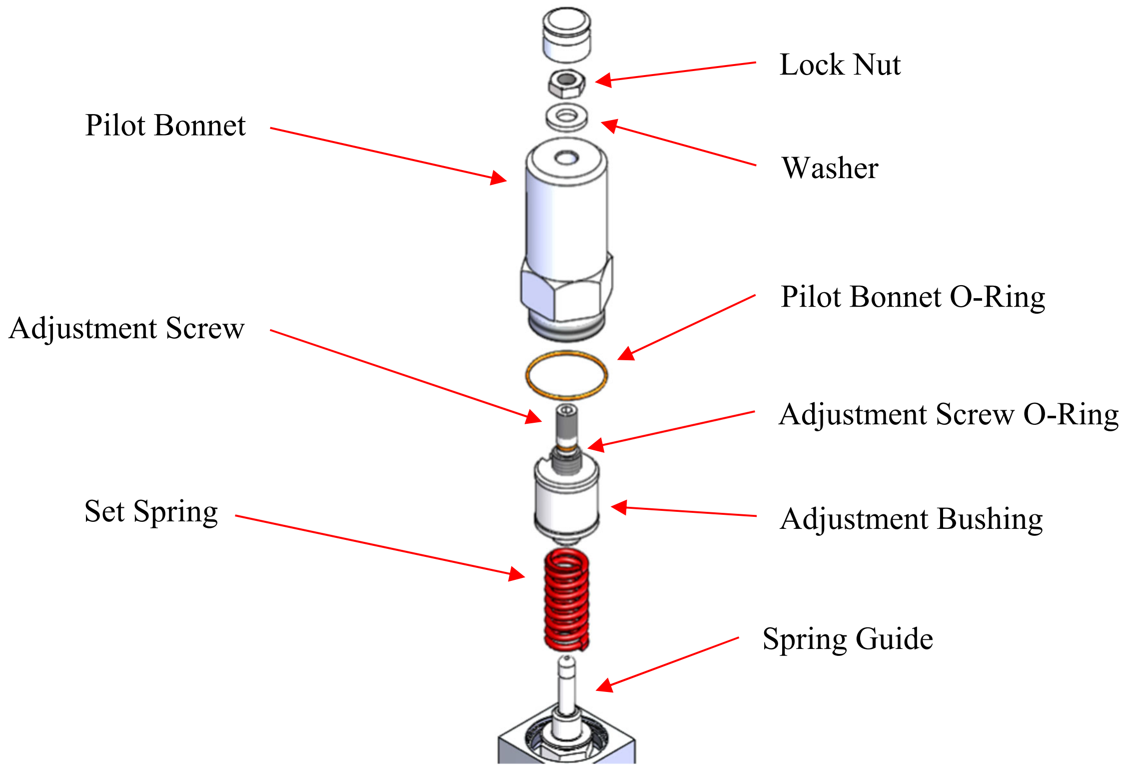


Figure 26: Internal Components of Pilot Bonnet

13. Unscrew and remove the retention nut and retention nut set screw (if present). See Figure 27.
    a) Check to see if there is a set screw on the side of the pilot above the field test connection port. If there is a screw, remove it before unscrewing the retention nut. This screw helps hold in the retention nut on older models.

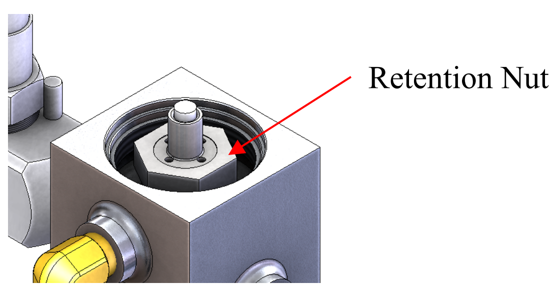


Figure 27: Pilot Retention Nut

14. Remove the disk guide bushing, upper disk, and upper nozzle subassembly. Remove the o-ring located below the upper nozzle subassembly. See Figure 28.
    a) Older snap pilots may have a one-piece upper nozzle subassembly. But all newer models and repair kits will have a three-piece upper nozzle subassembly that is retrofitted to directly replace the one-piece upper nozzle subassembly.
        i) A replacement disk guide is included in the repair kit.
        ii) A replacement upper disk is included in the repair kit.
        iii) A replacement upper nozzle subassembly (3 pieces) is included in the repair kit.
        iv) A replacement o-ring is included in the repair kit.

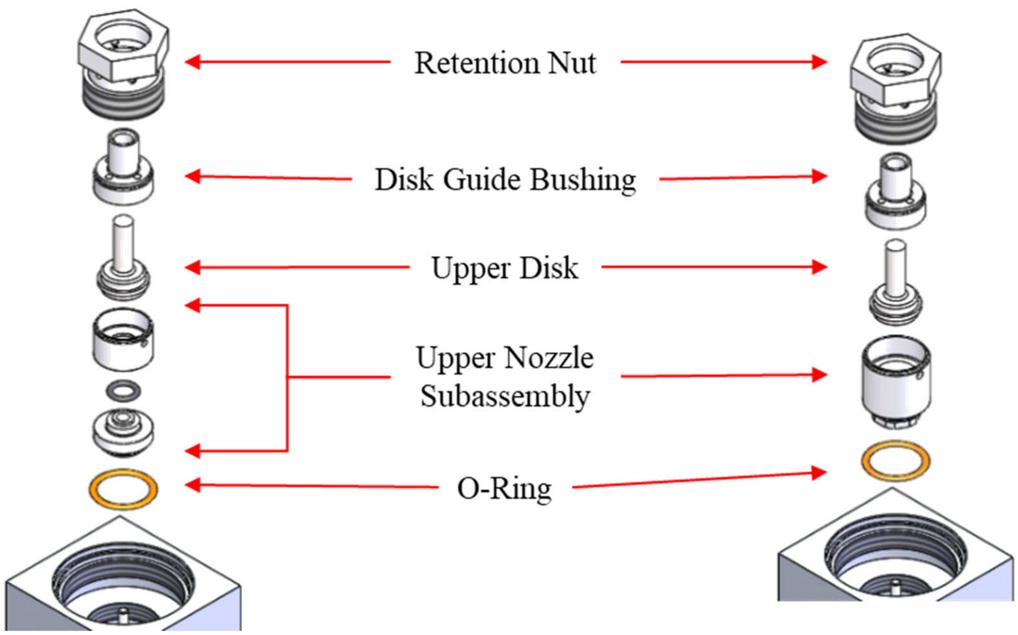


Figure 28: Upper Seat and Disk Components (New Style on Left, Old Style on Right)

15. The upper portion of the pilot valve is now disassembled.

<u>Lower Portion of Snap Pilot Valve</u>

16. Remove the blowdown nut set screw on the bottom of the blowdown nut. See Figure 29.
    a) This set screw is off center and locks down the blow down adjustment.
    b) DO NOT UNSCREW THE CENTER SCREW.

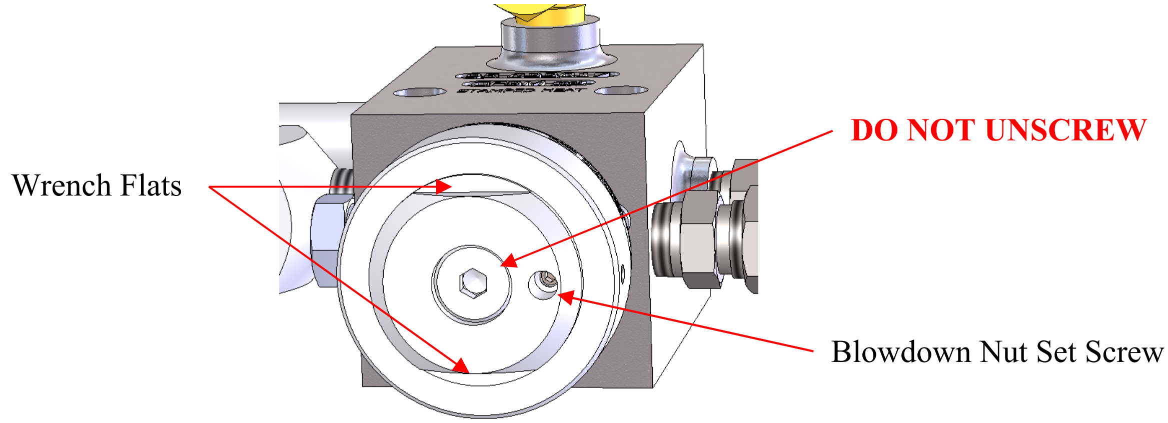


Figure 29: Set Screw on Bottom of Lower Cage

17. Remove the blowdown ring set screw on the side of the blowdown ring. See Figure 30.
    a) This set screw locks the ring to prevent blowdown adjustment.
18. Utilize the wrenching flats and unscrew the blowdown nut from the pilot body. See Figure 30.
    a) At a certain point, the blowdown will be fully unscrewed but will still be held in from the friction of the o-rings.
    b) Pull the lower cage out from the pilot body.

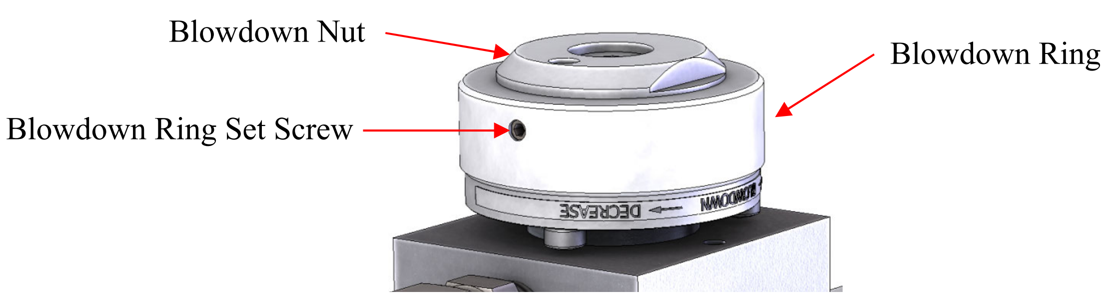


Figure 30: Set Screw on Side of Blowdown Ring (Valve is Shown Upside Down)

19. Slide the blowdown ring off from the lower cage.
20. Place a 0.175 in. (4.5 mm) metal rod into the hole on the side of the lower cage to rigidly affix it and prevent rotation. See Figure 31.
    a) A 5/32” hex key works well for this.

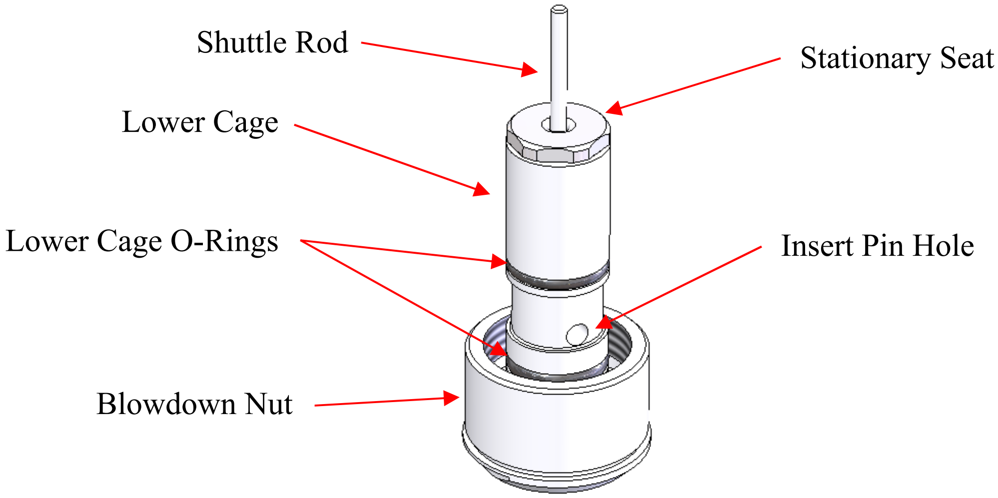


Figure 31: Lower Cage Subassembly

21. With the lower cage rigidly affixed, unscrew and remove the stationary seat from the lower cage.
22. Remove the o-ring from the stationary seat. See Figure 32.
    i) A replacement o-ring is included in the repair kit.

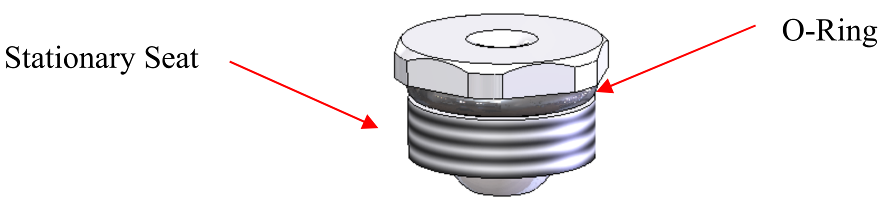


Figure 32: Stationary Seat

23. Remove the shuttle subassembly from the bore of the lower cage. See Figure 33. The shuttle has a lower seal. See Figure 34.
    i) A replacement shuttle is included in the repair kit.
    a) There are 3 different shuttles. See Figure 35. The first option is the standard shuttle, which is used when there is <u>no</u> field test connection present.
    b) The second option is a standard field test connection shuttle.
    c) The third option is an offshore field connection shuttle.

