Application Description AG/WW104-EN Rev. B

# Thermal mass flowmeter for sludge gas and biogas in sewage treatment plants

## Measurement made easy

## Accurate and reproducible measurement results thanks to the most effective instrumentation

### Introduction

Achieving the most effective cleaning performance while ensuring the best energy efficiency is a key consideration when treating waste water at sewage treatment plants. When the sewage sludge is fermented in digesters, methane gas is produced, which can be used to generate electricity. The quantity of gas produced is an important figure indicating the operation of the digester and the processes taking place inside. When the exact quantities are known, the process engineering can be optimized, enabling the gas energy source to be exploited efficiently. This means that further considerations in terms of energy optimization can be explored for operating the digester and also for using combined heat and power plants.

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## The problem

Due to the low upstream pressure, the fluctuating quantities, which are very small in relation to the conductor cross-section, and the contamination level, which can be high, this essential measurement process has always posed a significant challenge for measurement technology. ATV instruction sheet M 264 addresses this issue and provides information for practical use. Various comparisons and tests have also been carried out by institutions, operators and engineering firms to verify the suitability of different measurement methods. All studies found the thermal mass flowmeter to be the most effective instrument for measuring sludge gas, and this method is the only way to achieve accurate and reproducible measurement results.

## The solution

According to ATV instruction sheet M 264, thermal mass flowmeters are more effective than other methods thanks to their low pressure loss and large measuring span of up to 1:150. The direct measurement of the mass flow can be used directly as a control signal for the combustion process, without time-consuming pressure and temperature compensation, which would be necessary when measuring the volume flow (e.g. orifice measurements).

The sensor is installed using a weld-on adapter made from stainless steel; the weld-on adapter can be combined with a conventional ball valve with weld-on ends. For nominal diameters up to DN 65, solid pipe components (e.g. as a partial measuring section or wafer flange version) are recommended, as these ensure that the sensor is aligned as effectively as possible within the piping. The flanged connection with centering pin ensures that the sensor is constantly positioned accurately and enables a high level of reproducibility, even after removing and refitting the sensor. In other systems with compression fitting, this is generally not guaranteed and leads to an additional measurement error.

The instruments for sludge gas/biogas measurement must be suitable for explosion-proof measurement in Zone 1. The Sensyflow FMT500-IG thermal mass flowmeter is an ATEX-certified device with digital signal processing and a graphical display. The device can be mounted in a separate or compact design. Digital signal processing provides unprecedented possibilities for diagnosis and process monitoring. A direct PROFIBUS DPV1 communication module can also be supplied (also for ATEX Zone 1).

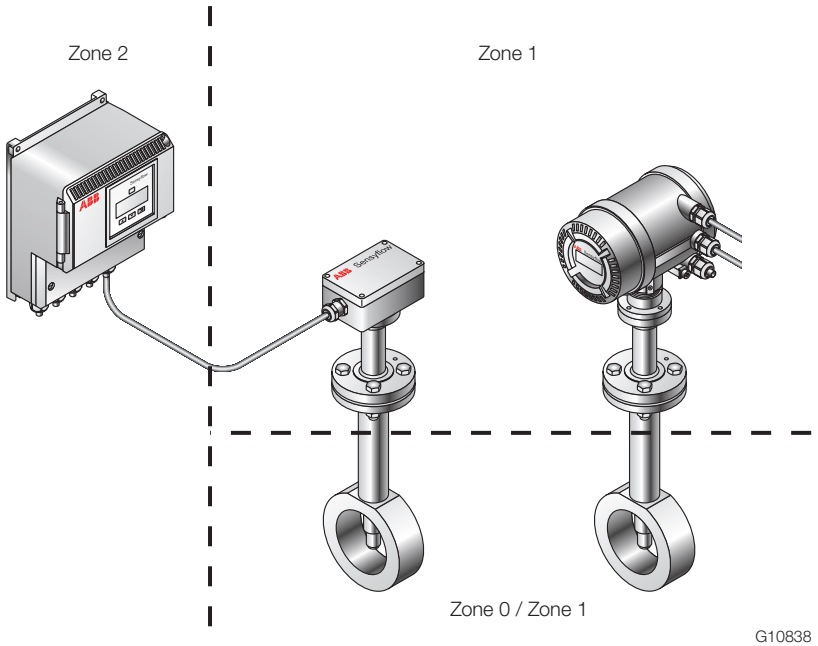



**Fig. 1: Mounting options of the Sensyflow FMT500-IG in separate or compact design in a potentially explosive atmosphere**

