

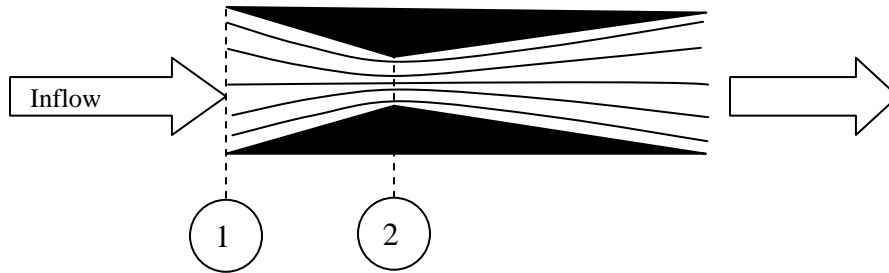
## Experiment No.4 : Venturi-meter

### Objective:

The purpose of the experiment is to demonstrate a typical flow measurement device: venturi-meter and then calibrate it.

### Theory:

Reliable and quick estimates of flow rate are of great importance in any industry handling fluids. For flow measurements in ducts or confined flows, constriction type of flow meters are used, namely venturi-meter, nozzle meter and orifice meter. For any incompressible fluid, if the flow is forced to go through a contraction, the velocity has to increase in for mass balance. This increase in velocity causes pressure to drop locally. This pressure drop can be related to flow rate with the help of Bernoulli's theorem. This is the basis for all Constriction type flow meters.



**Figure 1 Venturi-meter with position of application of BE.**

Applying the BE at section 1 and 2 as shown in Figure 1 between points 1 and 2, we get

$$Q_{th} = \frac{A_1 A_2 \sqrt{2g(\rho_m - \rho_f)}}{\sqrt{(A_1^2 - A_2^2)\rho_f}} \sqrt{h} \quad (1)$$

Here,  $Q_{th}$  is the volume flow rate,  $A_1$  and  $A_2$  are the areas at section 1 and 2 respectively. In actual practice there are energy losses, hence actual flow rate ( $Q_a$ ) is always less than theoretical value. Hence

$$C_d = \frac{Q_a}{Q_{th}} \quad (2)$$

The experimental set up is shown in Figure 2.

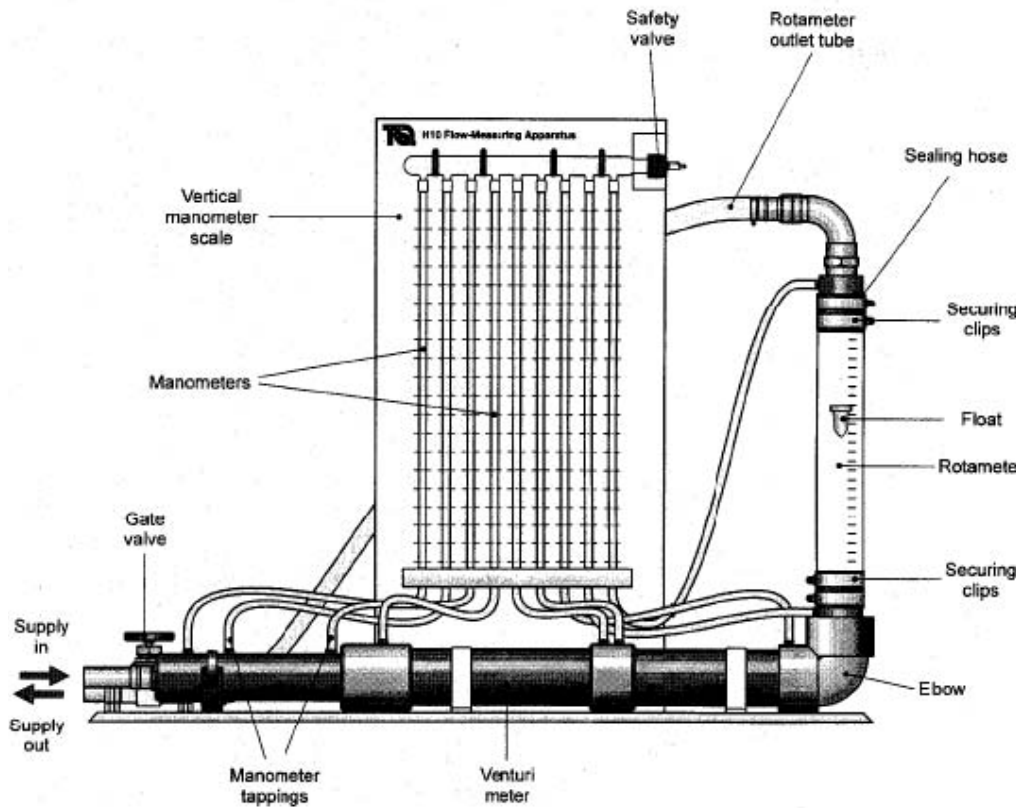


Figure 2 Experimental set up.

**Given Data**

1. Tank Area (A)= 2ft × 2ft

**Observations:**

S.NO	Level of water Rise in collecting tank	Time for collecting water	Manometric Reading			Height In Rotameter
			X <sub>1</sub>	X <sub>2</sub>	h in m	

**Result table**

S.N O	Actual Flow Rate (Q <sub>a</sub> ) from tank	Actual Flow Rate (Q <sub>a</sub> ) from Rotameter	Theoretical Flow rate Q <sub>th</sub>	Coefficient of Discharge (C <sub>D</sub> )		Reynolds Number	Head h <sub>m</sub> = h*(ρ <sub>m</sub> - ρ <sub>f</sub> ) / ρ <sub>f</sub>
				Tank	Rotameter		

### **Graphs to be plotted**

1.  $Q_a$  vs  $h_m$  for rotameter and tank on one graph (Calibration curve)
2.  $C_d$  vs  $h_m$  for rotameter and tank on one graph
3.  $\log Q_a$  vs  $\log h_m$  and determine the constants  $K$  and  $n$  for  $Q = Kh_m^n$ .

### **Discussion**

1. Discuss the key results for this experiment?
2. Derive the relationship for theoretical discharge?