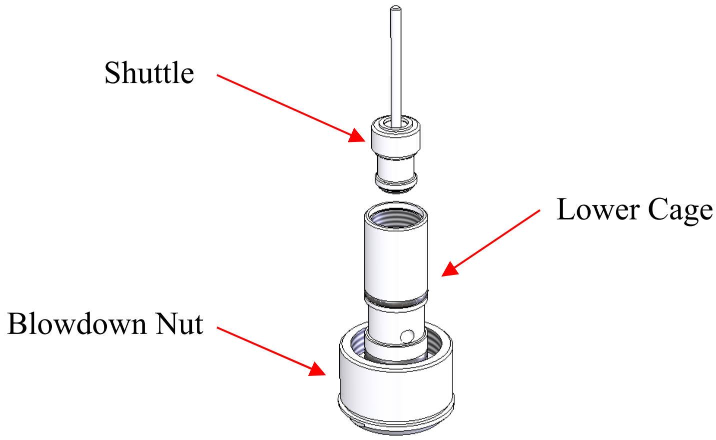


Figure 33: Shuttle and Lower Cage

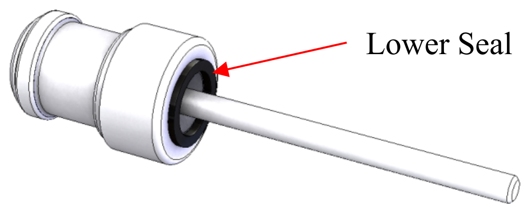


Figure 34: Shuttle Subassembly

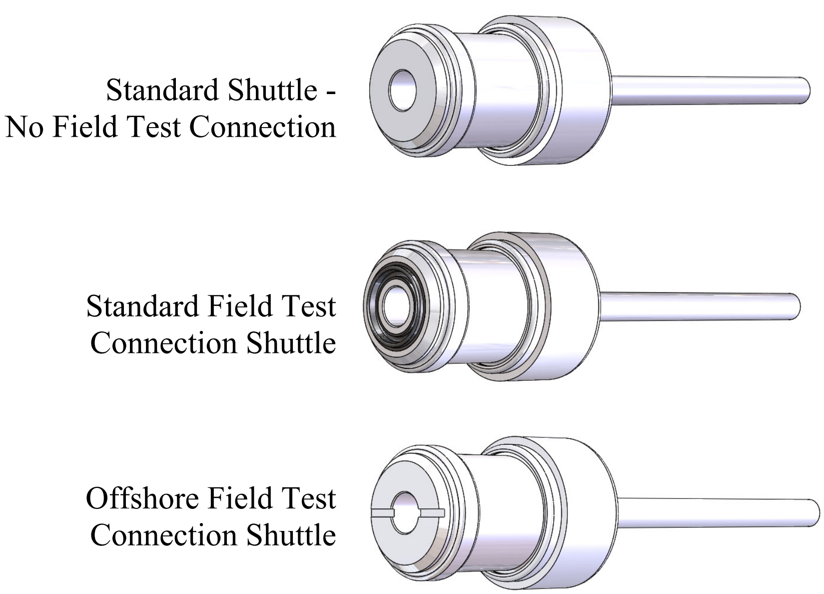


Figure 35: Different Types of Shuttles

24. Remove the two o-rings from the outer diameter of the lower cage. See Figure 31.

a) It is easier to remove the bottom o-ring before the top o-ring due to the size difference. The bottom o-ring is thicker and can get stuck in the upper slot if the top o-ring is removed first.
   i) Replacement o-rings are included in the repair kit.

d) Pilot Options Disassembly

The following instructions should be used in the disassembly of any POPRV accessories.

Backflow Preventer (BFP)

If equipped, the backflow preventer can be removed. Refer to Section VII b) or see Figure 36.

a) Make sure there is not pressure within the main and pilot valves.
b) Remove the tubing to and from the BFP.
c) Take the BFP off the bonnet of the main valve. See Figure 16.
d) Remove the fittings from the BFP body. See Figure 36.
e) Push the shuttle out from the bore of the BFP body.
   i) A replacement shuttle with preinstalled o-rings is included in the repair kit.
f) Inspect the BFP body's internal bore for damage or wear. Replace, if needed.
   i) Replacement fittings are included in the repair kit.

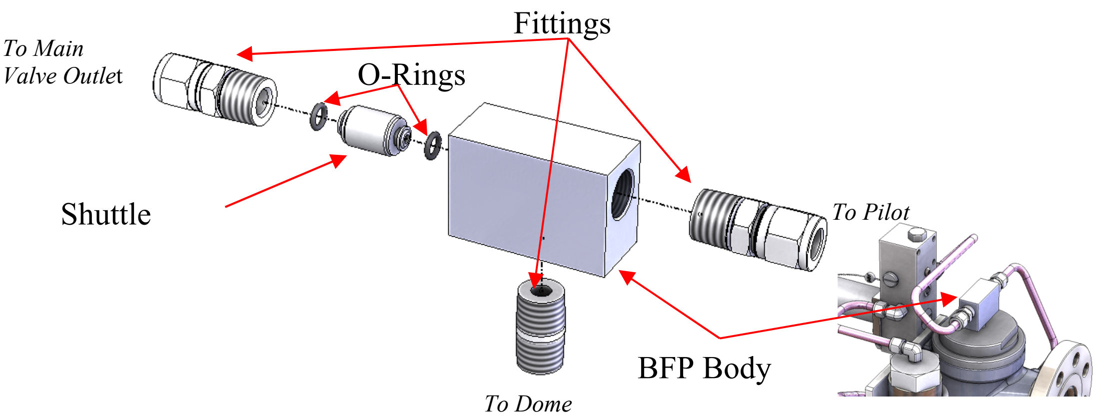


Figure 36: Backflow Preventer

Pressure Snubber (PS)

A common maintenance routine that will help prolong the reliability of the valve is regular draining of the pressure snubber.

a) Make sure there is not pressure within the main and pilot valves.
b) Remove all the tubing leading to the PS.
c) Remove the U-bolt mounting the PS to the main valve.
d) Rigidly affix the body and unscrew the cap. See Figure 37.

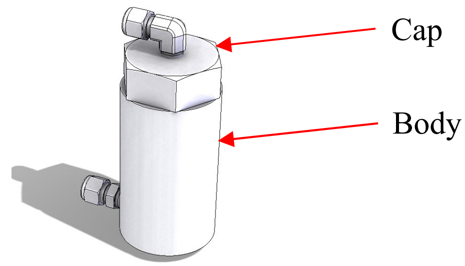


Figure 37: Pressure Snubber

e) Remove the o-ring on the cap that is located just above the threads.
    i) A replacement o-ring is included in the repair kit.
f) Remove the PS disks from the bore of the body.
g) Remove all the o-rings from the disks. See Figure 38.
    i) Replacement o-rings are included in the repair kit.

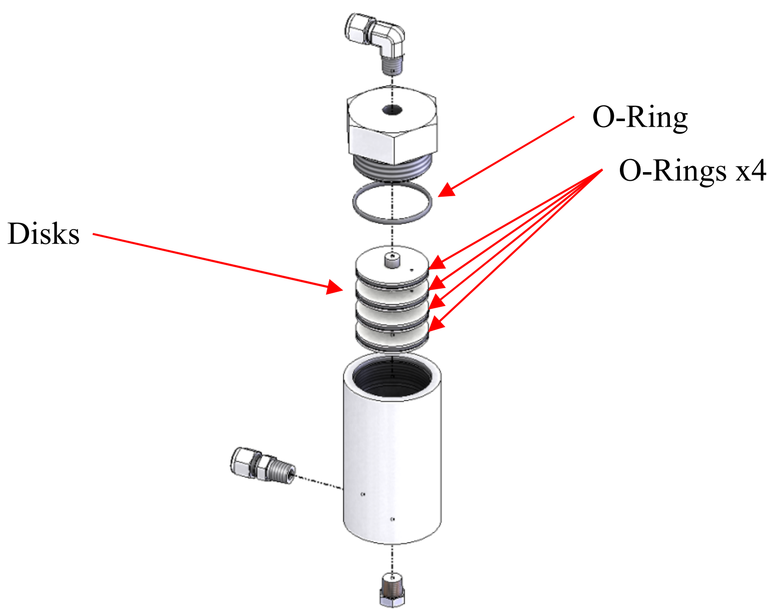


Figure 38: Pressure Snubber Exploded Assembly

Auxiliary Filter (AF)

A common maintenance routine that will help prolong the reliability of the valve is regular draining of the auxiliary filter.

a) Make sure there is not pressure within the main and pilot valves.
b) Remove all the tubing leading to the AF.
c) Remove the U-bolt mounting the AF to the main valve.
d) Rigidly affix the body and unscrew the cap. See Figure 39.

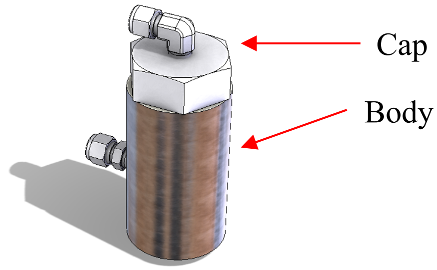


Figure 39: Auxiliary Filter

e) Remove the o-ring on the cap that is located just above the threads. The filter element should be connected to the cap. See Figure 40.
   i) A replacement o-ring is included in the repair kit.

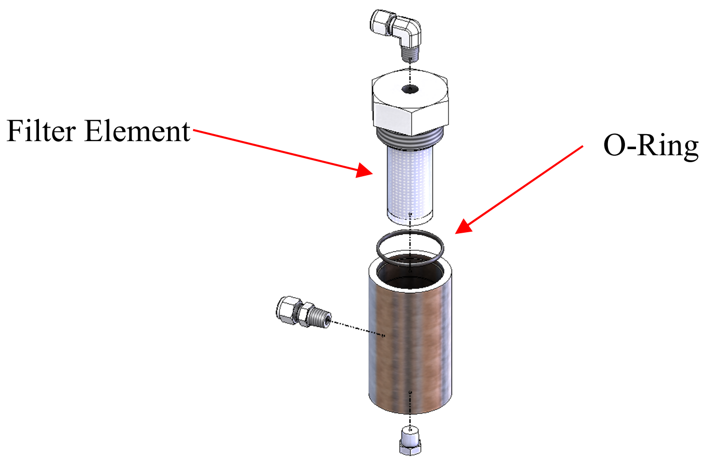


Figure 40: Auxiliary Filter Exploded Assembly

f) The filter element can be cleaned.
   i) A replacement filter element subassembly is not included in the repair kit but can be specially ordered.

e) Lift Lever Disassembly

1. Cut and remove the seal wire. See Figure 41.

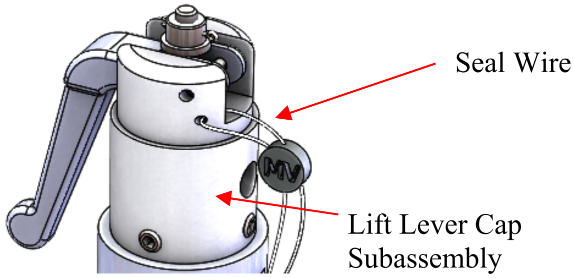


Figure 41: Lift Lever Cap

2. Bend straight and pull out the cotter pin. See Figure 42.
   i) A replacement cotter pin is <u>not</u> provided in the repair kit.
3. Unscrew and remove the stem lift nut. See Figure 42.

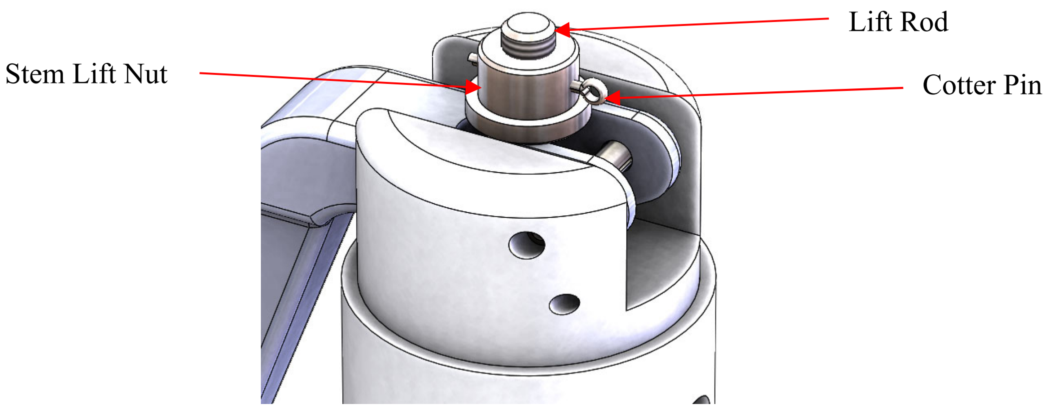


Figure 42: Upper Portion of Lift Lever Cap

4. Loosen the three lift lever cap set screws. See Figure 43.
   a) These must be unscrewed enough so that they no longer engage the lift lever lock nut.

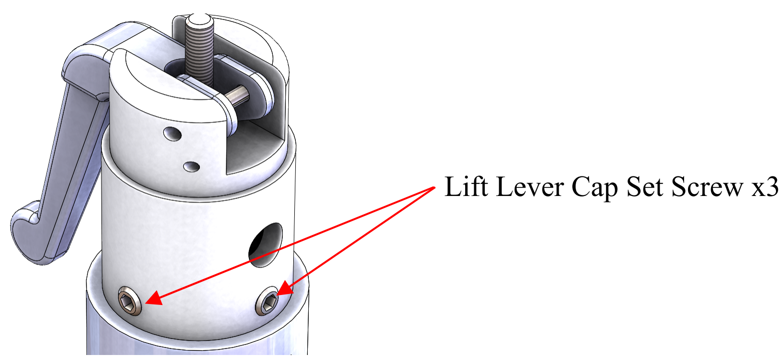


Figure 43: Lift Lever Cap Set Screws

5. Raise the entire lift lever cap to remove it from the bonnet.

6. Loosen the lock nut and jam it against the seal adjustment nut. See Figure 44.

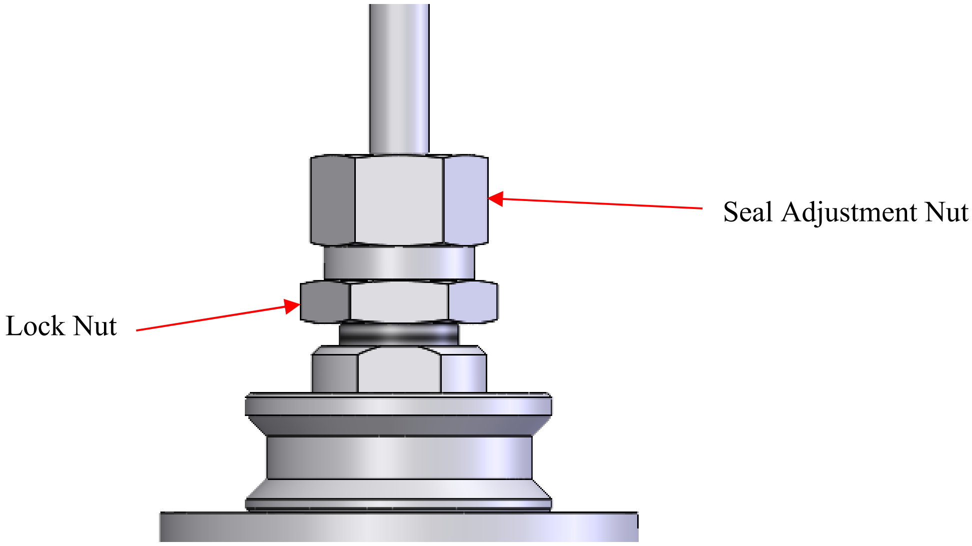


Figure 44: Lock Nut Jammed Against Seal Adjustment Nut

7. With the locknut and seal adjustment nut tightened against each other, turn the adjustment screw counter clockwise to remove the spring load.
8. Unscrew and remove the seal adjustment nut. See Figure 45.

