Correct Sizing of a Pressure Reducing Valve

A question that All Valve Industries receives regularly throughout the plumbing industry is ‘how do I correctly size a pressure reducing valve?’ Control valves such as pressure reducing valves need to be sized correctly in order for optimum control of the water; whether the control valve is made for flow control, or in the case of this article, a pressure reducing valve for pressure control. Undersized or oversized valves can mean poor control accuracy, under flows, noise, cavitation or premature wear of components.

The first step that needs to be considered for selecting the correct size of pressure reducing valve is:

**WHAT IS THE CALCULATED FLOW REQUIREMENT MINIMUM & MAXIMUM?**

Do not size only for a maximum flow requirement. During low flow demand, an oversized valve will operate in a nearly closed position causing premature wear and an undesirable noise may occur.

If normal flow requires a line size PRV, a smaller PRV, piped parallel to the main PRV should be considered. Adjusting the smaller bypass PRV at 50-70kPa higher than the main PRV will ensure that during periods of low flow demand, these lower flows are handled by the smaller bypass PRV and prevent premature wear and possible noise of the larger valve.

Once the minimum and maximum flow rates required in the system have been considered, then the valve size may be selected. The correct parameter to base the valve size selection is by velocity.

**SIZE FOR 1 - 2 M/S VELOCITY**

Size the pressure reducing valve based on a velocity of 1-2 m/s. This range is advisable for good pressure control within the valve’s optimum flow rate range.

With the nominal flow rate required, select a valve size that intersects the flow rate within 1-2 m/s on the water velocity chart. Sometimes there is a choice in terms of valve size within the acceptable water velocities; at that point you can decide if you want a better control at reduced flow rates with higher velocity and higher pressure loss at nominal flow rates (selecting the smaller size) or vice versa. The corresponding pressure loss graph may then be used at the same flow rate and valve size to obtain the pressure loss.

If the minimum flow rate expected is less than around 0.3 m/s on the main PRV, then install a bypass line with a smaller valve where the minimum flow rate ideally falls within a velocity of 1-2 m/s of the valve.

Although sizing a valve based on a pressure loss curve can usually achieve a similar size selection as a selection based on velocity, it is not the ideal method. A good control valve will have a lower pressure loss at the same flow rate than a similar poorly designed valve: whether this is due to the rough internal casting, or an inefficient internal configuration. The internal fluid-dynamic shape and smooth surfaces of the Caleffi pressure reducing valve makes it possible to attain low pressure losses, even when a large number of draw off outlets are open.
SIZING EXAMPLE

The steps to be taken for correct sizing are as follows:

Referring to AS3500.1, use the probable simultaneous demand (PSD) flow rate based on the number of dwellings. For example, Table 3.2 suggests the minimum flow for 9 dwellings should be 1.64 l/s (98.4 l/m3).

Alternatively, calculate the flow on the basis and types of devices present in the system, adding up their individual nominal flow rates.

Example: Apartment Block; 2 bathrooms units x 9 units in complex

- 1 shower Q = 6 l/min
- 2 washbasins Q = 12 l/min
- 2 WCs Q = 12 l/min
- 1 bath Q = 18 l/min
- 1 kitchen sink Q = 6 l/min
- 1 dishwasher Q = 12 l/min

Q tot = 66 l/min x 9 units = 594 l/min
Total number of fixtures = 72

The design flow is calculated using the simultaneous-use factors table (European PSD table).

Table showing simultaneous-use factors as %

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Example:
Qds = Q tot x % = 594 x 17% = 101 l/min; similar to the 98.4 l/m PSD as per Australian Standards.

EXAMPLE BASED ON THE CALEFFI 535 SERIES PRESSURE REDUCING VALVE

The size of the pressure reducing valve is determined by means of graph 1, starting with the design flow figure and bearing in mind that the ideal velocity is between 1 and 2 m/s (blue band).

for Qds = 98.4 l/min the 32mm size is selected (see graph 1)

Using graph 2, still starting with the design flow figure, identify the pressure drop intersecting the curve relating to the size already selected (the downstream pressure falls by a value equal to the pressure drop in relation to the zero flow calibration pressure).
Note that this chart shows curves at a 800kPa inlet pressure and 300kPa set pressure; curves for other settings are similar. The curve shifts slightly to the left for a smaller differential and to the right for a greater differential.

**WHAT IS THE DESIRED REDUCED DOWNSTREAM PRESSURE?**

The final consideration when selecting a pressure reducing valve is the amount of pressure reduction required. Optimal performance is achieved at a 2:1 ratio, and a maximum of no more than 4:1. Example: 600kPa supply pressure, 300kPa static downstream pressure. Where large pressure drops are required, for example in multi-storey buildings where inlet pressures are likely to exceed 1,000 kPa, this may be achieved through staged pressure reduction measures. A situation with low flow and a high differential pressure forces the valve to operate in a near closed position, potentially resulting in cavitation and possible noise.