Cv Flow Coefficients & Valve Sizing

The flow coefficient, Cv, is the volume (in gallons) of water at 60° F that will flow per minute through a valve with a pressure drop of 1 psi across the valve. Numerically this definition can be expressed as:

$$Cv = F \div \sqrt{\Delta P}$$

The use of the flow coefficient offers a standard method of comparing valve capacities and sizing valves for specific applications that is widely accepted by industry. The general definition of the flow coefficient can be expanded into equations modeling the flow of liquids, gases and steam as follows:

Liquid flow

$F = Cv\sqrt{\Delta P \div S}$ $Cv = F \div \sqrt{(\Delta P \div S)}$ $\Delta P = S\,(F \div Cv)^2$

Gas flow

When the downstream pressure (P_2) is greater than 53% of the inlet pressure (P_1), the following formulae apply:

$F = 1{,}391Cv\sqrt{(P_2\Delta P \div S\,T)}$ $Cv = F \div 1{,}391\sqrt{(P_2\,\Delta P \div S\,T)}$ $\Delta P = ST\,(F \div 1{,}391\,Cv)^2 \div P_2$

When the downstream pressure is equal to or less than *53% of the inlet pressure (P_1), the following formulae apply:

$F = 695.4\,Cv\,P_1 \div \sqrt{(S\,T)}$ $Cv = F\sqrt{(S\,T)} \div 695.4\,P_1$ $P_1 = F\sqrt{(S\,T)} \div 695.4\,Cv$

Steam flow

When the downstream pressure (P_2) is greater that 57% of the inlet pressure (P_1), the following formulae apply:

$F = 3\,Cv\sqrt{(P_2\Delta P \div X)}$ $Cv = F \div 3\sqrt{(P_2\Delta P \div X)}$ $\Delta P = X\,(F \div 3\,Cv)^2 \div P_2$

When the downstream pressure (P_2) is equal or less than 57% of the inlet pressure (P_1), the following formulae apply:

$F = 3\,Cv\,P_1 \div 2\sqrt{(X)}$ $Cv = 2\,F\sqrt{(X)} \div 3\,P_1$ $P_1 = 2\,F\sqrt{(X)} \div 3\,Cv$

Note: Equations are for saturated steam

Definitions

Cv	Flow coefficient or flow capacity rating of valve
F	Rate of flow in USGPM for liquids, SCFH for gases, and lbs/hr for steam.
T	Absolute temperature in degrees Rankine (°R) (460 + degrees Fahrenheit(°F))
S	Specific gravity (relative to air or water)
P_1	Inlet pressure, PSIA
P_2	Downstream pressure, PSIA
ΔP	Pressure drop across the valve, PSI
X	Quality of steam in decimal form. i.e. 80% quality = 0.80
USGPM	U.S. gallons per minute
SCFH	Standard cubic feet per hour
PSI	Pounds per square inch
PSIA	Pounds per square inch absolute (PSIA = PSI + 14.7)

* *The 53% is accurate for air, nitrogen, hydrogen, and oxygen. The values for other fluids will vary slightly. For instance: helium and argon 49%, methane and carbon dioxide 55%.*

Cv Flow Coefficient Chart for ATKOMATIC Valves

	ANGLE TYPE VALVE: BARSTOCK BODY			GLOBE TYPE VALVE: CAST BODY					
VALVE ORIFICE SIZE	1000 2000 50000	7004	14000	JJ HS 500 15400	4000 5000 6000 30400	3000	12000	8000 15800 30800	16000
1/32″	0.020	—	—	—	—	—	—	—	—
3/64″	0.056	—	—	—	—	—	—	—	—
1/16″	0.093	—	0.093	—	—	0.093	—	—	0.093
3/32″	0.22	—	0.22	—	—	0.22	—	—	0.22
1/8″	0.44	—	0.40	—	—	0.44	—	—	0.44
5/32″	—	—	—	—	—	—	—	—	—
3/16″	0.72	—	—	—	—	0.72	—	—	0.72
7/32″	—	—	—	—	—	—	—	—	—
1/4″	—	1.0	—	1.4	1.4	—	—	1.1	—
3/8″	—	2.0	—	2.7	2.7	—	2.8	2.5	—
1/2″	—	2.0	—	3.5	3.5	—	4.2	5.1	—
3/4″	—	—	—	7.5	8.4	—	8.5	7.5	—
1″	—	—	—	9.1	9.5	—	8.9	12.5	—
1 1/4″	—	—	—	19.5	19.5	—	—	21.0	—
1 1/2″	—	—	—	21.0	21.0	—	—	21.5	—
2″	—	—	—	46.0	43.0	—	—	45	—
2 1/2″	—	—	—	—	63.0	—	—	—	—
3″	—	—	—	—	71.0	—	—	—	—