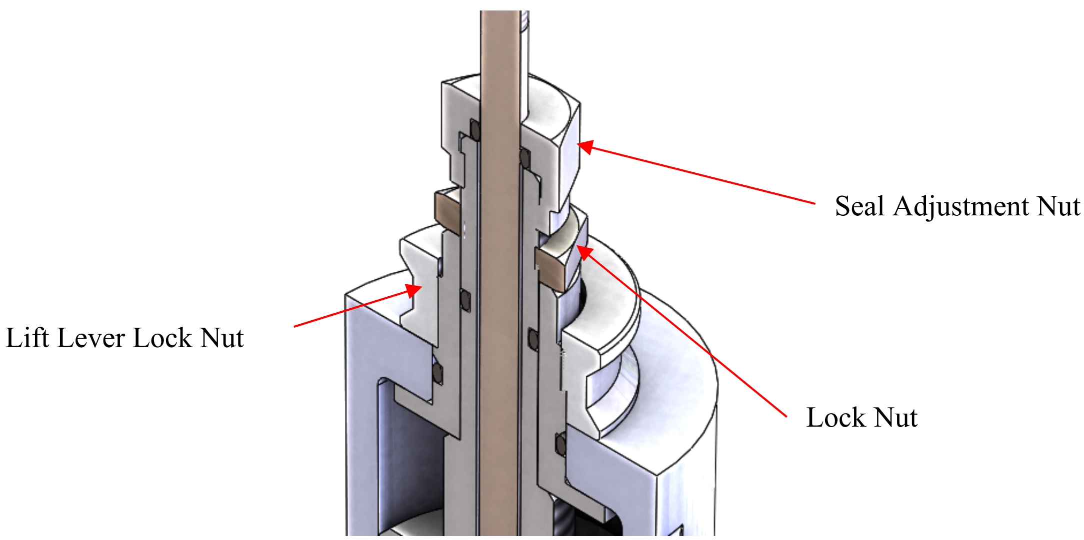


Figure 45: Removed Lift Lever Cap

9. Remove locknut.

If removing the center bushing, continue to step 10. Otherwise, skip to step 11.

10. If necessary*, the lift lever lock nut may be removed by using a wrench on the flats of the center bushing and a pipe wrench on the lift lever lock nut. See Figure 46.
    a) One wrench should remain stationary while the other is applied on the other component to break the two parts loose.
    b) *These components do not have to be disassembled unless the center bushing o-ring is suspected of leaking. Removing these parts is not recommended.
    c) This lock nut has high strength thread retainer applied and can be difficult to remove.
    d) The center bushing o-ring is not included in the repair kit and needs to be specially ordered.

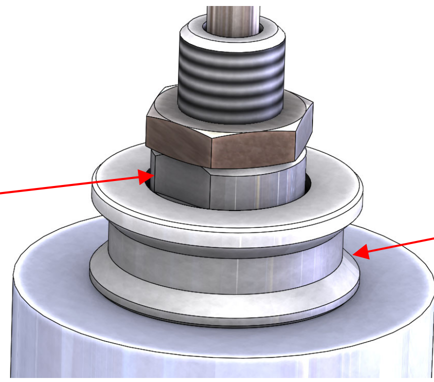


Figure 46: Lift Lever Lock Nut Removal

11. The disassembly is now typical of the process described for a non-lift lever configuration. Return to step 8 in Section XIII c).

XIV. Reassembly

The following general procedure is recommended for the reassembling of a 9500 Series snap POPRV. Parts should not be difficult to put back together and excessive force should **never** be used.

Always remove and clean any form of preexisting thread sealant from components prior to reapplication of thread sealant and reassembly. This will help prevent the accumulation of thread sealant over time and reduce the chances of clogging any ports and passages.

a) Cleaning, Lubricating, & Sealing

Cleaning:

- All of the snap pilot parts **except** the shuttle and upper seat can be cleaned with a solvent bath. This will help rid debris from within the pilot valve. **Remove all soft goods before applying solvent.**
- An abrasive pad may be used to clean dirty surfaces. Always rinse off parts after using Scotch-Brite™.
- All parts shall be drained and dried before reassembly.
- **Parts should never be media blasted.** This process leaves beads/ sand in the valve, which can cause improper function. It may also ruin a required surface finish condition.
- After parts have been cleaned, they can be re-lubricated.

Lubricating:

- All o-rings should be lubricated with silicone grease similar to Molykote® 33 grease. It is especially important to grease the o-rings on the lower cage since they are slid into tight fits. This will make assembly easier and help prevent cutting the o-rings.
- The threads (where indicated) should be lubricated with a small amount of anti-seize, preferably a nickel base type. For example, a good method for doing this is to apply a small line of anti-seize on the upper half of the adjustment screw threads. When the adjustment bushing is threaded on, the anti-seize will be spread. This prevents using too much.
- The adjustment bushing should be greased on the outer cylindrical area with a water resistant lubricant similar to Aqualube.
- **Never apply grease, oil, or other lubricants on seats, seal faces, or sliding components.**

Thread Sealant on Pipe Fittings:

- Wrap the threaded portion of pipe fittings with PTFE pipe tape.
- Do not use too much tape and make sure that the tape is only exposed on the thread.
- The recommended number of wraps of tape is three wrap levels; this should be done in a manner that does not cause the tape to unravel during tightening.
- If the tape isn't located exclusively on the threads, a portion could break free and get lodged in the flow path and cause the pilot valve to get blocked.
- Tighten pipe plugs/ fittings approximately 2-3 turns past hand tight.

b) Filter Reassembly

1. If the pressure probe was removed, reinstall it in its original orientation.
   a) The sense line port must be oriented horizontally so the pitot tube inlet is facing downwards, parallel to the flow. See Figure 47.

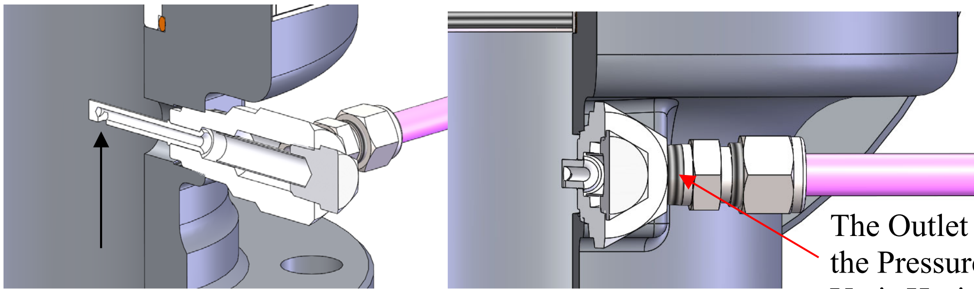


Figure 47: Pressure Probe Orientation

2. Utilizing pipe thread sealant, thread the probe filter into the pressure probe until tight.
3. To install the filter screens located in the pilot valve, make sure that the outside of the filter screen is towards the process flow (convex) and replace each filter screen. See Figure 20 for an illustration of the proper orientation of the filter screens.
4. The appropriate fittings should then be rethreaded into the pilot valve.

c) Snap Pilot Valve Reassembly

Once all of the components have been cleaned and lubricated, the pilot valve is ready to be reassembled.

<u>Top Portion of Snap Pilot Valve</u>

Reassembly should begin with the top portion of the pilot valve.

1. Lightly apply a small amount of silicone grease to the o-ring that seals the upper nozzle subassembly into the pilot body. See Figure 28.
2. Install the o-ring located below the upper nozzle subassembly.
   a) It is easiest for installation if the grease allows this o-ring to stick to the bottom of the upper nozzle subassembly.
3. Install the o-ring located in the upper nozzle subassembly.
   a) It should fit into the upper piece and will be pushed into place by the lower piece of the subassembly when they are combined.
4. Gently place the upper nozzle subassembly with o-ring into the pilot body.
   a) Make sure that the o-ring remains centered and does not get pinched.
   b) The upper seat should appear centered in the bore.
   c) The upper seat should have no cuts and a smooth surface. A rough surface or cut may affect the sealing.
5. Place the upper disk on top of the upper nozzle subassembly.

   a) The upper disk nosepiece should have a smooth and clean finish without any scratches or abrasions. Scratches may affect sealing.
6. Place the disk guide bushing on top of the upper disk and upper nozzle subassembly.
7. Apply a light anti-seize to the threads of the retention nut. See Figure 48.

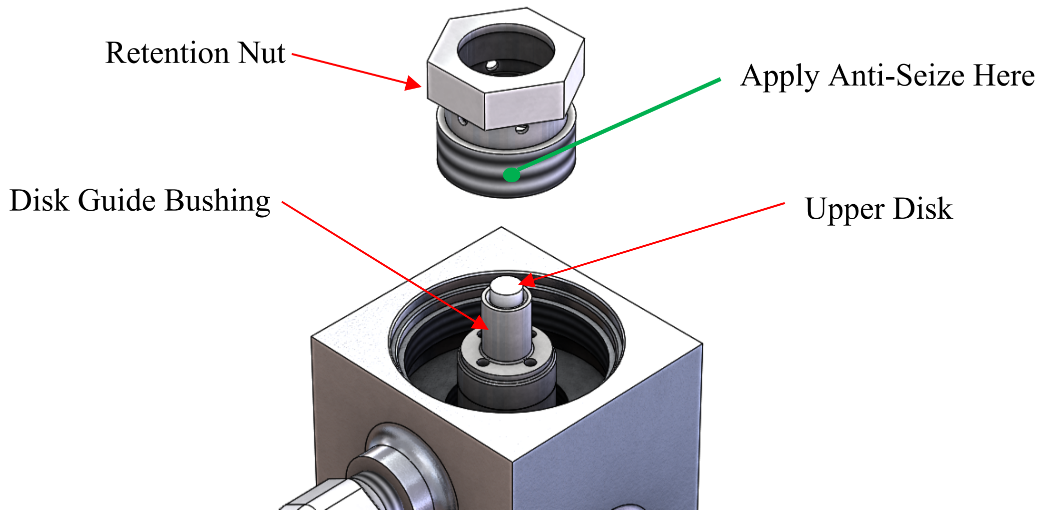


Figure 48: Retention Nut and Upper Seat

8. Thread the retention nut by hand into the pilot body.
   a) This will keep upper nozzle subassembly, upper disk, and disk guide bushing together.
9. Tighten the retention nut to the value shown in Table 5.
   a) If originally equipped, reinstall the retention nut set screw. This set screw should have medium strength thread retainer applied on its threads and tightened.

Table 5: Retention Nut Torque Value

Component	Torque, lb-ft (N-m) ± 5%
Retention Nut	100 (135)

10. Place the spring guide on top of the disk as shown in Figure 49.

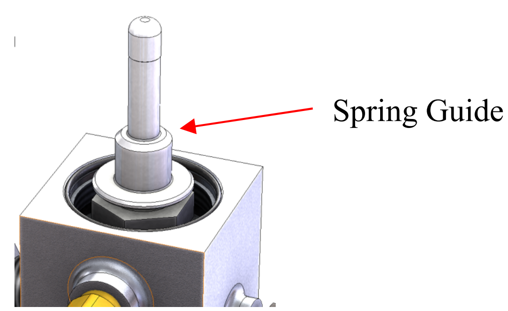


Figure 49: Spring Guide atop the Disk

11. Make sure the spring guide is not in contact with the disk guide bushing.
    a) It should have a free feeling, ball-and-socket type of interface and be balanced on the top of the disk.
12. Check the spring dimensions to make sure that the correct spring is being used for the intended set pressure of the overall safety pressure relief valve.
    a) Mercer's spring chart, a separate document, contains this information.
    b) Make sure the spring appears square and is not bent.
13. Install the spring on top of the spring guide.
14. Lightly apply a small amount of silicone grease to the adjustment screw o-ring.
15. Carefully place the adjustment screw o-ring onto the adjustment screw, making sure not to cut the o-ring. See Figure 50.
    a) The o-ring should reside in a notch groove below the upper threads of the adjustment screw.

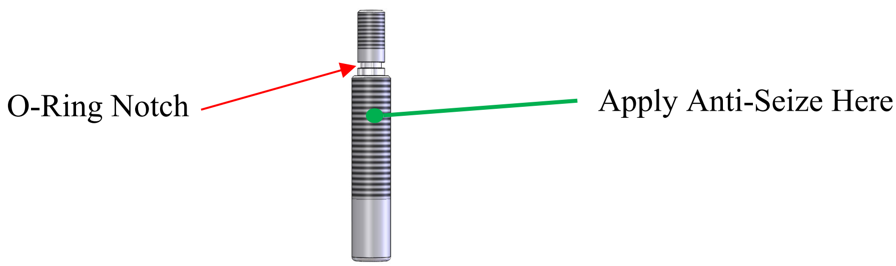


Figure 50: Adjustment Screw

16. Lightly apply a small amount of anti-seize to the threads of the adjustment screw.
17. Thread the adjustment bushing onto the adjustment screw until approximately 2 threads of the adjustment screw are visible from the top.
    a) These have left handed threads.

If the pilot valve has a lift lever, go to Section XIV e). Otherwise, continue with the following steps.

18. Lightly coat the outer surface of the adjustment bushing with a water-resistant grease similar to Aqualube. See Figure 51.