According to ATV instruction sheet M 264, the flowmeter should be installed behind a gravel filter and a foam trap in order to avoid measurement interference caused by condensate. Measurement interference caused by condensate can also be prevented by installing the device in an uphill position. In special cases, trace heating can also be used.

If these installation instructions are observed, the user will be able to benefit from a perfectly suited device providing a wide range of analysis options, thanks to its state-of-the-art electronics and particularly short response times of less than 2 seconds.

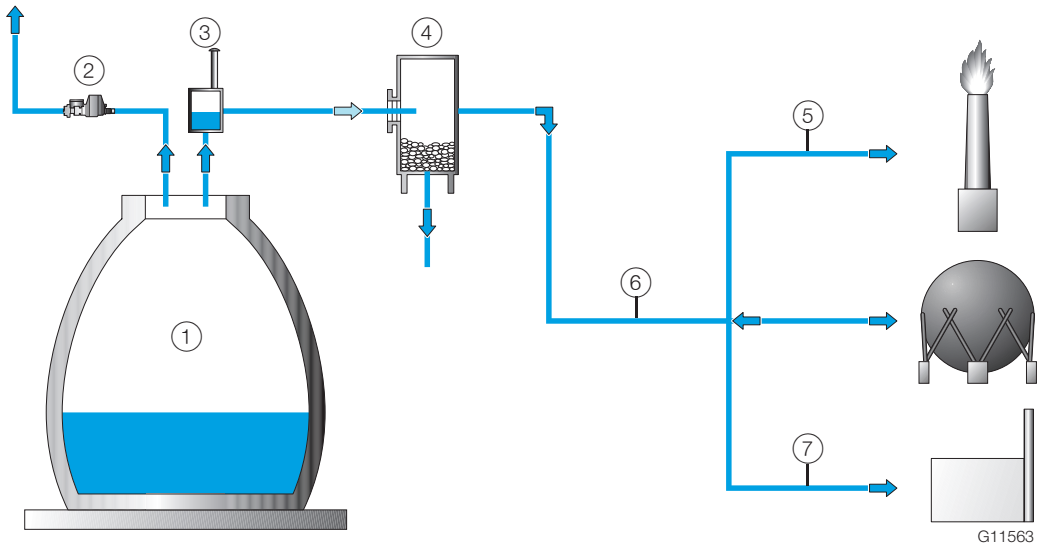
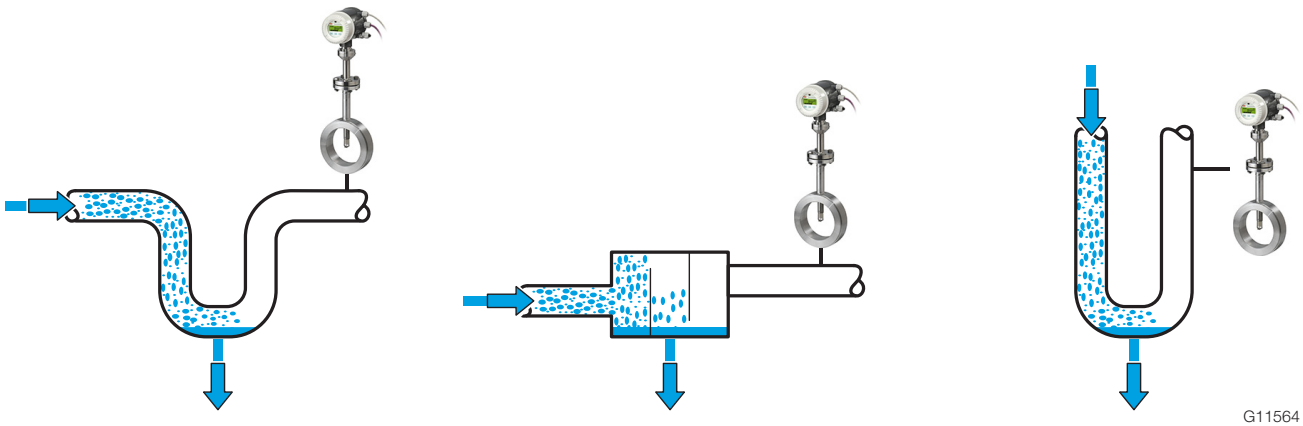



