MEMO

From: F. Baneyx
To: Team D
Subject: Air Flow Measurements

Our plant has been using a combination of orifice meters and Venturi meters to measure the average velocity and flow rate of air through our piping system. However, the plant is now interested in measuring the maximum velocity in the center of the pipes but does not want to replace all of the meters. In one section of piping a Pitot tube has been added to allow you to measure the maximum velocity and to compare those measurements with those from the upstream Venturi meter and the downstream thermal mass flow meter and orifice meter. **Please provide a plot showing the average velocity over a range of Reynolds numbers for the Venturi meter, the orifice meter and the Pitot tube.** Each plot should span the widest range of Reynolds numbers possible.

A variable speed fan controls the flow rate of air throughout the piping system. Before taking measurements a short amount of time is needed to reach a steady state. Consider this when planning your experiment setup. This time is considerably smaller than in past experiments because you will **not** be using the thermal flow meter.

When measuring flow rates with the Pitot tube, you have the option of using manual or electronic reading for the pressure difference. The sensor provides a linear voltage output varying from 2 to 10 volts as the pressure difference varies from 0 to 0.25 inches of water. The sensor's voltage output can be read on a computer display. The value is "filtered" (by averaging a specified number of sequential measurements) to reduce the impact of "noise", i.e., rapid pressure fluctuations caused by fan blade rotation and turbulence. The other option is to use the manometer system (equipped with micrometers for measurement of small pressure differences). In either case, describe and justify your procedures.

In your experimental set-up select one flow meter component and develop a Comsol model to understand the flow behavior.