

Subject	Page of
GAS FLOW THRU REGULATOR	File no.
PER CGA E-4 - 2006	Date MARCH 5 / 2013

	ARGON	METHANE
	A	CH ₄
% BY VOLUME	90	10
M lbm/lbmol	39.9	16
R ft-lbf/lbm-R	38.7	96.4
k	1.47	1.32
C _v	.074	.449
C _p	.124	.593

$$C_v = .2$$

$$P_H = 2000 \text{ psig}$$

$$P_L = 100 \text{ psig}$$

$$\frac{P_L}{P_H} = \frac{100 + 14.7}{2000 + 14.7} = .0569$$

$$\begin{aligned} \text{MOLE MASS } M_m &= .9 M_1 + .1 M_2 \\ &= .9 \times 39.9 + .1 \times 16 \\ &= 35.91 + 1.6 \\ &= 37.51 \text{ lbm/lbmol} \end{aligned}$$

$$\begin{aligned} k_m &= \frac{\sum m_i C_{p_i}}{\sum m_i C_{v_i}} \\ &= \frac{M_1 C_{p_1} + M_2 C_{p_2}}{M_1 C_{v_1} + M_2 C_{v_2}} \\ &= \frac{35.91 \times .124 + 1.6 \times .593}{35.91 \times .074 + 1.6 \times .449} \\ &= 1.6 \end{aligned}$$

$$\begin{aligned} R_m &= \frac{\sum \frac{m_i R_i}{M_m}}{\frac{M_1 R_1 + M_2 R_2}{M_m}} \\ &= \frac{35.91 \times 38.7 + 1.6 \times 96.4}{37.51} \\ &= 41.16 \text{ ft-lbf/lbm-R} \end{aligned}$$

$$S_g = \frac{M_m}{M_{air}} = \frac{37.51}{29} = 1.29 \approx 1.3$$

$$\frac{P_c}{P_H} = \left(\frac{2}{k_m + 1} \right) \left(\frac{k_m}{k_m + 1} \right)^{\frac{1}{k_m - 1}} = \left(\frac{2}{1.6 + 1} \right) \left(\frac{1.6}{1.6 + 1} \right)^{\frac{1}{1.6 - 1}} = .497$$

(CRITICAL PRESSURE RATIO)

$$\text{so } \frac{P_L}{P_H} < \frac{P_c}{P_H} \text{ (SONIC FLOW)}$$

$$\begin{aligned} \text{USING } A &= \frac{6413.248}{\sqrt{M_m}} \sqrt{k_m} \left(\frac{2}{k_m + 1} \right)^{\left[\left(\frac{k_m}{k_m + 1} \right)^{\frac{1}{k_m - 1}} - .5 \right]} \\ &= \frac{6413.248}{\sqrt{37.51}} \sqrt{1.6} \left(\frac{2}{1.6 + 1} \right)^{\left[\left(\frac{1.6}{1.6 + 1} \right)^{\frac{1}{1.6 - 1}} - .5 \right]} \\ &= 750.22 \end{aligned}$$

$$\begin{aligned} \text{AND } Q &= \frac{A C_v P}{\sqrt{T}} \\ &= \frac{750.22 \times .2 \times 2014.7}{\sqrt{70 + 460}} \\ &= 1313.7 \text{ SCFM} \\ &= 219 \text{ SCFM} \end{aligned}$$