

## Some considerations in sizing Pressure Reducing valves for water pipelines

Self actuated Pilot Operated Water Control Valves are very flexible in that they can be used to do many functions and a combination of functions. It is not uncommon to have combinations such as Pressure Reducing and Pressure Sustaining on one valve. The other beauty about this type of valve is that as long as inexperienced staff do not tamper with the settings, the valve will operate reliably for many years without any trouble. It is this flexibility and reliability which makes users often think that these valves are wonderful, and can do anything that you want the valve to do. The answer to that is an emphatic **NO!!** Even though these valves have all the attributes mentioned above, they still have to comply with some basic laws of nature.

In sizing control valves some basic considerations must come into the picture ie

- What is the maximum flow
- What is the minimum flow
- What is the upstream pressure (minimum and maximum)
- What is the downstream pressure (minimum and maximum)

Every control valve has a maximum recommended flow rate beyond which the life of the valve will be compromised, not to mention excessive noise. The reason for this is that the velocities through (and inside) the valve will be too high if this value is exceeded, causing high velocity erosion damage to the valve's internals.

Every control valve also has a minimum recommended flow rate. If the flow goes below this value chances are that the valve will become unstable and cause vibrations and instability in the pipeline and which can have catastrophic effects such as a burst pipe.

Every control valve also has a limit to the pressure drop which it can handle before cavitation sets in which can cause serious damage. Normally this can be expressed in a ratio of inlet to outlet pressure and for most standard self-actuated control valves is 3:1. The **Ultra ACV Control Valve** distributed by Ultra Control Valves can handle a ratio of 4:1 which is already a benefit.



**Ultra ACV Control Valve**

So, how do we decide what size control valve will be ideal for a particular application. Let's go through the steps:

#### **Maximum flow**

Max recommended flow rates are published by most control valve companies and is normally based on a velocity of 6 meters per second. As long as the required pressure drop is slightly higher than 2bar, this normally indicates that a valve at least one size smaller than line size can be installed. It is normally only in cases where required pressure drop is at or below 2bar that a full line size valve would be installed.

#### **Minimum flow**

Even though valve companies publish minimum recommended flow rates per valve, it would be more correct to publish minimum CV values at which the valve can operate without instability, as it is the closeness to the seat of the valve which makes the globe (or plug) become unstable, and which is dependent on both flow rate and pressure drop. In most Pressure Reducing valves feeding a network of domestic houses, one can be sure that the minimum flow rate the valve has to cope with will be lower than the valve's capability. So what to do about it ?

A solution is to install a smaller bypass valve to the main PRV and set at a slightly higher pressure (0,5bar) than the main valve. At times when demand is low (at night), the bypass valve will automatically continue to feed the demand, with the main valve in the closed position. Although it solves the problem of instability it does add some complication which cannot be avoided.

#### **Required Pressure drop**

If the required pressure drop through the valve exceeds the valve's capability, cavitation damage would occur, the severity of which depends on the degree by which the rules are broken. The author has seen valve life reduced to a few weeks on some low pressure applications such as at a reservoir (subject of a previous article) where the pressure drop exceeded the anti-cavitation index of the valve. So again, how do we overcome cavitation damage in a Pressure Reducing valve which has to operate beyond its pressure drop capability ?

In a Pressure Reducing valve which normally has to operate over a wide range of flow rates, the only answer is to put two valves in series. This again adds complications but in order to ensure acceptable valve life, one has no choice in the matter. One of the downsides to having two pilot operated Pressure Reducing valves act in series is that there is the potential of the valves interacting (or hunting), which can cause an instability in the controlled pressure. There are ways of reducing this phenomena by slowing down the reaction time of one of the valves (preferably the upstream valve). Ultra Control Valves also has the option of using their Ratio reducing valve on the upstream side. This unique valve has a very fast reaction time and will immediately follow what the downstream Pilot operated valve is doing without any fear of instability. Incidentally, the Ultra Ratio Reducing valve does not have any pilots and is used extensively in the mining industry where the valve has been used with great success to reduce pressure from 40bar to 8bar. So you can see that despite the complications involved, **there is always a solution which is practical and works !!** The key is to know about the pitfalls and to design them out.



### Ultra Ratio Reducing Valve

One further issue to be addressed in Pressure Reducing applications is “**dead end service**”. Simply put it means that if the demand deteriorates to zero, the valve must still maintain the required downstream pressure. This is a perfectly normal requirement but often overlooked – again some people expect the valve to maintain the downstream pressure under all circumstances without giving it much thought.

How does a Pressure Reducing valve reduce pressure from a higher to a lower value ? It is achieved by destruction of energy, by the valve “throttling” down on the flow – with emphasis on the word **flow**. If there is no flow the valve has no control over what happens to the downstream pressure. In the case of Pressure Reducing valves feeding a network where flow can deteriorate to zero (at night), the only way to ensure the integrity of the downstream pressure is by installing a Relief valve on the downstream side. During rapid demand reductions or dead end situations, the relief valve would blow off pressure for short periods while the PRV is busy closing down.

### Axial Flow Control Valves

Most standard Control valves are of the Globe type where flow is under and over the seat of the valve offering inherent change in flow direction and which assists in creating energy losses. There are some “new” designs which have an “Axial Flow” path and which offer tremendous hydraulic benefits over the standard Globe style valves. One such valve is the **C-Valve** and which amongst others has the following benefits:

- Pressure drop capability of up to 12:1. This is almost unheard of in the industry and can only be achieved with standard control valves with complicated and expensive “trims”. The C-Valve offers this with the standard product.
- Low flow capability down to “whisper” flows.

All this means that with this product one would never require valves in parallel or series. Full details of the C-Valve can be viewed on the website [www.ultravalves.co.za](http://www.ultravalves.co.za)



## **C-Valve**

In **conclusion** the above factors are important to consider in any Pressure Reducing application in order to ensure complete satisfaction with the valve's performance. Professional Control Valve suppliers would normally ask all the right questions at quoting stage to try to eliminate mistakes and ultimate dissatisfaction when control valves don't perform to expectations. Ultra Control Valves are also in a position to supply complete Pressure Reducing stations with Bypass valves, Relief valves and isolating valves – all connected and supplied as one unit. This is one way of ensuring that mistakes are eliminated, and that responsibility lies with one supplier.

Until the next time

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