# CHAPTER 8: Pressure Reducing Valves (PRV's)

## SECTION I: OVERVIEW

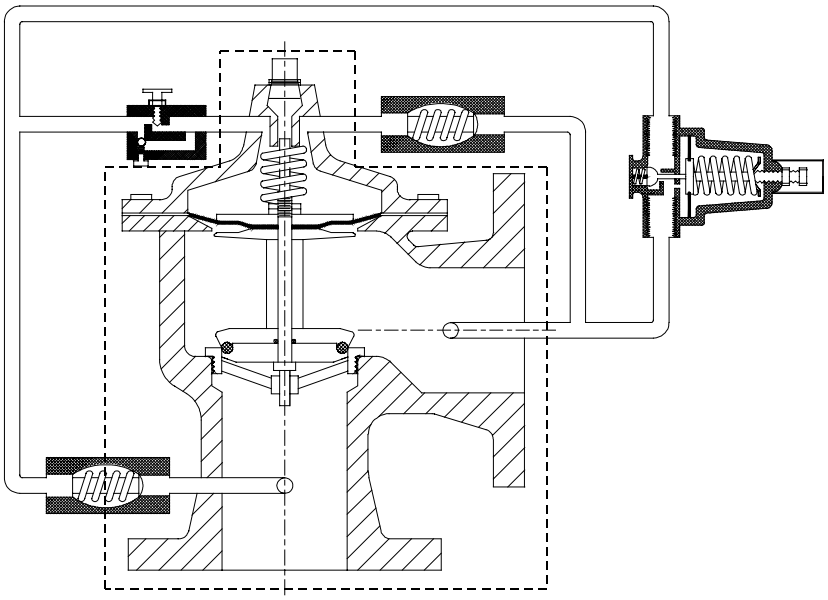
### Maintaining a Constant System Pressure

- The discharge pressure for a booster system is dependent largely on the suction pressure, and to a lesser degree on the flow rate. These conditions can vary greatly during the normal, day-to-day operation of a system.
- A booster system must be able to deliver a reliable, constant system pressure in order to satisfy the requirements of a particular application. This is accomplished by regulating the discharge pressure of each pump using a pressure reducing valve, or PRV.
- The PRV reduces the system pressure according to the conditions at discharge to maintain a constant system pressure.
- The system is designed so that the discharge pressure from the individual pumps always exceeds the desired system pressure. This overage is then reduced to the desired system pressure by the PRV.
- The action of the PRV will account for variations in pump performance across the pump curve and for variations in the system supply (suction) pressure.

### PRV Components

The PRV can be broken down into two main assemblies:

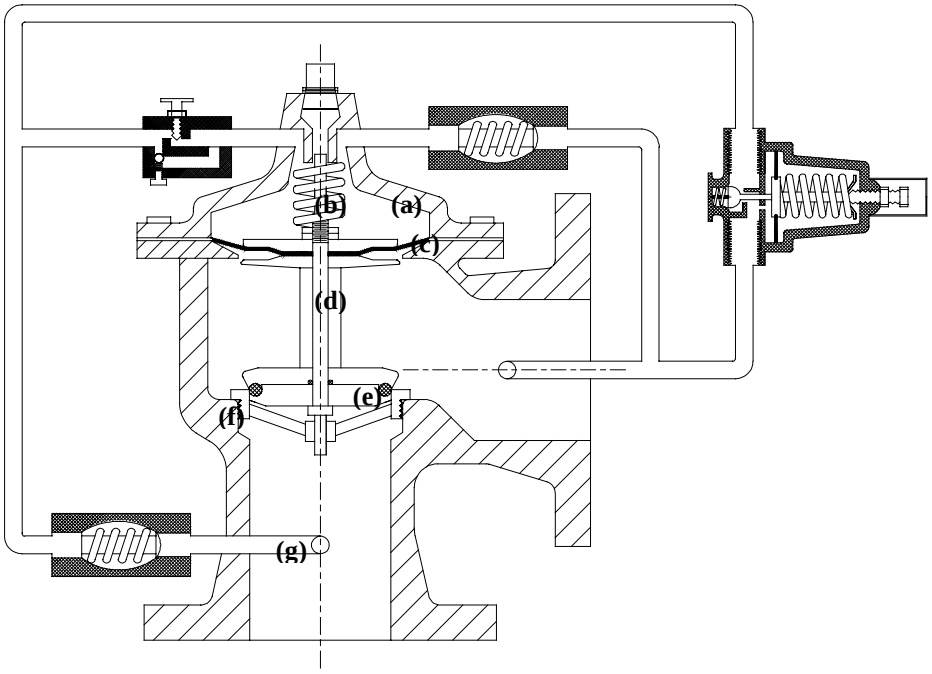
a) The main body valve assembly
b) The pilot assembly



