


# from experience

## Dropping the Hammer: Controlling Water Hammer

The phenomenon of water hammer can impact any fluid system, whether it is a traditional potable water system, or other ingredient or product system pumped to your processes or fillers. You are likely already aware of or have experienced the consequences of water hammer: startled operators, pipe stress, leaking flanges and leaking valves.

A frequent culprit that creates the water hammer effect is the sudden closure of a valve, resulting in a rapid change in the velocity of the flowing liquid in your process or utility lines. The reflected momentum or energy from fluid on the valve and back into the piping system results in a measurable pressure increase in the system, which will move pipes or exceed the holding pressure of gaskets or valves, resulting in leaks.

For a piping system, the water hammer pressure rise caused by sudden valve closure can be estimated by the following equation:

$$P_{max} = P_{op} + \left( \frac{0.011 \times Q \times \rho \times L}{T \times D^2} \right)$$

Where…
Pmax = maximum pressure developed in the piping system (psig)
Pop = operating pressure in the piping system (psig)
L = length of the piping system, from source of pressure to valve (feet)
Q = flow rate (GPM)
T = valve closure time (seconds)
ρ = specific gravity of the fluid
D = pipe inside diameter (inches)

While other system variables can exacerbate or dampen the actual pressure increase in the system, there are steps you can take to reduce water hammer. The two key variables are fluid flow rate (Q) and valve closure speed (T). For example, a pump could be programmed to “wind down” or be turned off as a set point is approached to reduce the flow rate and operating pressure prior to closing the control valve. Likewise, a valve can be throttled or “dribbled” to a partially closed position as the set point is approached to reduce the fluid flow rate. Similarly, the actuator speed can also be adjusted to increase the valve closure time (e.g., from 0.5 seconds to 1.0 second, reducing water hammer pressure 50%). Of course, such actions require coordination with your controls engineer to ensure that the accuracy of your ingredient or product delivery system is maintained.

## experience in brief

Install sanitary control valves so that the valve closes against the flow whenever possible. This prevents the momentum of the flow from quickly forcing the valve closed, which can result in water hammer.

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