Tech Sheet #CVR 409

Definition of the Metric Valve Flow Coefficient K_v

This tech sheet defines the relationship between the valve flow coefficient C_v and the valve flow factor K_V, both of which are commonly used for the purpose of calculating valve flow capacity or allowable leakage limits (Reference FCI 70-2, Standards for Control Valve Leakage Testing). K_V represents the conversion of the C_V sizing coefficient into metric terminology to meet the need for consideration of the metric system and the international system of units (SI) in particular.

Definitions

The flow coefficient (C_V or K_V) is a constant to the geometry of a valve that can be used to predict flow rate under specific pressure conditions for a given valve opening.

The flow coefficient C_V is experimentally determined for a specific valve. At a given valve travel, its value is 1 with a flow rate of 1 gallon per minute of water at a temperature of 40-100°F and a pressure differential across the valve of 1 psid.

Similarly, the flow factor K_V has a value of 1 with a flow rate of 1 cubic meter per hour of water at a temperature of 5°C to 30°C and a pressure differential across the valve of 1 bar.

Equations

The equation for both coefficients can generically be expressed as:

$$C_V \ or \ K_V = Q\sqrt{\frac{G_f}{\Delta P}}$$

Where,
Q = liquid flow rate
G_f = liquid specific gravity
ΔP = pressure differential across valve

The relationship between C_V and K_V is established by converting between the standard units and metric units:

1 GPM = 0.227 m^3/hr

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1 psi = 0.069 bar
G_f = 1 (unitless)

Plugging the metric unit conversions into the equation for C_V yields:

$$C_V = 0.227 * \sqrt{\frac{1}{0.069}} = 0.865$$

In order to make C_V = 1 in the above equation, the inverse of the unit conversion, or 1.156, must be factored into the equation.

Therefore,

$$C_V = 1.156\, Q \sqrt{\frac{G_f}{\Delta P}}$$
$$= 1.156\, K_V$$

Where, Q = Flow rate in m^3/hour
ΔP = pressure differential across the valve in bar
G_f = liquid specific gravity

Conversely,

$$K_V = 0.865\, C_V$$