



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

IRRIGATION ENGINEERING

[BTAI 2201]

Prepared by:

Birabhadra Rout

Assistant Professor

Dept. of Agricultural Engineering
SoABE, CUTM, Paralakhemundi

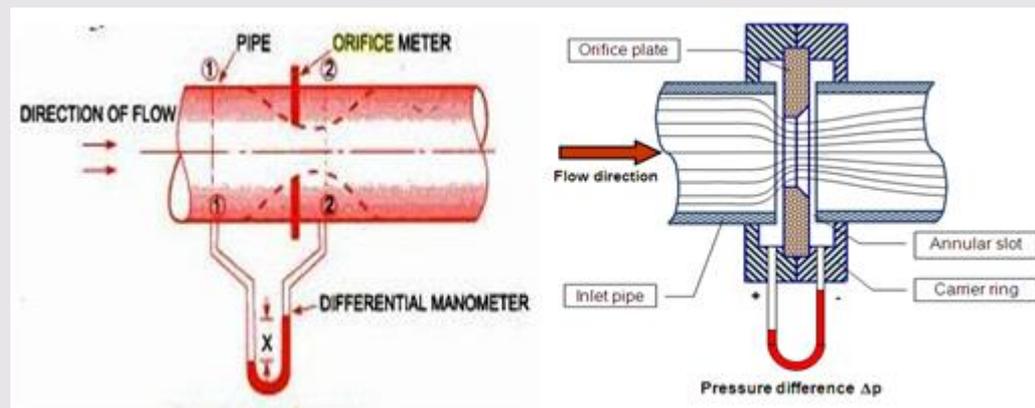


Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Pipe Orifice

- ❑ Orifice meter or orifice plate is a device (cheaper than a venture meter) employed for measuring the discharge of fluid through a pipe.
- ❑ It consists of a flat circular plate which has a circular sharp edged hole called orifice, which is concentric with the pipe.
- ❑ The orifice diameter is kept generally 0.5 times the diameter of the pipe, though it may vary from 0.4 to 0.8 times the pipe diameter.





Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Pipe Orifice

Principle of Operation

- The fluid on reaching the orifice plate converges to pass through the small hole and in doing so the velocity and pressure changes.
- The point of maximum contraction is called the vena contracta. Beyond the vena contracta, the fluid expands and the velocity and pressure change once again.
- By measuring the difference in fluid pressure between the normal pipe section and at the vena contracta, the volumetric and mass flow rates can be obtained from Bernoulli's equation.

$$Q = \frac{c_d a_0 a_1 \sqrt{2gh}}{\sqrt{a_1^2 - a_0^2}}$$

a_1 = area of pipe at section 1

a_0 = area of orifice

h = differential head

g = acceleration due to gravity

c_d = co-efficient of discharge for orifice meter.



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Water Meter

A water meter is a scientific instrument for accurate measurement of quantity of water distributed to the consumers.

There are two basic requirements for accurate operation of the water meter:

- (1) the pipe must flow full at all time, and
- (2) the rate of flow must exceed the minimum for the rated range.

Meters are calibrated in the factory and field adjustments are usually not required.

When water meters are installed in open channels, the flow must be brought through a pipe of known cross sectional area





Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Water Meter

Three basic type of water meters are:

- a) Low pressure line water meter: They are used in underground pipe line water distribution system.
- b) Open flow meters: They are used to measure the flow in open channels or gravity-flow in closed conduit system.
- c) Vertical flow meter: They are used to measure flow in vertical pipes.



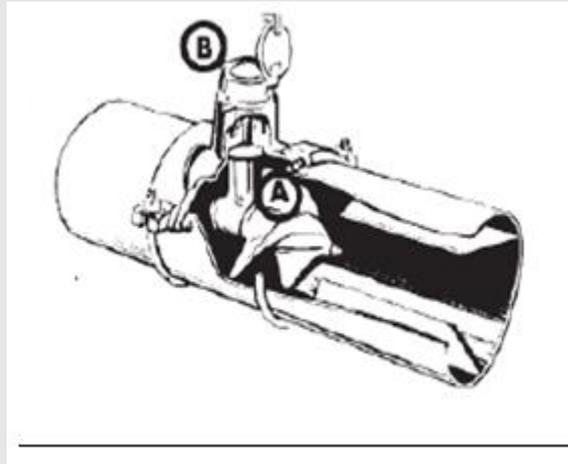
Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Propeller Meter

Propeller meters (mechanical meter) are commercial flow measuring devices used at the ends of pipes and in conduits flowing full and under pressure.

Propeller meters uses multiple blades made of rubber, plastic, or metal. The main parts of the flow meter consist of a propeller (A) mounted in a short section of pipe and geared to a revolution counter (B) which records the rate of flow and the cumulative total.





Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Propeller Meter

Flow meter measures velocity of flow by the water turning the propeller as it passes by, and the area is determined from the size of the pipe.

The dial of the meter then reads directly in volume (m³, gallon, liters etc).

Rate of flow (i.e., liter per second) is then obtained by simply noting the rate of flow on the dial for any given length of time as measured by a watch.

Propellers are designed to pass (to some degree) weeds, moss, and other debris, only a limited amount of foreign material that can be tolerated in the flow.

Even moderate amounts of floating moss or weeds can foul a propeller unless it is protected by screens.



Centurion
UNIVERSITY

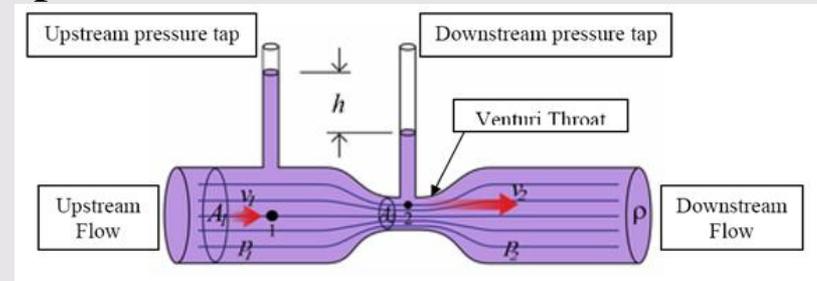
Shaping Lives...
Empowering Communities...

Venturimeter

A venturimeter is a device used to measure the rate of flow of a fluid through a pipe and is often fixed permanently at different sections of the pipeline to know the discharge there.

Venturimeter consists of three parts:

1. A short converging part
2. A throat
3. A diverging part



Due to the constriction there is an increase in the flow velocity and hence an increase in the kinetic energy.

In the venturimeter the fluid is accelerated through a converging cone of angle $15-20^\circ$ and the pressure difference between the upstream side of the cone and the throat is measured and provides the signal for the rate of flow.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Venturimeter

Principle of Operation

- ❑ It works on the Bernoulli's principle. From Bernoulli's principle the increase in kinetic energy gives rise to a reduction in pressure.
- ❑ Rate of discharge from the constriction can be calculated knowing the pressure reduction across the constriction, area of cross-section, density of fluid and the coefficient of discharge.
- ❑ Coefficient of discharge is the ratio of actual flow to the calculated flow and it takes into account the stream contraction and frictional effects.

$$Q_{act} = C_d \cdot A_2 \cdot \sqrt{\frac{2(P_1 - P_2)}{\rho(1 - \beta^4)}}$$



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

THANK YOU