Flow Computations

The pipe size in the system ordinarily will determine the valve size. However, to assure accurate throttling or positioning, it is advisable to calculate the valve size. Formulas for liquid and gas are as follows:

Liquid Flow Formula*

$$C_V = Q_a \sqrt{\frac{sg}{\triangle P}}$$

$$Q_a = C_V \sqrt{\frac{\triangle P}{sg}}$$

$$\triangle P = sg \left(\frac{Q_a}{C_V}\right)^2$$

Where:

C_V = Flow coefficient (gpm/$\triangle$P)
sg = Specific gravity
Q_a = Actual flow (gpm)
$\triangle P$ = Actual pressure drop P_1-P_2(psi)

Gas Flow Formula*

$$C_V = \frac{Q}{1360} \sqrt{\frac{sg(T)}{\triangle P}} \sqrt{\frac{2}{P_1 + P_2}}$$

$$Q = 1360\, C_V \sqrt{\frac{\triangle P}{sg(T)}} \sqrt{\frac{P_1 + P_2}{2}}$$

$$\triangle P = P_1 - \sqrt{P_1^2 - (sg \times T) \left(\frac{Q}{963 \times C_V}\right)^2}$$

Where:

Q = Volumetric flow (SCFH)**
sg = Specific gravity
T = Absolute flowing temperature (°F + 460)
P_1 = Inlet pressure (psia)
P_2 = Outlet pressure (psia)
$\triangle P$ = Pressure drop (P_1-P_2)
C_V = Valve coefficient from tables

* Fluid Controls Institute Inc. Standard FCI 62-1
** SCFH (standard cubic foot per hour) of gas is measured at 60°F (519.7R) and 14.696 psia. CFH (cubic foot per hour) is measured at any temperature and pressure.

Conversion of CFH to SCFH is as follows:

$$SCFH = \frac{P_{actual}}{14.696} \times \frac{519.7\ ^oR}{T_{actual}} \times CFH_{actual}$$

Note 1: The design of the Straightway Valves are not conducive to good throttling characteristics.

Where:

SCFH = Standard cubic feet per hour
P_{actual} = Pressure of gas in psia
T_{actual} = Temperature of gas (°F + 460)

Important:
In general, any reduction in outlet pressure below one half the absolute inlet pressure will give no further increase in flow. The value of the ratio of pressure at which maximum flow is obtained varies somewhat depending on the actual fluid.