# Ultrasonic Flow Measurement





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# Ultrasonic Flow Meters Basics

The ultrasonic flow meter is a noninvasive liquid flow measurement device that emits ultrasonic signals into the flow path.



#### How it Works?

There are two main types of Ultrasonic meters:

Transit timeDoppler

# Transit Time (Time of Flight)

- This type of meter sends two ultrasonic signals across the interior of the pipe at an angle, one with the direction of the flow and one against the flow.
- The measurement of flow is based on the principle that sound waves traveling in the direction of flow requires less time than when traveling in the opposite direction.
- The difference in the transit time of the two waves or synchronized signals is used to calculate the flow velocity.

#### Transit time diagram



# **Doppler Flowmeter**

- Doppler type flowmeters also send an ultrasonic signal across the pipe.
- Instead of tracking the time it takes to cross the other side, it relies on having the signal deflected by particles in the flowstream. These particles are traveling at the same speed of the flow. Therefore, as the signal passes through the stream, its frequency shifts in proportion to the mean velocity of the fluid.

# Doppler Flowmeter Cont.

- A receiver detects the reflected signal and measures its frequency.
- The meter calculates flow by comparing the generated and detected frequencies.

#### Differences Between Doppler and Transit Time Meters

**\***Transit-time meters rely on an ultrasonic signal's completely traversing the pipe, so the path must be relatively free of solids and air or gas bubbles. Bubbles in particular tend to attenuate the acoustic signals

\*Doppler meters, on the other hand, rely on reflectors in the flowing liquid. To obtain reliable measurements, therefore, attention must be given to the lower limits for concentrations and sizes of solids or bubbles. The flow must also be rapid enough to keep these materials in suspension.

✤For both Doppler and transit-time flowmeters to indicate true volumetric flow rate, the pipe must always be full. A Doppler meter on a partially full pipe, however, will continue to indicate flow velocity as long as the transducers are both mounted below the liquid level in the pipe.

#### **Advantages of Ultrasonic Meters**

- Clamp-on transducers eliminate in-line installation, allowing one meter to be used at many locations.
- Exterior installation eliminates pressure losses and prevents leaking that can be associated with in-line meter installations.
- Easy installation, no moving parts and no contact between transducer and liquid.

#### Disadvantages of Ultrasonic Meters



#### Pipe wall needs to be fairly clean and free of rust and irregularities

# **Typical Piping & Meter Configuration**





# Ultrasonic Meters available in the Division

#### **Controlotron Meter**

#### Innova-Sonic 210





#### **Placement Methods**

#### **Direct Mode (Z mode)**





Adverse conditions -Limited Space
Old, thick scale buildup on the inside of the pipe
Large pipe diameter

Plastic pipe

## **Reflect Mode Installation** (V Method)



#### W Method



**Requirements for Accurate Measurement of Flows** 

The prerequisites for successful flow measurement are:

Pipe is full

Fluid media conducts sonic energy

Pipe wall is in good condition.

# Other Considerations for Best Flow Measurement

- Place transducers in the longest available pipe straight run
- Avoid installing the transducer downstream of a throuttling valve, mixing tank, or anything that will potentially airate the liquid or that will provide flow disturbances and excessive vibration.
- Never mount transducers on the top or bottom of a pipe or on pipe with surface abberation.
- Use Reflect mode whenever possible, however for plastic pipe and very short pipe run use Direct mode.
- Remove any scale, rust, grit, corrosion, loose paint, etc from mounting section of the pipe.



#### Meter Demonstration



Spacing Pointers



#### Procedure

- **Mount the Transducers**
- **Enter Pipe Parameters**
- **Begin Taking and Recording Data**





#### **Transducers face each other**



# **Pipe Parameters**

Pipe Diameter
Wall Thickness
Material



#### **Ensure Quality Flow Measurement**

- Check Signal Strength & Quality Menu 90
- You want the SS to be above 60 and Q to be above 50

