CLEAN AIR AND GAS REGULATORS

A comprehensive overview of Point of Use Clean Gas Regulators and Self-Relieving Regulators

STERIFLOW

How do standard POU regulators function? What are the basic components?

Figure 1 illustrates a standard off-the-shelf clean gas regulator: These regulators are usually constructed of, and certified to the following standards: 316L barstock material with a 20 Ra µin (0,5 Ra µm) Electropolished finish for the body and wetted trim (stem and plug). The diaphragm and soft seat are FDA and USP Class VI certified thermoplastics and elastomers.

The PRV in Figure 1 is shown in a closed position. However, if that regulator were actually sitting on a work bench at atmospheric pressure it would normally be open. That's because the Main spring force (pushing down on the diaphragm) exceeds the opposing force from the small, non-adjustable return spring, and more significantly, the pressure on the underside of the diaphragm... the pressure from the outlet side of the of the valve. Since the stem and plug are affected by, and connected to the position of the diaphragm, the main spring ultimately pushes the stem and plug in a downward direction, away from the soft seat insert, opening the valve.

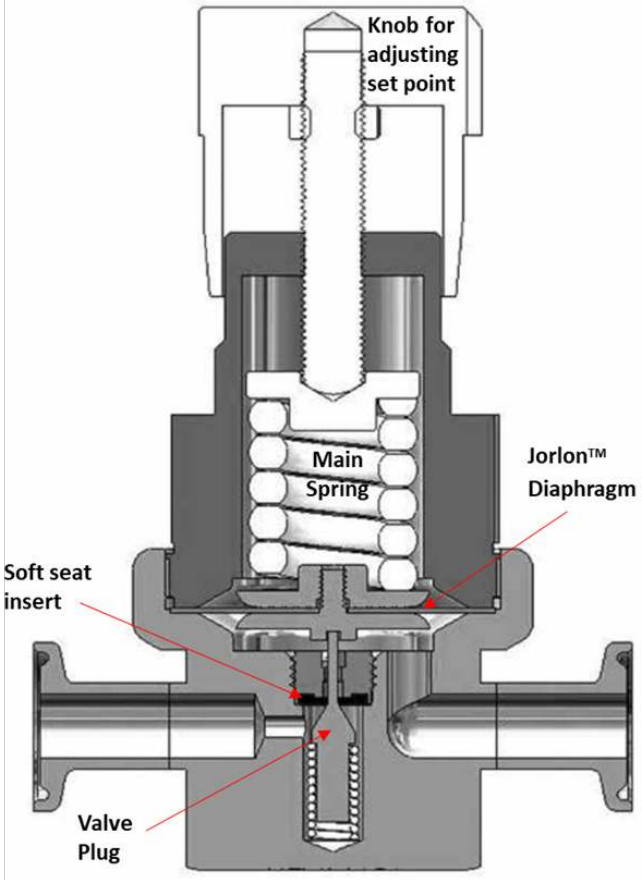

Figure 1: Cut-away view of clean gas, POU pressure reducing valve shown in closed position

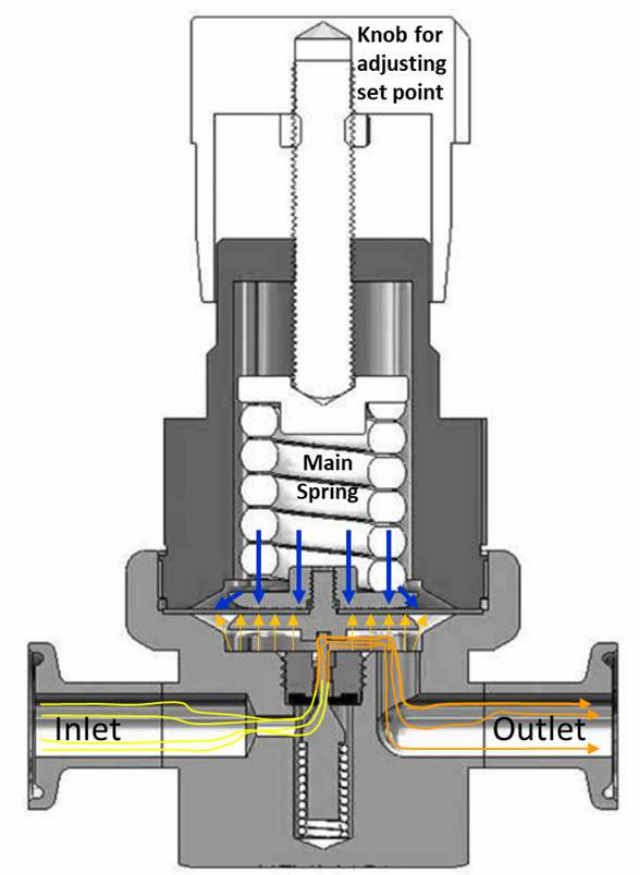

Figure 1: Cut-away view of clean gas, POU pressure reducing valve shown in open position

