Measuring flowrate using differential pressure sensor

An effective way to measure the flow rate through a pipe is to place some type of restriction within the pipe and to measure the pressure difference between the low velocity, high-pressure upstream section, and the high-velocity, low-pressure downstream section. One common method is the use of an orifice plate.

The volumetric flowrate ($Q$) is given by:

$$Q = C \cdot A_2 \cdot \sqrt{\frac{2(p_1 - p_2)}{\rho \left[1 - \left(\frac{A_2}{A_1}\right)^2\right]}}$$

where

- $A_1$ = Area of pipe upstream from restriction
- $A_2$ = Flow area of pipe at restriction
- $p_1$ = pressure upstream from restriction
- $p_2$ = pressure at restriction
- $\rho$ = density of fluid
- $C$ = correction factor for energy losses

The orifice diameter is 0.8mm.
1. Run the LabVIEW program **EMANT300 Fluid Measurements.VI**
2. When the program runs, press the Zero Offset button.
3. Click on the button **Show Flowrate**
4. Now you can monitor the airflow. When you breath into the inlet or attach an aquarium air pump to the inlet, you can measure the airflow.

The same LabVIEW program can be used to measure hydrostatic pressure. Connect the Pressure Application Adaptor as shown on the right and change the pressure unit to cm H₂O.
Another experiment you can try with the **EMANT300 Fluid Measurements.VI** and the Pressure Application Adaptor is to measure friction loss in pipes. Using an aquarium air pump, various lengths of air tubes (eg 0.5m to 2m in 0.5 m steps), you can demonstrate that the head loss changes linearly with the length of the air tube. Note that you need to add a receiver (a water bottle will do) between the air pump and the air tubes. You will also observe different head losses when the air tube is straight and when it has bends.