Vacuum Control

Vacuum Applications

Vacuum regulators and vacuum breakers are widely used in process plants. Conventional regulators and relief valves might be suitable for vacuum service if applied correctly. This section provides fundamentals and examples.

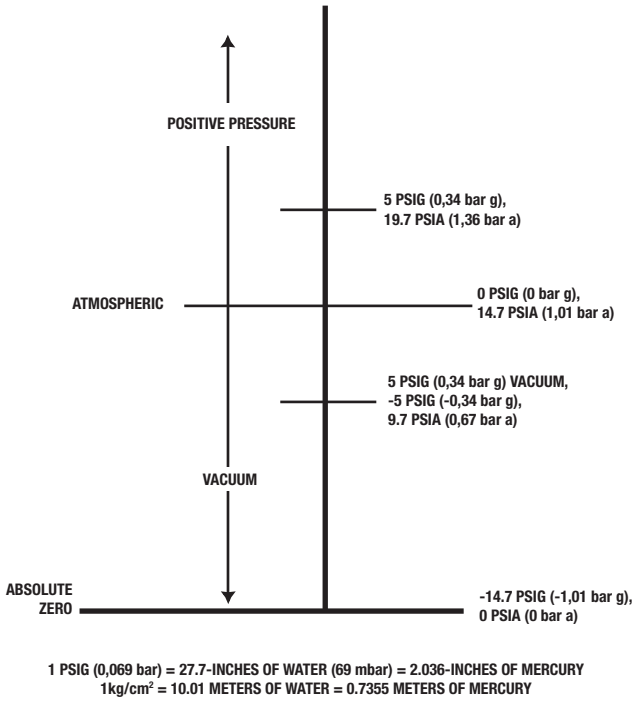

Figure 1. *Vacuum Terminology*

Vacuum Terminology

Engineers use a variety of terms to describe vacuum, which can cause some confusion. Determine whether the units are in absolute pressure or gauge pressure (0 psi gauge (0 bar gauge) is atmospheric pressure).

- 5 psig (0,34 bar g) vacuum is 5 psi (0,34 bar) below atmospheric pressure.
- -5 psig (-0,34 bar g) is 5 psi (0,34 bar) below atmospheric pressure.
- 9.7 psia (0,67 bar a) is 9.7 psi (0,67 bar) above absolute zero or 5 psi (0,34 bar) below atmospheric pressure (14.7 psia - 5 psi = 9.7 psia (1,01 bar a - 0,34 bar = 0,67 bar a)).

Vacuum Control Devices

Just like there are pressure reducing regulators and pressure relief valves for positive pressure service, there are also two basic types of valves for vacuum service. The terms used for each are sometimes confusing. Therefore, it is sometimes necessary to ask further questions to determine the required function of the valve. The terms vacuum regulator and vacuum breaker will be used in these pages to differentiate between the two types.

Vacuum Regulators

Vacuum regulators maintain a constant vacuum at the regulator inlet. A loss of this vacuum (increase in absolute pressure) beyond setpoint registers on the diaphragm and opens the disk. It depends on the valve as to which side of the diaphragm control pressure is measured. Opening the valve plug permits a downstream vacuum of lower absolute pressure than the controlled vacuum to restore the upstream vacuum to its original setting.

Besides the typical vacuum regulator, a conventional regulator can be suitable if applied correctly. Any pressure reducing regulator (spring to open device) that has an external control line connection and an O-ring stem seal can be used as a vacuum regulator. Installation requires a control line to connect the vacuum being controlled and the spring case. The regulator spring range is now a negative pressure range and the body flow direction is the same as in conventional pressure reducing service.

Vacuum Breakers (Relief Valves)

Vacuum breakers are used in applications where an increase in vacuum must be limited. An increase in vacuum (decrease in absolute pressure) beyond a certain value causes the diaphragm to move and open the disk. This permits atmospheric pressure or a positive pressure, or an upstream vacuum that has higher absolute pressure than the downstream vacuum, to enter the system and restore the controlled vacuum to its original pressure setting.

