

Steam balancing

with the flowmeters

VortexMaster and SwirlMaster



Calculating mass and energy flow without installing additional heat computers

Measurement made easy

VortexMaster and SwirlMaster

Introduction

Steam is used in nearly all industries for transmitting energy or for cleaning purposes. In times of limited resources and rising energy prices, economic and optimal usage of energy sources is becoming increasingly important.

The necessary prerequisite for this is reliable measurement of the amount of energy. This can only be achieved by accurately measuring the volumes, taking the parameters of temperature and pressure into account.



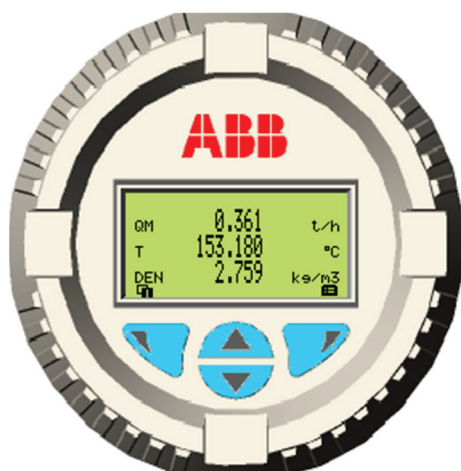
Steam balancing

with the flowmeters VortexMaster and SwirlMaster

- 01 HMI 3 line presentation
- 02 HMI steam selection possibilities

Instrumentation

The new ABB VortexMaster FSV450 and SwirlMaster FSS450 flowmeters not only offer the possibility of processing the pressure and temperature effect in the device, but also simultaneously perform the complex calculations of mass flow and energy flow and provide internal counters for these process variables.



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In addition to energy usage, steam consumption is also counted in mass and volume units. The current counter values are made available online to users via a HART communication. This allows e.g. evaluations of the energy efficiency to be carried out at any time.

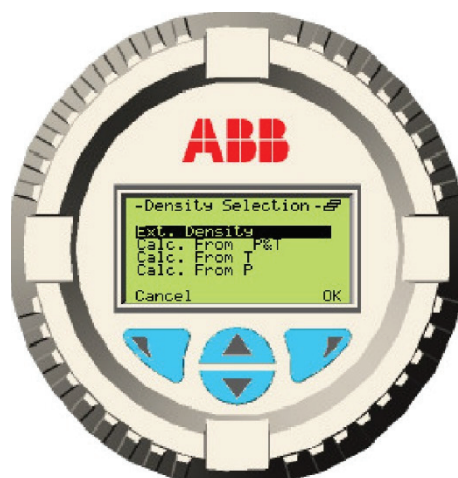
In addition to the 4 to 20 mA / HART current output, the devices offer a binary output, which means the energy flow can also be processed as a pulse value or standardized frequency in a control system.

Functionality

Vortex and swirl flowmeters use a vortex frequency procedure to measure the volumes and operating conditions in the traditional sense.

In the case of the VortexMaster, the medium is swirled over a defined swirl body in a targeted manner. With the SwirlMaster, the medium is rotated by an inlet guide body. This measurement method is characterized by increased accuracy and lower sensitivity to disturbances in the flow profile. This means significantly shorter inlet and outlet sections are required.

The detected vortex frequency or rotational frequency is directly dependent on the flow velocity in the device. An integrated temperature sensor in the flowmeter also detects the steam temperature.



02

For saturated steam measurement, these two measurements would be perfectly adequate to perform mass or energy balancing. For overheated steam, and also for monitoring the steam state (wet steam / saturated steam / hot steam), the pressure in the piping also needs to be considered. The flowmeter can therefore correctly detect the steam state, precisely calculate the density and energy content of the steam. If there is a wet steam state, the flowmeter warns the user via the LCD display and HART communication.

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03 Typical installation for
measuring medium
temperatures of up to
280 °C

The user should avoid wet steam states, because the water that condenses from the steam is deposited on the piping, where it collects and often leads to damaging water hammer effects in the system.