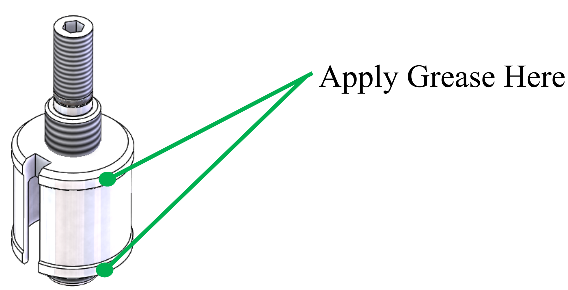


Figure 51: Adjustment Bushing

19. Carefully slip fit the adjustment screw and bushing into the bore of the bonnet by aligning the index pin of the body with the notch of the adjustment bushing.
    a) The center bushing should end against the top of the inner bonnet.
    b) The adjustment bushing must slip into the valve bore freely but with little radial play.
    c) Remove and inspect/ re-clean parts if the fit is not correct.
    d) DO NOT FORCE THE ADJUSTMENT BUSHING INTO THE VALVE BODY. Forcing the parts may restrict valve lift and **cause serious malfunction**.
20. Place the washer over the top of the bonnet and onto the adjustment screw with the rounded edge side of the washer away from the body (towards the top of the valve).
21. Thread the lock nut on over the top of the bonnet and onto the adjustment screw.
    a) DO NOT fully tighten. The lock nut just needs to be hand tight at this point, only to retain the inner bonnet components.
    b) The lock nut will be tightened once the setting process is completed.
22. Lightly apply a small amount of silicone grease to the bonnet o-ring.
23. Install the bonnet o-ring onto the bottom of the pilot bonnet. See Figure 52.
    a) The o-ring should slip over the bonnet threads.
24. Lightly apply a small amount of anti-seize to the threads of the bonnet. See Figure 52.

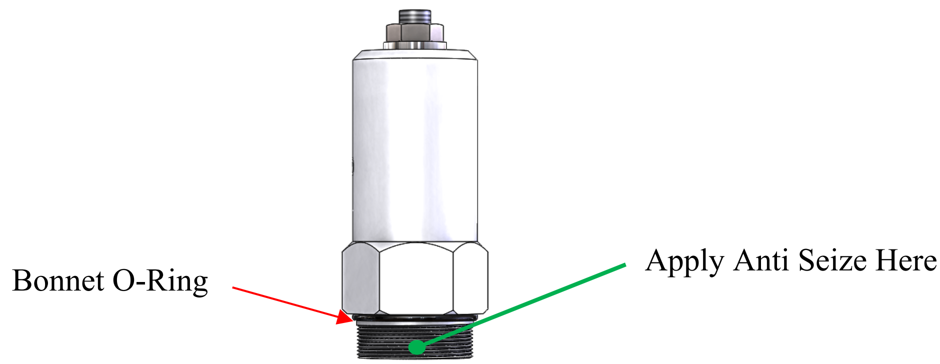


Figure 52: Snap Pilot Bonnet

25. Thread the bonnet and its internal components by hand onto the pilot body.
    a) The spring and spring guide should slide into the center of the adjustment screw.
    b) Make sure the bonnet o-ring does not get caught in the threads of the bonnet as the bonnet is tightened down.
26. Rigidly hold the body and tighten the bonnet to the value shown in Table 6.

Table 6: Pilot Bonnet Torque Value

Component	Torque, lb-ft (N-m)
Pilot Bonnet	min. 200 (270)

27. Turn the adjustment screw clockwise until resistance is felt; the spring is engaged. Turn the adjustment screw an additional 4-5 more times.

a) This is increasing the compression on the spring.

Lower Portion of Snap Pilot Valve

28. Lightly apply a small amount of silicone grease to the o-rings located on the lower cage. See Figure 31.
29. Install the two o-rings located on the lower cage.
    a) Installing the top o-ring first helps in the installation of the lower o-ring. Due to the size difference, the bottom o-ring can get stuck in the upper o-ring slot if the top o-ring is not installed first.
    b) The lower o-ring is larger in width than the top o-ring.
30. Install the shuttle into the lower cage. See Figure 33.
    a) The shuttle side goes in first with the rod sticking out of the top of the lower cage.
31. Lightly apply a small amount of silicone grease to the stationary seat o-ring.
32. Install the o-ring on the stationary seat. See Figure 32.
33. Lightly apply a small amount of anti-seize to the threads of the stationary seat. See Figure 53.

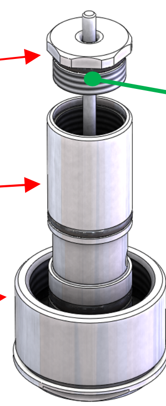


Figure 53: Lower Assembly

34. Place a 0.175 in. (4.5 mm) metal rod into the hole on the side of the lower cage to rigidly affix it and prevent rotation. See Figure 31.
    a) A 5/32" hex key works well for this.
35. With the lower cage rigidly affixed, install the stationary seat onto the lower cage. See Figure 31.
    a) The shuttle rod will stick through the center of the stationary seat.
36. Tighten the stationary seat to the value shown in Table 7.

Table 7: Stationary Seat Torque Value

Component	Torque, lb-ft (N-m) ± 5%
Stationary Seat	20 (27)

37. Check and make sure the blowdown nut spins on the lower cage with a snug fit.

   a) If the fit is too loose or too tight, the operation of the valve may be affected.
   b) The blowdown nut should have the ability to freely spin about the lower cage, but should have a limited movement in all other directions.
   c) If needed, replace the lower cage assembly.

38. Install the blowdown ring onto the blowdown nut. See Figure 54.
   a) The blowdown ring should only be able to go onto the lower cage with one orientation.
   b) The fit between the blowdown ring and blowdown nut should be snug but not so tight that free spinning is limited.

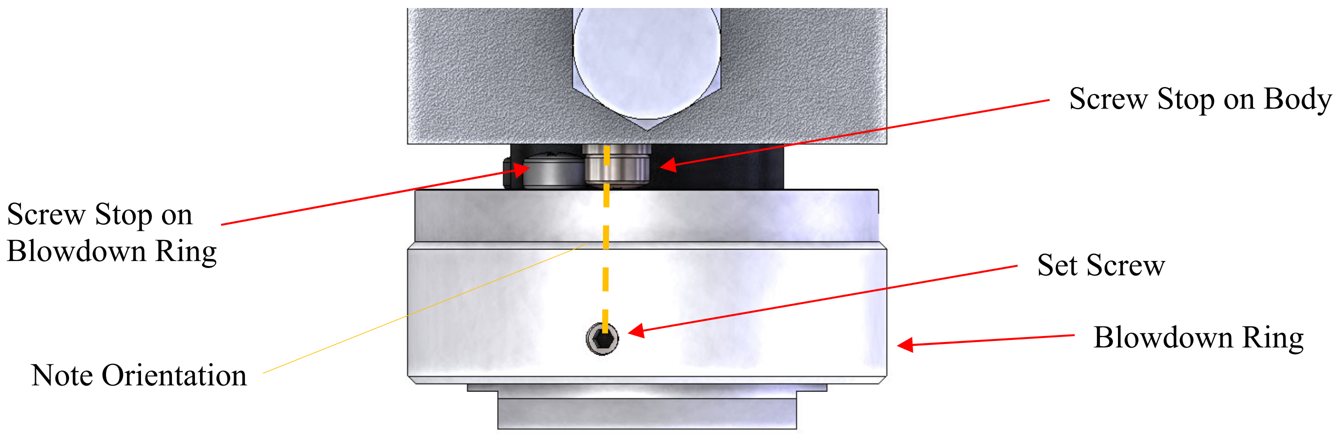


Figure 54: Initial Blowdown Ring Orientation

39. Grease the lower threads of the pilot body with anti-seize. See Figure 55.

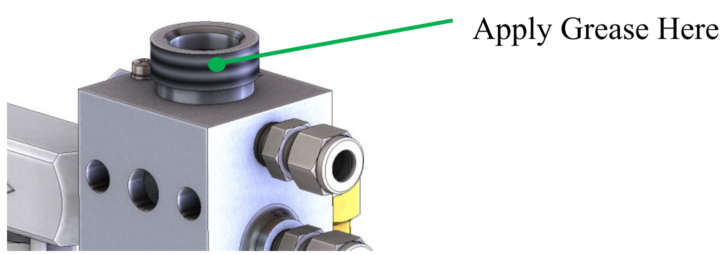


Figure 55: Lower Threads of Pilot Body (Pilot Shown Upside Down)

40. Carefully push the cage subassembly into the pilot body.
   a) Do not twist while installing, as this can cut the o-rings.
41. Turn the blowdown nut into the pilot body by hand until the shuttle rod touches the upper disk.
   a) This will be felt as resistance when turning the cage assembly in (clockwise).
   b) Make sure the blowdown ring stops are set to have the most adjustment. This can be done by aligning the set screw hole with the blowdown stop on the body as shown in Figure 54.
42. Loosen or back the blowdown nut out 1.5–2 turns.

   a) This will make the blowdown long but will give a good starting point prior to the final blowdown adjustment.

43. Apply a small amount of low strength thread retainer on the threads of the set screws for the blowdown ring and blowdown nut.
44. Install the set screws into the blowdown ring and blowdown nut but do not tighten them down.
45. Assembly is complete and the snap pilot valve is now ready to have its set pressure adjusted. See Section XV.
46. Once the snap pilot valve has been set, leak check the pilot valve.
    a) This can be done by submerging the pilot's exhaust vent under water in a cup and observing if bubbles are formed when pressure exists. Bubbles would indicate a leak in the pilot.

If the pilot valve has a lift lever, return to step 9 in Section XIV e) to install the lift lever cap before proceeding to step 47. If there is no lift lever, continue with the following steps.

47. Install the pilot valve onto the main valve by using the mounting bolts. See Figures 18 and 19.
48. Tighten the pilot mounting bolts to the value shown in Table 14.
49. Install any accessories that were equipped on the valve and tighten all fittings.
50. Recheck the set pressure of the POPRV with the pilot and all accessories attached to the main valve.

Backflow Preventer

51. Reinstall the shuttle.
52. Insert the shuttle into the bore of the BFP body.
53. Reinstall all the fittings onto the BFP body.
54. Reinstall the BFP onto the dome port on the main valve bonnet. See Figure 36.

d) Main Valve Reassembly

1. Lightly apply a small amount of silicone grease to the nozzle base o-ring.
2. Insert the new nozzle o-ring into the nozzle pocket.
3. Apply a small coat of anti-seize to the new nozzle subassembly threads. See Figure 56.

Figure 56: Nozzle/ Seat Subassembly

4. Install the nozzle subassembly into the main valve body's nozzle pocket.
5. Tighten the nozzle to the appropriate value shown in Table 8.

Table 8: Nozzle Torque Values

Nozzle Orifice	Inlet & Outlet Size	Torque, lb-ft (N-m) ± 5%
D, E, F	1x2; 1-1/2x2	200 (270)
G, H, J	1-1/2x3; 2x3	350 (475)
J, K, L	3x4	500 (680)
L, M	4x6	600 (810)
N, P	4x6; 4x6x6	600 (810)
Q, R	6x8; 6x8x8	SS - 25 (34)/ bolt; CS - 65 (88)/ bolt
T	8x10; 8x10x10	SS - 50 (68)/ bolt; CS - 130 (176)/ bolt
1-1/2" FB	1-1/2x2; 1-1/2x3; 2x3	200 (270)
2" FB	2x3	350 (475)
3" FB	3x4	500 (680)
4" FB	4x6; 4x6x6	SS - 7 (10)/ bolt; CS - 19 (26)/ bolt
6" FB	6x8; 6x8x8	SS - 25 (34)/ bolt; CS - 65 (88)/ bolt
8" FB	8x10; 8x10x10	SS - 50 (68)/ bolt; CS - 130 (176)/ bolt

*SS = Stainless Steel Body; CS = Carbon Steel Body

Piston Sleeve

Inspect the piston sleeve bore. If there are scratches or damage present, then the piston sleeve will need to be specially ordered and replaced. If the piston sleeve was removed, continue to step 6. Otherwise, skip to the next section (Reassembly of Piston Subassembly).

6. Lubricate the piston sleeve o-ring and back-up ring (if it exists) with a silicone grease.
7. Install the piston sleeve o-ring and back-up ring (if it exists).
   a) When a backup ring is being installed, it gets positioned as shown in Figure 57 with the top being towards the dome volume.

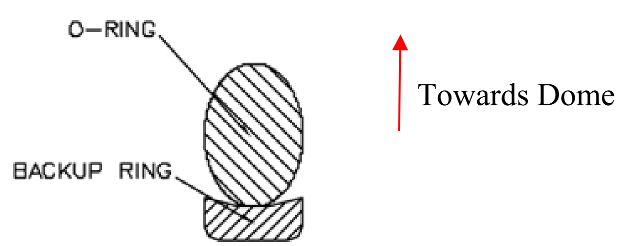


Figure 57: Proper O-Ring and Back-Up Installation Orientation

8. Apply a small amount of medium strength thread retainer on the piston sleeve's threads. See Figure 58.

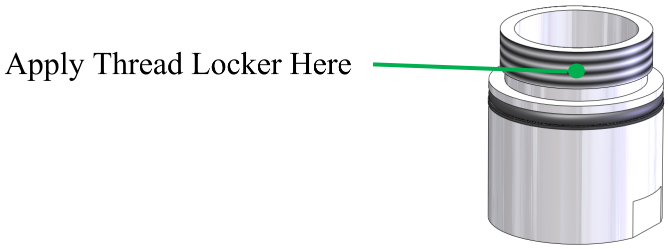


Figure 58: Piston Sleeve

9. Screw the piston sleeve by hand into the bonnet. See Figure 21.
   a) Make sure the o-rings do not get cut when installing the sleeve.
10. Tighten the piston sleeve to the appropriate value shown in Table 9.

Table 9: Piston Sleeve Torque Values

Nozzle Orifice	Inlet & Outlet Size	Torque, lb-ft (N-m)
D, E, F	1x2; 1-1/2x2	10 (14) max.
G, H, J	1-1/2x3; 2x3	35 (47) max.
J, K, L	3x4	50 (68) max.
L, M	4x6	35 (47) max.
N, P	4x6; 4x6x6	50 (68) max.
Q, R	6x8; 6x8x8	40 (54) max.
T	8x10; 8x10x10	SS - 25 (34)/ bolt; CS - 65 (88)/ bolt
1-1/2" FB	1-1/2x2; 1-1/2x3; 2x3	40 (54) max.
2" FB	2x3	35 (47) max.
3" FB	3x4	50 (68) max.
4" FB	4x6; 4x6x6	80 (110) max.
6" FB	6x8; 6x8x8	SS - 25 (34)/ bolt; CS - 65 (88)/ bolt
8" FB	8x10; 8x10x10	SS - 25 (34)/ bolt; CS - 65 (88)/ bolt

*SS = Stainless Steel Body; CS = Carbon Steel Body

Reassembly of Piston Subassembly

Inspect the piston subassembly for any damage or excessive wear. If damages are evident, the piston may need to be specially ordered and replaced. Inspect the radius on the disk for any scratches or dents. If the disk has damage that could affect the sealing, the disk should be polished or replaced. The disk can be polished with Scotch-Brite™ or a fine abrasive paper. Polishing may not remove all damages, however. **Any form of heavier cutting should not be done to restore the disk.**

If the piston was disassembled, continue to step 11. Otherwise, skip to step 20.

