Application Guide Lines For The CPS-460 and 460P Doppler Flowmeter

Doppler Flowmeters are designed to monitor liquid flows containing suspended particles (solids) or entrained air/gas bubbles. Flow velocities, of which the suspended solids will represent, should be in the range of 0.50 to 30.0 fps (feet/second). The flow should be Newtonian in nature with a well defined flow profile for best results. Reynolds numbers greater than 4000 are preferred and is considered a turbulent flow. Flows with less than 4000 Reynolds numbers are considered to be in a transitional condition from turbulent flow to laminar flow (flows of less than 2000 Reynolds number). This usually occurs at low velocities (below 2.0 fps) and can have an affect on both accuracy and retrievability of the flow signal. In the absence of sufficient solids, an aerator device may be used to introduce gas/air bubbles into the flow for improved performance.

Liquid Characteristics

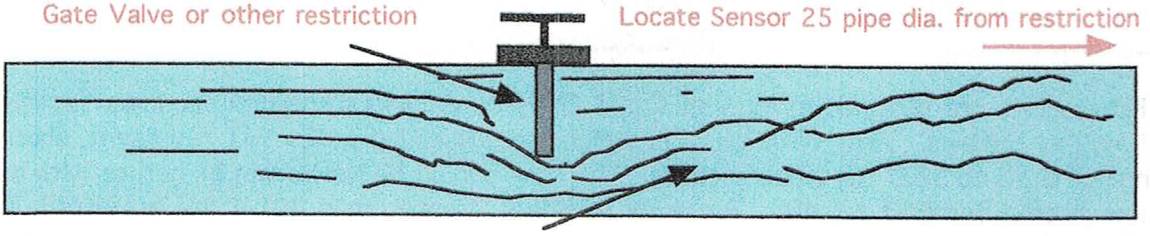
Requirements for best performance are:

1] Uniform distribution of suspended particles or gas/air bubbles, 75ppm minimum. Particles/bubbles that tend to accumulate in pockets may cause significant flow errors. This type of flow may be considered non-symetrical or ERRATIC and require that the user select NON-SYMetrical flow type under MISC SETUP mode in the 460's program.
2] Flow should be Newtonian for best results. Non-Newtonian flows may not be measurable. Non-Newtonian flow is a flow in which a non-linear relationship exists between the applied shear stress and the rate of liquid deformation.
3] Suspended colloids (non-Newtonian) may not be measurable.
4] Suspended particles such as starches or powders may not be good sonic reflectors resulting in poor (erratic) operation. Select NON-SYMetrical flow type under MISC SETUP for this condition, provided you are receiving a flow signal.
5] Dissovled solids (salts etc.)are not acceptable.

Problem Areas

Some things to consider and avoid when selecting a site for sensor mounting.

1] Low suspended solids in the liquid reduces the amount of sonic reflectors. This is the case with potable water, well water etc. The sensor may have to be located such that the sonic wave is reflected by flow disturbances such as swirls, shear pressure points, vortices etc., created by flanged connections, fully opened valves, elbows, tees etc. Generally the flowmeter will require an in-field calibration 'correction factor' be programmed in the system, but only if you can establish a repeatable flow signal. This type of application is not considered good.
2] Avoid venturies, partially closed valves and reduced pipe sections. These cause restrictions to the flow and will increase the flow velocity in their vicinities, causing significant volumetric errors.



Increased Flow Velocity caused by gate valve or other restriction will cause volumetric errors if flow is monitored in the vicinity of the restriction.

Note: In liquids with low solids (less than 75-100ppm), it may be necessary to find a section of pipe that creates disturbances/turbulence in the flow in order to retrieve a useful flow reading. Finding a good location on the pipe under these circumstances may require some trial and error. In general, it will be necessary that the sensor be located several pipe diameters from the source of the disturbance to allow some diffusion of the disturbance in the flow stream.

3] The greater the amount of noise in an application (mechanical and/or electrical) the more solids/bubbles required in the liquid to maintain a good flow reading i.e. good signal-to-noise ratio.

