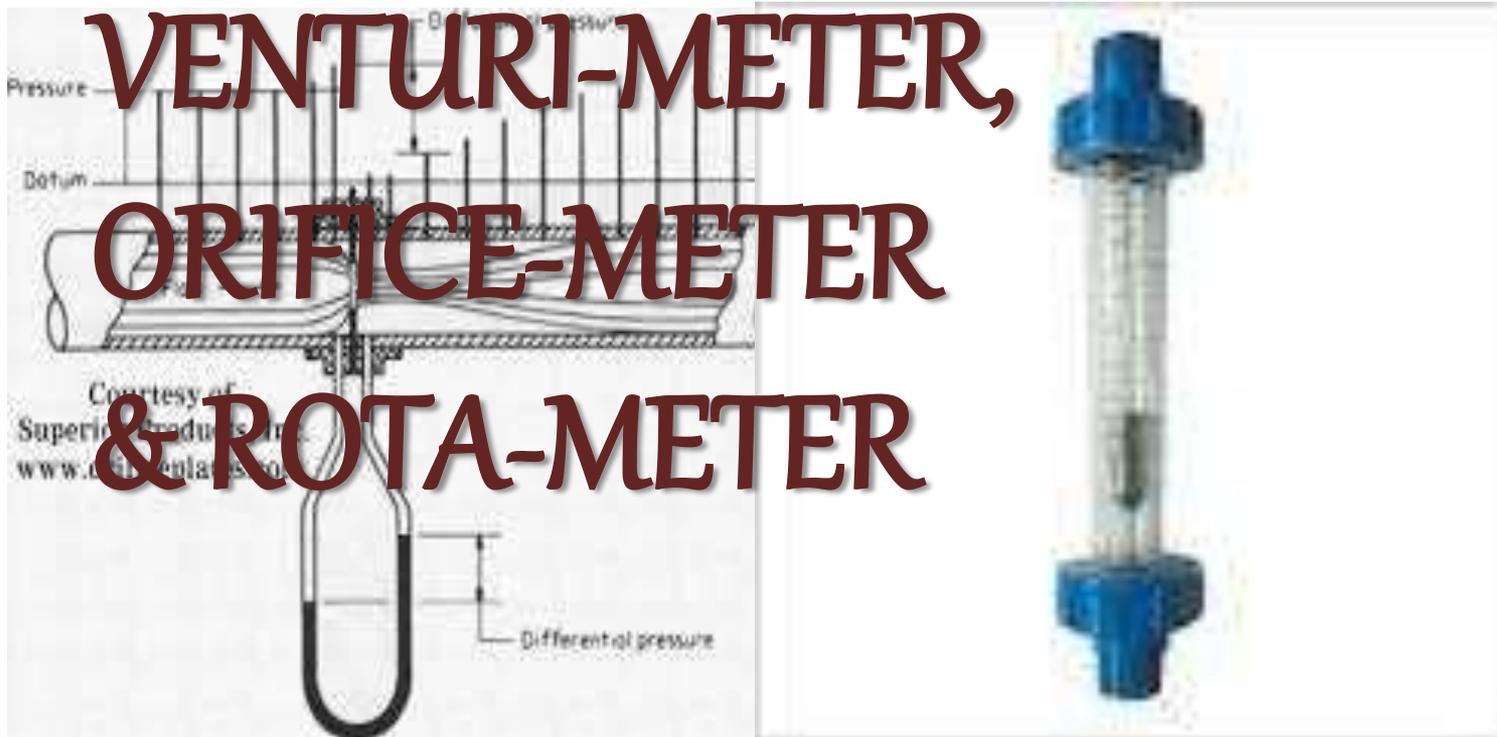


TITLE



FLOW-METERS:

**VENTURI-METER,
ORIFICE-METER
& ROTA-METER**



VENTURIMETER

A Venturimeter is a device used for measuring the rate of flow of fluid flowing through a pipe.

