Orifice Sizing:

Hurzel Huang p113

$$A_{injection} = \dot{m}\sqrt{\frac{2.238 \cdot K}{\rho\ \Delta p}}$$

K: coeff of headloss
- depends on orifice passageways
square or rounded, 1.7 to 1.2
ρ: density [lbs/ft^3]
Δp: pressure drop per propellant [psi]
$\dot{m}$: propellant mass flow rate [lbm/s]

$$d_{orifice\ propellant} = \left(\frac{3.627 \cdot K \cdot (\dot{m})^2}{\rho \cdot \Delta p \cdot N^2}\right)^{1/4}$$

N: number of orifices

Givens: N2O IPA

$\dot{m}_o = 1.5$ kg/s
$\rho = 785$ kg/m^3 20°C
$\Delta p = 175$ PSI

$\dot{m}_f = 0.5$ kg/s
$\rho = 785.027$ kg/m^3 20°C
$\Delta P = 175$ PSI

K = 1.7, assuming sharp corners

Pressure drop est:
1000 − 150 = 850 150 lost over plumbing
0.2(850) = 175 PSI 20% less over injector

Work:

$$A_{oxidizer} = (1.5)(2.20462)\sqrt{\frac{2.238 \cdot 1.7}{(785 \cdot 0.0624)(175)}}$$
$$= 0.06967\ in^2$$

$$\frac{lb}{s}\sqrt{\frac{1}{\frac{lb}{in^2} \cdot \frac{lb}{ft^3}}}$$

$$\frac{\cancel{lb}}{s} \cdot \frac{in}{\cancel{lb}}\sqrt{ft^3}$$

$$d_{ox} = \left(\frac{3.627 \cdot 1.7\ (1.5 \cdot 2.20462)^2}{(785 \cdot .0624)(175)\ N^2}\right)^{1/4}$$
N=6 d = .12158 in
N=8 d = .1053 in

$$A_{fuel} = (0.5)(2.20462)\sqrt{\frac{2.238 \cdot 1.7}{(788 \cdot 0.0624)(175)}}$$
$$= 0.02348\ in^2$$

$$d_{fuel} = \left(\frac{3.627 \cdot 1.7\ (0.5 \cdot 2.20462)^2}{(788 \cdot .0624)(175)\ N^2}\right)^{1/4}$$
N=6 d = 0.070 in
N=8 d = 0.061 in