How to Choose a Gas Regulator That’s Right For Your Application

**SINGLE-STAGE GAS REGULATOR**

**TWO-STAGE GAS REGULATOR**

What is the difference between the Single Stage and Two Stage Gas Regulator? =>

Gas pressure regulators are used to reduce the pressure of gas supplied from a high-pressure cylinder of gas.
to a workable level that can be safely used for operating equipment and instruments. There are two basic types of gas pressure regulators: single-stage and two-stage.

Single-stage pressure regulators reduce the cylinder pressure to the delivery or outlet pressure in one step. Two-stage pressure regulators reduce the cylinder pressure to a working level in two steps. Since the performance of each is influenced by mechanical characteristics, the choice of gas regulator depends on the type of application for which it is intended.

The two most important parameters to be considered are droop and supply pressure effect.

Droop is the difference in delivery pressure between zero flow conditions and the gas regulator's maximum flow capacity. Supply pressure effect is the variation in delivery pressure as supply pressure decreases while the cylinder empties. For most regulators, a decrease in inlet pressure causes the delivery pressure to increase.

The effect of these differences on performance can be illustrated with some examples. For instance, when a centralized gas delivery system is supplying a number of different chromatographs, flow rates are apt to be fairly constant. Supply pressure variations, however, may be abrupt especially when automatic changeover manifolds are used. In this scenario, a two-stage regulator with a narrow accuracy envelope (supply pressure effect) and a relatively steep droop should be used to avoid a baseline shift on the chromatographs.

Single-stage and two-stage gas regulators have different droop characteristics and respond differently to changing supply pressure. The single-stage regulator shows little droop with varying flow rates, but a relatively large supply pressure effect. Conversely, the two-stage regulator shows a steeper slope in droop but only small supply pressure effects.

On the other hand, if gas is being used for a short duration instrument calibration, a single-stage gas regulator with a wide accuracy envelope (supply pressure effect) but a comparatively flat droop should be chosen. This will eliminate the need to allow the gas to flow at a constant rate before the calibration can be done.

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**REGULATOR SELECTION (MATERIALS)**

**General Gas Use**

The selection of the proper gas regulator involves many factors including body and internal materials of construction. For general use, regulators of brass construction with elastomeric diaphragms will give good service in noncorrosive service where slight contamination or diffusion from an elastomeric diaphragm is not important. Brass regulators with stainless steel diaphragms prevent air diffusion and adsorption of gases on the diaphragm. This is particularly important with low concentration mixtures of hydrocarbons in which the trace component may be adsorbed on the elastomeric diaphragm.

The gas regulator must be constructed using materials suited to the application. Industrial general purpose regulators are often constructed with either Buna-N or Neoprene diaphragms. Regulators with Buna-N or Neoprene diaphragms are not suitable for GC analysis that can be affected by the diffusion of atmospheric oxygen through the elastomer diaphragm or the outgassing of monomers and dimers from the elastomer. In fact, laboratories that perform temperature programmed analysis are faced with excessive baseline drift and large unresolved peaks due to this diffusion and outgassing.

**High-Purity Gas Service**

The ideal construction for high-purity gas service is a gas regulator that has a stainless steel diaphragm. Such
regulators are noncontaminating and assure satisfactory use for all applications of noncorrosive and mildly corrosive gases. Regulators for corrosive gases must be selected from those recommended with each gas listing.

A gas regulator equipped with a stainless steel diaphragm has several advantages over the elastomeric type. It does not outgas organic materials and it also prevents the diffusion of atmospheric oxygen into the carrier gas. Both Buna-N and Neoprene diaphragms are permeable to oxygen. The chemical potential of oxygen between the carrier gas and the atmosphere provides sufficient driving force for oxygen to intrude the carrier gas through a permeable diaphragm.

Materials of Construction Summary

The intended gas service for which the gas regulator is used must be compatible with the materials of construction that come in contact with the gas stream. The wetted materials must be compatible with the gas composition.