PRINCIPLE: Bernoulli's equation: It states that in a steady ideal flow of incompressible fluids, the total energy at any point of the fluid is constant.

$$P.E + K.E + P.E = \text{Const.}$$

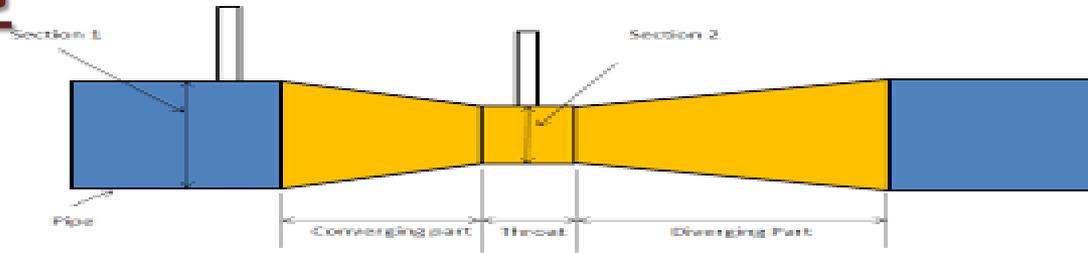
CONSTRUCTION

1. Short convergent part: It is that portion where fluid get converges i.e. radius decreases .

2. Throat : It is middle portion of venturi .Here the velocity of fluid increases and pressure decreases .It possesses the least cross-section area .

3. Diverging part : In this portion the fluid diverges.

WORKING



1. Here we have considered two cross section , first at the inlet and the second one at the throat. The difference in the pressure heads of these two sections is used to calculate the flow through Venturimeter.
2. As the water enters at the inlet section i.e. in the converging part it converges and reaches to the throat.
3. The throat has the uniform cross section area and least area in the venturimeter. As the water enter in the throat its velocity gets increases and due to increase in the velocity the pressure drops to the minimum.
4. Now there is a pressure difference of the fluid at the two sections .at the section 1 i.e. at the inlet the pressure of the fluid is maximum and the velocity is the minimum and at the section2 i.e. at the throat the velocity of the fluid is maximum and the pressure is minimum.
5. The pressure difference at the two sections can be seen in the manometer attached at both the sections.
6. This pressure difference is used to calculate the rate flow of a fluid flowing through a pipe.

APPLICATIONS

1. PLUMBING: It is used in pipelines at waste water collection systems and treatment plants because of their overall design structure allows solids to pass through it instead of collecting in front of it.

2. Flow of chemicals in pipelines: The temp. and pressure of chemicals in pipelines do not affect the accuracy of venturi and because of this they are used in crude oil pipelines .

3. Carburetors: The venturi allows the carburetor to adjust and calibrate the distribution of fuel and air to the engine as needed.

ADVANTAGES

- 1.It can be installed in any direction .
- 2.It can be used for dirty fluids.
- 3.Smooth construction and low cone angle.
- 4.High pressure recovery and low permanent pressure drop.

DISADVANTAGES

- 1.Cannot be used in pipes having small diameter.
- 2.Size and cost is high.
- 3.Non linear
- 4.Maintenance is not easy.

