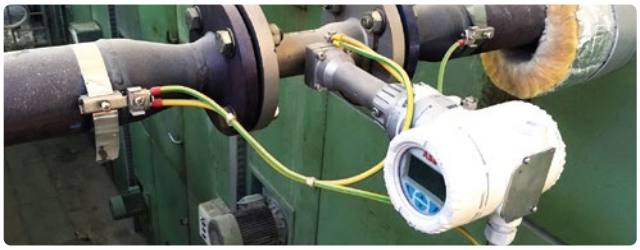
ABB FLOW APPLICATION

Natural Gas Measurement in Power Plants, Boilers & Incinerators

Introduction

Natural gas as a fossil fuel is used in many applications such as gas or steam turbines for power generation or as direct fuel in process boilers, furnaces or in the production of hot water. Compared with other fossil fuels, natural gas is considered clean as its combustion results in fewer residues and lower carbon dioxide emissions.

Due to legal requirements such as ISO 50001 for monitoring the energy efficiency of power plants, it is increasingly important to measure and record the energy flows in installations.



Natural gas is a naturally occurring mixture of gaseous hydrocarbons with varying compositions which can vary widely even after the gas treatment, depending on the origin.

The major component of natural gas is methane which is also the energy source of the gas. Further constituents are longer chain hydrocarbons, carbon dioxide, nitrogen, hydrogen sulfide, ethane, propane, butanes, pentanes, carbon dioxide and water vapor.

The Solution

The Vortex and Swirl flowmeters of the latest generation offer a good alternative. They are highly accurate and completely independent from the measuring medium and provide, when sized appropriately, measurement dynamics that are fully sufficient for these applications.

Pressure and temperature effects are compensated in the device, whereby the gas flow is measured and shown in standard units.

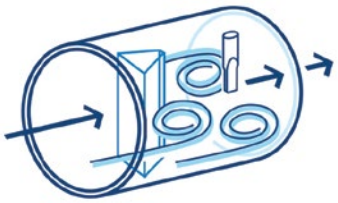
Generally for process gases, the compensation of pressure and temperature is performed through a calculation formula for ideal gases. The accuracy of the measurement and conversion is improved by specific procedures for the natural gas calculation in accordance with ISO 12212-2 / AGA8 or ISO 12212-3 / SGERG88.

Internal counters simultaneously totalise the measured operating volumes and the calculated standard volumes that are compensated to standard units, and show them via HART, MODBUS communication or LCD display.

VortexMaster and SwirlMaster

Vortex Flowmeters

The VortexMaster works according to the vortex frequency principle. A solid body, also called ‘bluff body’, is introduced into the flow. On the bluff body, vortex sheddings occur whose frequency is directly thereafter detected with a piezo sensor.



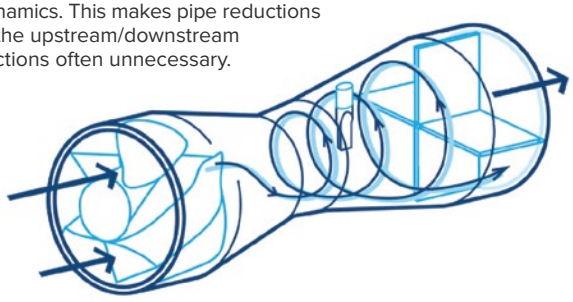
Over a wide Reynolds numbers range, this frequency is directly proportional to the flow velocity. The exact ratio will be determined on the test bench individually for each flowmeter and deposited in the device in the form of calibration factors. Using flow velocity and pipe cross-section the volume flow rate is calculated.

Swirl Flowmeters

The SwirlMaster operates on a similar principle. Instead of a bluff body a fixed rotary body, called ‘inlet guide body’ is used which causes the measuring medium to rotate. Here, the rotational frequency is decisive for determining the flow velocity.

The swirl measurement method is characterised by higher accuracy and less sensitivity to disturbances in the flow profile, thereby requiring significantly shorter inlet and outlet sections.

Another advantage of this measurement method are the measuring ranges of the nominal diameter. These are designed for today’s industry standard medium velocity of about 1.5 to 60m/s, and therefore offer very good measurement dynamics. This makes pipe reductions in the upstream/downstream sections often unnecessary.



Depending on the involvement in the process, versatile installation options emerge:

- No pipe reductions are necessary
- No additional flow straightener is required
- Installation 5 x DN possible after control valves
- 3 x DN inlet, 1 x DN outlet section sufficient or even no inlet/outlet section required

WHGood Automation

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Functionality of the VortexMaster & SwirlMaster

VortexMaster as well as SwirlMaster primarily measure the operating volume flow. The measured operating volume considers neither the pressure nor the temperature of the measuring medium.

