

# **Flow Measuring Devices**

Flow measurement is the quantification of bulk fluid movement. Flow can be measured in a variety of ways. Positive-displacement flow meters accumulate a fixed volume of fluid and then count the number of times the volume is filled to measure flow. Differential pressure flow meters use Bernoulli's equation to measure the flow of fluid in a pipe. Other flow measurement methods rely on forces produced by the flowing stream as it overcomes a known constriction, to indirectly calculate flow. Flow may be measured by measuring the velocity of fluid over a known area. For very large flows, tracer methods may be used to deduce the flow rate from the change in concentration of a dye .

There are many types of flow measuring instruments and they rely on different principles the most common principles are:

- Differential pressure flow meters
- Velocity flow meters
- Positive displacement flow meters
- Mass flow meters
- Open channel flow meters

## **Orifice Meter**

An Orifice Meter is basically a type of flow meter used to measure the rate of flow of Liquid or Gas, especially Steam, using the Differential Pressure Measurement principle. It is mainly used for robust applications as it is known for its durability and is very economical.

As the name implies, it consists of an Orifice Plate which is the basic element of the instrument. When this Orifice Plate is placed in a line, a differential pressure is developed across the Orifice Plate. This pressure drop is linear and is in direct proportion to the flow-rate of the liquid or gas.

Since there is a drop in pressure, just like Turbine Flow meter, hence it is used where a drop in pressure or head loss is permissible.

### **Principle:**

When a liquid / gas, whose flow-rate is to be determined, is passed through an Orifice Meter, there is a drop in the pressure between the Inlet section and Outlet Section of Orifice Meter. This drop in pressure can be measured using a differential pressure measuring instrument.

Since this differential pressure is in direct proportion to the flow-rate as per the Bernoulli's Equation hence the differential pressure instrument can be configured to display flow-rate instead of showing differential pressure.

The working principle of Orifice Meter is the same, as that of Venturi meter.

Petrochemicals and Refineries

### **Advantages of Orifice meter:**

1. The Orifice meter is very cheap as compared to other types of flow meters.
2. Less space is required to Install and hence ideal for space constrained applications
3. Operational response can be designed with perfection.
4. Installation direction possibilities: Vertical / Horizontal / Inclined.

### **Disadvantages of orifice meter**

1. Requires homogeneous fluid.
2. Requires single phase liquid.
3. Requires axial velocity vector flow.
4. Causes a pressure drop in fluid.
5. Their accuracy is affected by density , pressure and viscosity fluid.
6. Fluid viscosity limits measuring range.
7. Requires straight pipe runs to ensure accuracy is maintained.
8. Pipe line must be fully especially for liquid flow measurement.
9. They have low range-ability.

### **Ultrasonic flow meter:**

Ultrasonic flowmeters use sound waves to determine the velocity of a fluid flowing in a pipe. At no flow conditions, the frequencies of an ultrasonic wave transmitted into a pipe and its reflections from the fluid are the same. Under flowing conditions, the frequency of the reflected wave is different due to the Doppler effect. When the fluid moves faster, the frequency shift increases linearly. The transmitter processes signals from the transmitted wave and its reflections to determine the flow rate.

Transit time ultrasonic flowmeters send and receive ultrasonic waves between transducers in both the upstream and downstream directions in the pipe. At no flow conditions, it takes the same time to travel upstream and downstream between the transducers. Under flowing conditions, the upstream wave will travel slower and take more time than the (faster) downstream wave. When the fluid moves faster, the difference between the upstream and downstream times increases. The transmitter processes upstream and downstream times to determine the flow rate. They represent about 12% of all flowmeters sold

**Advantages of ultrasonic flow meter for Gas flow measurement:**

- 1.High Accuracy
- 2.Approved for custody transfer
- 3.High turndown/rangeability measure low and high pressure
- 4.Repeatable
- 5.Can clamp on pipe with no penetration
- 6.Tolerate extreme temperature
- 7.Long term reliability
- 8.No moving parts to replace or lubricate.So low maintenance cost

**Disadvantages of ultrasonic flow meter for gas flow measurement:**

- 1.High initial cost
- 2.Dirt and fluid impact performance and measurement accuracy
- 3.Noise even beyond human hearing range interfere with ultrasonic signals for clamp-on meter
- 4.Pipe walls can interfere with ultrasonic signals for clamp-on meter.
- 5.Build-up on the inside pipe walls can reduce inside diameter of pipe and affect measurement accuracy