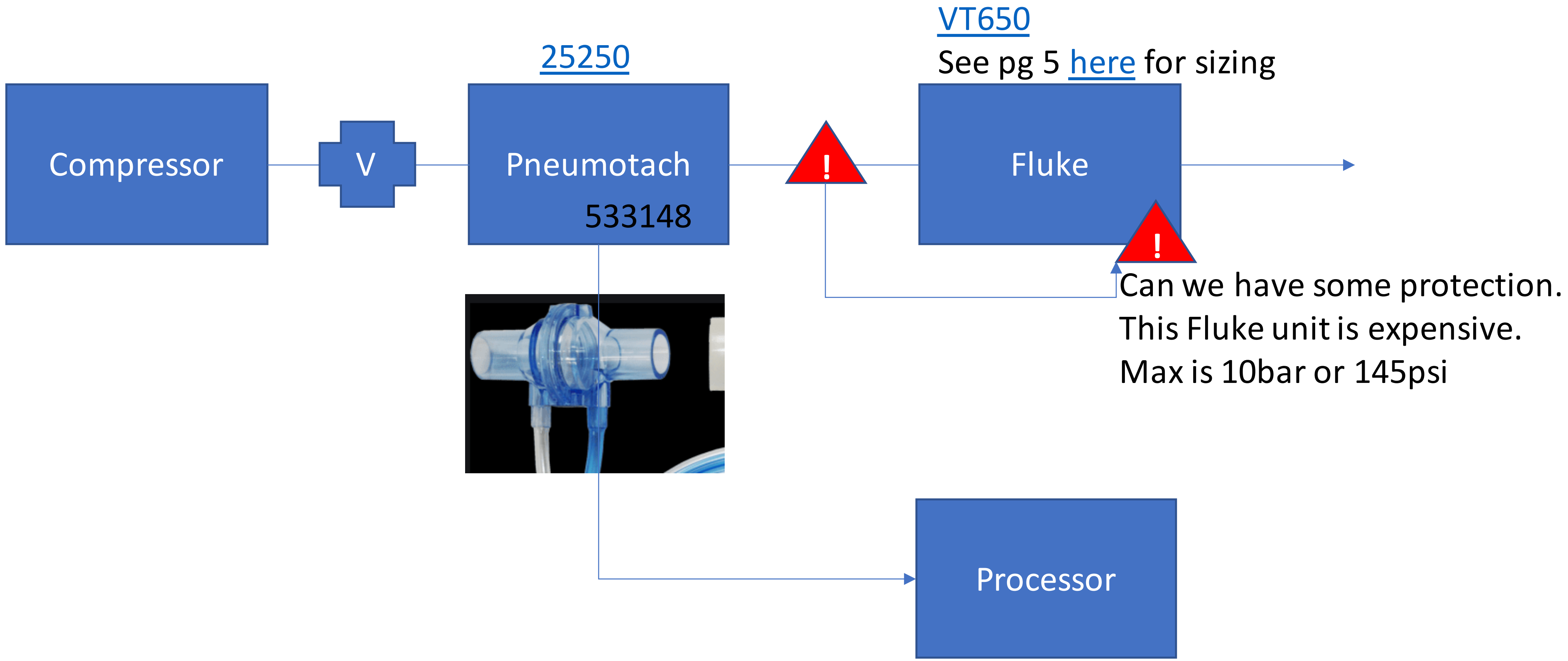
Fluke Test Setup

June 8th, 2021

Initial Proposed Set-Up

Relationship between Flow and Diff. Pressure

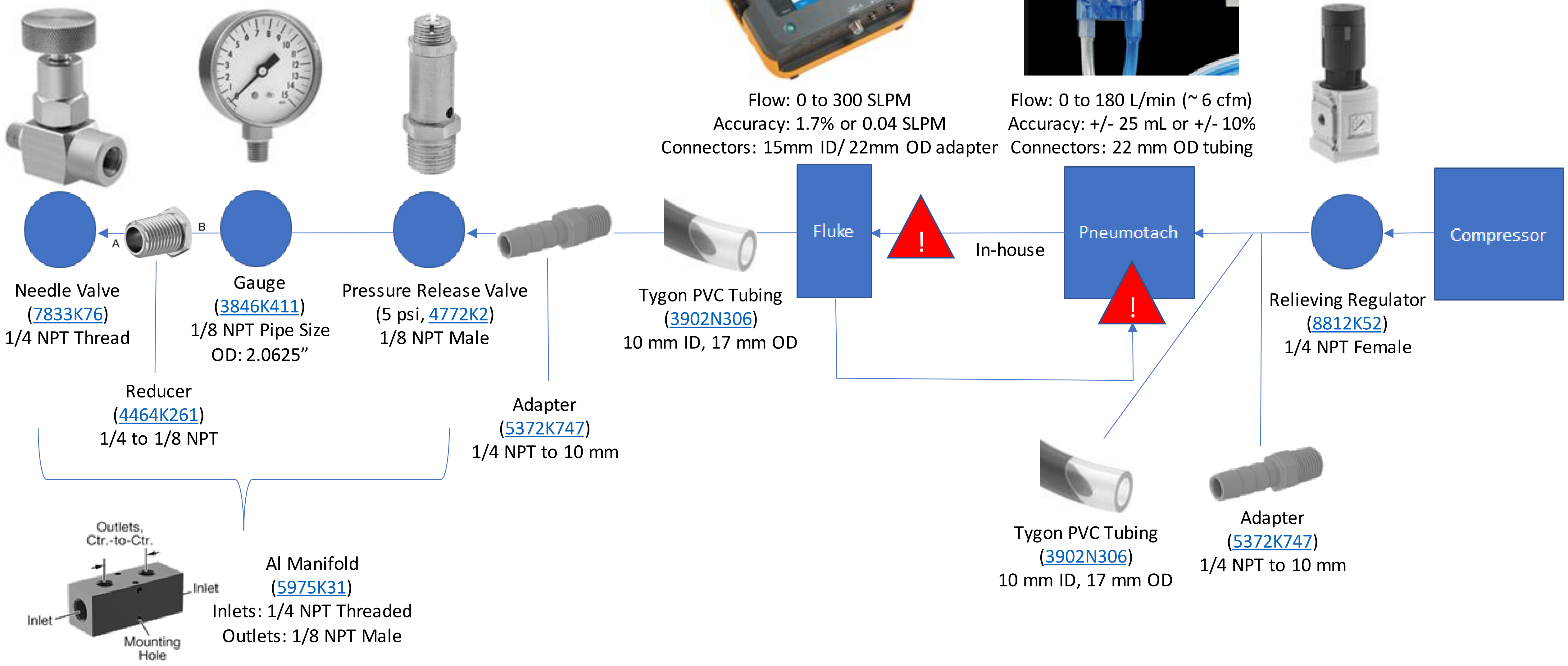
Flow range: 0 to 180Liters/min
Resolution: 40ml/min



Final Proposed Set-Up

Relationship between Flow and Diff. Pressure
Operating Parameters: 1 psi max, up to 180 L/min (~6 cfm)

Note: Tygon tubing to be attached to Fluke outlet and Pneumotach inlet via moisture-seal heat shrink (74965K57)



NOT USED - Idealized Mathematical Representation

Note: Bernoulli's is idealized, so it may not account for real-world friction, pressure drops, etc.

Bernoulli's Eq: $P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$

$$(P_2 - P_1) = \frac{1}{2}\rho(v_1^2 - v_2^2) + \rho g\cancelto{0}{(h_1 - h_2)}$$

Last term cancels out to 0 because there is a negligible change in height from the inlet to the outlet

$$(P_2 - P_1) = \frac{1}{2}\rho(v_1^2 - v_2^2)$$

$$\frac{2(P_2 - P_1)}{\rho} = v_1^2 - v_2^2 \qquad (2)$$

$$\frac{2(P_2 - P_1)}{\rho} = v_1^2 - (\frac{A_1}{A_2} \cdot v_1) \qquad (1)$$

$$(P_2 - P_1) = \frac{1}{2}\rho\left[(\frac{\dot{m}_1}{\rho A_1})^2 - (\frac{\dot{m}_2}{\rho A_2})^2\right]$$

$$\dot{m} = \rho v A \qquad (3)$$

P2-P1+pgh2=1/2pv1^2

Variable Definition:

ρ: density of air
v: velocity of air
h: height of inlet/ outlet
P: pressure energy
P2-P1: differential pressure
$\dot{m}$: mass flow rate
A: cross-sectional area of the tubing (pi*r^2)

Approach:

1. Use measured differential pressure Eq (1) to determine v1
2. Use measured differential pressure and calculated v1 in Eq (2) to determine v2
3. Use equation 3 with either v1 or v2 to determine mass flow rate, $\dot{m}$