

Rosemount 3051S MultiVariable™ Transmitter Real Time Dynamic Compensation

Full Dynamic Compensation

Full dynamic compensation is when all of the DP flow coefficients (discharge coefficient, gas expansion factor, thermal expansion, velocity of approach factor) in the full DP mass and energy flow equation are continuously calculated and updated using real time measurements of differential pressure, static pressure and temperature.

$$Q_m = C_d E Y_1 d^2 \sqrt{DP_x p}$$

The 3051S MultiVariable Mass and Energy Flow transmitter combines differential pressure, static pressure, and temperature measurements with an integral flow computer to dynamically and continuously calculate all of the DP flow coefficients for fully compensated mass and energy flow for a wide variety of fluids and primary elements. With real time dynamic calculations, the 3051S MultiVariable transmitter can improve the performance of DP flow with an orifice plate to 0.65% of mass flow rate over an 14:1 useable flow range.

Traditionally, a static compensation method has been used to calculate DP based mass flow. This involved using a simplified mass flow equation that employed a single constant to represent the variables for discharge coefficient, gas expansion factor, velocity of approach factor and thermal expansion.

$$Q_m = K \sqrt{\frac{DP_x P}{T}}$$

For gas applications, the Ideal Gas Law has typically been used for determining compressibility or density. This simplification method is generally used because the full compensation method is difficult and time consuming to configure.

The problem with simplification is that significant errors can occur in the mass flow measurement. This simplification also leads to the perception that DP based flow measurements are inaccurate with low rangeability. Multivariable transmitters that are capable of measuring differential pressure, static pressure, and temperature with real time dynamic calculation of each of the mass flow equation coefficients provide users with more accurate DP flow measurement over a wider flow range than has been achievable in the past. Liquid applications also benefit from dynamic compensation with increased flow rangeability due to real time calculation of discharge coefficient.

Another compensation method being employed is a modified form of the simplified mass flow equation. This method uses the measured variables to compensate for changes in the value of coefficients calculated at reference conditions. However, this method is not true dynamic compensation. Significant errors can still be introduced into the mass flow calculation if all of the differential based mass flow coefficients as well as density or compressibility are not calculated continuously and updated real time.



Rosemount 3051SMV

3051S MultiVariable Benefits

- Mass and energy flow
- +/- 0.65% of rate over 14:1 usable flow range
- Many measurements in 1 (Mass Flow, DP, P, T)
- Support for a wide variety of primary elements
- Support for a wide variety of fluids
- Support for a wide variety of standards
- Dynamic calculation of all DP Flow coefficients

Differential pressure transmitters have been used to measure flow in process industries for many decades. In the last two decades a number of other technologies have emerged to compete with DP based flow Technology. Even with the wide variety of choices available, DP based flow metering continues as the primary choice in most flow applications.

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