A vacuum breaker is a spring-to-close device, meaning that if there is no pressure on the valve the spring will push the valve plug into its seat. There are various Fisher® brand products to handle this application. Some valves are designed as vacuum breakers. Fisher brand relief valves can also be used as vacuum breakers.

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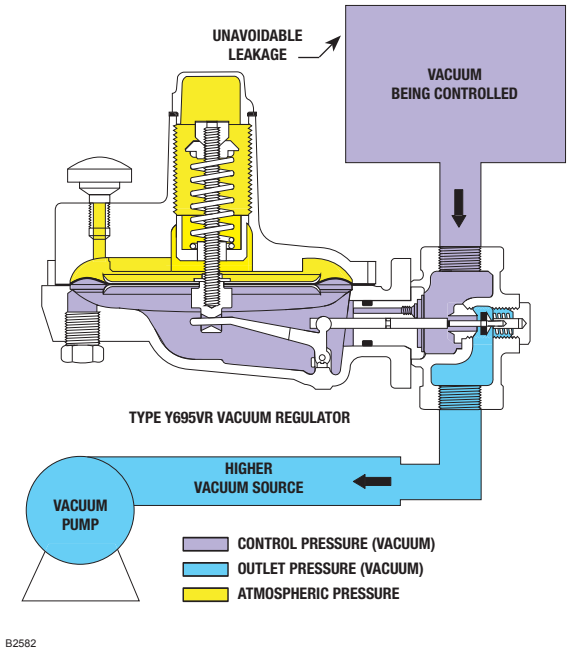

Figure 2. *Typical Vacuum Regulator*

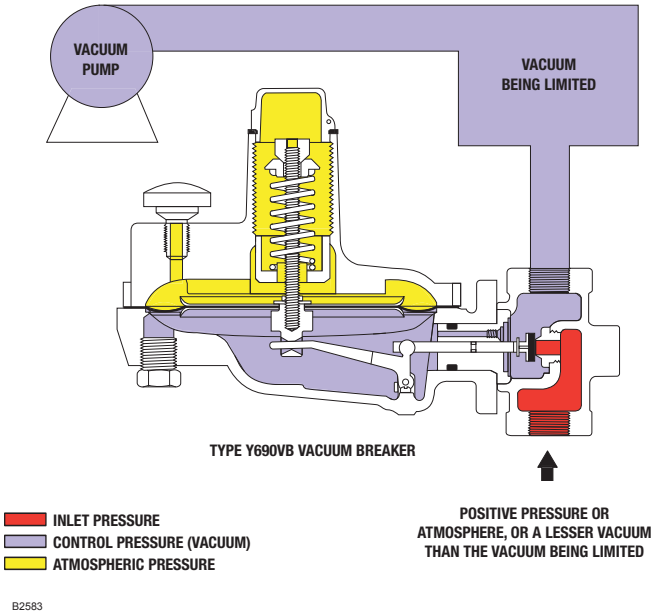

Figure 3. *Typical Vacuum Breaker*

A conventional relief valve can be used as a vacuum breaker, as long as it has a threaded spring case vent so a control line can be attached. If inlet pressure is atmospheric air, then the internal pressure registration from body inlet to lower casing admits atmospheric pressure to the lower casing. If inlet pressure is not atmospheric, a relief valve in which the lower casing can be vented to atmosphere when the body inlet is pressurized must be chosen. In this case, the terminology “blocked throat” and “external registration with O-ring stem seal” are used for clarity.

A spring that normally has a range of 6 to 11-inches w.c. (15 to 27 mbar) positive pressure will now have a range of 6 to 11-inches w.c. (15 to 27 mbar) vacuum (negative pressure). It may be expedient to bench set the vacuum breaker if the type chosen uses a spring case closing cap. Removing the closing cap to gain access to the adjusting screw will admit air into the spring case when in vacuum service.

