VENTURIMETER

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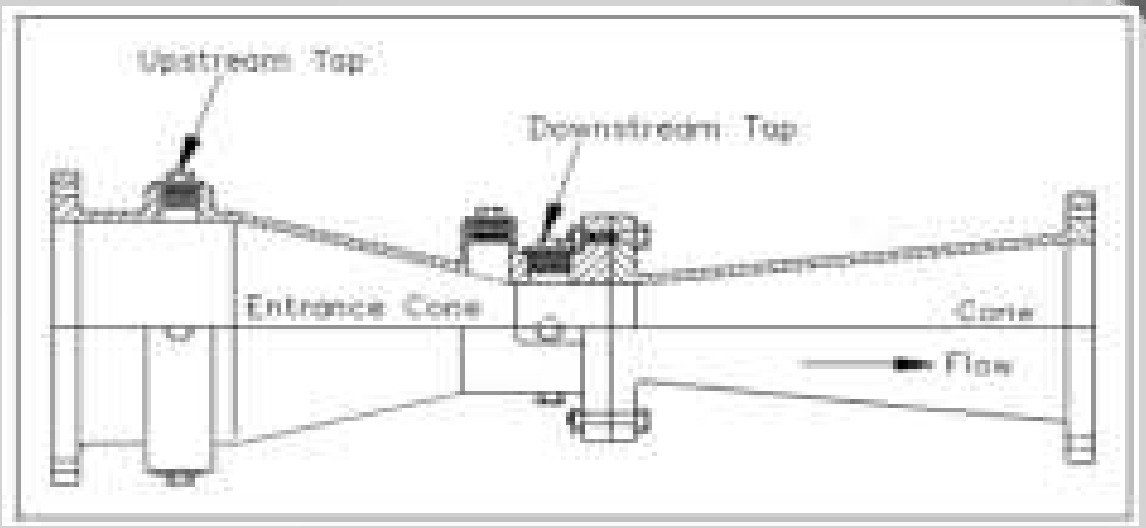
VENTURIMETER

- It's a device, used to measure the rate of flow of fluid through a pipe
- It consists of :

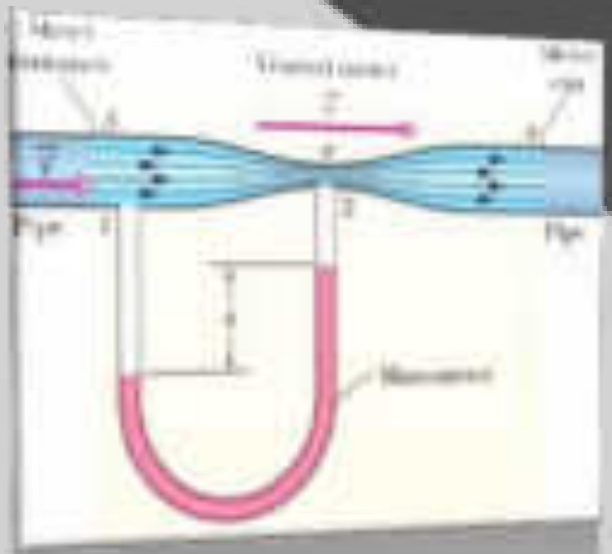
1. Inlet section.
2. Convergent section,
3. A cylindrical throat.
4. A gradually divergent cone.

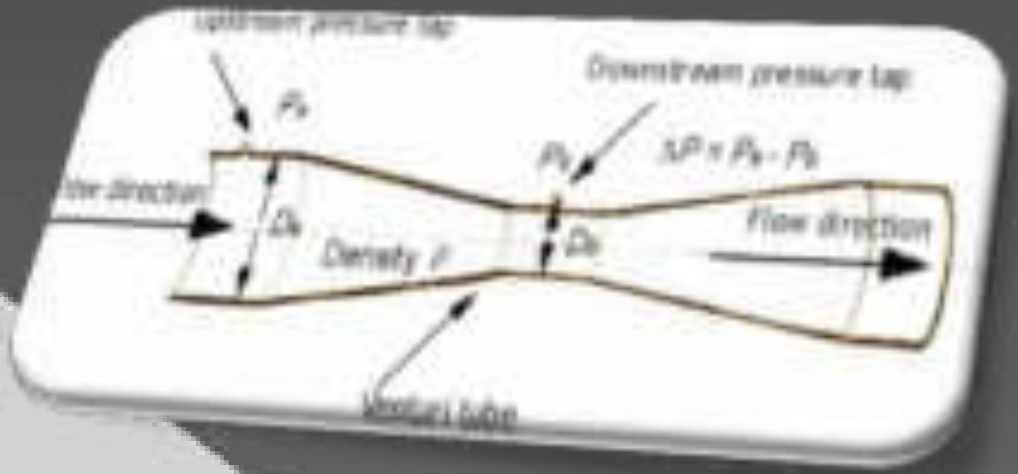


INTRODUCTION

- Venturimeter are used to measure the velocity of flow of fluids in a pipe.
- They consist of short length of pipe shaped like vena contracta, or the portion with the least cross-sectional area , which fits into a normal pipeline.
- The obstruction caused to the flow of liquid at the throat of the venturi produces a local pressure drop in the region that is proportional to the rate of discharge.
- This phenomenon, using Bernoulli's equation, is used to calculate the rate of flow of fluid flowing through the pipe.