Pipe Considerations

1] Pipe must be acoustically compatible. It must allow the high frequency transmit and return signal to pass through the pipe wall and into the flow stream.
2] Liner materials tend to insulate and attenuate the ultrasonic signal. This may make it difficult to acquire a flow signal.
3] Deposits on the inside pipe wall (i.e. calcium, rust etc.) will both tend to block the flow signal and decrease the pipe ID causing volumetric readings to increase.
4] Some liners such as coal tar can result in erroneous readings due to sonic refraction. A calibration factor can be entered in the program to correct under this condition.
5] Pipe should be homogeneous. Any breaks in liners or change in pipe wall materials may prevent flow readings from being made.

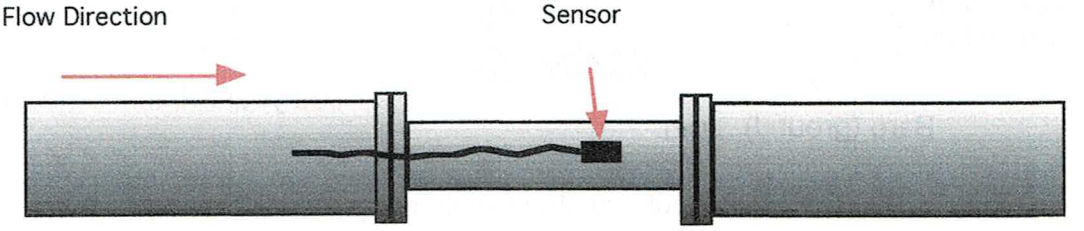
ACCEPTABLE PIPE MATERIAL

GOOD	*OK*	*PROBLEM*
Carbon Steel	Brass	Flex Tubing
PVC	Fiberglass	Sleeve Liners
Stainless Steel	Rigid Plastic	Copper
Aluminum	Cast Iron	Concrete
Ductile Iron	Concrete Lined*	Some Liners

*note: concrete lined pipes can be unpredictable

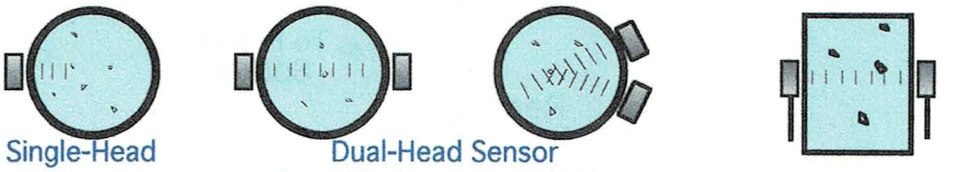
Measuring Site Considerations

1] Piping meets above criteria.
2] Measuring point and controller should be located to accommodate the cable length. No attempts should be made to lengthen the sensor cable.
3] Site location should avoid potential interference from AC motors, variable speed drives, transformers, radio transmitters (antennas), valves or other restrictions.
4] Sensor mounting point should be easily accessible.
5] Sensor location should provide at least 10 pipe diameters of straight run. Shorter pipe runs may work fine but may require an in-field calibration by programming a 'calibration factor'.
6] Low solids in the flow stream may require moving the sensor closer to elbows or other flow disturbances to acquire a flow reading.
7] Mount the sensor on the reduced pipe section when different pipe size sections are encountered.



8] Mount the sensor at a 3/9 o'clock position on a horizontal pipe (does not apply to vertical pipes). Dual-Head sensors mount across from each other on same horizontal plane. When the pipe size is greater than 12 inches, the sensors may need to be mounted on the same side of the pipe at a 2 and 4 o'clock position.

Sensors On Horizontal Pipe ***Vertical Pipe***



9] Choose a section of pipe that is always full. Empty pipes can be noisy and partially full pipes with flow will yield erroneous volumetric readings.
10] Mount the sensor using the supplied couplant (Silicone Grease). A generous amount should be used to fill all the gaps between the sensor surface and the pipe wall. Use a metal hose clamp (permanent) or duct tape (temporary) to secure the sensor to the pipe. DO NOT over tighten. Lithium grease or zinc oxide may be used as a temporary alternative couplant.

Read Your Instruction Manual!!

III. application guide