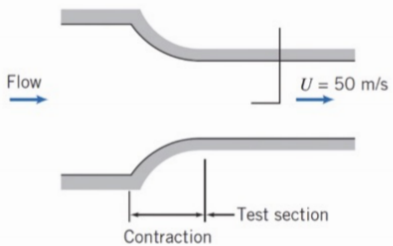
Quiz 4 . Solution.

The inlet contraction and test section of a laboratory wind tunnel are shown. The air speed in the test section is U = 50m/s. A total-head tube pointed upstream indicates that the stagnation pressure on the test section centerline is 10 mm of water below atmospheric. The laboratory is maintained at atmospheric pressure and a temperature of −5°C. Evaluate:

a) the dynamic pressure on the centerline of the wind tunnel test section (gage pressure).
b) Compute the static pressure at the same point (gage pressure).

p_{atm} = 101·kPa
ρ_w = 999 kg/ m^3
Air at T = −5°C:
R = 287 J/kg·K



Basic Equation: $P_{dyn} = \frac{1}{2} \cdot \rho_{air} \cdot U^2$

$P_0 = P_s + P_{dyn}$

$\rho_{air} = \frac{P}{R_{air} \cdot T}$

$\Delta p = \rho_w \cdot g \cdot \Delta h$

Plug in, we get:

$\rho_{air} = \frac{P_{atm}}{RT} = 1.31 \frac{kg}{m^3}$

$P_{dyn} = \frac{1}{2} \rho_{air} U^2 = 1.64 kPa$

$P_0 = \rho_w \cdot g \cdot h_0 = -98.0 Pa$ (gage)

$P_0 = P_s + P_{dyn} \Rightarrow P_s = P_0 - P_{dyn}$

$= -1.738 kPa$