We Have No Straight Tube… What Should We Do?!

- **The Straight Tube Problem:** There is a reason why Micro Motion was so reluctant to release a straight tube and why all straight tube manufacturers still prefer selling bent tubes.

- Straight tubes are notoriously **sensitive to changes in fluid density and temperature as well as piping stresses and vibration effects.**

**Extreme Temperature Compensation Required**

- The Micro Motion straight-tube coriolis sensor has two separate temperature measurement circuits.

- The first temperature circuit consists of one RTD **directly connected to the flow tube**, which measures the temperature of the process fluid via the flow tube.

- The second temperature measurement circuit consists of three RTDs: two on the reference tube and one on the case. These three RTDs are used to compensate for differences in temperature between the case, reference tube, and the flow tube.

**Balance & Load Considerations**

- When a single, straight flow-tube vibrates at its resonant frequency it does not vibrate similarly to the reference tube, which causes an **imbalance in the metering system.** It is increasingly difficult to compensate for the inherent imbalance when there are changes in fluid density, which only affect the single flow tube and not the reference tube.

- The reference tube needs to be rigid, which in turn causes it to be more susceptible to pipe and thermal stress.

- Micro Motion requires four RTD’s(!) and two temperature circuits to compensate for differences in elasticity and rigidity of the flow tube relative to the reference tube and case transition bracket due to even the slightest changes in temperature, which in turn effect balance and load.
The Dual Tube Solution

- Dual curve tubes are symmetrical and easier to balance.

- Each flow tube, which also acts as the other tube's reference tube, experiences the same changes in fluid density and temperature making them much more robust regardless of process dynamics.

- Dual tubes are less rigid and consequently free to expand with changes in temperature without incurring stresses on the metering system. Accordingly, curved dual-tubes measure density and mass flow more accurately than straight tubes.

Bent Tubes Better on Two-Phase Flow

- Straight tubes are affected more by undesirable two phase flow than Bent Tubes

- Dual-tube sensors vibrate at lower tube frequencies, allowing for any entrained gas to move more easily with the side-to-side motion of the vibrating flow tube — in turn allowing for less opportunity for meter-stall due to the dampening affect of the entrained gas on the tube oscillation.

- Straight tubes, on the other hand, vibrate at relatively high tube frequencies, accentuating the entrained gas’s dampening affect on the natural frequency of the flow tube, causing meters to “stall.”

Expose the Straight-tube Myth About Coatings

- When a single, straight flow-tube vibrates at its resonant frequency it does not vibrate similarly to the reference tube, which causes an inherent imbalance in the metering system. The problem is compounded when the flow tube becomes coated because the reference tube, which does not come in contact with the process, will not experience the same coating.

- When uniform coating occurs on both flow tubes in a bent tube design, the mass output is unaffected. Remember that the coriolis force is proportional to the mass that is accelerating through the meter (F= M*A). Consequently, uniform coatings that have “mass” do not affect the coriolis forces in a bent tube design since the mass of the coating does not accelerate through the meter and the system is inherently balanced.

- Mass will affect the density output if the mass of the coating is different than the mass of the flowing fluid. Notwithstanding, the mass output is not a function of the density.

- It is good to monitor buildup by monitoring the density.

Use Bent Tubes Whenever Possible!

- When your customer says he needs a straight tube, ask him why?

- Less than 10% of all coriolis meters sold are straight tubes and less than half of those require such tube geometry.

- Straight Tube meters have given coriolis technology a black eye…