11. Insert the stem into the bore of the piston. See Figure 22.

12. Align the hole of the stem with the small side hole of the piston and insert a rigid pin into both parts.
    a) This is to prevent movement of the disk stem during reassembly.
13. Apply a small amount of high strength thread retainer on the male threads of the stem retaining bushing. See Figure 59.

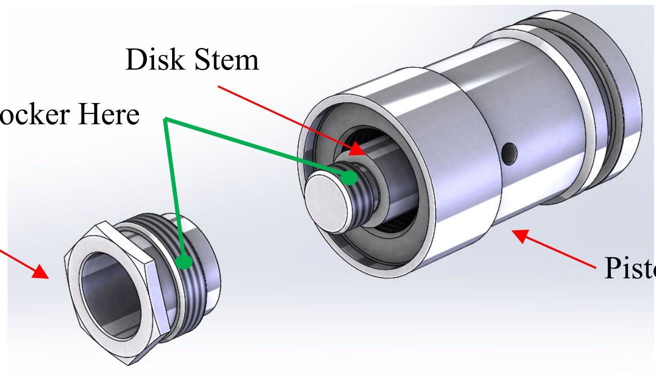


Figure 59: Disk Stem and Stem Retaining Bushing

14. Thread the retaining bushing into the piston by hand.
    a) This should keep the stem secured inside the piston.
15. Tighten the retaining bushing to the appropriate value shown in Table 10.

Table 10: Retaining Bushing Torque Values

Nozzle Orifice	Inlet & Outlet Size	Torque, lb-ft (N-m) ± 5%
D, E, F	1x2; 1-1/2x2	15 (20)
G, H, J	1-1/2x3; 2x3	100 (135)
J, K, L	3x4	100 (135)
L, M	4x6	150 (200)
N, P	4x6; 4x6x6	200 (270)
Q, R	6x8; 6x8x8	250 (340)
T	8x10; 8x10x10	10 (14)/ bolt
1-1/2" FB	1-1/2x2; 1-1/2x3; 2x3	100 (135)
2" FB	2x3	100 (135)
3" FB	3x4	200 (270)
4" FB	4x6; 4x6x6	200 (270)
6" FB	6x8; 6x8x8	10 (14)/ bolt
8" FB	8x10; 8x10x10	25 (34)/ bolt

16. Apply a small amount of high strength thread retainer on the male threads of the stem. See Figure 59.
17. Thread the disk onto the stem by hand.

18. Tighten the disk to the appropriate value shown in Table 11. Use the wrenching flats.

Table 11: Disk Torque Values

Nozzle Orifice	Inlet & Outlet Size	Torque, lb-ft (N-m) ± 5%
D, E, F	1x2; 1-1/2x2	5 (7)
G, H, J	1-1/2x3; 2x3	25 (34)
J, K, L	3x4	30 (41)
L, M	4x6	35 (47)
N, P	4x6; 4x6x6	50 (68)
Q, R	6x8; 6x8x8	50 (68)
T	8x10; 8x10x10	75 (100)
1-1/2" FB	1-1/2x2; 1-1/2x3; 2x3	30 (41)
2" FB	2x3	30 (41)
3" FB	3x4	50 (68)
4" FB	4x6; 4x6x6	50 (68)
6" FB	6x8; 6x8x8	75 (100)
8" FB	8x10; 8x10x10	100 (135)

19. Remove the pin that was inserted through the stem and the piston and let the thread retainer dry.

Reassembly of the Bonnet/ Piston

20. Lightly apply a small amount of silicone grease on the bonnet o-ring.
21. Install the bonnet o-ring.
22. Place the return spring in the top of the piston subassembly.
23. Insert the piston subassembly into the piston sleeve. See Figure 21.
    a) The piston sleeve should be attached to the main valve bonnet at this point.
    b) Make sure to keep the return spring centered in the piston.
24. Install the bonnet subassembly onto the main valve body.
    a) Make sure the piston stays in the piston sleeve when installing.
25. Either bolt or thread the bonnet onto the main valve.
26. Install the bonnet bolts, if applicable.
27. Tighten the bonnet (or bonnet bolts) to the appropriate value shown in either Table 12 or 13.

Table 12: Bonnet Bolt Torque Values

Bolt Size	Torque, lb-ft (N-m) ± 5%
5/8"-11	35 (47)
1"-8	115 (155)

Table 13: Threaded Bonnet Torque Value

Orifice Sizes	Torque, lb-ft (N-m) ± 5%
D, E, F & 1-1/2" FB	500 (680)

28. Though it isn't required by code, the main valve's lift can be checked.
    a) The lift is measured with a starting position of nozzle to disk contact.
    b) To accurately measure the lift, the soft seat may need to be compressed by cold pressing or other means. Refer to Section X g).
29. Reinstall the pilot valve onto the main valve by threading the mounting bolts by hand.
30. Tighten the pilot mounting bolts to the value shown in Table 14.

Table 14: Pilot Mounting Bolt Torque Value

Component	Torque, lb-ft (N-m) ± 5%
Snap Mounting Bolts	25 (34)

31. Reinstall any accessories that were equipped.
32. If any U-bolts are used, the U-bolt nuts should be tightened to the value shown in Table 15.

Table 15: U- Bolt Nut Torque Value

Component	Torque, lb-ft (N-m) ± 5%
U-Bolt Nut	11 (15)

33. Reinstall the tubing connections.
34. The entire assembly should now be tested for set pressure and checked for leaks.

e) Lift Lever Reassembly

If the center bushing was removed, begin with step 1. Otherwise, skip to step 4.

1. Lightly apply a small amount of silicone grease to the center bushing o-ring.
2. Carefully place the center bushing o-ring onto the center bushing.
    a) The o-ring should reside in a notch groove on the center bushing.
3. Install the center bushing over the top of the adjustment screw.
4. Lightly coat the outer surface of the adjustment bushing with a water-resistant grease similar to Aqualube.
5. Carefully slip fit the adjustment screw and other parts into the bore of the body.
    a) The adjustment bushing must slip into the valve bore freely.
    b) Remove and inspect/ re-clean parts if the fit is not correct.
    c) DO NOT FORCE THE ADJUSTMENT BUSHING INTO THE VALVE BODY. Forcing the parts may restrict valve lift and **cause serious malfunction**.

If the center bushing was removed, continue with step 6. Otherwise, skip to step 8.

6. Apply a small amount of high strength thread retainer on the threads of the center bushing only.
7. Install and tighten the lift lever lock nut against the center bushing. Tighten to the appropriate value shown in Table 17.
   a) When tightening, use the flats on the center bushing to stop the center bushing from turning.
8. Thread the lock nut onto the adjustment screw finger tight against the center bushing.
   a) Do not tighten fully.

Return to step 22 in Section XIV c).

To install a lift lever cap, the PRV must have its set pressure adjusted first.

9. Slip the seal adjustment nut over the lift rod and thread it onto the adjustment screw.
   a) The seal adjustment nut should be finger tightened so that the adjustment screw does not get turned.
10. Place the lift lever cap subassembly over the adjustment screw and lift lever lock nut.
11. Insert and tighten the three lift lever cap set screws to the value listed in Table 16. See Figure 43.

Table 16: Lift Lever Cap Set Screw Torque Value

Component	Torque, lbf-ft (N-m) ± 5%
1/4”-20 Lift Lever Cap Set Screw	6.3 (8.5)

12. Thread the stem lift nut onto the lift rod until its pin hole is aligned with the lift rod’s pin hole.
    a) It will be in light contact with the lift lever.
    b) Once installed, the lift lever should have some play in its action.
13. Insert the cotter pin through the two pin holes.
14. Slightly bend the end of the cotter pin so that it is captured within the lift rod and stem lift nut assembly.

Return to step 47 in Section XIV c).

f) Retroactively Installing an Accessory

Mercer Valve’s 9500 Series pilot operated pressure relief valves (POPRVs) can be equipped with several options, including a pressure snubber (PS) and/ or an auxiliary inlet supply filter (AF). Options are normally equipped on a POPRV at Mercer’s factory upon initial manufacturing. However, they can be added at a later time.

The order of routing the components, beginning at the inlet of the PRV, is shown below. If one of the options is not equipped, it can be eliminated from this order.

(1) Inlet Pressure Probe
(2) Auxiliary Inlet Supply Filter (option)

(3) Pressure Snubber (option)
(4) Pilot Valve
(5) Backflow Preventer (option)
(6) Bonnet Port/Dome Area

The PS and AF look similar aside from the location of the inlet port. See Figure 60 to help identify the difference between them.

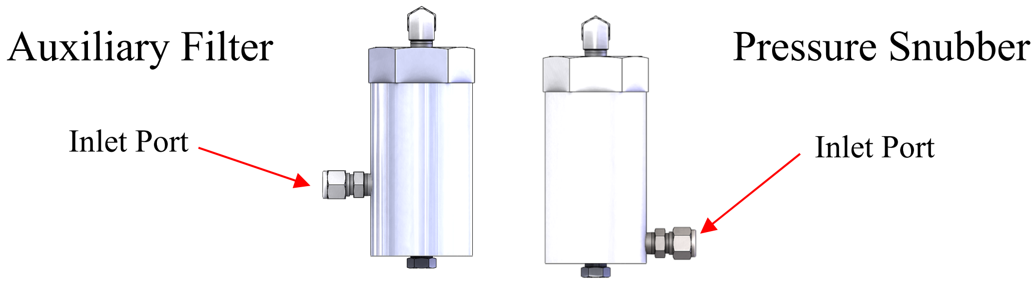


Figure 60: Auxiliary Filter Vs. Pressure Snubber

Mercer's 9500 Series POPRVs come in multiple sizes as far as orifice designation and overall body size. The actual configuration of the possible options largely depends on the size of the PRV. These instructions will display the most common configurations (as far as component locations), however, it is not reflective of all possible arrangements.

1. Remove the existing tubing connecting the pilot valve to the main valve. See Figure 61.
   a) *For threaded bonnets, continue to step 2. Otherwise, skip to step 3.*
2. Remove the bolts that hold the pilot to the main valve. See Figure 61.

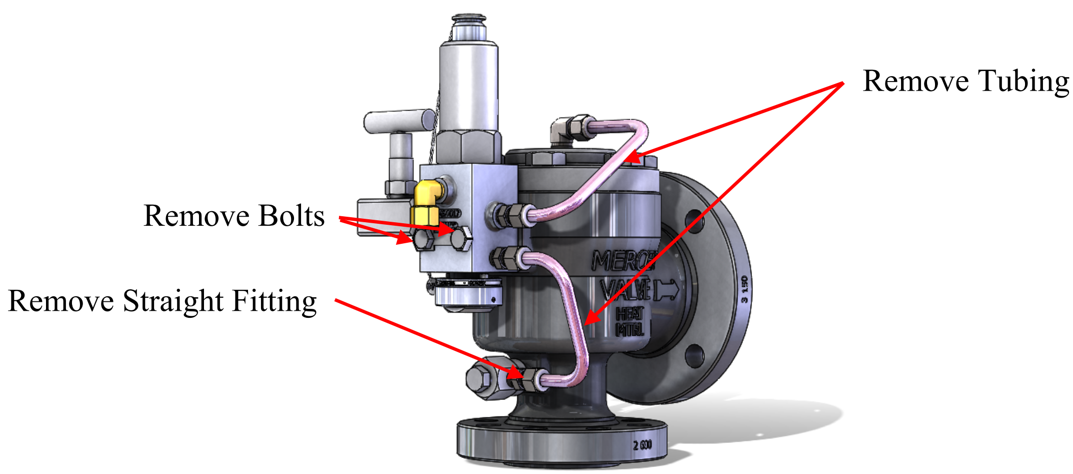


Figure 61: No Options Equipped

3. Remove the two bonnet bolts where the accessory mounting bracket is going to be located. See Figure 62.

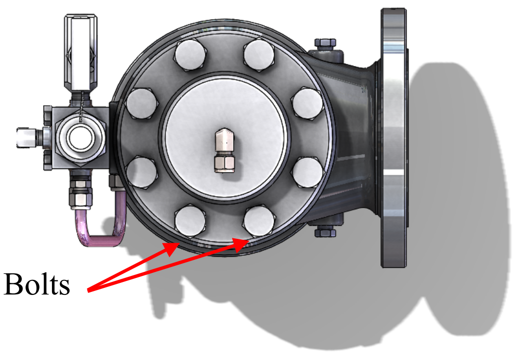


Figure 62: Bolted Bonnet - Remove Bonnet Bolts

4. Remove the 3/8” tube to 1/4” NPT straight fitting from the pressure probe. See Figure 61.
   a) The pressure probe should remain with the main valve.
5. Install the PS and/ or AF onto the mounting bracket(s) with the U-bolt included in the kit. See Figure 63.
   a) The U-bolt should be positioned around the body, not the hex cap.
   b) The fittings on the body are always oriented backwards (towards the pilot valve).
   c) The PS or AF may already be installed on the bracket from the factory.

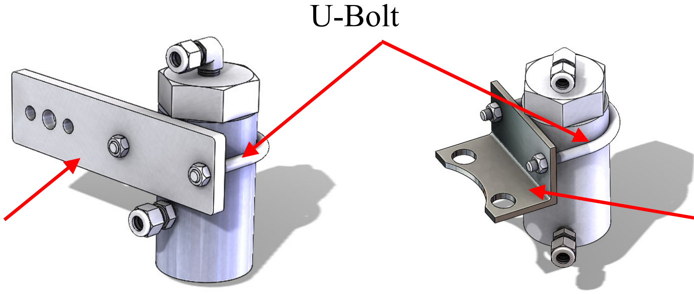


Figure 63: Accessory and Mounting Bracket

6. Install the 3/8” tube to 1/4” NPT elbow fitting included in the kit into the pressure probe. See Figure 64.
7. Install the mounting bracket with option(s) attached to the main valve:
   a) **Threaded Bonnets:** Install the bracket in between the pilot and the main valve with the new bolts supplied in the kit. See Figure 64.
   b) **Bolted Bonnets**: Install the bracket on top of the bonnet of the main valve with the new bolts supplied in the kit. See Figure 64.

