

TECH NOTES

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R. HANSON

Varec Biogas Safety Selector Valve The Significance of High Cv Values

Water Environment Federation, Manual of Practice No. 8 (MOP 8) recommend that digester and gas holder covers should be equipped with pressure and vacuum relief valves to protect the cover from structural damage caused by possible over- and under-pressure from the rapid pumping of the sludge into and out of the vessel. MOP 8 also recommends having two units, one duty and one back-up, mounted on a 3-way valve so that maintenance can be performed on one unit without leaving the digester unprotected. This is important due to the wet and dirty nature of biogas.



The maximum flow capacity, the tank's operating pressure and maximum allowable pressure need to be determined in order to properly size a Varec 5810B/5820B Series Pressure and Vacuum Relief Valve (PVRV) With Flame Arrester. These units are sized based on being able to relieve the required flow capacities before the tank design pressure is reached. This insures that the pressure inside the digester does not exceed the design pressure of the digester which could lead to cracks, lifting of the cover, or structural failure.

When sizing the PVRV, many designers forget to take into account the pressure loss through the three way valve. It is easy to overlook the pressure drop of the three-way block valve with pipe elbows, but this can become a critical error. Three-way block valves commonly result in high inlet pressure loss and contribute to excessive pressure drop and turbulence to any PVRV With Flame Arrester Assembly. That is why it is important to include not only the losses through the PVRV, but also the losses through the 3-way valve and all associated piping.

How do we achieve low pressure loss through our SSV?

The unique design of the Varec Biogas SSV creates a flow path offering low resistance leading to high Cv. The higher the Cv, the lower the pressure drop. Below we show an example of typical pressure losses of the SSV, a three-way ball valve, and a 3-way plug valve.

Conditions:

6" Valve

Flow (Q): 45,000 SCFH

Specific Gravity (Sg): 0.85

Set Point (P_o): 12" WC

Temperature (T): 95° F

Calculating the pressure drop we get:

1. For the SSV, with a Cv of 2713, the pressure drop would be 0.12" WC, or 1%
2. For a 3-way ball valve with a Cv of 884, the pressure drop would be 1.2" WC, or 10%
3. For a 3-way plug valve with a Cv of 345, the pressure drop would be 7.9" WC, or 66%

For the plug valve it is obvious why this would be detrimental because you would need to set the valve at least 8" WC more below the design pressure of the digester than you would if there was no valve there. Most engineers do not take this into account when sizing the valve and therefore most tanks with plug valves under the Pressure and Vacuum Relief Valve (PVRV) are a serious safety risk because the tank will be stressed beyond its capabilities should it be required to relieve an overpressure or vacuum condition.

For the ball valve it is not so obvious, as the extra 1.2" WC will probably not stress the tank beyond its design level or maximum allowable pressure. However, the American Petroleum Institute recommends no more than 3% pressure drop between the tank and the valve due to the chattering (rapid opening and closing) in the PVRV valve.

The Pressure/Vacuum Relief Valve are weight loaded devices. It relies on the pressure directly under the pallet to overcome the force of the weights and open the valve when the pressure in the tank exceeds its set point. If there is a pressure drop across the 3-way valve, which occurs when there is flow, then the pressure under the pallet will drop below the set point and the valve will close. Once the valve closes and there is no flow, the pressure under the pallet again will equal the pressure in the tank and the valve will open. All of this occurs within a fraction of a second and the effect is a rapid oscillation of the pallet, or chattering. Chattering will damage the valve pallet and could cause failure of the valve to relieve sufficient gas and prevent the tank from over-pressurizing. This leads to a potential failure of the tank.

The only way to get around this problem is to specify or provide a three-way plug or ball valve that is one or two sizes larger than needed. On stand-alone plug or ball valves, the pressure losses through the elbows and piping must also be taken into account. Note that the SSV pressure drop takes into account the complete flow path to the PVRV and flame arrester.



The significance of a high Cv is evident and this will hopefully help engineers make the obvious and intelligent choice. The Varec Biogas SSV has been extensively flow tested and we can provide test results from an ASME certified flow test facility and witnessed by an ASME observer.

We suggest that Engineers considering valves from other manufacturers ask for copies of their certified flow test curves. Cv values should be no less than the following to insure the pressure drop is less than 3%.

<u>Size</u>	<u>Cv</u>
2"	225
3"	612
4"	1061
6"	2713
8"	4512

Engineers should also be wary of valves which claim to have the same design as our Safety Selector Valve. The design of our Safety Selector Valve is unique wherein it has built in seat equalization. Seat equalization means that during change-over, the pressure on both sides of the seat is the same, making it simple to operate the valve under pressure without the need for actuators. All other valves claiming to be "Safety Selector or Switch Valves" use the three-way plug or ball valve design. Although some may have a valve body designed to have a similar flow path, the bottom line is that these valves have a plug valve or ball valve for their internals and will become difficult to operate after just a short time in service.

Please consult your local representative or factory experts for additional information on our Safety Selector Valve.

