C_v Flow Coefficients & Valve Sizing

The flow coefficient, Cv, is the volume (in gallons) of water at 60F 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:

$$Cv = F/\sqrt{DP}$$

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

$F = Cv \sqrt{}\ (DP / S)$ $Cv = F / \sqrt{}\ (DP / S)$ $DP = S\ (F / Cv)^2$

Gas flow

When the downstream pressure (P2) is greater than 53% of the inlet pressure (P1), the following formulae apply:

$F = 1391 Cv \sqrt{}\ (P2 \Delta P / S\ T)$ $Cv = F / 1391 \sqrt{}\ (P2\ DP / S\ T)$ $DP = ST\ (F / 1391\ Cv)^2 / P2$

When the downstream pressure is equal to or less than *53% of the inlet pressure (P1), the following formulae apply:

$F = 695.4\ Cv\ P1 / \sqrt{}\ (S\ T)$ $Cv = F \sqrt{}\ (S\ T) / 695.4\ P1$ $P1 = F \sqrt{}\ (S\ T) / 695.4\ Cv$

Steam flow

When the downstream pressure (P2) is greater that 57% of the inlet pressure (P1), the following formulae apply:

$F = 3\ Cv \sqrt{}\ (P2\ DP / X)$ $Cv = F / 3 \sqrt{}\ (P2\ DP / X)$ $DP = X\ (F / 3\ Cv)^2 / P2$

When the downstream pressure (P2) is equal or less than 57% of the inlet pressure (P1), the following formulae apply:

$F = 3\ Cv\ P1 / 2 \sqrt{}\ (X)$ $Cv = 2\ F \sqrt{}\ (X) / 3\ P1$ $P1 = 2\ F \sqrt{}\ (X) / 3\ Cv$

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 (460 + degrees Fahrenheit)
S = Specific gravity (relative to air or water)
P1 = Inlet pressure, PSIA
P2 = 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%.

C_v Flow Coefficient Chart for Atkomatic Valves

	Angle Type Valve – Barstock Body					Globe Type Valve – Cast Body			
Valve Orifice Size	1000 2000 5000	7004	14000	JJ HS 500 15400	4000 5000 6000 30400	3000	8000 15800 12000	30800	16000
1/32”	.020	-	-	-	-	-	-	-	-
3/64’	.056	-	-	-	-	-	-	-	-
1/16”	.093	-	.093	-	-	.093	-	-	.093
3/32”	.22	-	.22	-	-	.22	-	-	.22
1/8”	.44	-	.40	-	-	.44	-	-	.44
5/32”	-	-	-	-	-	-	-	-	-
3/16”	.72	-	-	-	-	.72	-	-	.72
7/32”	-	-	-	-	-	-	-	-	-
¼”	-	1.0	-	1.4	1.4	-	-	1.1	-
3/8”	-	2.0	-	2.7	2.7	-	2.8	2.5	-
½”	-	2.0	-	3.5	3.5	-	4.2	5.1	-
¾”	-	-	-	7.5	8.4	-	8.5	7.5	-
1”	-	-	-	9.1	9.5	-	8.9	12.5	-
1 ¼”	-	-	-	19.5	19.5	-	-	21.0	-
1 ½”	-	-	-	21.0	21.0	-	-	21.5	-
2”	-	-	-	46.0	43.0	-	-	45	-
2 ½”	-	-	-	-	63.0	-	-	-	-
3”	-	-	-	-	71.0	-	-	-	-