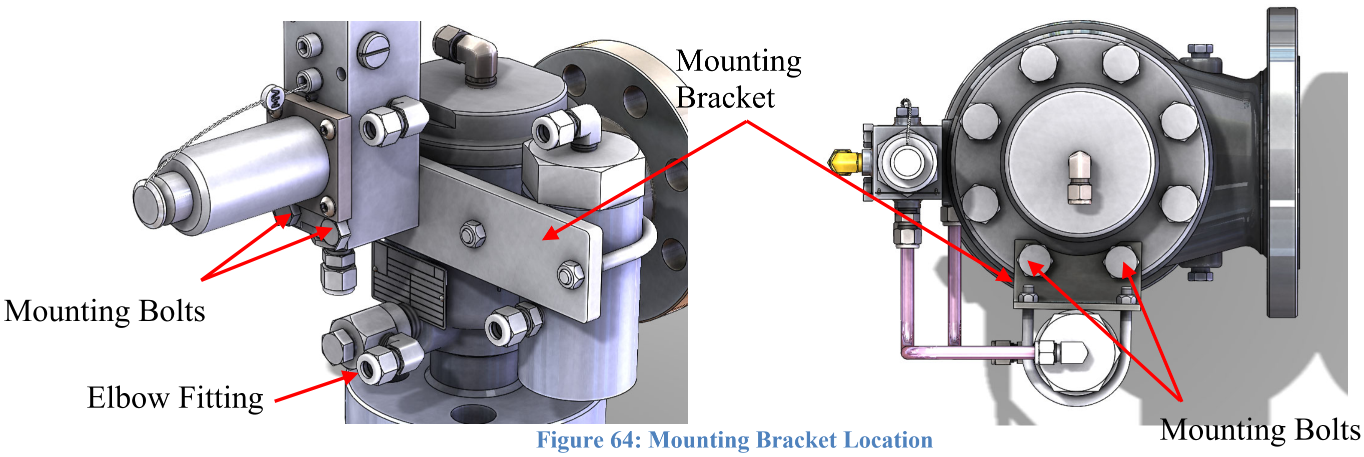


Figure 64: Mounting Bracket Location

8. Bend and install the tubing supplied in the kit to complete the flow circuit.
   a) Route components in the order listed previously.
   b) Routing path will vary with each configuration. Use simple and direct paths with "U" shaped runs.
   c) Consult Swagelok™ for more information regarding bending and fitting procedures.
9. The entire PRV should be tested for functionality and leakage before installing it onto a pressurized system.

XV. Snap Pilot Valve Setting Procedure

The idea of a snap pilot is that the main valve pops open and closed. Because pilot operated valves have a greater dome area than the main valve seat area, the dome pressure has to be reduced at the set pressure so that the forces on the piston are equaled out before the piston will move. The set pressure definition for a Mercer 9500 snap pilot operated valve is a “pop”.

Setting procedures are to be in accordance with ASME PTC 25. The ramp rate of the system pressure increase should be a slow increase when close to set pressure (within 15-20% of the set pressure). Within this range, the ramp rate should never be more than 2 psi/ sec (15 kPa/ sec). Ideally, each pressure increment on the pressure gauge should be able to be clearly read as the pressure is increased. Slow pressure increases help to accurately read the proper pressure readings.

The pilot valve will be set separately and then installed on the main valve to be verified. When setting the snap pilot, the set pressure adjustments must be completed before the blowdown adjustments are completed. Due to the volumes in test stands, the only way to properly set the blowdown of the valve is to set it on the pilot only.

Cold Differential Test Pressure (CDTP)

Some variables can affect the set pressure of the valve. For example, high temperatures cause materials to relax, causing a set pressure change. The cold differential test pressure is a compensation made to the set pressure for backpressure and temperature present on the valve when it is in service.

The CDTP is the pressure that the valve will go off at without the backpressure and temperature of the service conditions, i.e., when the valve is being set on a test stand. For pilot operated valves, the set pressure is not affected by backpressure. The temperature is all that is compensated for by a CDTP in pilot operated valves.

Setting the Snap Pilot Only

1. Install the pilot valve onto a test stand similar to the one shown in Figure 14.
   a) There will need to be a gauge on the inlet (system) pressure side and the dome pressure side.
2. Make sure the spring tension is above the set pressure.
   a) Turn the adjustment screw clockwise to add spring tension.
3. Bring the pressure up to the bench test pressure.
   a) When the pressure is increasing, the dome and inlet pressure gauges will track together.
4. Slowly reduce the spring tension by turning the adjustment screw counter clockwise. Turn the adjustment screw counter clockwise until the pilot pops open.
5. When the valve opens, the dome pressure should go to zero but the system should stay pressurized.
   a) If the dome pressure does not go to zero or if the valve reseats immediately, the blowdown may be in too far.

   b) The blowdown may have to be adjusted before finishing the set pressure adjustment.
6. Vent the inlet pressure until the upper seat re-seats and the dome is pressurized again.
7. Increase the inlet pressure until the pilot valve pops open again to verify set pressure.
   a) If the valve opens at the correct bench test pressure, then the set pressure has been set correctly and the lock nut can be tightened.
   b) Tighten the lock nut to the appropriate value shown in Table 17. When tightening, use an Allen wrench or the two jam nuts to prevent the adjustment screw from rotating so that the pilot set pressure will not be changed.

Table 17: Lock Nut Torque Values

Component	Torque, lb-ft (N-m) ± 5%
Lock Nut	25 (34)
Lift Lever Lock Nut	80 (108)

8. The pressure should then be vented and set pressure should be re-verified.
   a) This should be repeated a few times.
   b) If the set pressure is incorrect, the set pressure needs to be readjusted.
   c) This procedure of opening and venting should be repeated until the set pressure is correct and verified.
9. Once the pilot's set pressure has been adjusted, the blowdown can be set.
   a) Make sure that the valve has been popped and the dome pressure is at zero.
10. Bring the inlet pressure to 5% below the nameplate set pressure.
    a) This should be a larger percentage below the actual bench test pressure.
11. Turn the blowdown nut until the upper seat re-seats and the dome pressure returns.
12. Bring the inlet pressure back up to pop open the pilot valve and observe where the valve re-seats.
    a) Make sure both the set and reseat pressures are at the appropriate numbers. If not, make any necessary adjustments.
    b) The difference between the set pressure and reseat pressure is the blowdown.
13. The blowdown and set pressure should be verified 3-4 times to make sure that they are correct.
    a) If any adjustments are made, the pilot valve should be re-verified each time.
14. Remove the set screw that is located on the side of the blowdown ring.
15. Place a drop of medium strength thread locker on the threads of the blowdown ring set screw. See Figures 29 and 54.
16. Install and tighten the blowdown ring set screw with the blowdown ring in the shortest adjustment setting. See Figure 54.
    a) This orientation will be when the valve is fully turned to its right until it hits the stop.
    b) The decreasing direction yields the shortest blowdown. The shortest blowdown is 5% which was adjusted in the preceding steps.

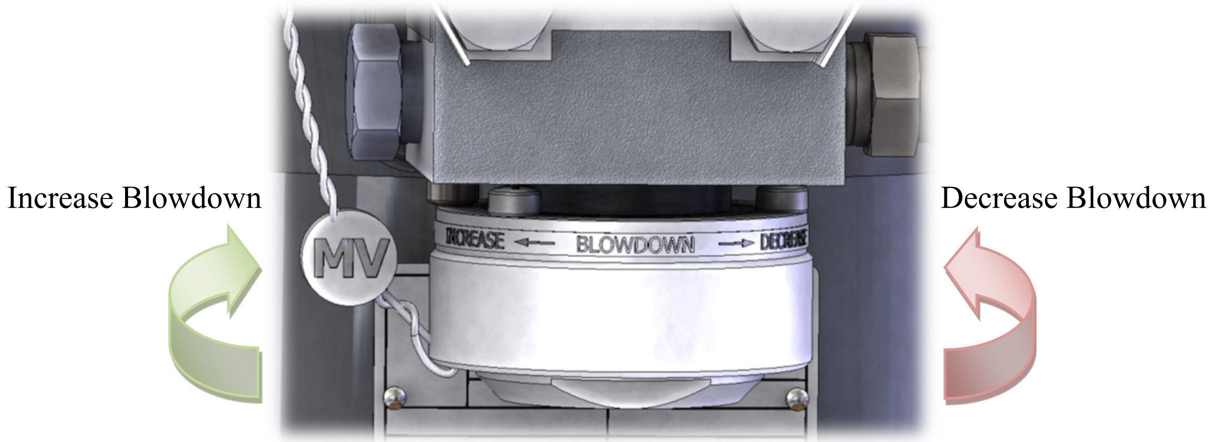


Figure 65: Blowdown Ring and Adjustments

17. Turn the blowdown ring to the longest (increasing) blowdown.
    a) The blowdown nut should now move with the blowdown ring.
18. Verify proper function of the valve.
    a) If the valve does not function properly, then move the blowdown ring to the short adjustment setting and redo the blowdown settings.
19. Once the valve is determined to be functioning properly, turn the blowdown ring to the short blowdown setting.
20. Remove the set screw on the bottom of the blowdown nut.
21. Apply a drop of medium strength thread locker to the threads of the blowdown nut set screw.
22. Reinstall the blowdown nut set screw back into the bottom of the blowdown nut and tighten.
23. After the pilot is set, thread the pilot cap onto the adjustment screw.
    a) If the pilot is a lift lever configuration, go to step 9 in Section XIV e).
24. Leak check the pilot.
    a) This can be done by submerging the pilot's exhaust vent under water in a cup and observing if bubbles are formed when pressure exists. Bubbles would indicate a leak in the pilot.
25. The pilot valve can now be installed onto the main valve using a new back-off clip and the mounting bolts as shown in Figure 18.
26. Recheck the set pressure and leak check the POPRV with the pilot and all accessories attached to the main valve.
27. Wire a seal wire from the pilot cap to the blowdown ring.

XVI. Tag Information

Information and identification about the valve can be found on the tag, also called the nameplate. This information can be used to verify if the valve is installed in the proper service. It also can be used to get an appropriate replacement. A POPRV will have two tags, one is located on the main valve and the other is located on the pilot valve.

A PRV's original nameplate must always remain attached. If changes are made that would alter its information, such as the part number, the original information should be crossed out but left legible. The updated information should either be stamped on the original or on an attached repair nameplate. The information on the tag is as follows:

- Product Number (PN) – This indicates the series and identifies the configuration of the valve.
- Serial Number (Serial No.) – This will be a unique identifier to the valve and provides a means of traceability through Mercer Valve Co., Inc.
- Set Pressure (Set P.) – Identifies the set pressure of the valve while in its service conditions.
- Cold Differential Test Pressure (CDTP) – This indicates the bench test pressure that was used to compensate for temperature and/ or backpressure of the service conditions.
- Backpressure (Back Press) – This indicates possible pressure in the valve's outlet.
- Valve Capacity (CAP. Air/ Water) – This indicates the capacity of the valve at standard atmospheric conditions of air for gas service valves or water for liquid service valves.
- Service Temperature (Service Temp) – This indicates the valve's normal operating condition. It is not a temperature limit.
- Size – This indicates the nominal inlet size of the valve.
- Repair Kit (Repair Kit No.) – This designates the associated repair kit for the product number.
- Date – This indicates the month and year the valve was made.
- CRN – This is the Canadian Registration Number.

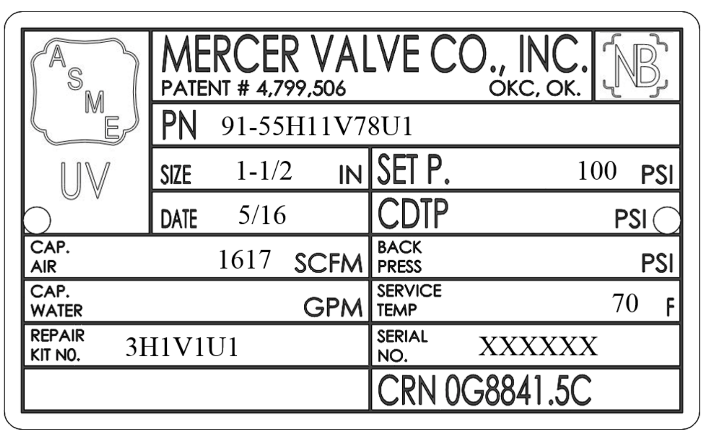


Figure 66: Example Tag

XVII. Basic Product Number System

Not all code combinations are valid product numbers. Not all possible configurations are shown. Consult Mercer Valve Co., Inc. for any questions on valid product number configurations.