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Vacuum Regulator Installation Examples

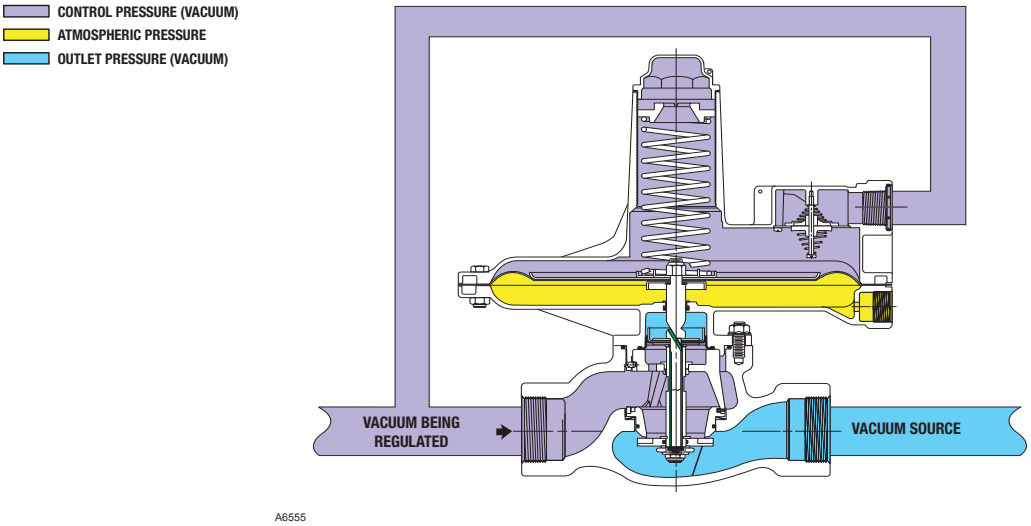

Figure 4. *Type 133L*

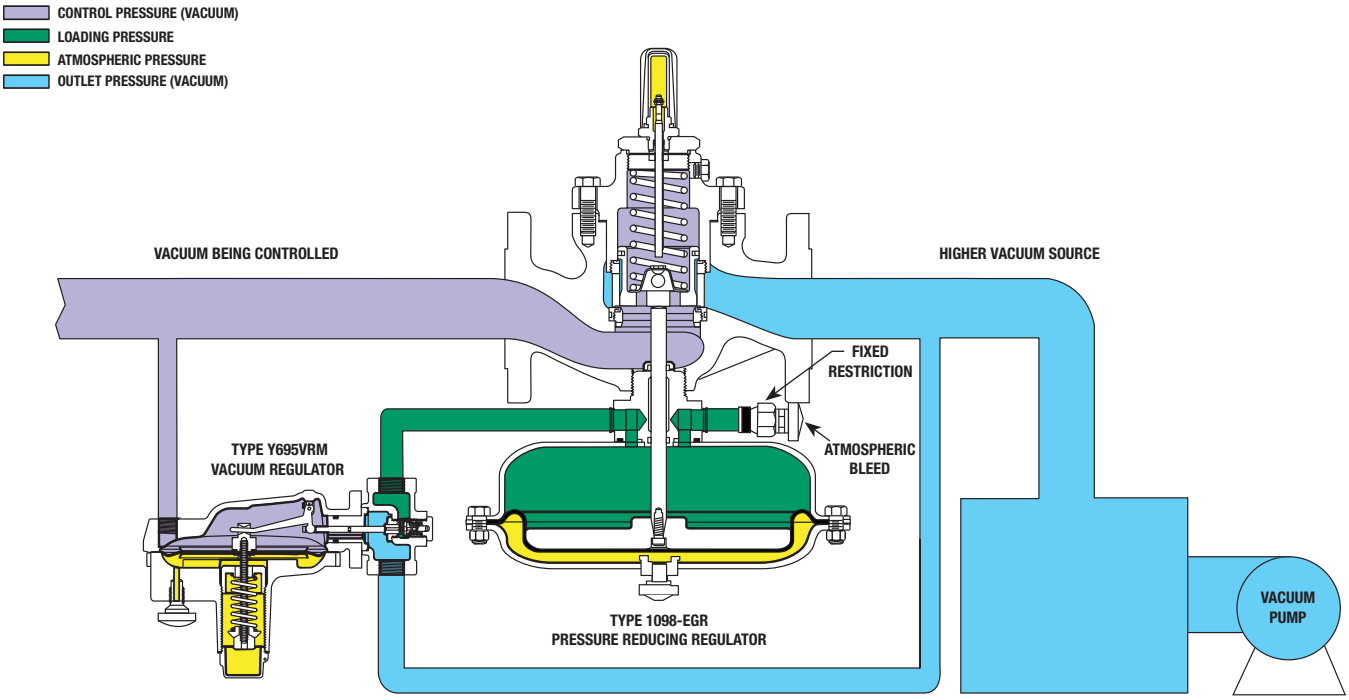

Figure 5. *Type Y695VRM used with Type 1098-EGR in a Vacuum Regulator Installation*

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Vacuum Breaker Installation Examples