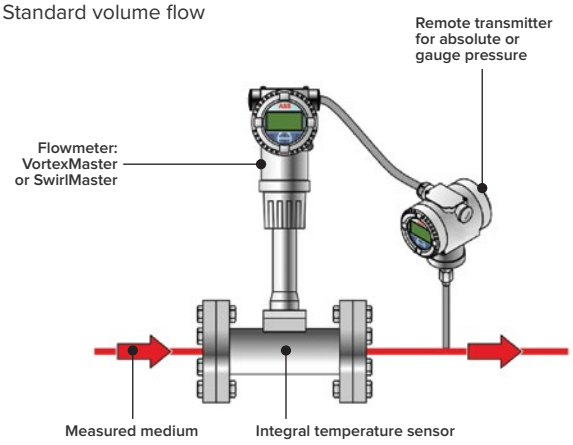
In general, the user is, however, especially with natural gases, interested in the measurement of the standard volume or the mass.

The conversion can take place directly in the flowmeter if the necessary state variables are measured or known.

Depending on which measured variable is to be calculated, VortexMaster and SwirlMaster can be configured using the multi-variable measurement of volume flow and temperature, and taking into account the operating pressure.

At constant pressure, or if the pressure is read via the flow input (type FSx450) or HART, the integrated flow computer can calculate and show the following measured variables using the integrated state equations and tables according to internationally accepted standards:

- Volume flow
- Mass flow
- Standard volume flow

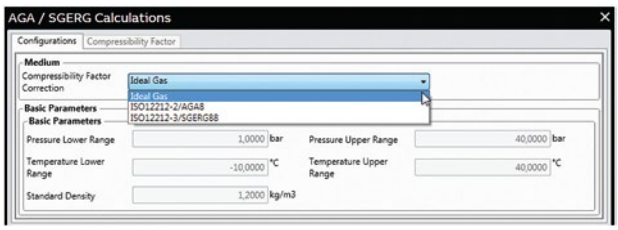


The equations stored in the transmitter to calculate the compressibility and thus the density and the mass flow of natural gas can be selected and parameterisation by the user.

The following standards are available:

- ISO 12213-2 (includes AGA8-DC92)
- ISO 12213-3 (includes SGERG-88 and AGA Gross Method 1)

Both calculation methods require a different number of process and gas parameters. To ensure the accuracy and clarity, the parameter input is easily performed using the DTM or EDD.



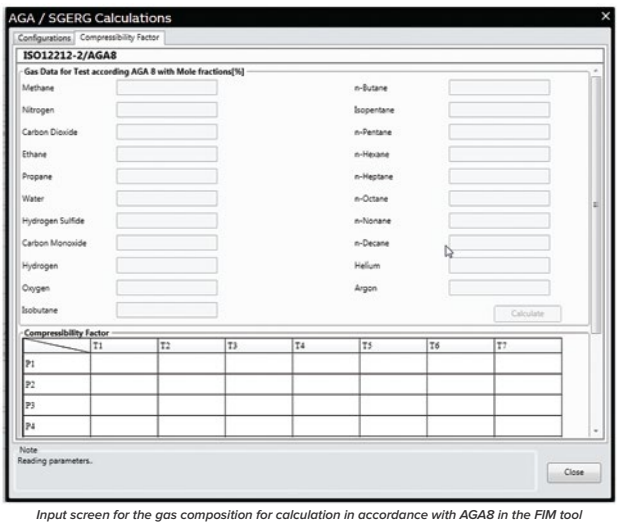
Selection screen of the calculation method in the Field Information Manager (FIM tool)

Here the calculation methods can be selected or changed. Using the 'Basic Parameters', a scope for the process parameters pressure and temperature is defined. The operating data should be within this scope, whereby it can be chosen generously.

In the example shown, the pressure can vary between 1 bar (absolute) and 40 bar (absolute) and the temperature between -10°C and +40°C.

Based on the gas composition and the previously defined limits for the operating conditions, the compressibility factors are calculated and stored in a table in the device.

Based on current pressure and current temperature the correction factor valid for the application is calculated in the device is included into the gas equation.



Input screen for the gas composition for calculation in accordance with AGA8 in the FIM tool

For the most accurate measurement of the volume flow in natural gases, the SwirlMaster FSS450 with internal temperature and pressure compensation in connection with the compression factor correction is ideal. The VortexMaster FSV450 provides a cheaper alternative to an accuracy of 1 % of the measured value in relation to the volume flow.