***The dashed line seperates the internal main body valve and the external pilot assembly.***

- The main body valve assembly is the portion of the PRV through which the main flow travels. The main body valve consists of the following parts and subassemblies:

    a) The valve cover
    b) The cover spring
    c) The main body diaphragm
    d) The valve stem
    e) The seal and retainer assembly
    f) The main body seat
    g) The strainer

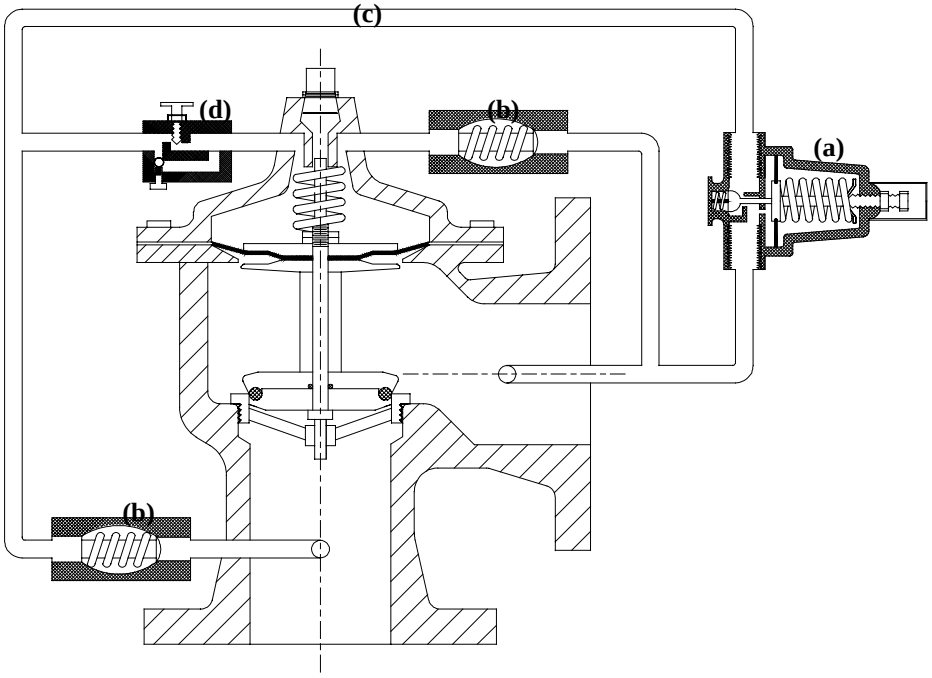



***Main body valve components and subassemblies.***

- The pilot assembly controls the opening and closing of the main body valve. The main body valve is, in fact, slave to the pilot setting. Opening the pilot valve will open the main body valve. Closing the pilot will close the main body valve.