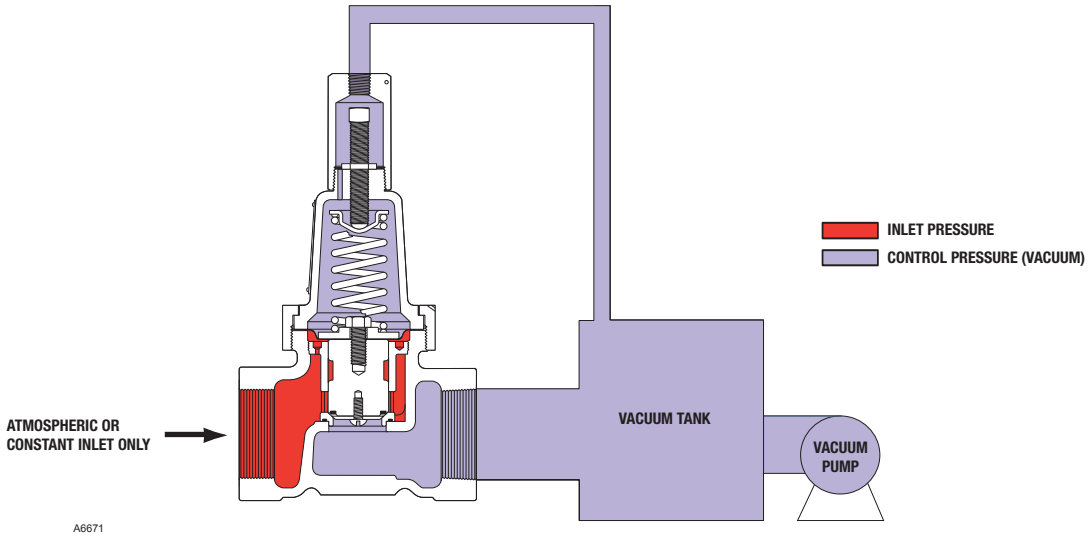

Figure 6. *Type 1805*

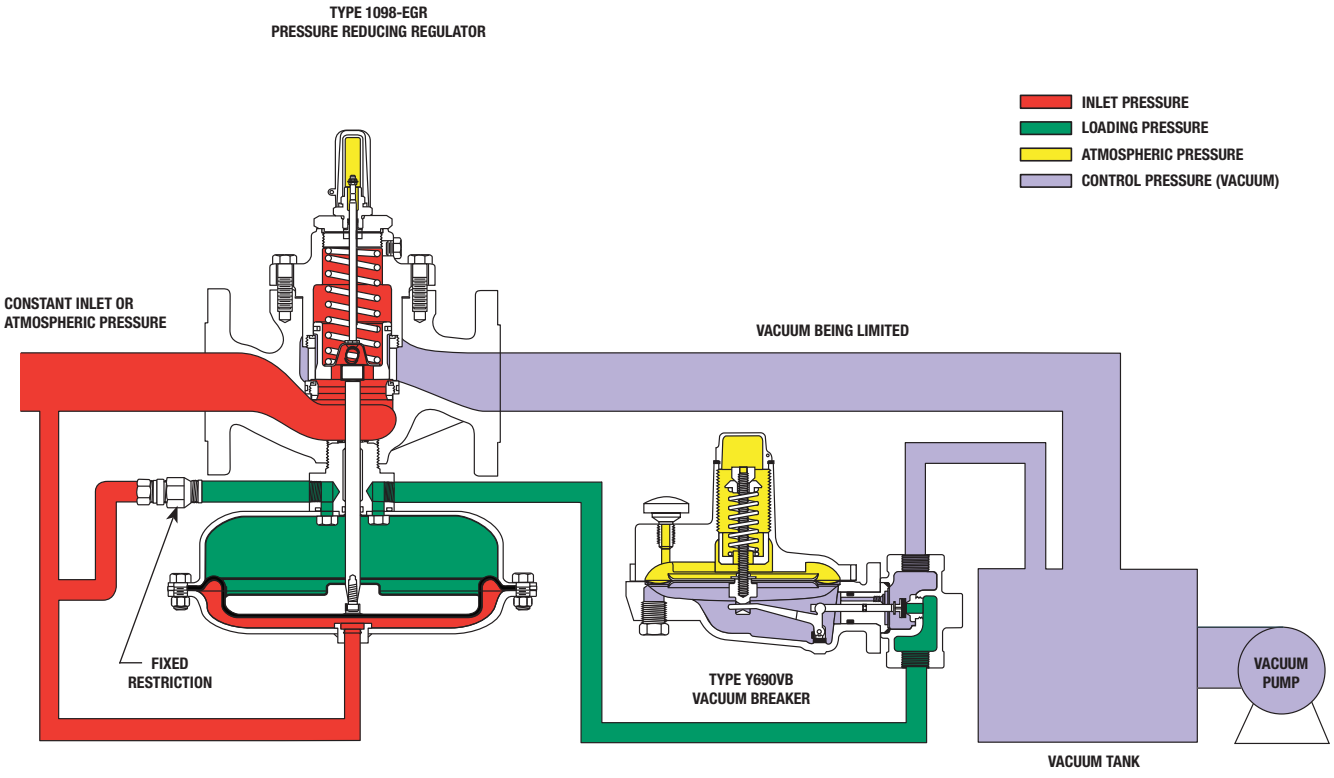

Figure 7. *Type Y690VB used with Type 1098-EGR in a Vacuum Breaker Installation. If the positive pressure exceeds the Type 1098-EGR casing rating, then a Type 67CF with a Type H800 relief valve should be added.*

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Vacuum Breaker Installation Examples

