Understanding and Predicting Cavitation in Control Valves

Cavitation in control valves occurs only with liquid media, and the principal factors are fluid velocity and pressure drop. Vapor bubbles will form if the liquid’s upstream pressure suddenly drops below its vapor pressure as it flows through the valve. Cavitation is the collapsing of these vapor bubbles as the pressure recovers downstream of the valve’s trim outlet.
Cavitation Damage

Cavitation damage is a form of hyper-erosion that can destroy both control valves and piping, which can result in unacceptable process failures. The vapor bubbles created as a result of a pressure drop will implode – nucleate, grow, collapse, and rebound – as the vapor returns to liquid form. The implosion of vapor bubbles in the cavitation phenomenon inflicts damage in the form of small pits in the metal, which cumulatively wear away surfaces.

Predicting Cavitation

Embedded in Trimteck’s AccuValve Sizing & Specification Software is the Sigma Cavitation Index for predicting the potential for cavitation given a set of valve process parameters. Sigma is the most widely-accepted and precise cavitation index used to quantify and predict cavitation in control valves. Simply put, Sigma is the ratio of the potential for resisting formation of vapor bubbles to the potential for causing formation of vapor bubbles.
Preventing Cavitation with Staged Pressure Reducing Trim

In applications with more severe cavitation (1.0 < σ < 1.5), the ideal solution is to reduce pressure gradually from the trim inlet to the trim outlet. By staging pressure reduction, the trim can prevent the process pressure from dipping below the vapor pressure – thereby preventing the formation of the damaging vapor bubbles altogether.
Trimteck’s Anti-Cavitation Trim Solutions

ST-1 Single Stage

A cost-effective single-stage trim that minimizes cavitation damage to valve and piping by diverting the location and controlling the concentration of imploding vapor bubbles to an area away from metal parts.

ST-2 Multi Stage
By reducing pressure through a series of restrictive channels and expansion areas, ST-2 Multi-Stage trim not only eliminates cavitation damage, but it often prevents cavitation from occurring altogether.

Trimteck’s Stacked Disc trim is a powerful solution designed to tackle the most severe pressure drops while reducing sound levels and eliminating the effects of cavitation.