Reference Material

Calculation formula for Cv value and flow capacity

Easy way to obtain the valve size is to use the chart of sizing for each type of valve.
For non- chart valve or to obtain detailed related values, calculate by following formula.
Obtain Cv by upper formula and flow rate by lower formula.

	In case of $\triangle P \leqq \frac{P_1}{2}$	In case of $\triangle P \geqq \frac{P_1}{2}$	Symbol
Steam	$Cv = \frac{WK}{0.198\sqrt{(P_1-P_2)P_2}}$ —(1) $\left\{ Cv = \frac{WK}{198\sqrt{(P_1-P_2)P_2}} \right\}$ $W = \frac{0.198Cv\sqrt{(P_1-P_2)P_2}}{K}$ $\left\{ W = \frac{198Cv\sqrt{(P_1-P_2)P_2}}{K} \right\}$	$Cv = \frac{WK}{0.099P_1} \left\{ Cv = \frac{WK}{99P_1} \right\}$ —(2) $W = \frac{0.099CvP_1}{K} \left\{ W = \frac{99CvP_1}{K} \right\}$	W : Flow rate kg /h P_1 : Inlet pressure kPa abs {MPa abs} P_2 : Outlet pressure kPa abs {MPa abs} K : 1+0.0013×(Superheated steam temperature− Saturated temperature) ℃
Gas	$Cv = \frac{V}{3.94}\sqrt{\frac{G(273+t)}{(P_1-P_2)P_2}}$ —(3) $\left\{ Cv = \frac{V}{3940}\sqrt{\frac{G(273+t)}{(P_1-P_2)P_2}} \right\}$ $V = 3.94Cv\sqrt{\frac{(P_1-P_2)P_2}{G(273+t)}}$ $\left\{ V = 3940Cv\sqrt{\frac{(P_1-P_2)P_2}{G(273+t)}} \right\}$	$Cv = \frac{V\sqrt{G(273+t)}}{1.97P_1}$ —(4) $\left\{ Cv = \frac{V\sqrt{G(273+t)}}{1970P_1} \right\}$ $V = \frac{1.97CvP_1}{\sqrt{G(273+t)}}$ $\left\{ V = \frac{1970CvP_1}{\sqrt{G(273+t)}} \right\}$	V : Flow rate m^3/h (normal) G : Specific gravity (Air=1) t : Temperature ℃ P_1 : Inlet pressure kPa abs {MPa abs} P_2 : Outlet pressure kPa abs {MPa abs} kPa abs {MPa abs} : Absolute pressure, Gauge pressure+101.3kPa {0.1013MPa}
	In case of ambient temperature (20℃)		
	$Cv = \frac{V}{0.23}\sqrt{\frac{G}{(P_1-P_2)P_2}}$ —(5) $\left\{ Cv = \frac{V}{230}\sqrt{\frac{G}{(P_1-P_2)P_2}} \right\}$ $V = 0.23Cv\sqrt{\frac{(P_1-P_2)P_2}{G}}$ $\left\{ V = 230Cv\sqrt{\frac{(P_1-P_2)P_2}{G}} \right\}$	$Cv = \frac{V\sqrt{G}}{0.115P_1} \left\{ Cv = \frac{V\sqrt{G}}{115P_1} \right\}$ —(6) $V = \frac{0.115CvP_1}{\sqrt{G}} \left\{ V = \frac{115CvP_1}{\sqrt{G}} \right\}$	
Liquid	$Cv = \frac{0.696Q\sqrt{\gamma}}{\sqrt{\triangle P}} \left\{ Cv = \frac{0.022Q\sqrt{\gamma}}{\sqrt{\triangle P}} \right\}$ —(7) $\left[Cv = \frac{11.6W\sqrt{\gamma}}{\sqrt{\triangle P}} \left\{ Cv = \frac{0.367W\sqrt{\gamma}}{\sqrt{\triangle P}} \right\} \right]$		Q : Flow rate ℓ/min [W m^3/h] γ : Specific gravity (Water at 4℃=1) △P : Differential pressure, P_1-P_2 kPa {MPa}

Note : 1. In case of vaporization at valve, this formula can't be applied.
2. In case of high viscosity fluid over 20mm²/s, flow rate shall be corrected by following formula.

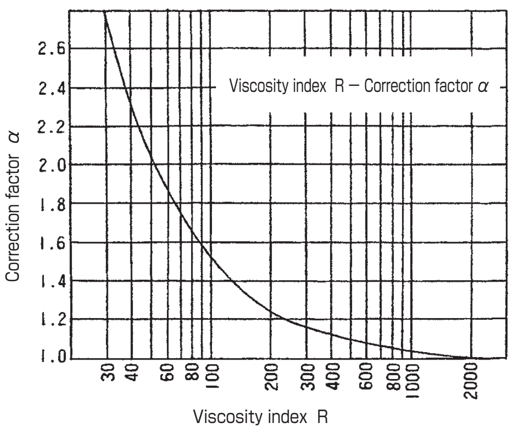
Correction of flow rate for high viscosity fluid

Calculate Cv value by formula (7).(Not taking account of viscosity)
Viscosity index R is calculated by formula (8).
Correction factor α is obtained from the chart on right.
Corrected flow rate Q' is obtained from multiplying Q by α.

$$R = \frac{2642 \times Q}{\sqrt{Cv} \times \text{Viscosity at operating temperature} \quad mm^2/s} \quad -(8)$$

$$\text{Corrected flow rate } Q' = Q \times \alpha \quad -(9)$$

Valve size should be selected by followings :
・Cv calculation by putting the corrected flow rate Q' into above formula (7).
・Applying the corrected flow rate Q' to the sizing chart of each valve type.



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