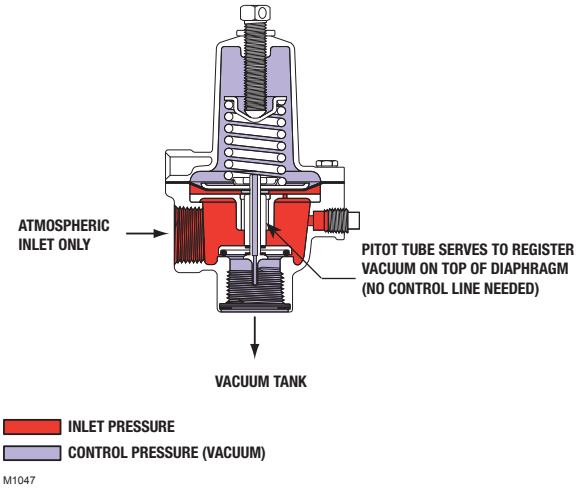
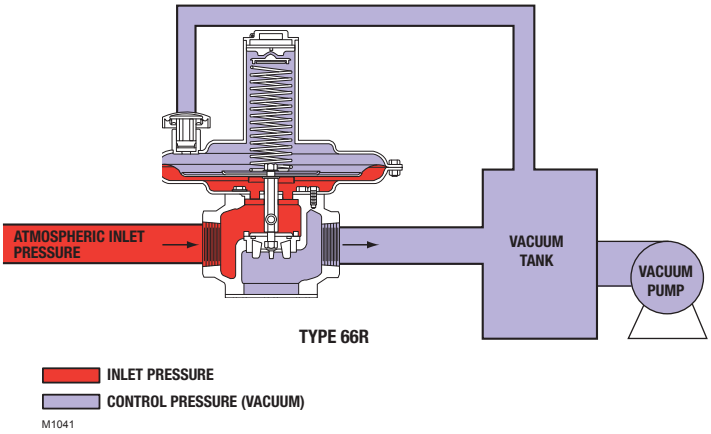


Figure 8. Type 289H Relief Valve used in a Vacuum Breaker Installation



If inlet is positive pressure:

- Select balancing diaphragm and tapped lower casing construction.
- Leave lower casing open to atmospheric pressure.

