Control Valve Sizing Formula for Liquid Service

A. Non-choked Flow $\Delta P < C_1^2(\Delta P_s)$	B. Choked Flow – cavitation or flashing $\Delta P > C_1^2(\Delta P_s)$
Volumetric Flow $C_V = 1.16q\sqrt{\dfrac{G_f}{\Delta P}}$	$C_V = \dfrac{1.16q}{C_1}\sqrt{\dfrac{G_f}{\Delta P_s}}$
Flow by Weight $C_V = \dfrac{1.16W}{\sqrt{G_f \Delta P}}$	$C_V = \dfrac{1.16W}{C_1\sqrt{G_f \Delta P_s}}$

$$\Delta P_s = P_1 - \left(0.96 - 0.28\sqrt{\frac{P_V}{P_C}}\right)P_V$$

or for simplicity, if $P_V < 0.5\,P_1$, $\Delta P_s = P_1 - P_V$

Where:

C_V = Valve flow coefficient

C_1 = Critical flow factor

G_f = Specific gravity at flowing temperature (water = 1 @ 15°C)

P_1 = Upstream pressure, bars absolute

P_2 = Downstream pressure, bars absolute

P_C = Pressure at thermodynamic critical point, bars absolute

P_V = Vapour pressure of liquid at flowing temperature, bars absolute

ΔP = Actual pressure drop $P_1 - P_2$, bars

q = Liquid flow rate, m^3/h

W = Liquid flow rate, 1000 kg per hour

Note: 1 bar = 1.02 kg/cm^2