Other company names and product names used in this document are registered trademarks or tradenames of their respective owners.

a) Main Valve Product Numbering

95 - 27 D 1 3 0 7 ___ S ___ ___

Inlet & Outlet Combination

Orifice Designation
- D through T
- or
- 1 - 1.5" FB
- 2 - 2" FB
- 3 - 3" FB
- 4 - 4" FB
- 6 - 6" FB
- 8 - 8" FB

Flange Type
- 1 - RF X RF
- 2 - RTJ X RTJ
- 3 - RTJ X RF

Body Material
- 3 - WCB Carbon Steel
- 4 - CF3M Stainless Steel
- 5 - LCC Carbon Steel

Options
- 0 - No Options
- 1 - Backflow Preventer
- 2 - Pressure Snubber
- 3 - Auxiliary Filter
- 4 - 1 & 2
- 5 - 1 & 3
- 6 - 2 & 3
- 7 - 1, 2, & 3

Seat Material
- 7 - PTFE
- 8 - FKM
- 9 - PEEK
- N - Neoprene
- B - Buna
- E - EPDM
- Y - Vespel

Sour Service Trim
- (Blank) - Non-Sour Service
- N - Sour Service

Pilot Type
- S - Snap Action
- M- Modulating
- L - Liquid Modulating

O-Ring Material
- (Blank) - Standard
- 3 - Peroxide Cured Buna
- 5 - Low Temp Buna
- 6 - FFKM
- 7 - FKM ED
- 9 - Neoprene
- C - EPDM
- K - James Walker Elast-O-Lion HNBR

Two Digit Special Code
- If Applicable
- (Assigned by Mercer)

Note:
1) Fluorocarbon (FKM) o-rings supplied with seat codes 7, 8, 9, and Y.
2) Seat codes N, B, and E receive like material o-rings. No o-ring code required.

b) Snap Pilot Valve Product Numbering

G - 1 A 0 0 0 07 ___ ___ ___

Body/ Bonnet Material
- 1 - CF3M/ CS
- 2 - CF3M/ 316 SS

Upper/ Lower Seat
- 1 - FKM/ FKM
- 5 - Buna/ Buna
- 6 - EPDM/ EPDM
- 7 - Neoprene/ Neoprene
- 8 - PC Buna/ PC Buna
- 9 - FFKM/ FFKM
- A - FKM/ PTFE
- H - James Walker/ PTFE
- D - Buna/ PTFE
- E - EPDM/ PTFE
- P - PC Buna/ PTFE
- K - FFKM/ PTFE
- V - FKM/ Vespel
- J - James Walker/ Vespel
- B - Buna/ Vespel
- G - EPDM/ Vespel
- T - PC Buna/ Vespel
- X - FFKM/ Vespel

Blowdown Type
- 0 - Standard (None)
- 1 - Manual Blowdown Valve
- 2 - Remote Blowdown Valve
- 3 - Lift Lever

Field Test Connection
- 0 - None
- 1 - Standard
- 2 - Offshore

Test Accessories
- 0 - None
- 1 - Test Gag

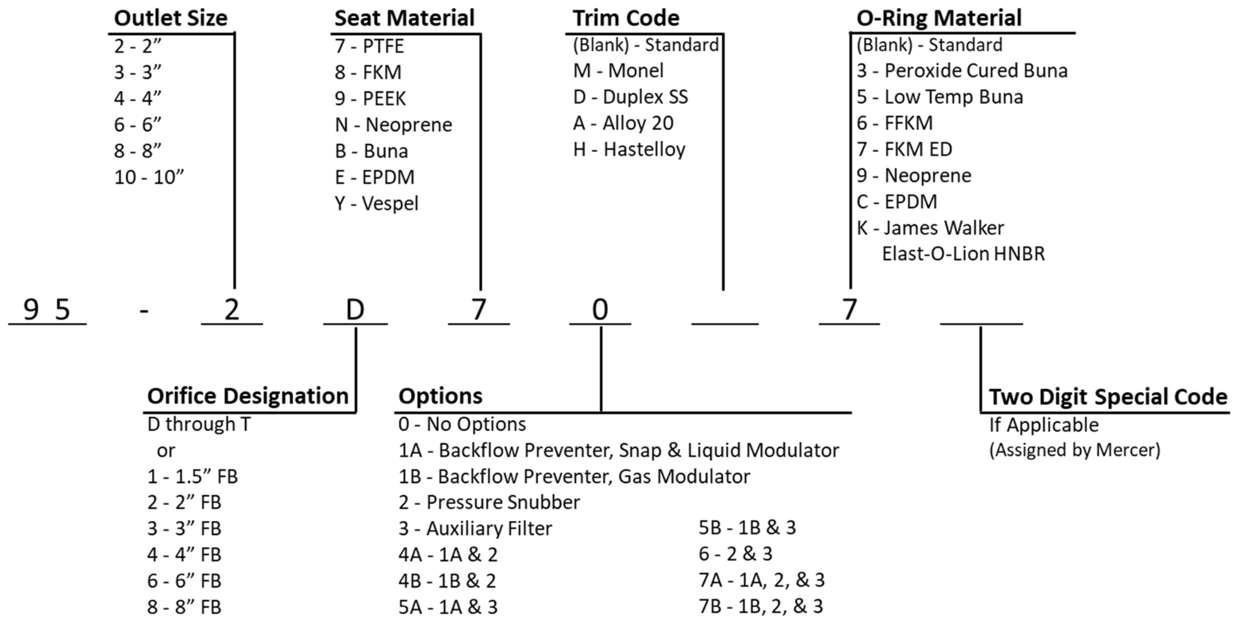
Spring Code

Sour Service Trim
- (Blank) - Non-Sour Service
- N - Sour Service

O-Ring Material
- (Blank) - Standard
- 7 - FKM ED

Two Digit Special Code
- If Applicable
- (Assigned by Mercer)

c) Main Valve Repair Kit Product Numbering



Note:
1) Fluorocarbon (FKM) o-rings supplied with seat codes 7, 8, 9, and Y.
2) Seat codes N, B, and E receive like material o-rings. No o-ring code required.

Parts Included in the Repair Kit:

(1) Nozzle Subassembly
(2) Complete Set of O-Rings
(3) Filter Subassembly

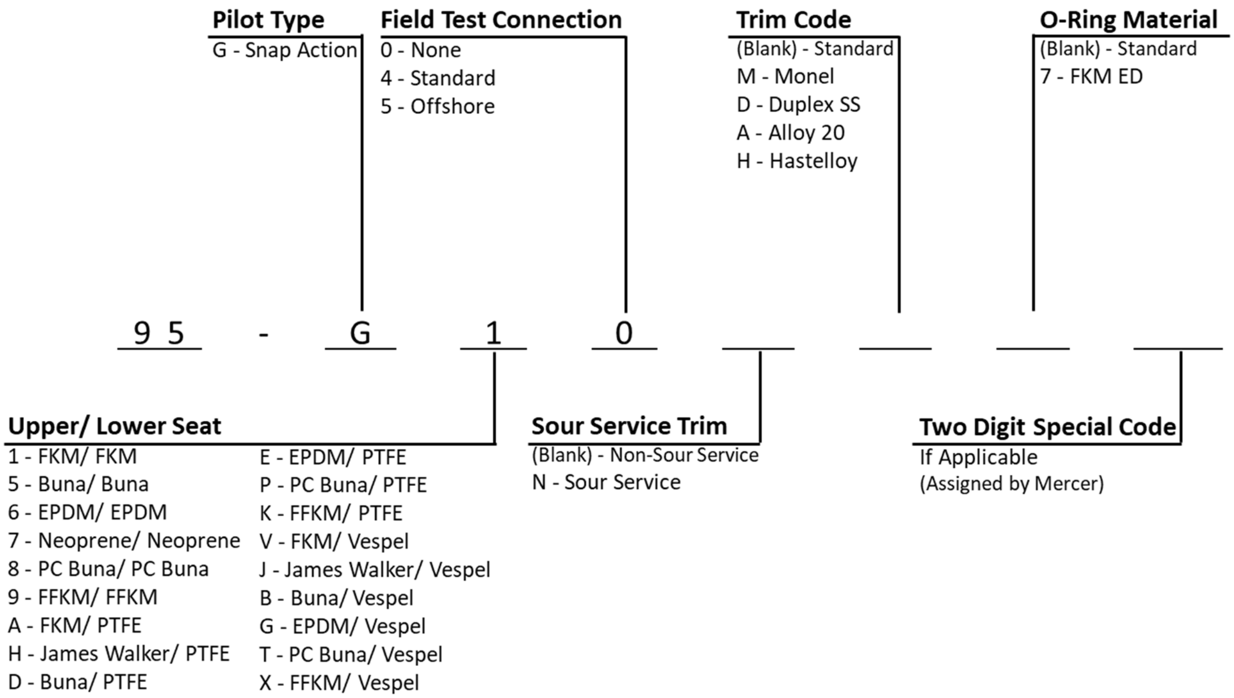
<u>NOTE:</u>

FOR Q AND R ORIFICE ONLY, ADD “B” FOR BOLTED NOZZLE (9/2005 & AFTER) AND “T” FOR THREADED NOZZLE (8/2005 AND BEFORE) TO THE END OF KIT NUMBER. ADD SPECIAL CODE “B” OR “T”, IF APPLICABLE.

Parts for Accessories Repair:

1. Backflow Preventer (BFP)
   - 2-009 O-Ring (2)
   - Shuttle (1)
   - Fitting (2)
2. Pressure Snubber
   - 2-133 O-Ring (1)
   - 2-031 O-Ring (4)
3. Auxiliary Pilot Filter
   a. 2-133 O-Ring (1)
   b. 95-629001 Filter (1)

d) Snap Pilot Valve Repair Kit Product Numbering



Parts Included in Repair Kit:

1. Upper Nozzle Subassembly
2. Upper Disk
3. Disk Guide Bushing
4. Shuttle
5. Back Off Clip
6. Pilot Body Filters
7. Complete set of O-Rings

Field Test Connection (FTC):

- Standard FTC includes molded seal in snap pilot shuttle
- Off-Shore FTC includes slotted snap pilot shuttle