Installed, and under operating conditions the principals are the same but the action is a little different. Gas will flow through a PRV as long as the outlet pressure is lower than the main spring force – the set point. As the outlet pressure increases and rises to the valve's set point, the diaphragm is pushed upward with the stem and plug following (in a closing direction), until the forces are in balance. When the forces are balanced the force exerted by the main spring (the set point pressure) is equal to the force exerted by the outlet pressure. The diaphragm and plug will stay in that position as long as the flow rate stays the same.

If flow ultimately stops, for example if someone closes a valve downstream of the regulator, the regulator will close but not before some of the upstream pressure leaks across the orifice. This is called Lock-up. Also, even though most clean gas regulators have ANSI/FCI class VI shut off, ultimately when closed, there will be slight leakage - that depending upon downstream volume, will allow upstream pressure to ultimately equalize across the seat. If your installation requires a Safety Relief Valve (SRV) downstream of the regulator it is important to know about this affect.

Next, we will discuss ways to alleviate, and prevent this build up in pressure.

What is a Self-Relieving regulator? What function does the Self-Relieving option provide? Why would you choose that option?

Let's take a look and find out.

Figure 1 illustrates the typical physical characteristics of a PRV with the Self-relieving option. That's the option that's available on Steriflow's Point of Use Gas Regulators. This particular drawing shows the cutaway view of that option in our JSRLF model, but the JSRLFLP, JSR and JSRLP all function in a similar manner.

Figure 1 also illustrates all gas regulators (PRV's) in the closed position. When a gas regulator is installed and operating, closure occurs when flow stops. The main valve plug seats against the valves Soft Seat main orifice preventing upstream gas from leaking through (1).

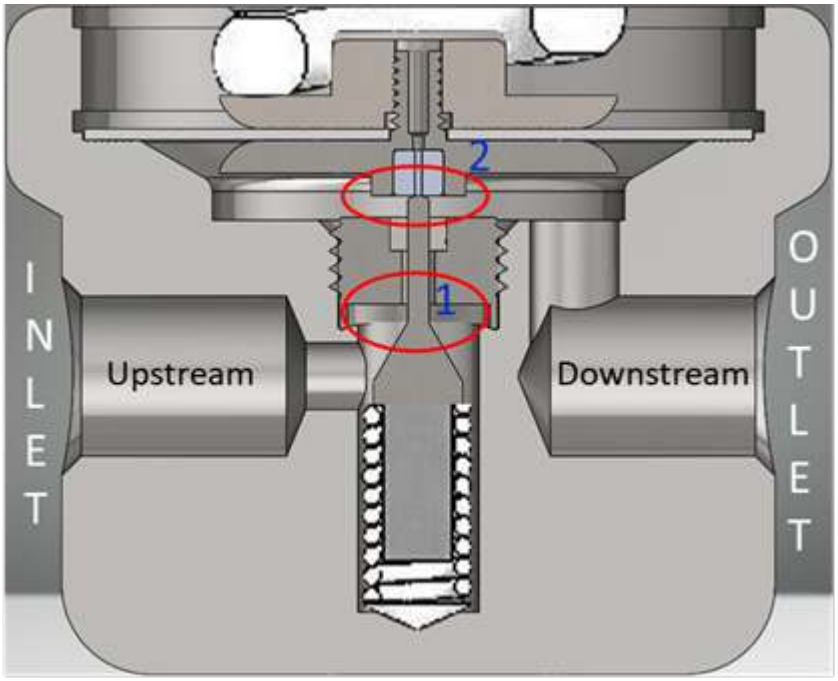

Figure 1: Self-Relieving Valve in Closed Position

Gas regulators with the Self-Relieving option have an additional feature. The top of the Stem (above the conical plug) rests up against a special PTFE Insert with an orifice (2) that is imbedded in the Lower Diaphragm Plate. That PTFE orifice is the entry point of a passageway to the inside of the spring housing. The spring housing is exposed to atmospheric pressure. During normal closed conditions (when downstream pressure ≤ the regulators set point), and during flowing conditions, that orifice is sealed by the top of the stem (2).