The components of the pilot assembly are as follows:

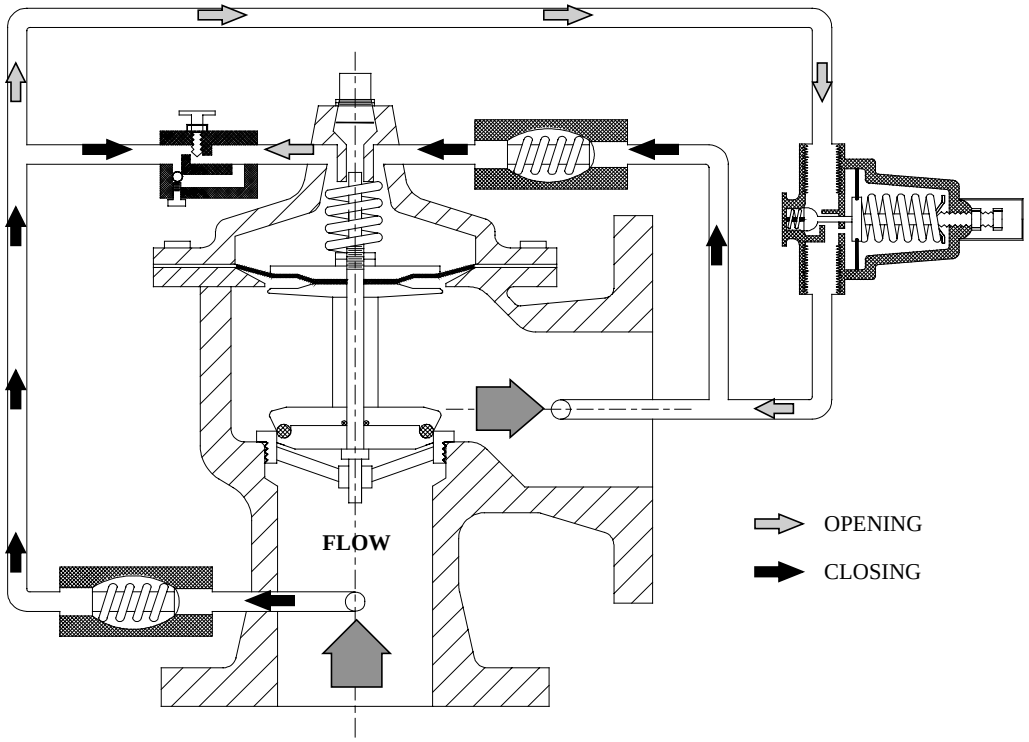
a) The pilot pressure reducing valve (with diaphragm)
b) The in-line check valves
c) The piping assembly
d) The closing speed control




***Pilot assembly and components.***

## SECTION II: HOW the PRV WORKS

- To effectively regulate the system pressure, the PRV must change the amount of pressure reduction depending on the pressure of the incoming flow. This is accomplished by the opening and closing of the main body valve.
- As the pressure of the flow entering the PRV increases, the main body valve closes causing a greater reduction in the out-flow pressure. Conversely, as the in-flow pressure decreases, the main body valve opens causing a lesser reduction in the out-flow pressure.




***Flow through the main body valve is controlled by varying the pressure in the pilot assembly. This is done by turning the set screw on the pilot pressure reducing valve. Closing the screw (as shown by the dark arrows) prevents flow through the top piloting tube. This causes pressure to build up on top of the diaphragm, closing the main valve. Opening the screw (as shown by the light arrows) increases flow through the top piloting tube. This reduces the pressure on top of the diaphragm causing the main valve to open.***

- The action of the main body valve is regulated by the piloting system. As the incoming pressure increases, so does the pressure in the pilot circuit. This pressure is transmitted to the top of the diaphragm forcing the valve closed. A reduction in pressure causes the reverse effect opening the valve.
- Why does the pilot "win out" over the main valve? The pressure above the diaphragm is exerted over an area 1.5 times greater than the seat area through which the main flow must travel. This area differential gives the pilot an advantage (a type of hydraulic leverage), enabling it to control the action of the main valve.

