

THE IDEAL WAY



Flow Calculations for Liquids

The coefficient of flow (Cv) is a formula which is used to determine a valve's flows under various conditions and is thus useful for selecting the correct valve for a flow application. For liquids, Cv expresses the flow in gallons per minute of 60° F water with a pressure drop across the valve of 1 psi. Because gases are compressible fluids, the formula is altered to accommodate changes in density. Please refer to the following page for a Cv formula for gases. Valve specifications list a single Cv value for each valve model which represents the Cv value at full open. Ideal Aerosmith also created flow charts which display the Cv value at 15 different turns allowing for calculating flows for varying conditions at any of these points. The following is the Cv formula for liquids.

Where:

- Q = Liquid flow in Gallons per Minute
- ΔP = Pressure Drop. P₁ - P₂ in psi
- P₁ = Upstream (inlet) pressure in psia
- P₂ = Downstream (outlet) pressure in psia
- psia = Absolute pressure. This is psig (gage pressure) plus 14.7 (atmospheric pressure)
- S.G. = Specific Gravity of medium where water at 60° F = 1.0

$$Cv = Q / \sqrt{\frac{\Delta P}{S.G.}}$$

$$Q = Cv \times \sqrt{\frac{\Delta P}{S.G.}}$$

Example:

Determine which orifice size should be used for the following application. Upstream pressure is 100 psia, downstream is 60 psia. The medium is acetone (S.G.=.79) and the desired flow range is between .1 and .5 gpm.

$$Cv_{Low} = .1 / \sqrt{\frac{40}{.79}}$$

$$Cv_{High} = .5 / \sqrt{\frac{40}{.79}}$$

$$Cv_{Low} = .0141$$

$$Cv_{High} = .0703$$

The required Cv range for this application than is .0141 to .0703. If you'll examine the Cv flow charts, you will see that the Ideal Aerosmith -2- (.0625) orifice best fits this application. The Cv value of .0141 is reached at approximately turn 2.3, while the Cv value of .0703 is reached at approximately turn 14.6. The Ideal -2- orifice will meter the desired flows between turns 2.3 and 14.6, thus offering 12.3 turns of metering precision. The optional vernier micrometer handle displays the number of turns open accurate to 1/10 turn, thus giving the user in this application 123 visual reference points.

Flow Characteristics of orifice sizes -1- (.031); -2- (.062); -3- (.094); -4- (.125)				
No. Turns Open	Cv			
	-1-	-2-	-3-	-4-
1	-	0.0053	0.0176	0.0236
2	0.0007	0.0120	0.0353	0.0443
3	0.0017	0.0184	0.0509	0.0635
4	0.0027	0.0245	0.0644	0.0814
5	0.0037	0.0303	0.0762	0.0980
6	0.0047	0.0358	0.0863	0.1133
7	0.0057	0.0410	0.0948	0.1273
8	0.0067	0.0458	0.1021	0.1402
9	0.0077	0.0504	0.1081	0.1520
10	0.0087	0.0546	0.1130	0.1628
12	0.0107	0.0623	0.1204	0.1812
14	0.0127	0.0688	0.1254	0.1960
16	0.0148	0.0742	0.1292	0.2075
18	0.0169	0.0786	0.1331	0.2162
20	0.0190	0.0818	0.1383	0.2224

Specific Gravities of various liquids			
Liquid	S.G.	Liquid	S.G.
Acetic Acid	1.050	Glycerine	1.260
Acetone	0.790	Glycol	1.125
Acetaldehyde	0.782	Isopropyl Alcohol	0.780
Alcohol, Ethyl	0.790	Kerosene	0.820
Alcohol, Methyl	0.800	Mercury	13.620
Aniline	1.020	Nitric Acid	1.502
Benzol	0.878	Oil, Crude	.81 to .97
Carbolic Acid	1.081	Oil, Vegetable	0.925
Ether	0.741	Sulfuric Acid	1.831
Formic Acid	1.229	Turpentine	0.870
Gasoline	0.750	Water	1.000

The Cv table is shown in a graph form on the following page.