Lab #4: Pipe Flow and Flow Meters

MAE 107
Jeff Mishler, Prof. Yun Wang
Objectives and Tasks

- Understand the characteristics of pipe flow and flow meters
- Take measurements for:
  - 3 straight-line pipes with different diameters (6 flow rates)
  - Venturi pipe (6 flow rates)
  - Orifice pipe (4 flow rates for each orifice plate)
- The following measurements should be made:
  - Flow rate, pipe diameter and length (given), and pressure drop $\Delta P$
Location of Pipes

Venturi

D=10.6mm

Orifice

D=2.8mm

D=7.1mm
Procedure
Begin with a fresh stand

Screw in the pipe, tight enough to hold, but not so tight that you cannot remove it later.

Turn it on!

The source and effluent tanks will fill up.
Put flow meter tubing on the pipes

It is very important that there be NO bubbles in the flow meters. The easy way to fix this is below.

To remove bubbles:
- Hold the tubes vertically until only water remains
- The end of the tube should look like this:
- Attach to the test stand:
- Wait for all bubbles to escape:
For each pipe you must take measurements at 6 different flow rates.

Adjust the flow rate by changing the height of the effluent pipe:

Record the flow rate using the stopwatch and graduated cylinder:

For the picture above, there were 100mL in 10 seconds. Please always convert to SI units.
Take measurements for venturi

- Make sure the flow rate is small enough that there is no air in the flow:
There are two orifice plates. Please ensure they are oriented correctly.

8mm and 12mm plates:

Undo the screws to switch plates:

Orifice Orientation Guide:

- Beveled edge
- Sharp edge

Upstream flow

Downstream flow
There are only one of each pipe, venturi, and orifice. Leaders, please coordinate and share between the two groups to ensure that all measurements are made during the lab session.
Pipe Flow: 7.1mm diameter, 360mm length

<table>
<thead>
<tr>
<th>Run #</th>
<th>Time (s)</th>
<th>Volume (mL)</th>
<th>Flowrate (mL/s)</th>
<th>Flowrate (m³/s)</th>
<th>P1 (cm H₂O)</th>
<th>P1 (cm H₂O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>250</td>
<td>25</td>
<td>2.50E-05</td>
<td>38</td>
<td>24</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>520</td>
<td>26</td>
<td>2.60E-05</td>
<td>38</td>
<td>24</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>400</td>
<td>40</td>
<td>4.00E-05</td>
<td>45</td>
<td>38</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>750</td>
<td>37.5</td>
<td>3.75E-05</td>
<td>45</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>150</td>
<td>15</td>
<td>1.50E-05</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>280</td>
<td>14</td>
<td>1.40E-05</td>
<td>44</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td>250</td>
<td>25</td>
<td>2.50E-05</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>20</td>
<td>520</td>
<td>26</td>
<td>2.60E-05</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>400</td>
<td>40</td>
<td>4.00E-05</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>10</td>
<td>20</td>
<td>750</td>
<td>37.5</td>
<td>3.75E-05</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>150</td>
<td>15</td>
<td>1.50E-05</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
<td>280</td>
<td>14</td>
<td>1.40E-05</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>