Figure 9. Type 66R Relief Valve used in a Vacuum Breaker Installation

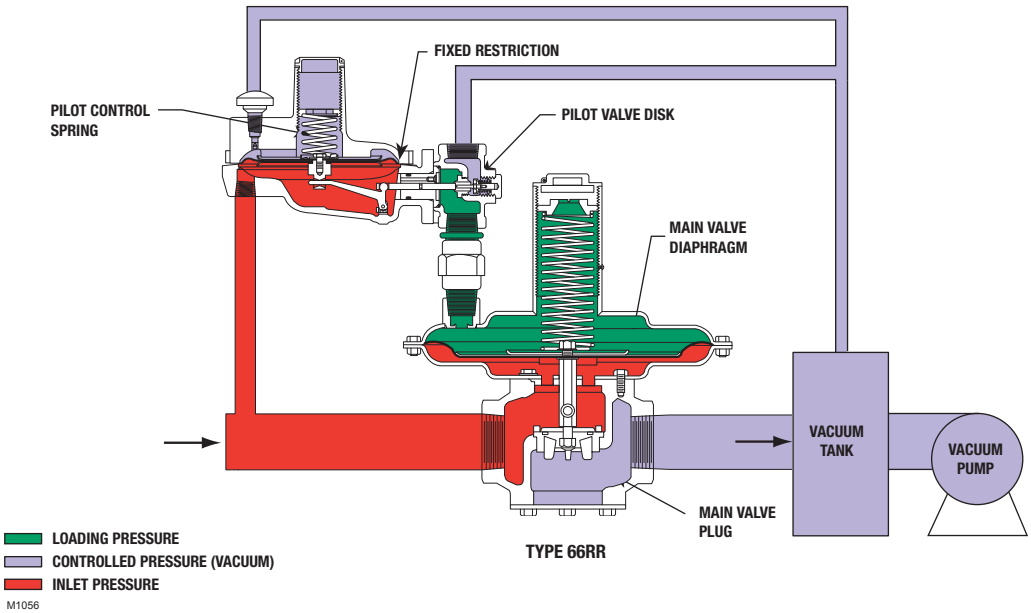


Figure 10. Type 66RR Relief Valve used in a Vacuum Breaker Installation

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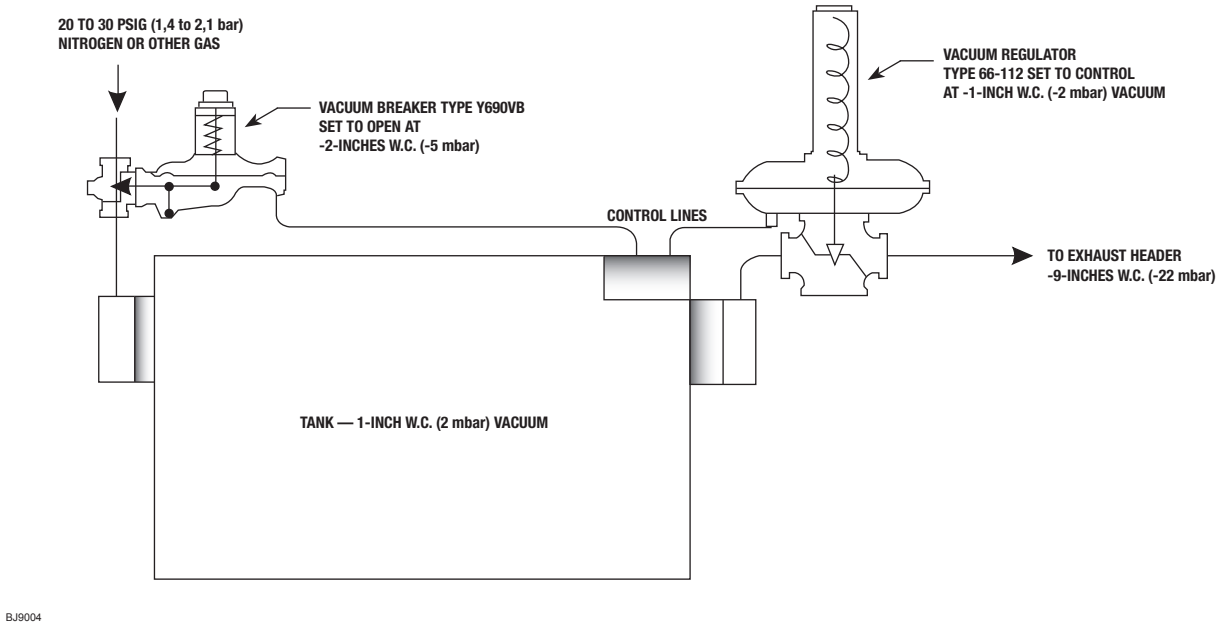

Figure 11. *Example of Gas Blanketing in Vacuum*

Gas Blanketing in Vacuum

When applications arise where the gas blanketing requirements are in vacuum, a combination of a vacuum breaker and a regulator may be used. For example, in low inches of water column vacuum, a Type Y690VB vacuum breaker and a Type 66-112 vacuum regulator can be used for very precise control.

Vacuum blanketing is useful for vessel leakage to atmosphere and the material inside the vessel is harmful to the surrounding environment. If leakage were to occur, only outside air would enter the vessel because of the pressure differential in the tank. Therefore, any process vapors in the tank would be contained.

Features of Fisher® Brand Vacuum Regulators and Breakers

- **Precision Control of Low Pressure Settings**—Large diaphragm areas provide more accurate control at low pressure settings. Some of these regulators are used as pilots on our Tank Blanketing and Vapor Recovery Regulators. Therefore, they are designed to be highly accurate, usually within 1-inch w.c. (2 mbar).
- **Corrosion Resistance**—Constructions are available in a variety of materials for compatibility with corrosive process gases. Wide selection of elastomers compatible with flowing media.
- **Rugged Construction**—Diaphragm case and internal parts are designed to withstand vibration and shock.
- **Wide Product Offering**—Fisher® brand regulators can be either direct-operated or pilot-operated regulators.
- **Fisher Brand Advantage**—Widest range of products and a proven history in the design and manufacture of process control equipment. A sales channel that offers local stock and support.
- **Spare Parts**—Low cost parts that are interchangeable with other Fisher brand in your plant.
- **Easy Sizing and Selection**—Most applications can be sized utilizing the Fisher brand Sizing Program and Sizing Coefficients.