I. ENVH 557 Exposure Controls
M. Yost, Winter 2006 Problem set II (due Thurs. Feb 2, 2006)

1. Standard conditions in ventilation are: T = 70ºF, P = 29.9in Hg, air density = 0.075 lbm/ft3. Express the temperature in degrees C, R and K. Express the pressure in the following units: mm Hg, inches of water, atm and psi. What change in temperature or pressure is needed to make a change in the air density of at least 5%?

2. Air is flowing at a velocity of 3500ft/min (FPM) through a circular duct section 15 inches in diameter and 12 ft long. Assume standard conditions. What is the volume flow rate? What is the mass flow rate?

3. At the end of the 15-inch section above, the duct diameter reduces to 9 inches and after 18 feet at this diameter, changes to a 9" x 12" rectangular duct section 12 feet long. Draw a sketch of this duct network and label each section (a,b,c, etc.). What is the new velocity, volume flow rate and Re number in each section of duct? (HINT: to calculate Re for a non-circular duct, you need to find the equivalent hydraulic diameter of the duct section.)

4. Air is moving through a pipe at a volume flow rate of 2000 CFM and a temperature of 70ºF. If the temperature increases to 95ºF, what is the new volume flow rate, assuming the barometric pressure (1 atm) remains constant? What is the new mass flow rate?

5. The velocity pressure of air in a duct is 1.5 in w.g. What is the velocity?

6. The static pressure in a 5-inch diameter duct is measured as -2.5 in w.g. The total pressure (or stagnation pressure) is -1.3 in w.g. What is the velocity of the air in the duct? What is the volume flow rate?

7. Assume a ventilation system is operating with a 4-inch diameter duct. At what volume flow rate (cfm) will the upper limit of laminar flow be reached?