ORIFICE-METER

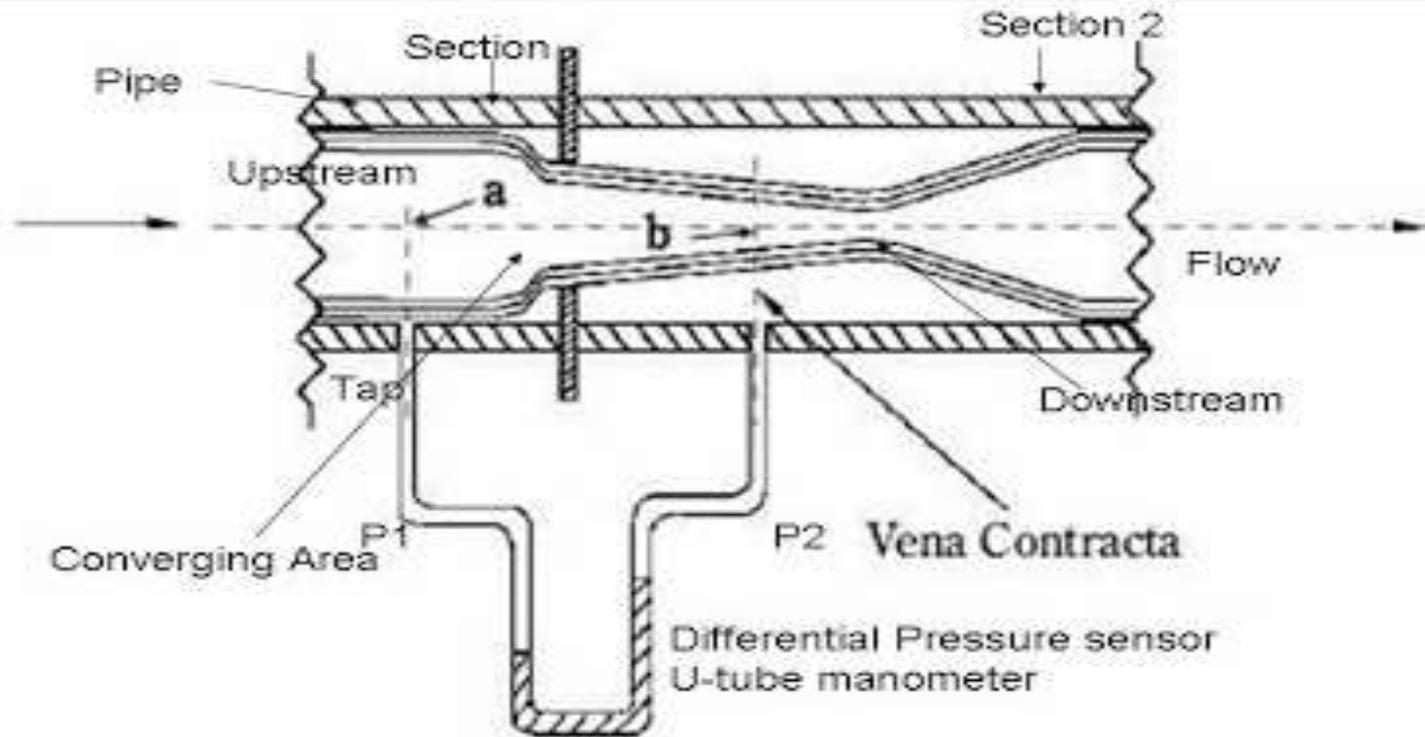
An orifice plate is a device used for measuring flow rate, for reducing pressure or for restricting flow .

PRINCIPLE: When an orifice plate is placed in a pipe carrying the fluid whose rate of flow is to be measured, the orifice plate causes a pressure drop which varies with the flow rate. This pressure drop is measured using differential pressure sensor and when calibrated this pressure drop becomes a measure flow rate.

CONSTRUCTION

1. A stainless steel orifice plate which is held between flanges of a pipe carrying the fluid whose flow rate is being measured.
2. It should be noted that for a certain distance before and after the orifice plate fitted between the flanges, the pipe carrying the fluid should be straight in order to maintain laminar flow conditions.
3. Openings are provided at two places 1 and 2 for attaching a differential pressure sensor .

WORKING:



1. The fluid having uniform cross section of flow converges into the orifice plate's opening in its upstream. When the fluid comes out of the plate it's cross section is minimum and uniform for a particular distance and then the cross section of the fluid starts diverging in the down stream.

2. At the upstream of the orifice, before the converging of the fluid takes place, the pressure of the fluid (P_1) is maximum. As the fluid starts converging, to enter the orifice opening its pressure drops. When the fluid comes out of the orifice, its pressure is minimum (p_2) and this minimum pressure remains constant in the minimum cross section area of fluid flow at the downstream.

3. This minimum cross sectional area of the fluid obtained at downstream from the orifice edge is called VENA-CONTRACTA.

4. The differential pressure sensor attached between points 1 and 2 records the pressure difference ($P_1 - P_2$) between these two points which becomes an indication of the flow rate of the fluid through the pipe when calibrated.