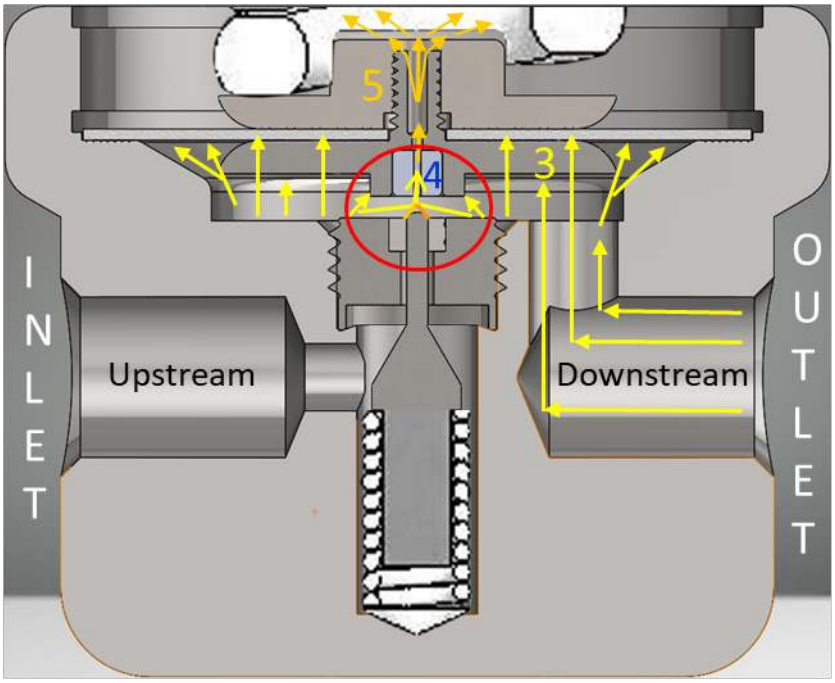

Figure 2: Self-Relieving Valve in Closed Position when equalization occurs (P2 > set point)

After closing, if the downstream pressure increases for any reason (equalization leakage, for example) to a point where it is higher than the set point (P2 > set point), the excess pressure (3) will overcome the set point main spring force and push the diaphragm assembly off the top of the Upper Stem exposing the orifice in the PTFE Insert (4). The excess downstream pressure will vent through the PTFE orifice, through the passage in the diaphragm assembly (5) and into the spring housing. Once the excess pressure is vented, the diaphragm assembly will return to it's normal resting position on top of the stem, sealing the orifice in the PTFE insert. See Figure 1, (2).

- Another reason for specifying a self-relieving regulator is if you want instantaneous relief of pressure. In other words, if you reduce the valve's outlet set point pressure. As soon as the valve is adjusted to a lower pressure, a Self-Relieving valve will relieve all pressure in excess of the new set point as described earlier.

- Self-relieving regulators will also reduce what the valve industry calls "Lock-up". Lock up is pressure set point creep when flow goes to zero. Creep is the opposite of droop. When flow through a gas PRV approaches zero, the outlet pressure will tend to exceed the set point. In other words, the outlet pressure tries to equalize to inlet pressure before the main plug seats.

- Lastly, If the regulated media is clean compressed process air, most users will normally allow the self-relieved air to vent through a weep hole in the side of the spring housing into the surrounding atmosphere. For example, Clean dry air could be vented to atmosphere.

Note: For certain hazardous gasses, you must vent the gas via tubing to a safe location to prevent gas build up in the area around the valve. If so, order the Captured Vent option. That option provides a weep hole with an integral 1/8" FNPT fitting on the spring housing. With that option, a tube fitting can be installed and tubing run to a safe disposal area.

ABOUT THE AUTHOR

Karl J. Lutkewitte has spent his career working for two companies. For the last 10 years, Karl has been with Richards Industrials' Steriflow Division as the Product Manager, and more recently as Product and Sales Manager. He has been with Richards Industrials for almost 20 years. For 12 prior years, he was with two Emerson Electric Companies: Emerson Process Management – Rosemount, and the Alco Controls Division.

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