The Ultrasonic Doppler flow sensor incorporates a technology offering an increased range of applications. Because of its non-invasive nature, no pressure drop is created, and this type of flowmeter can be used to measure the flow of fluids and slurries which ordinarily cause damage to conventional sensors.

The basic principle of operation employs the frequency shift (Doppler Effect) of an ultrasonic signal when it is reflected by suspended particles or gas bubbles (discontinuities) in motion. This metering technique utilizes the physical phenomenon of a sound wave that changes frequency when it is reflected by moving discontinuities in a flowing liquid. Ultrasonic sound is transmitted into a pipe with flowing liquids, and the discontinuities reflect the ultrasonic wave with a slightly different frequency that is directly proportional to the rate of flow of the liquid (Figure 1). Current technology requires that the liquid contain at least 100 parts per million (PPM) of 100 micron or larger suspended particles or bubbles.

A typical system incorporates a transmitter/indicator/totalizer and a transducer. The transducer is mounted on the exterior of the pipe. It is driven by a high frequency oscillator in the transmitter through an interconnecting cable. The transducer generates an ultrasonic signal which it transmits through the wall of the pipe into the flowing liquid. The transmitter measures the difference between its output and input frequencies and converts this difference into electronic pulses which are processed to provide an analog indication and a voltage or current output signal. Additionally, the pulses are scaled and totaled to provide flow quantity.

The transmitter frequency power levels and transducer configuration are selected to accommodate a wide variety of liquids, pipe sizes, percentage of solids, and pipe liners.

The transmitter also incorporates circuitry which allows adjustment of the signal threshold, permitting elimination of undesirable ambient noises (both mechanical and electrical). As a result, instrumentation is possible in a variety of locations subject to high levels of sonic, mechanical, and electrical noise.

**ACCURACY**

**Without Field Calibration**

The accuracy of a flowmeter operating on the Doppler principle is mainly a characteristic of flow velocity profile integration by the ultrasonic wave. The ability to do this is basically a function of: percentage of sound reflectors (solids and bubbles), their size, variation and distribution, the line size, and the flowmeter’s design features. Therefore, it is unrealistic to state a general accuracy without knowing the full application details and the transducer selection.

**With Field Calibration**

The accuracy of this method with a field flow calibration can be as high as ±1% plus the accuracy of the flow calibration on the actual application at given conditions.

**Clean Liquids**

As noted, the basic ultrasonic Doppler flowmeter requires that the liquid to be measured contain a minimum of at least 100 PPM of suspended solids or bubbles at least 100 microns larger in size. The transducer frequency for these requirements is 1 megahertz. Lower frequencies require more PPM and a larger micron size. Until recently, 100 PPM of suspended solids or bubbles of at least 100 microns or larger, constituted the cleanest measurable application. The solution for clean liquid applications is the FDT family of Transit Time Ultrasonic flow meters FDT-30, FDT-80 and FDT100 products. In these designs, the time of flight of the ultrasonic signal is measured between two transducers—one upstream and one downstream. The difference in elapsed time going with or against the flow determines the fluid velocity. Transit time flow meters feature the world’s most advanced non-invasive flow measurement technology—providing a measuring system with unsurpassed accuracy, versatility, ease of installation and dependability.

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More than 100,000 Products Available!

- **Temperature**

- **Flow and Level**
  Air Velocity Indicators, Doppler Flowmeters, Level Measurement, Magnetic Flowmeters, Mass Flowmeters, Pitot Tubes, Pumps, Rotameters, Turbine and Paddle Wheel Flowmeters, Ultrasonic Flowmeters, Valves, Variable Area Flowmeters, Vortex Shedding Flowmeters

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  Conductivity Instrumentation, Dissolved Oxygen Instrumentation, Environmental Instrumentation, pH Electrodes and Instruments, Water and Soil Analysis Instrumentation

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  Displacement Transducers, Dynamic Measurement Force Sensors, Instrumentation for Pressure and Strain Measurements, Load Cells, Pressure Gauges, Pressure Reference Section, Pressure Switches, Pressure Transducers, Proximity Transducers, Regulators, Strain Gages, Torque Transducers, Valves

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