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Thermal Mass Flow Air Flow Measurement
(AFM-2)

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A Background of Several Technologies

Thermal (mass flow) velocity measurement is a time proven technology. It is popular in medical and industrial instrumentation, mass flow controllers as well as HVAC systems.

Mass Flow has many advantages   which include excellent accuracy at low flow rates, very high turndown ratio's, near constant accuracy through the span, and a wide range of reporting menus in the circuitry.

This technology is based on the rate of heat transfer to the fluid (air) stream. A heated sensor transfers heat to the air stream in accordance to the velocity of the airstream. The difference between the energy required to heat the sensor and the temperature of the fluid is related to the velocity of the fluid. Conditioning the energy differences will output a signal linear to Flow.

This convective heat transfer should be contrasted to other methods of velocity measurement. Differential pressure is dependent on the dynamic pressure of the air stream. Vortex shedding is dependent on the frequency of the vortices. Both the latter two forms of energy transfer are then dependent on the dynamic energy velocities of the fluid stream, which diminishes quickly at low velocities. However convective heat transfer continues with equal accuracy to zero flow.

Advantages

- High Turndown ratios – which permit application in VAV systems with very low flow rates.

- Temperature compensation permits predictable accuracies when temperatures change during the in the fluid.

- Relative resistance to yawed or skewed flow --- the heat transfer is through a glass bead thermister or RTD with a cylindrical profile. This heat transfer is uniform regardless of the direction of the velocities.

- Thermal transfer is relatively insensitive to turbulence. Turbulence is normally generated by duct mounted items such as turning vanes, duct stiffeners etc. In addition to turbulence these devices will generate acoustical signals.

- With the proper conditioner design the output circuitry will include zero off set and gain compensation permitting field adjustment to compensate for self heating errors as well unexpected velocity contours. The signal conditioner will accept and average an output from each sensor which will the result in a true air flow velocity average.

- Velocities toward zero flow are very easily sensed since the signal difference between the heated sensor and the ambient temperature becomes larger at higher flow rates.

- The temperatures of the thermal sensors will minimally influence the ambient air stream. The sensible heat transfer from an average sensor density will add about 41 BTU (0.038 F – 0.021C) to the ambient fluid temperature.

Considerations During Design and Application

- The sensors should be applied in a non-condensing atmosphere. Dry particles will not affect the heat transfer but damp or wet particles may adhere to the thermistors.

- The heat transfer is dependent on the mass of the fluid. Any normal change in the fluid temperature is compensated for during product development. If there are any significant absolute pressure changes from product test conditions (sea level) an appropriate correction factor must be applied.

- For explosion proof requirements a suitable barrier or location must be provided—see your local codes and contact the factory.