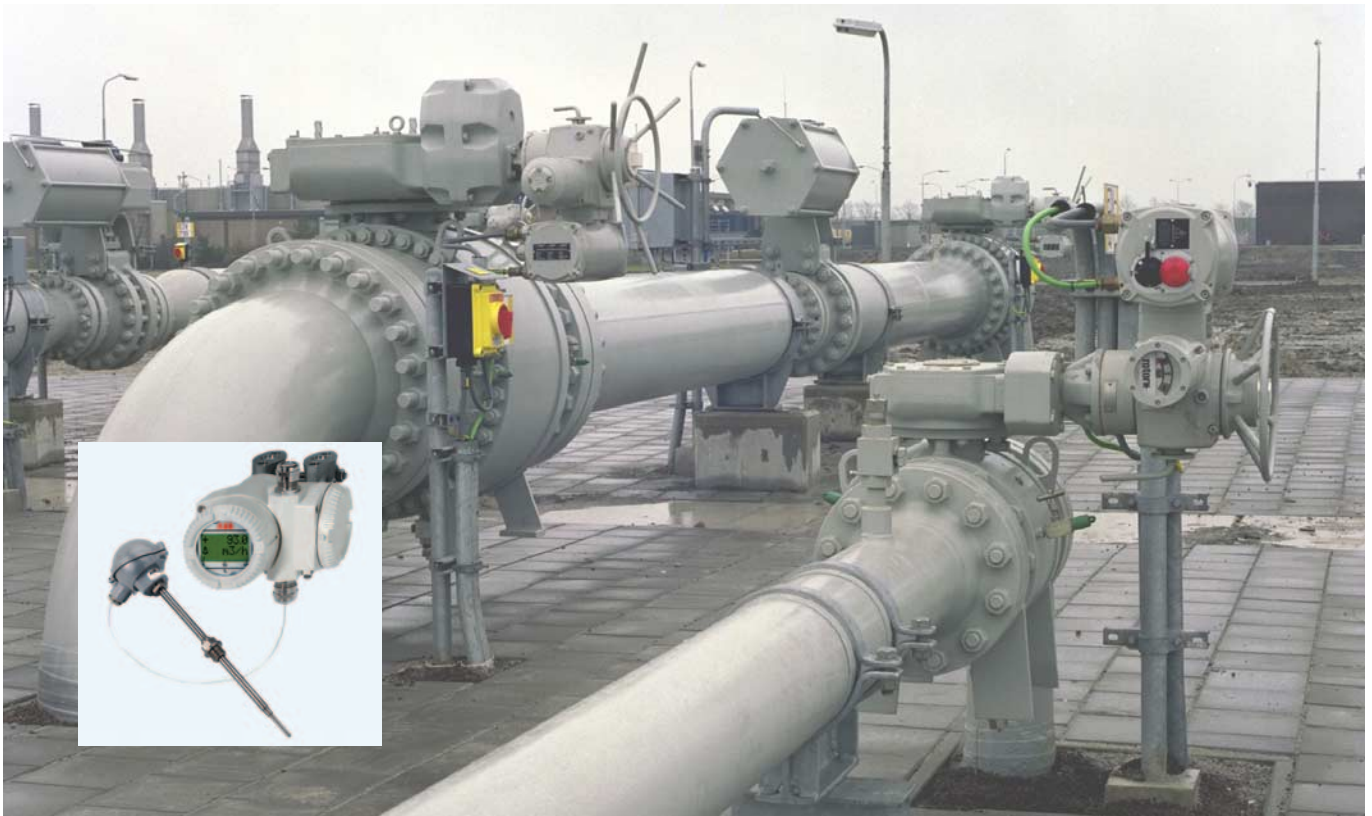




Oil & Gas

Instrumentation Solutions



- Economic setup of a measuring point
- High-accuracy measurement of standard volume flow
- Suitable for working pressure up to 410 bar

1 Introduction

The use of natural gas is subject to seasonal and daytime-dependent variations. Nevertheless, a constant gas production must be ensured. For this purpose, the produced gas must be stored, for example in subterranean caverns at a high pressure of approximately 350 to 380 bar.

It is important for the operator of such caverns to know exactly how much gas is stored in each cavern. This can be achieved by measuring the gas flow while filling in or taking out gas.

For reasons of economy, flow measurement using the differential pressure method is especially suitable for high-pressure measurements of this type.

As, however, the pressure and temperature are varying in this application, the wanted information can be obtained only when the resulting gas density changes are considered and the standard volume flow of the natural gas is given as the measured value. Only then it can be ensured that the record of the stored quantity always refers to determinate reference conditions.

In order to be able to calculate the density of gases, their temperature and pressure must be known. This means that at least three process variables must be measured at such a point:

- the differential pressure on the used primary as a measure of the flowrate
- the process temperature
- the process pressure

Additionally, a function is required which calculates the gas density from the measured variables and performs a state correction of the flow signal.

2 Solution

The multivariable transmitters of type 267CS or 269CS perfectly fit for this measuring task, as they can measure all the needed process variables and are also capable of calculating the necessary state correction. The transmitter's output signal is proportional with the standard volume flow, even in case of a measurement with a pressure of up to 410 bar.

