

**MET E352 Fluids Labs**  
**FALL 2004**

**THE CONTINUITY & BERNOULLI'S EQUATIONS**

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**Objectives of the experiment:**

The objective of this lab is to develop an understanding of the relationship between pressure, velocity, density, specific weight, volumetric flow rate and mass flow rate, relative to the Continuity & Bernoulli Equations. These relationships will be demonstrated by experimentation and the calculation of theoretical values.

**Procedure:**

1. An experimental study of the continuity equation and Bernoulli's equation will be accomplished using a device known as the "Venturi Tube". This device is commonly used for measuring the flow rates of liquids based on the static pressure of the circulating fluid at different points along the tube. A schematic diagram of this device will be provided.
2. Measure the following geometries : (nb: dimensions are furnished on diagram)
  - a) the horizontal distance of the pressure taps in reference to the first upstream pressure tap.
  - b) The inside diameter of the tube at these locations of the pressure taps.
3. Circulate the water to pass completely through the Venturi Tube and produce observable columns of water in the manometers connected to the pressure taps.
4. When the flow has stabilized, record the height from reading the water level on the five manometers.
5. Measure the amount of liquid flowing in the tube with the help of a container and a stop- watch. At some point, start collecting the liquid at the discharge of the system in a container while simultaneously timing the process.
6. Use the continuity equation to calculate the average velocities of the flow at the locations of the pressure taps of the venture tube.
7. Calculate the pressure head theoretically and compare with the experimental ones.
8. Repeat steps 3 to 7 for different flow rates.

## Required Results for the Venturi/Orifice Experiment

### Venturi

- 1.) For the Maximum flow condition, use the pressure taps at locations “A” through “E” to plot the pressure profile thru the venturi. The pressure readings are to be converted and expressed in the units of PSI. Indicate the positions of the pressure taps on the pressure profile plot.
- 2.) For each flow condition determine the discharge coefficient “C” and the

### Reynolds

- Number “Re” for the throat of the venturi. Produce a plot of “C” versus Log Re. Compare this with comparable plots presented in Handbooks or Textbooks.
- 3.) From your plot of “C Versus Log Re”, recommend a value of “C” which can be Used as a calibration factor for the Venturi. Compare this recommended value of “C” with one determined using a handbook or textbook.
  - 4.) At each experimental flow rate, determine the error in the flow equation for the Venturi using the recommended value of the discharge coefficient “C” determined in Part (3) above.

### Orifice

- 1.) Plot  $Q_{\text{exp}}$  versus  $(\Delta p)^{1/2}$ . From the plot determine the flow coefficient “K” for the orifice using the slope method.
- 2.) Use the flow discharge coefficient “K” determined in part (1) above in the orifice flow equation to estimate the flow at each experimental flow rate and determine the % error.
- 3.) From a handbook or the textbook determine a value of the flow coefficient that could be used for the orifice. Compare the handbook value with the value determined using the method in Part (1) above.