XVIII. Exploded Views

a) Main Valve

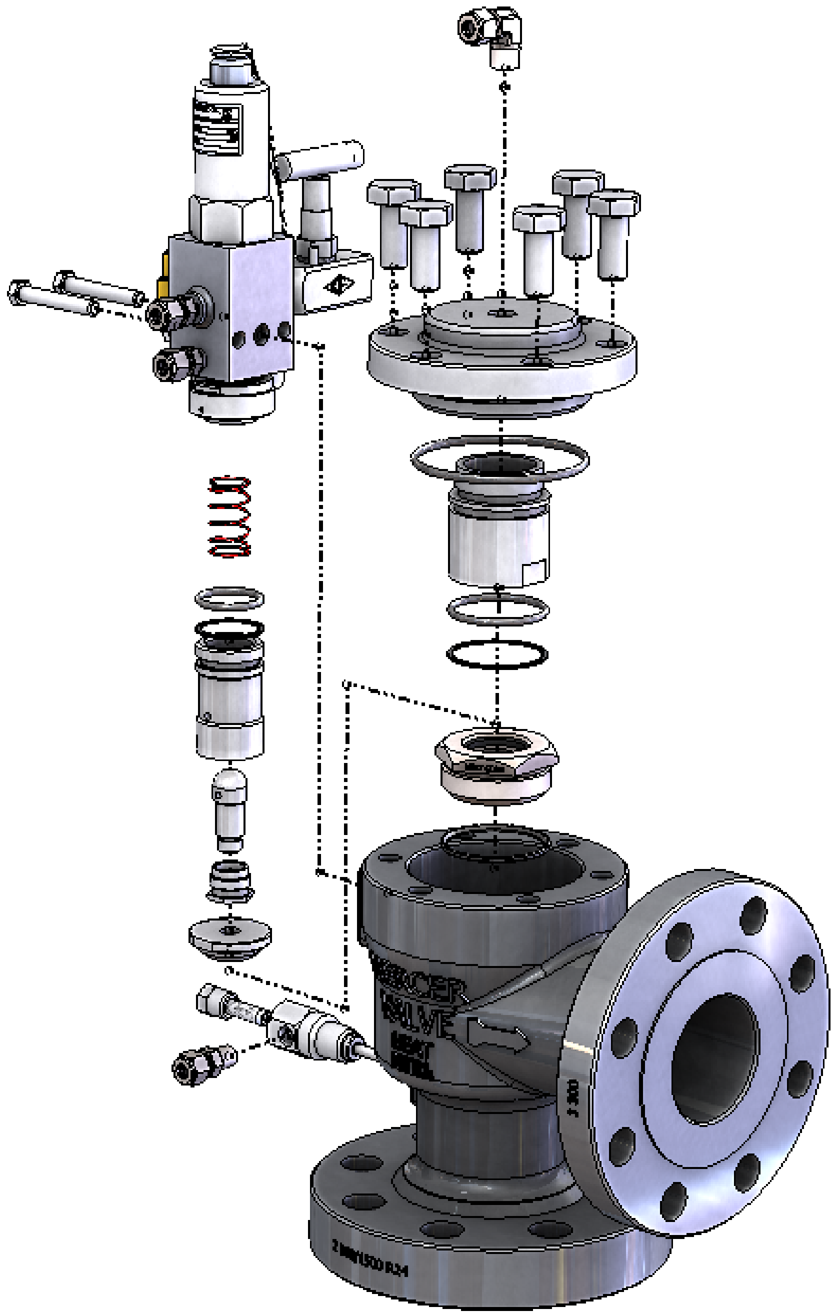


Figure 67: Exploded View of Main Valve

b) Snap Pilot Valve

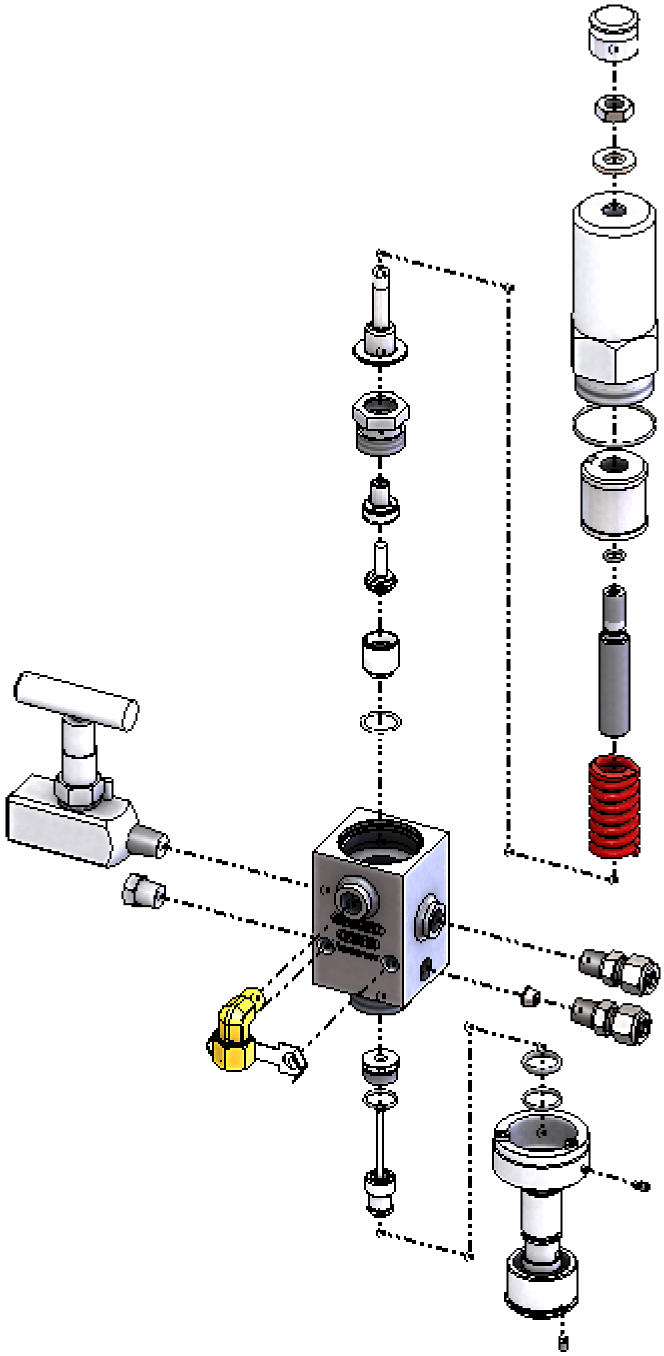


Figure 68: Exploded View of Snap Pilot Valve

XIX. Cutaway Views

a) Main Valve

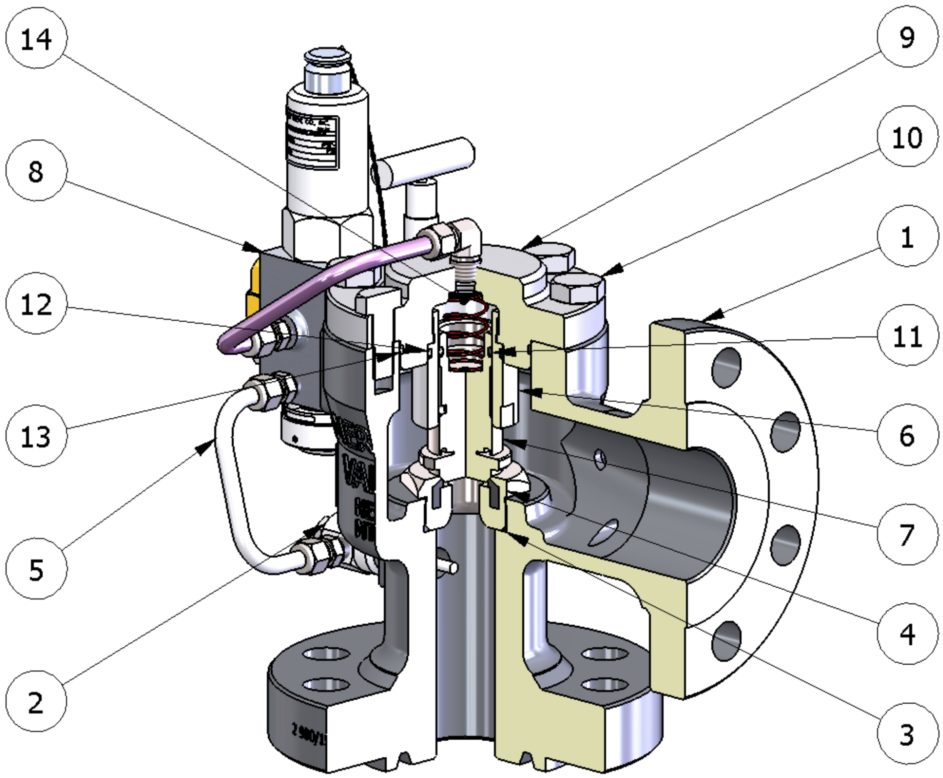


Figure 69: Cutaway View of Main Valve

Item No.	Part Name	Standard Materials
1	Main Valve Body	Carbon Steel
2	Pressure Probe Subassembly	Carbon Steel w/ Stainless Steel Trim
3	Nozzle Pocket O-Ring	Fluorocarbon
4	Nozzle Subassembly	Stainless Steel w/ Soft Seat
5	Pressure Sensing Line	Stainless Steel
6	Piston Sleeve	Stainless Steel w/ Nedox® Coating
7	Piston Subassembly	Stainless Steel
8	Snap Pilot Valve	-
9	Main Valve Bonnet	Carbon Steel
10	Bonnet Bolts	Carbon Steel
11	Piston O-Ring	Fluorocarbon
12	Piston Sleeve O-Ring	Fluorocarbon
13	Bonnet O-Ring	Fluorocarbon
14	Return Spring	Stainless Steel

b) Snap Pilot Valve

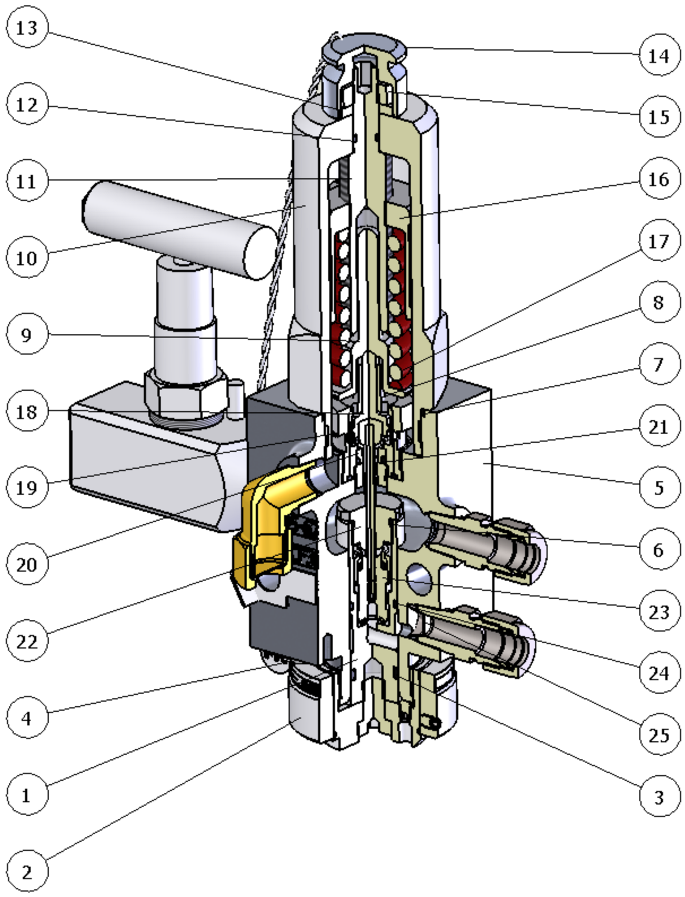


Figure 70: Cutaway View of Snap Pilot Valve

Item No	Part Name	Standard Materials	Item No	Part Name	Standard Materials
1	Cage Subassembly	Stainless Steel	14	Closed Cap	Aluminum
2	Blowdown Adjustment Ring	Carbon Steel	15	Lock Nut	Stainless Steel
3	Cage Lower O-Ring	Fluorocarbon	16	Adjustment Bushing	Stainless Steel
4	Blowdown Stop	Carbon Steel	17	Set Spring	Stainless Steel
5	Snap Pilot Body	Stainless Steel	18	Upper Disk	Stainless Steel
6	Stationary Seat O-Ring	Fluorocarbon	19	Retention Nut	Stainless Steel
7	Bonnet O-Ring	Fluorocarbon	20	Upper Nozzle Subassembly	Stainless Steel
8	Disk Guide	Stainless Steel	21	Upper Nozzle O-Ring	Fluorocarbon
9	Spring Guide Subassembly	Stainless Steel	22	Stationary Seat	Fluorocarbon
10	Bonnet Subassembly	Carbon Steel	23	Shuttle Subassembly	Stainless Steel
11	Adjustment Screw	Stainless Steel	24	Cage Upper O-Ring	Fluorocarbon
12	Adjustment Screw O-Ring	Fluorocarbon	25	Pilot Body Filter	Stainless Steel
13	Washer	Carbon Steel			

XX. O-Ring Reference Guide

The following can be used as a quick guide in determining the o-ring usage within the pilot valve. These are all included in a repair kit. Figure 71 outlines the o-rings and is approximately a 1:1 scale which can be used to identify each of the o-rings.

Table 18: Repair Kit O-rings in Snap Pilot

Inner Diameter, in. (mm)	Width, in. (mm)	Location/ Description	Reference ID
5/8 (15.54)	3/32 (2.62	Lower Cage (Bottom)	A
13/16 (20.29)	3/32 (2.62)	Lower Cage (Top) & Upper Seat	B
9/16 (14.00)	1/16 (1.78)	Stationary Seat	C
1-5/8 (41.00)	1/16 (1.78)	Bonnet Base	D
5/16 (7.65)	1/16 (1.78)	Adjustment Screw	E

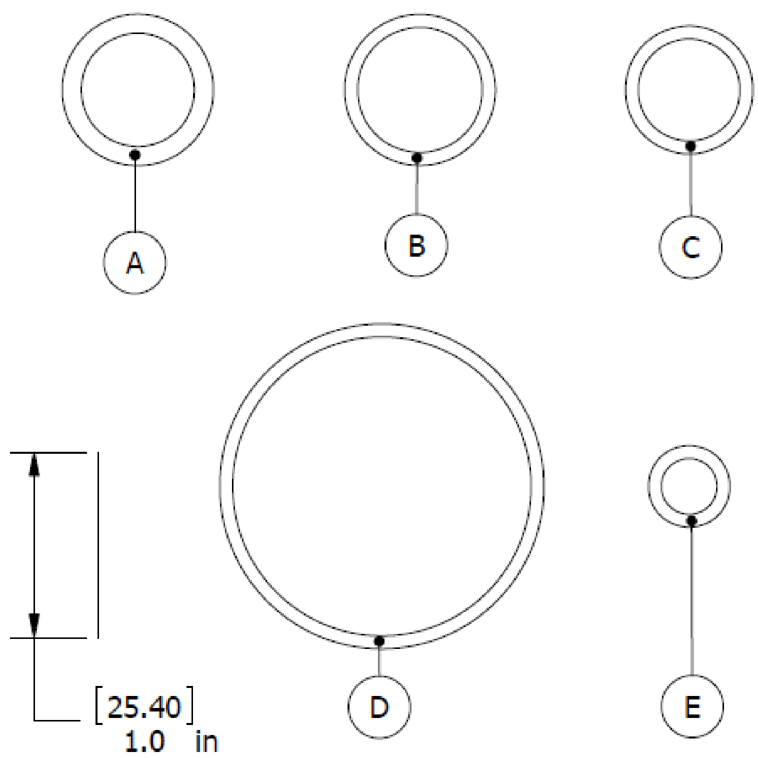


Figure 71: Snap Pilot O-Rings

XXI. Trouble Shooting Guide

The following describes some, but not all, problems that could occur in PRVs. This list is not exhaustive. Complicated problems and causes may exist, which require more involved solutions.

- Always take the proper safety precautions when working with PRVs.
- Always work on the valve within a controlled environment, not on an active pressurized system.

1) Symptom
a) Possible Cause (ordered by priority)
i) Solution (ordered by priority)

1) There is a leak coming from the main valve on initial startup.
a) The disk is not initially fully seated against the nozzle.
i) Push the piston down against the nozzle seat by pressurizing the dome or manually pushing the disk and piston down when no pressure is present.
ii) Check main valve seat and replace if needed. It is possible during startup for debris in the system to be blown through and cut the main valve seat.
b) The backflow preventer (BFP) is allowing blow-by.
i) Make sure the BFP shuttle is seated against either side of its seals; when shuttle is centered, blow-by can occur.
ii) Check and replace backflow preventer seals.
c) A pilot accessory is delaying signal to the pilot.
i) Give reasonable time for pressure to work its way through all accessories.

2) There is a leak coming from the main valve.
a) The main valve seat is leaking.
i) Inspect disk and nozzle seat for damages; replace if needed.
b) The dome area is leaking.
i) Check and/ or replace piston seal o-rings.
ii) Check and/ or replace piston sleeve seal o-rings.

3) There is a leak coming from the dome vent of the pilot valve.
a) An o-ring is cut or missing
i) Inspect the pilot seals for cuts or other possible causes of leakage; replace if needed.
b) The upper seat is leaking.
i) Inspect the upper disk for signs of abrasions; polish or replace if needed.

4) The valve is relieving at a pressure lower than the set pressure tolerance allows (-2 psi or -3% of set pressure, whichever is greater).
a) A fitting is leaking.
i) Make sure that all fittings are tight and have the appropriate sealing element.
b) The pilot valve's settings are not correct.

      i) Recheck the set pressure.
   c) There are blockages in a port(s), filter(s), or sensing line(s).
      i) Remove filters and lines and ensure that they are clean. Check ports and passages for blockages and make sure they are clean.
      ii) Make sure the environment is not causing freezing within the tubing lines.
   d) Pressure pulses/ spikes are causing valve to relieve.
      i) Check and make sure the operating conditions are suitable for the valve.
      ii) Install a pressure snubber.
   e) Vibrations are causing the valve to relieve.
      i) Check and make sure the operating conditions are suitable for the valve.
      ii) Remote mount pilot valve and accessories to isolate it away from vibrations.
   f) Vibrations are causing stresses in either the sensing lines or accessory mounting brackets. This is causing either cracking or breaking of the sensing line, which leads to leaking of the dome pressure.
      i) Remote mount pilot valve and accessories to isolate it away from vibrations.
      ii) Utilize flexible lines to absorb some of the vibrations.

5) **The valve is relieving at a pressure higher than the set pressure tolerance allows (+2 psi or +3% of set pressure, whichever is greater).**
   a) A fitting is leaking.
      i) Make sure that all fittings are tight and have the appropriate sealing element.
   b) The pilot valve's settings are not correct.
      i) Recheck the set pressure.
   c) There are blockages in a port(s), filter(s), or sensing line(s).
      i) Remove filters and lines and ensure that they are clean. Check ports and passages for blockages and make sure they are clean.
      ii) Make sure the environment is not causing freezing within the tubing lines.

6) **The valve is opening below set pressure and is back flowing into the system.**
   a) Superimposed backpressure is higher than the operating pressure.
      i) Add a backflow preventer. (Total backpressure must not exceed 30% of the set pressure when a backflow preventer is installed).

This page was intentionally left blank.

MERCER VALVE COMPANY, INC.
9500 SERIES SNAP PILOT PRESSURE RELIEF VALVE
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

MERCER VALVE CO., INC.®

"AUTO SEAT TECHNOLOGY"®

CORPORATE HEADQUARTERS

9609 NW 4th STREET

OKLAHOMA CITY, OK 73127

1-800-833-6402

PHONE: (405) 495-6533, FAX: (405) 495-8728

SALES@MERCERVALVE.NET

FOR MORE INFORMATION PLEASE VISIT OUR WEBSITE AT

WWW.MERCERVALVE.NET