Formula to calculate Cv Value, Flow Rate, and Differential Pressure (Pressure Loss)

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Calculation in our website is based on the following formula.
This calculation is a simple calculation that does not include valve data.

■Non-Choked Flow ($\Delta p < 0.5p_1$)

	Cv Value	Flow Rate	Differential Pressure (Pressure Loss)
Liquid	$C_V = 11.6Q\sqrt{\frac{G_f}{\Delta p}}$	$Q = \frac{C_V}{11.6}\sqrt{\frac{\Delta p}{G_f}}$	$\Delta p = \left(\frac{11.6Q}{C_V}\right)^2 \cdot G_f$
Gas	$C_V = \frac{V}{2.78}\sqrt{\frac{G_gT_1}{\Delta p(p_1+p_2)}}$	$V = 2.78C_V\sqrt{\frac{\Delta p(p_1+p_2)}{G_gT_1}}$	$\Delta p = p_1 - \sqrt{p_1{}^2 - \left(\frac{V}{2.78\times C_V}\right)^2 \times G_gT_1}$
Saturation Steam	$C_V = \frac{7260W}{\sqrt{\Delta p(p_1+p_2)}}$	$W = \frac{C_V}{7260}\sqrt{\Delta p(p_1+p_2)}$	$\Delta p = p_1 - \sqrt{p_1{}^2 - \left(\frac{7260W}{C_V}\right)^2}$
Superheated Steam	$C_V = \frac{7260W(1+0.0013T_{SH})}{\sqrt{\Delta p(p_1+p_2)}}$	$W = \frac{C_V}{7260(1+0.0013T_{SH})}\sqrt{\Delta p(p_1+p_2)}$	$\Delta p = p_1 - \sqrt{p_1{}^2 - \left(\frac{7260W(1+0.0013T_{SH})}{C_V}\right)^2}$

■Choked Flow ($\Delta p \geqq 0.5p_1$)

	Cv Value	Flow Rate	Differential Pressure (Pressure Loss)
Liquid	Not Applicable	Not Applicable	Not Applicable
Gas	$C_V = \frac{V}{2.43}\frac{\sqrt{G_gT_1}}{p_1}$	$V = 2.43C_V\frac{p_1}{\sqrt{G_gT_1}}$	Not Applicable
Saturation Steam	$C_V = \frac{8340W}{p_1}$	$W = \frac{C_V}{8340}\cdot p_1$	Not Applicable
Superheated Steam	$C_V = \frac{8340W(1+0.0013T_{SH})}{p_1}$	$W = \frac{C_V}{8340(1+0.0013T_{SH})}\cdot p_1$	Not Applicable

■Explanation of Symbols

- Cv Flow Coefficient (Cv Value)
- V Gas Volume Flow Rate (Nm^3/h)
- p_1 Absolute Static Pressure Upstream of Valve (kPa abs)
- Δp Differential Pressure between Upstream and Downstream Valve (kPa) ($\Delta p = p_1 - p_2$)
- Gg Specific Gravity of Gas at Standard Condition compared to Air at Standard Condition
  As air being one (1).
- T_1 Absolute Temperature Upstream of valve (K)
- T_{SH} Degree of Superheat (℃)
- Q Liquid Volume Flow Rate (m^3/h)
- W Mass Flow Rate (t/h)
- p_2 Absolute Static Pressure Downstream of Valve (kPa abs)
- Gf Specific Gravity of Liquid at Operating Temperature compared to Water at Standard Condition
  As water being one (1).

Even if the differential pressure (differential pressure between upstream and downstream of the valve) is increased, in choked flow condition flow rate does not increase.

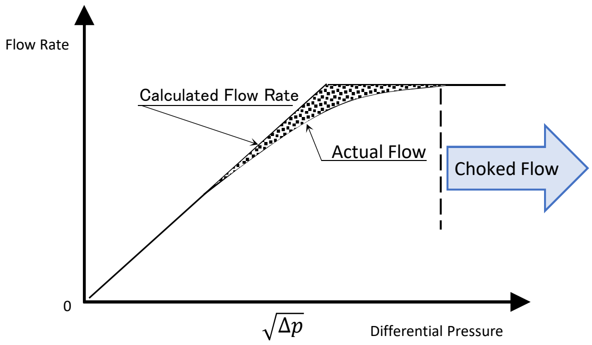

Figure 1: Relationship between Differential Pressure and Flow Rate