Experiment 1

Objective:

To gain an understanding of the pitot-static tube and the manometer, and to verify the conservation of mass equation.

Discussion:

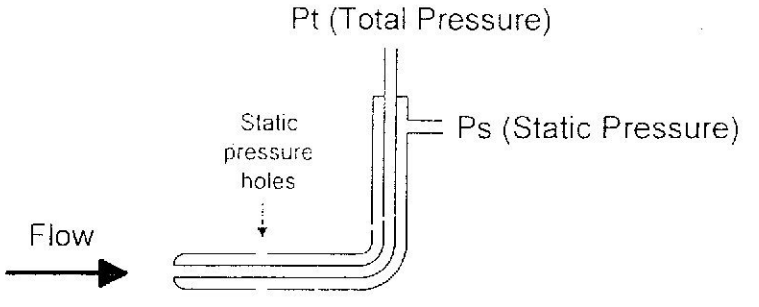
The term **pitot tube** is used to encompass a specific class of instruments that measure fluid pressures. The three basic types of pitot tubes are as follows:

1. **Pitot tube** - measures the total pressure of a moving fluid, also known as total pressure tube or stagnation tube.
2. **Static tube** - measures the static pressure of a fluid.
3. **Pitot-static tube** - simultaneously measures the total and static pressure in moving fluids, also known as a total-static tube.

Static pressure is the pressure that would be measured by an instrument moving with the flow. Since this is impractical, it is measured by an opening that is perpendicular to the flow - thus not including the pressure force as a result of the velocity of the flow. (Static pressure is also known as bursting pressure and is the pressure that is being exerted on the duct sidewalls)

Total pressure is the sum of two pressures - static pressure and velocity pressure, and is measured by placing an opening (coupled to a meter) directly facing the flow

The device to be used in this experiment will be the pitot-static tube and is depicted in the following figure:



The pitot-static tube measures both the total and static pressure which can then be used to calculate the velocity of the air flow (as seen in experiment 2). The geometry of a pitot tube affects its measuring capabilities, with the shape of its head determining its sensitivity to non-parallel flows, i.e. yaw and pitch angles. The length of the sensor head determines its sensitivity to flow velocity or Mach number, with longer sensor heads being more accurate over wider flow ranges. The pitot tubes used on the Hampden H-6910 Wind Tunnel are modified Prandtl type and have an upper limit for static pressure of approximatly Mach 0.7 (due to the formation of local shock waves near the tip of the sensor).