The differential pressure and absolute pressure are directly measured by the transmitter, whereas a Pt100 temperature sensor must be connected to the multivariable transmitter for the process temperature measurement. The necessary terminals are provided in the device's terminal compartment in addition to the signal and power supply terminals.



Fig. 2-1: Example of a set up measuring point

Another important advantage of using only one transmitter is the higher accuracy. All values are measured with high accuracy, digitized, and processed directly. Multiple signal conversion from digital to analog and vice versa as it would be required for the signal transmission between several devices, e.g. from the transmitter to the flow computer, usually results in accuracy losses.

State correction with best in class accuracy is achieved by the transmitter which does not only determine the gas density in dependence of the pressure and temperature, but also performs a “dynamic state correction” in accordance with AGA 3 and EN ISO 5167. This means that all variables that are considered for flow calculation and depend on the pressure, temperature and flowrate are compensated.

These are:

- the discharge coefficient – depending on the primary element and the Reynolds number
- the velocity of approach factor – depending on the temperature
- the gas expansion factor – depending on the medium
- the compressibility factor – depending on the medium

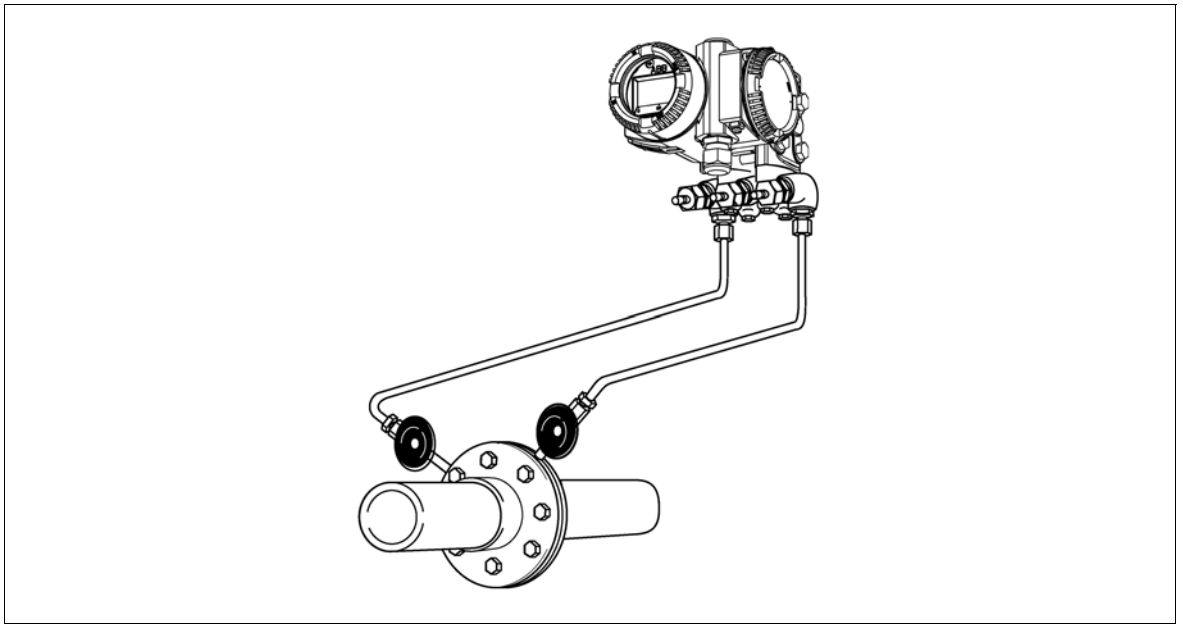


Fig. 2-2: Schematic diagram of a gas flow measurement system using the differential pressure method

3 Benefit analysis

Multivariable transmitters of type 267CS/269CS provide the advantage over conventionally equipped measuring points that only one transmitter is needed and the efforts for the installation, electrical connection and handling are reduced considerably, resulting directly in cost savings.

4 Features of the used componentes


Instrumentation	
	<p>Multivariable transmitters 267CS/269CS</p> <p>Measurement of:</p> <ul style="list-style-type: none"> Differential pressure, absolute pressure and process temperature <p>Calculation:</p> <ul style="list-style-type: none"> Dynamic calculation of the mass flow for steam and liquids and of the standard volume flow for gas <p>Accuracy:</p> <ul style="list-style-type: none"> 0.04 % (269..) or 0.075 % (267..) turn down ratio up to 100:1 <p>Communication:</p> <ul style="list-style-type: none"> HART / 4 ... 20 mA, PROFIBUS PA, FOUNDATION Fieldbus or Modbus <p>Differential pressure measuring range:</p> <ul style="list-style-type: none"> 0.5 kPa ... 2 MPa <p>Absolute pressure measuring range:</p> <ul style="list-style-type: none"> 0.6 ... 41 MPa <p>Temperature measuring range:</p> <ul style="list-style-type: none"> -50 ... 650 °C <p>Explosion protection:</p> <ul style="list-style-type: none"> Intrinsically safe acc. to ATEX, FM, Flameproof enclosure acc. to ATEX, FM, CSA

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