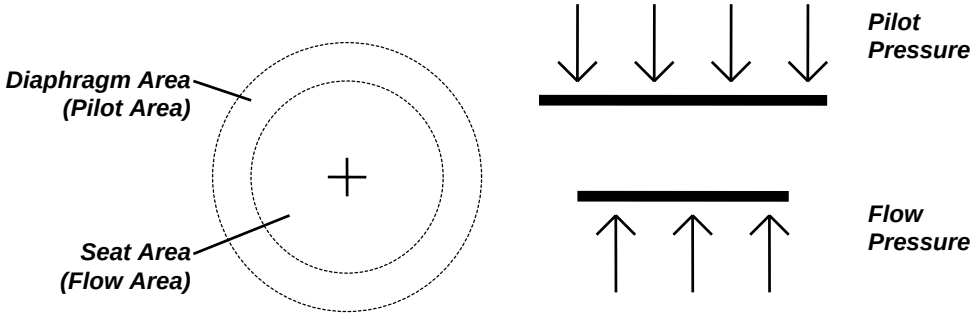



***Fig.# 5: The pilot pressure "wins out" over the flow pressure due to hydraulic leverage advantage.***

## SECTION III: COMMON PRV ADJUSTMENTS

- The performance of the PRV's in a booster are critical to the optimal performance of the entire system. Occasional adjustments and maintenance are required in order to keep the system running smoothly. Often, an improperly set or damaged PRV will show itself in the booster system's overall behavior.
- The symptoms of PRV problems are not difficult to recognize. PRV's sometimes will not close, will not open, or will not regulate the pressure at the set point. The causes of the symptoms can be more difficult to diagnose. In general, before you begin to dissasemble a PRV, it is advisible to first check that the problem is with the PRV.
- This section discusses some of the most common problems encountered with PRV's.
- When encountering PRV reguating problems, first check that the system around the PRV is running properly. During normal operation all isolation ball valves to and from the PRV should be open. Check that the closing speed control and pilot valves are not closed. You may then want to inspect the PRV for leaks and visible damage.
- Before begining the following procedures, close the isolation ball valves to the PRV in question.

### Stem Binding

- This is an easy test to perform before you fully dissasemble the PRV.
- Insert a 2 to 3" 10-32 screw into the tapped stem at the centre of the main body cover. Using a set of pliers, pull the screw outwards. The stem should freely travel as you perform this action.

### Air in Control Circuit or Pilot

- Air in the PRV pilot assembly must be bled off at startup and can sometimes become a problem if the system is shut down for an extended period of time.
- To begin this procedure, open the isolation ball valves to the PRV. Carefully open the check valve cocks allowing some water to bleed out. This will vent any trapped air in the pilot piping and under the main body valve cover.

### Clogged Strainer

- The strainer can be removed from the main body valve after closing the PRV isolation ball valves.
- The strainer is mounted on a brass fitting just below the seat assembly. Remove this fitting and clean the strainer of any debris.

### Diaphragm Failure

- The two diaphragms of the PRV are subject to wear and occasionally require replacement.
- Main body diaphragm failure is characterized by the inability of the PRV to close. A ruptured main body diaphragm upsets the pressure balance inside the valve causing it to fly open.
- To replace a damaged diaphragm, remove the valve cover and the two nuts mounted on the stem. Pull away the diaphragm washer plate, and remove and replace the diaphragm.
- Pilot diaphragm failure is easier to diagnose. The pilot valve will leak water if the diaphragm is damaged.
- To replace, simply remove the four screws on the pilot cover being careful not to lose the spring and retainer. Remove and replace the diaphragm.

**Seal Failure**

- Seal failure is characterized by failure of the PRV to close.
- Replacing the seal on a PRV is probably the most involved maintenance procedure you will be required to perform. The procedure is simple, but you must be careful to replace parts carefully on reassembly. Be especially careful not to damage the diaphragm and to replace both nuts on the stem.
- Remove the main body cover and diaphragm. Remove completely the stem and seal retainer assembly.
- The most common seal repair is replacement of the seat or the stem 'O'-ring.
- You will see that the seal retainer has a top plate, the retainer, and a bottom plate, the "Quad-Seal" retainer plate. The "Quad-Seal" plate is fastened to the stem, but the retainer will come free. With a mallet made of a soft material, gently tap the top of the stem while holding the retainer. The plate will come free allowing you to remove and replace either of the 'O'-rings.

> ***Tip: The seat 'O'-rings are reversible. Each has two seal surfaces and can be reversed to provide double the life of an ordinary 'O'-ring.***