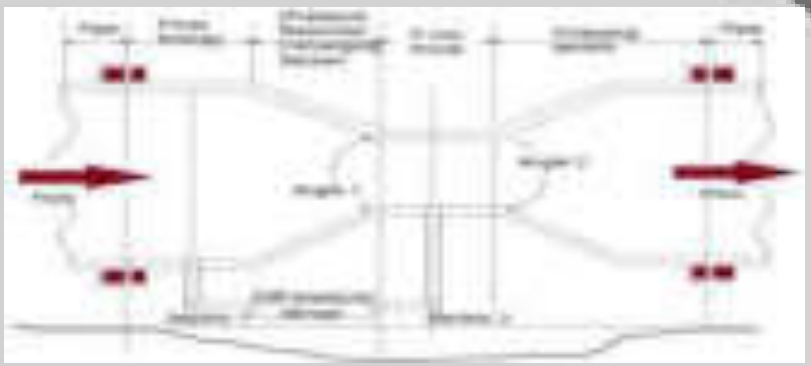
PARTS




Downstream pressure tap
Flow direction
Density ρ
Flow direction

CONSTRUCTION

- The entry of the venture is cylindrical in shape to match the size of the pipe through which fluid flows. This enables the venture to be fitted to the pipe.
- After the entry, there is a converging conical section with an included angle of 19' to 23'.
- Following the converging section, there is a cylindrical section with minimum area called as the throat.
- After the throat, there is a diverging conical section with an included angle of 5' to 15'.
- Openings are provided at the entry and throat (at sections 1 and 2 in the diagram) of the venture meter for attaching a differential pressure sensor (u-tube manometer, differential pressure gauge, etc) as shown in diagram.



WORKING

- The fluid whose flow rate is to be measured enters the entry section of the venturimeter with a pressure P1.
- As the fluid from the entry section of venturimeter flows into the converging section, its pressure keeps on reducing and attains a minimum value P2 when it enters the throat.
- That is, in the throat, the fluid pressure P2 will be minimum.
- The differential pressure sensor attached between the entry and throat section of the venturimeter records the pressure difference(P1-P2) which becomes an indication of the flow rate of the fluid through the pipe when calibrated.
- The diverging section has been provided to enable the fluid to regain its pressure and hence its kinetic energy. Lesser the angle of the diverging section, greater is the recovery.

CHARACTERISTICS

- There is no restriction to the flow down the pipe.
- They can be manufactured to fit any required pipe size.
- The temperature and pressure within the pipe does not affect the meter or its accuracy.
- There are no moving parts.
- The accurate shape required of the inside of the meter makes them relatively expensive to manufactured.

FORMULAE

- Pressure Difference(H)=12.6*h
- Qactual=A*R/t

Where,

A=Area of the Tank
R=Level of Water in Measuring Tank
t=Time in Seconds

- $Q_{theoretical}=a_1*a_2\sqrt{2gH}/(\sqrt{a_1})^2-(a_2)^2$

Where,

a_1=Area of inlet of Ventuirmeter
a_2=Area of throat of Venturimeter

- Co-efficient of Discharge=Qactual/Qtheoretical

ADVANTAGES

- Less changes of getting clogged with sediments
- Coefficient of discharge is high.
- Its behaviour can be predicted perfectly.
- Can be installed vertically, horizontally or inclined.

LIMITATIONS

- They are large in size and hence where space is limited, they cannot be used.
- Expensive initial cost, installation and maintenance.
- Requires long laying length. That is, the venturimeter has be proceeded by a straight pipe which is free from fittings and misalignments to avoid turbulence in flow, for satisfactory operation. Therefore, straightening vanes are a must.
- Cannot be used in pipes below 7.5cm diameter.

APPLICATIONS

- It is used where high pressure recovery is required.
- Can be used for measuring flow rates of water, gases, suspended solids, slurries and dirty liquids.
- Can be used to measure high flow rates in pipes having diameters in a few meters.

PRECAUTIONS

- Drive out all entrapped air from differential mercury manometer.
- Maintain a constant discharge before taking any reading.

OBSERVATION TABLE

h(m)	R (m)	P diff.(H)= 12.6*h	Actual discharge	Theoretical discharge	Co. dis(cd)= Qact/Qth
0.026	0.075	0.3276	3.75*10^-4	4.03*10^-3	0.93
0.043	0.154	0.542	5.13*10^-4	5.413*10^-4	0.947
0.016	0.097	0.202	3.23*10^-4	3.305*10^-4	0.977