SELECTING PRESSURE REGULATORS

Most specialty gases are supplied in cylinders compressed to high pressures. Pressure regulators reduce these high pressures to lower pressures that can be safely used in an operating system. Proper regulator selection is critical for both safety and effectiveness of operating systems.

***Note:** Regulators are designed to control pressure. Generally they are supplied with gauges that indicate pressure. Regulators do not measure or control flow unless equipped with devices (such as a metering valve or flowmeter) specifically designed for those purposes.*

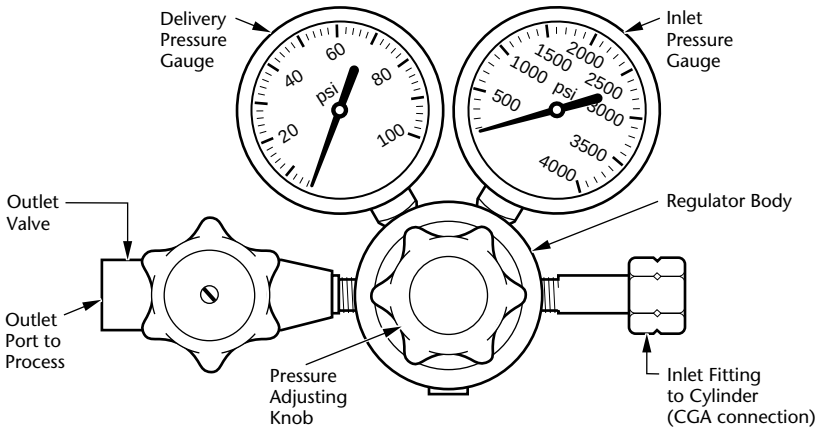

FIGURE 1, Front View – Typical Cylinder Pressure Regulator

Many variables are involved in selecting the proper pressure regulator. While certainly not a comprehensive list, the following provides some of the more important considerations. To further assist in making proper regulator selections, refer to the Equipment Recommendation tables at the rear of this catalog.

1. Materials Compatibility: Materials used to construct regulators must be compatible with the gas—especially those materials (wetted parts) in contact with the gas. Advanced offers a wide variety of regulators with various materials of construction to help ensure that the correct regulator is available for your needs.

Note: More information on "Gas Compatibility" can be found on page 140.

2. Inlet Pressure Rating: Regulators must be able to safely handle incoming gas pressure. Here again, a wide selection is available which includes regulators that handle inlet pressures of 6000 or even 10,000 psig.

3. Delivery Pressure Range: Regulators must be able to reduce pressure to levels compatible with the operating system and consistent with process needs. Advanced's extensive line of pressure regulators provides numerous choices with delivery pressure ranges available as low as 0.3–3 psig, or as high as 300–6000 psig.

4. Gas Purity: Like all system components, regulators should be selected to protect the purity of the service gas. As an example, regulators with stainless steel diaphragms are recommended for high purity applications because they tend to be more "diffusion-resistant" than those with elastomeric diaphragms. For low particulate applications, consideration should be given to selecting regulators with machine welded VCR® connections. Optional Helium Leak Tests also help to ensure the integrity of regulator purchases.

5. Single- or Two-Stage Design: Single-stage regulators reduce pressure in one step. As gas is consumed, pressure in the cylinder (and therefore the inlet pressure to the regulator) decreases. This reduced inlet pressure provides less force against the regulator valve, causing the regulator to open wider, resulting in an increased delivery pressure setting. Therefore, single-stage regulators are most useful in applications where:

- periodic manual adjustments to delivery pressure settings are not a problem or
- inlet pressure remains relatively constant, such as where the gas is a liquid under pressure (e.g., Carbon Dioxide or Propane).

Two-stage regulators are actually two regulators housed in one body. The first regulator (first stage) is nonadjustable and reduces incoming pressure to an intermediate setting (typically 250 to 300 psig). The second stage is adjustable and reduces intermediate pressure to final desired delivery pressure. Because the second stage sees only relatively minor inlet pressure changes from the first stage, two-stage regulators maintain steady delivery pressure and do not require periodic adjustment. They are well suited for applications where constant delivery pressure is essential.

6. Line or Cylinder Regulator: Cylinder regulators, as their name implies, are connected directly to gas cylinders. Typically offered in both single and two-stage designs, cylinder regulators normally have inlet and delivery pressure gauges.

Line regulators, on the other hand, are used directly in piping systems, such as downstream of a manifold or bulk storage vessel. Because inlet pressure in piping systems is normally constant, line regulators are typically single-stage configurations with delivery pressure gauges only.

7. Other Considerations: Other criteria for consideration include operating temperature, flow requirements, regulatory issues (e.g., medical regulators manufactured to FDA standards), attached poppet configurations, and so on.

MECHANICS OF PRESSURE REGULATORS

SINGLE-STAGE REGULATORS

Gas enters the inlet (high pressure) chamber and its pressure is indicated on the inlet pressure gauge. When the pressure adjusting knob is turned counterclockwise and completely backed out to the stop (Figure 2), a valve and seat assembly located between the inlet chamber and the delivery (low pressure) chamber prevents gas from moving any further. A filter, located at the inlet port or at the inlet to the valve and seat assembly, removes particulate matter from the gas stream to help protect the seat area.

