Unified Engineering Spring 2008
Fluids Problem 11

In the Wright Brothers tunnel, the flow accelerates rapidly from $V_1 = 10\,\mathrm{m/s}$ just upstream of the test section, to $V_2 = 40\,\mathrm{m/s}$ inside the test section. The test section door is open, so that its pressure inside is $p_2 = p_{\mathrm{atm}} = 10^5\,\mathrm{Pa}$. Also, the temperature inside the test section is $T_2 = 300\,\mathrm{K}$, and $R = 287\,\mathrm{J/kg\,K}$. These quantities are measured away from the tunnel-wall boundary layers.

a) Assuming that this is a low-speed flow, estimate the pressure drop $p_2 - p_1$.

b) Determine all the upstream conditions p_1, T_1, ρ_1.

c) Was the assumption of a low-speed flow in a) justified? Explain.

d) A soap bubble machine sends small bubbles at point 1. What is the percentage change in the volume of a soap bubble when it moves to point 2 in the test section?