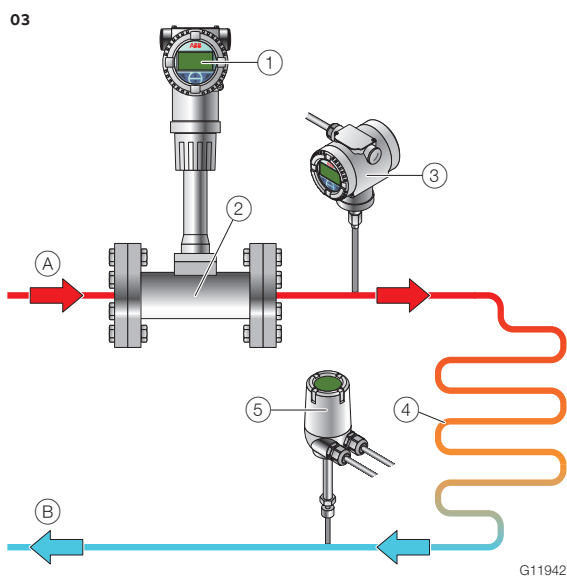
As an accurate measurement of the proportion of steam and condensate is not possible in this scenario, the integrated measurement computer performs calculations using saturated steam values based on the internal temperature measurement.

Energy flows are calculated in accordance with IAPWS standards (The International Association for the Properties of Water and Steam).

User Benefits

The integrated solution described has the following advantages:

- Minimal installation costs
- Elimination of external temperature measurement via a separate transmitter and power supply unit
- Full saving of costs for the external measurement computer, including installation costs
- Increased system accuracy by directly applying the provided pressure measuring signal, which is usually already available for safety purposes
- Direct detection of the steam state and warning of wet steam states where the proportion of steam and condensate cannot be measured accurately.



Pos.	Description
(A)	Steam supply
(B)	Condensate return
(1)	3VortexMaster / SwirlMaster flowmeter
(2)	Integrated temperature sensor
(3)	Remote transmitter for absolute pressure or gauge pressure
(4)	Heat Exchanger
(5)	Optional remote temperature transmitter for balancing net energy consumption

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04 VortexMaster
flowmeter installed in an
insulated steam pipe

Example calculation

Initial state

Description	Value
Saturated steam absolute pressure	6 bar (290 psi)
Temperature	159 °C
Resulting density for the mass calculation	3.1817 kg/m ³

Change of state: overheating of the steam to avoid condensate build-up

Description	Value
Overheating	2 °C
Resulting density for the mass calculation without consideration of the pressure	3.3383 kg/m ³
Resulting density error or measurement error	5 %

Additional charge calculation based on a 5 % measurement error

Description	Value
Sample costs	€ 60 / MWh
Energy flow	3 t/h = 2300 kW
Piping	DN 100
Load	50 %
Additional charges resulting from the 5 % error – density error or measurement error	€ 5000 / month

Pressure measurement and compensation will ensure the steam state is monitored reliably and correctly and the errors shown are virtually eliminated.

The 0.5 % increase in accuracy when using SwirlMaster as compared to traditional vortex flowmeters can mean saving up to €500 per month in the case of the example described. The slightly higher investment costs for this technology will therefore be amortized in the first few months after commissioning.

Balancing net energy consumption is also possible if energy from the process is transmitted back in the form of condensate.

Here, the transmitter directly calculates the energy that is used by the process. For this purpose, a remote temperature transmitter can be connected to the flowmeter along with the existing pressure transmitter, either via HART communication or a passive analog 4 to 20 mA signal.

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Notes

Notes

ABB Limited
Measurement & Analytics
Howard Road, St. Neots
Cambridgeshire, PE19 8EU
UK
Tel: +44 (0) 870 600 6122
Fax: +44 (0)1480 213 339
Mail: enquiries.mp.uk@gb.abb.com

ABB Inc.
Measurement & Analytics
125 E. County Line Road
Warminster, PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

ABB Automation Products GmbH
Measurement & Analytics
Dransfelder Str. 2
37079 Goettingen
Germany
Tel: +49 551 905-0
Fax: +49 551 905-777
Mail: vertrieb.messtechnik-produkte@de.abb.com

abb.com/flow