Turning the pressure adjusting knob clockwise (Figure 3) causes the adjusting screw to push against a spring button which compresses the pressure adjusting spring. The force of the compressed spring, in turn, causes the diaphragm to flex and push against the poppet. This opens the regulator allowing gas to flow from the inlet chamber to the delivery chamber of the regulator.

Gas entering the delivery pressure chamber begins to build pressure and creates a counter-force (counter to the pressure adjusting spring) on the diaphragm. This pressure is indicated on the delivery pressure gauge attached to the delivery chamber. When pressure builds sufficiently to counteract the spring tension, it pushes the diaphragm away from the poppet allowing the regulator to close.

In this manner, pressure in the delivery chamber is controlled or regulated by the amount of spring tension placed on the diaphragm, and is selectable by turning the pressure adjusting knob until desired pressure is indicated on the delivery pressure gauge.

When gas from the delivery pressure chamber is sent to the end process, the resulting decrease in gas volume in the delivery chamber causes a pressure reduction in the chamber. When this occurs, the spring tension again causes the diaphragm to push the poppet open, allowing additional gas to enter the delivery chamber.

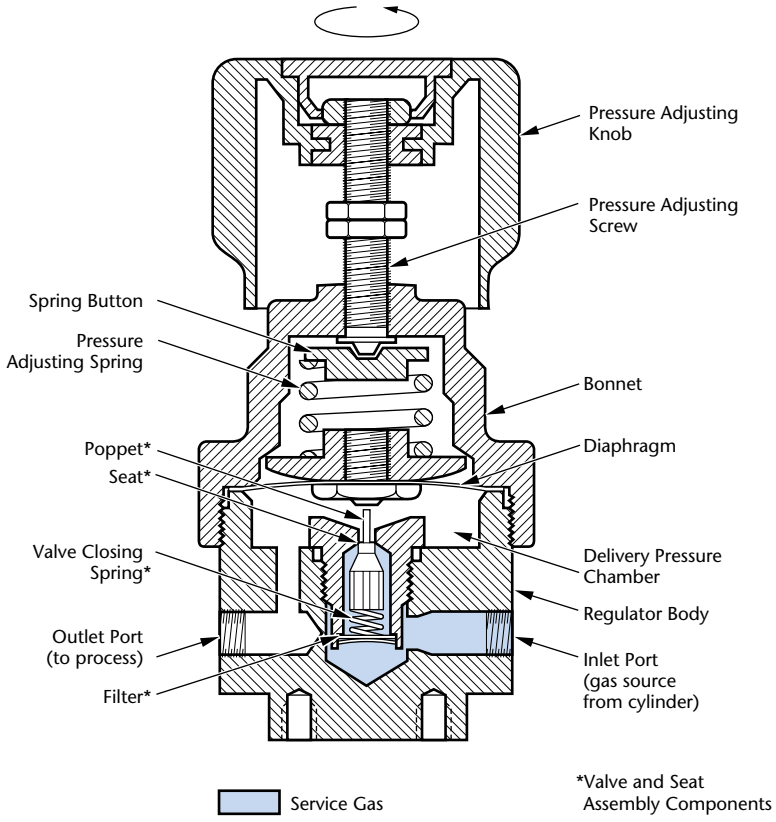

FIGURE 2, Single-Stage Regulator in Closed Position

TWO-STAGE REGULATORS

These regulators incorporate all components of a single-stage regulator. In addition, however, they also contain a second pressure adjusting spring; diaphragm; and valve and seat assembly. The first stage is not user adjustable with the pressure adjusting spring "precompressed" at the factory. This allows the first stage to feed pressure at approximately 250 to 300 psig to the second (adjustable) stage. The second stage then performs in a manner similar to that of a single-stage regulator, except that the inlet pressure to the second stage is relatively constant.

Because of the two-step pressure reduction, final delivery pressure of a two-stage regulator shows little effect from changes in cylinder pressure.

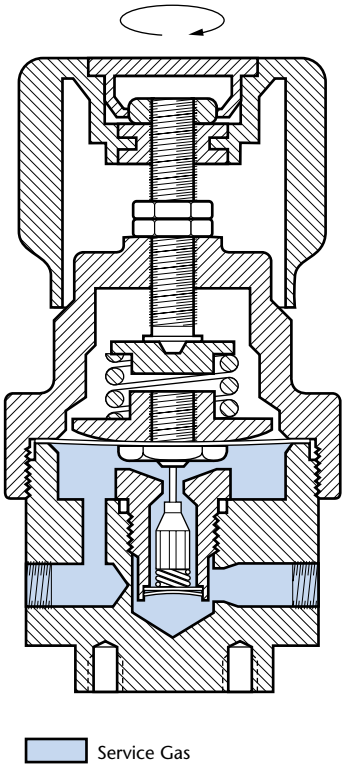

FIGURE 3, Single-Stage Regulator in Open Position