- **Noncorrosive (Typical Materials):** Aluminum, Brass, Stainless Steel, Buna-N, PCTFE, Neoprene, Teflon®, Viton®, Nylon
- **Corrosive (Typical Materials):** Aluminum, Stainless Steel, Monel®, Nickel, PCTFE, Teflon®

Regulator Gauges

Generally single and two-stage gas regulators are equipped with two gauges: a cylinder or inlet pressure gauge, and a delivery or outlet pressure gauge. The cylinder pressure gauge has the higher pressure range and is located adjacent to the inlet port. The delivery pressure gauge of lower pressure range is located adjacent to the outlet port. Although most cylinder regulators have two gauges, regulators utilized on cylinders containing liquefied gases may not have a cylinder pressure gauge because the cylinder pressure varies only with temperature as long as liquid is present in the cylinder.

Operating Delivery Pressure Range

Determining the delivery pressure range can be confusing. First, it is important to determine the gas pressure that is needed. Second, determine the maximum pressure the system might require (these two pressures are often the same). Third, select the delivery pressure range so that the required pressures are in the 25 to 90% range of the gas regulator's delivery pressure (a regulator's performance is at its best within this range).

Regulator Placement (Cylinder or Line)

Specialty gas regulator applications are divided into two types. The first is when the regulator is fastened to a gas cylinder using a Compressed Gas Association (CGA) fitting (or BS or DIN). The second application is when a regulator is located in a gas line - providing a means to further reduce the line pressure. A line regulator is identified by having the inlet and outlet opposite of each other, and by a single gauge which is in the 12 o'clock position to indicate the reduced pressure.

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**SELECTION CRITERIA SUMMARY**
The application determines which gas regulator to select. For example, a brass regulator should not be used in corrosive gas service. The duration of gas use time helps to identify whether a single-stage or two-stage regulator provides the best service. A single-stage is a good performer for short duration gas usage. A two-stage gas regulator performs best when it is attached to the cylinder and adjusted to the desired reduced pressure, and then remains in service until the cylinder is ready for changeout.

Consider this criteria when planning your next pressure reduction requirements.

1. Use a gas regulator for all pressure reduction requirements.
2. Use a valve for flow control.
3. Materials used in the gas regulator construction are to be compatible with the intended gas service.
4. Determine the delivery pressure requirements.
5. Do you need a cylinder regulator or a line regulator or perhaps both?
6. Determine the accessories to be included with your gas regulator.
7. Determine how you intend to use the pressure regulator. Generally a single-stage regulator is good for short duration applications; a two-stage regulator is good for long duration applications.

The safest means to reduce cylinder pressure is through a pressure reduction regulator.

REGULATOR OPERATING INSTRUCTIONS AND SAFETY PRECAUTIONS

To operate a pressure regulator, you should be trained in its proper use or be under competent supervision.

1. Use safety glasses when installing and operating gas handling equipment.
2. Mark each new gas regulator with its intended gas service and never use a regulator for more than one service. Regulators that have been used in oxygen or oxidizing gas service must not be used in another service. To ensure safety and to avoid contamination, it is strongly recommended that regulators be dedicated to one gas service.
3. Never heat or expose a cylinder or gas handling equipment to temperatures above 125°F (52°C).
4. Never use a regulator as a shut-off valve. Be certain that the gas stream is shut off at its source when not in use.
5. Be certain that the gas cylinder valve and regulator connection are clean and compatible with the service for which they are used.
6. When the regulator is pressurized and/or in operation, no attempt should be made to reposition or detach the regulator.
7. Do not subject the regulator to an inlet pressure greater than is recommended.
8. Gas cylinders should be moved only on carts designed for cylinders.
9. Never move a gas cylinder without its valve protection cap in place.
10. If you have any questions, contact your Specialty Gas Supplier for gas regulator recommendations for use with corrosive & oxidizing gases, pure gases and gas mixtures.