Applications of Orifice Meter

1.The concentric orifice plate is used to measure flow rates of pure fluids and has a wide applicability as it has been standardized.

2.The eccentric and segmental orifice plates are used to measure flow rates of fluids containing suspended materials such as solids, oil mixed with water and wet steam.

ADVANTAGES

- 1.It is very cheap & easy .
- 2.It occupies less space.

3.Can be use to measure flow rate in large pipes

Limitations of Orifice Meter

1.The vena-contracta length depends on the roughness of the inner wall of the pipe and sharpness of the orifice plate.

2.Pressure recovery at downstream is poor.

3.Gets clogged when the suspended fluids flow.

4.The orifice plate gets corroded and due to this after sometime, inaccuracy occurs.

5.The coefficient of discharge is low.

ROTAMETER

This device is used to measure fluid flow, in which a float rises in a tapered tube to a height dependent on the rate of flow through the tube

PRINCIPLE: It is a variable area meter works on the principle of upthrust force exerted by fluid and force of gravity .

CONSTRUCTION

1. **Graduated Tapered tube**

- ❖ Safety shielded glass tube is used for measuring both liquids and gases.
- ❖ Metal tubes are used where temp. and pressure requirements are high.
- ❖ Plastic tubes are used where lower cost and higher strength is required.

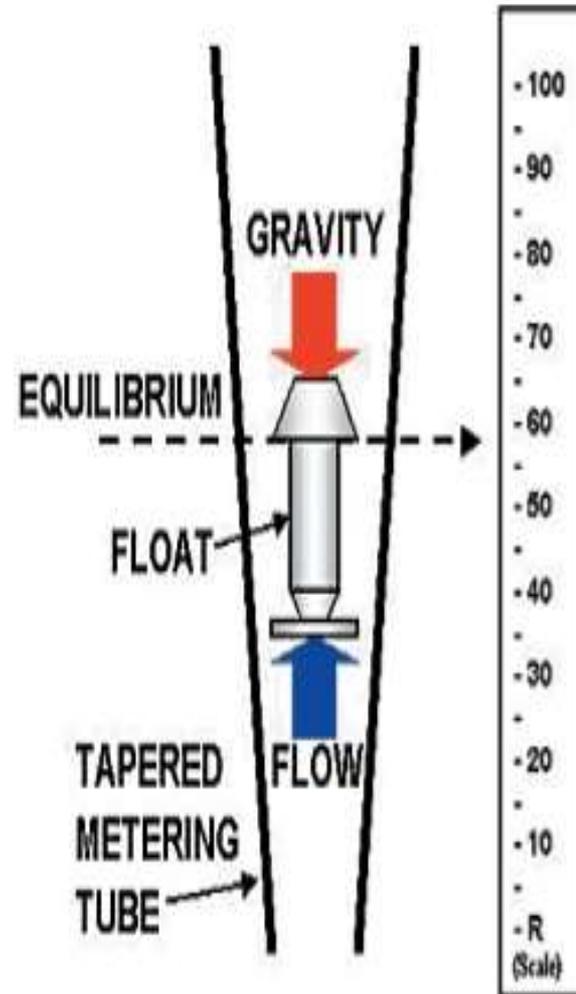
2. **Float**

WORKING

- ❑ Fluid enters the tapered tube , some of the fluid strikes directly the float. Some of the fluid passes from the sides.
- ❑ Two forces are acting in this case.
 1. Upthrust force [buoyancy].
 2. Weight of the float.
- ❑ Annular space increases due to increase in area of tube.
- ❑ When equilibrium is established the float comes to rest.

MEASUREMENT OF FLOWRATE:

1. The flowrate is measured directly from calibrated scale.
2. The reading is noted generally from ending point of cap of the float.



ADVANTAGES

- No external power or fuel is required.
- Manufactured of cheap materials.
- Since the area of passage increases as the float moves upwards so the scale is approximately linear.

DISADVANTAGES

- Impact of gravity.
- Uncertainty of measurements.
- Accuracy is not good.

Thank You