**Fig. 2: Measuring points for the gas flow rate in a sewage treatment plant**
(1) Digestion tower (2) Overfill protection (3) Foam trap (4) Gravel filter (5) Quantity measurement F1 (6) Quantity measurement F2 (7) Quantity measurement F3

## Installation Instructions and Specifications

When installing the devices, the steadying lengths specified in the data sheets must be observed;
15 times the nominal diameter is recommended in the inlet and 5 times the nominal diameter in the outlet.-
Installation on areas prone to heavy condensation (e.g. pipe troughs) should be avoided in all cases.




After piping trough | Behind condensate trap | In riser

**Fig. 3: Recommended installations**

## Typical sludge gas measuring ranges

When selecting the size of the device, the nominal diameter of the piping can be of assistance. The large measuring span of the flowmeter also allows the detection of small quantities of gas. A reduction of the piping with associated pressure loss is therefore not necessary in most cases. The flowmeter itself experiences pressure loss, which is typically less than 1 mbar.

| Nominal Diameter | $Q_{min}$ [$Nm^3/h$] | $Q_{normal}$ [$Nm^3/h$] | $Q_{max}$ [$Nm^3/h$] |
|---|---|---|---|
| DN 50 | 5 | 50 | 450 |
| DN 65 | 9 | 65 | 850 |
| DN 80 | 13 | 80 | 1200 |
| DN 100 | 20 | 100 | 2000 |
| DN 125 | 35 | 150 | 3500 |
| DN 150 | 60 | 200 | 5500 |

$Q_{min}$ Minimum meaningful value on the display
$Q_{normal}$ Upper measurement range value normally configured
$Q_{max}$ Maximum possible upper calibration value of the device

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## Characteristics of the components used

| Measuring point | Instrumentation | |
|---|---|---|
| F1, F2, F3 |  | Thermal mass flowmeter FMT500-IG in compact design<br>— Approved for use in zone 1<br>— Measuring accuracy: from 0.95%/1.9% of measured value<br>— Reproducibility: < 0.2% of measured value<br>— Large measuring span 1:150<br>— Defined mounting using flange with centering pin<br>— HART communication or PROFIBUS DP-V1<br>— Pulse and switch output |
| F1, F2, F3 |  | Thermal mass flowmeter FMT500-IG in separate design<br>— Sensor approved for use in zone 1, transmitter in zone 2<br>— Measuring accuracy: from 0.95%/1.9% of measured value<br>— Reproducibility: < 0.2% of measured value<br>— Large measuring span 1:150<br>— Defined mounting using flange with centering pin<br>— HART communication or PROFIBUS DP-V1<br>— Pulse and switch output |

## Contact us

**ABB Limited**
**Process Automation**
Oldends Lane, Stonehouse
Gloucestershire, GL10 3TA
UK
Tel: +44 (0)1453 826661
Fax: +44 (0)1453 829671

**ABB Inc.**
**Process Automation**
125 E. County Line Road
Warminster, PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183
measurement@us.abb.com

**ABB Automation Products GmbH**
**Process Automation**
Dransfelder Str. 2
37079 Goettingen
Germany
Tel: +49 551 905-534
Fax: +49 551 905-555

**www.abb.com**

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