Theory:

A Bourden tube is a device that measures gauge pressure. A Bourden is a flat tube formed into a C or a spiral. As the tube is pressurized, the cross-section of the tube goes from flat to more circular. This causes a strain in the tube which, in turn, causes the tube to try to straighten out. This is then mechanically amplified by gears and the gauge pressure shown by an arrow pointing to a number.

Experiment:

1

Adjustable Height Gate – reduction in area

Square Cross-section

2

Circular cross sections. Vary flow rate to do more than 1 run.

at point 2, P=Patm(need this or else we couldn’t find P1- because we have to calibrate the gauge)

Relationships:

Between points (1) and (2), the mass is conserved:

$$\dot{m}=\dot{m}$$

$$ρA\_{1}v\_{1}=ρA\_{2}v\_{2}$$

$$⇒v\_{1}=\frac{A\_{2}}{A\_{1}}v\_{2}$$

Alternatively you can determine either velocity from the volume flow rate:

 $v=\frac{Q}{A}$ (1)

Steady, incompressible flow:

 $\frac{P\_{1}}{γ}+Z\_{1}+\frac{v\_{1}^{2}}{2g}=\frac{P\_{2}}{γ}+Z\_{2}+\frac{v\_{2}^{2}}{2g}$ (2)

Because the external pressure is zero, and the height is not changing appreciably, equation (2) simplifies to:

$$P\_{1}=\left[\frac{v\_{2}^{2}-v\_{1}^{2}}{2g}\right]\*γ$$

 $⇒P\_{1}=\left[\frac{v\_{2}^{2}-v\_{1}^{2}}{2}\right]\*ρ$ (3)

Requirements:

Lab:

In here we need to talk about how the experiment is performed, I.E. What they have to do to change the pressure and what they need to record. I am thinking they just let the pump go at max flow, changing only the gate at the end to vary the velocity, and therefore vary the pressure. Maybe they could record the velocity at each point and the pressure on the gauge. For their report maybe they just have to calculate the percent difference at each point between the theoretical pressure and the gage pressure and recommend an average percent difference.

Report:

Stuff in here about what they need to write about in their report.

Questions:

1. In the experimental procedure, we did not account for the headloss of the pipe and fitting between points (1) and (2). What would the effect of this headloss be on the experiment if it was taken into consideration?
2. Would the headloss increase or decrease as the gate was lowered?
3. The Bourden tube is made mainly for quasi-static loads. During the experiment, did you give ample time for the pressure to equalize? If not, how would this affect the data?