

ELECTRONIC TURBINE GAS METERS

TME 400-VMF/VCF

TME 400-VMF/VCF (Turbine Meter Electronic) are approved for custody transfer according to MID and offer a number of advantages over classical mechanical Turbine Meters. This includes display of actual flow rate, data and parameter archiving and various interfaces.



METHOD OF OPERATION AND CONSTRUCTION

Introduction

The new type TME 400 turbine meters are designed for custody transfer operation with purely electronic totalizers. In contrast to mechanical turbine meters, in the TME 400 the volume flow is converted in the mechanical meter body to electrical impulses, which are transmitted to the electronic meter head where they are processed.

In this way, the TME 400 can not only display and save the totalizer reading, but also, for example, the actual flow rate. In addition, several totalizers can be realized and the meter can transmit its measured values as well as additional signals directly via various interfaces (pulses, analog, digital). Furthermore, the version TME 400-VCF offers a fully-fledged volume corrector integrated in the meter head, including pressure and temperature measurement. It calculates the standard volume besides operating flow rate and operating volume. An external volume corrector is no longer needed. For all TME 400-Versions, a long-lasting backup battery ensures continued reliable operation even in the case of a complete power failure for 6+ years.

TME 400-VMF

TME 400-VMF (Volume Meter Fiscal) is the name of the turbine meter for measurement of volume under operating conditions (custody transfer approved). It is the electronic further development of the classical mechanical turbine meter.

Features

- **Approval acc. to MID** (European Measurement Directive)
- **Design acc. to EN 12261** (European Standard for Turbine gas Meters)
- **Electronic totalizers**
Main totalizer, additional start-stop or resettable totalizer for low flow (or slow down) cut-off by external signal.
- **Low-torque metering system with long-term stability**
Turbine design with a minimum of moving parts.
- **Battery or mains operation**
Autonomous operation with lithium cell for 6+ years or external power supply and backup battery to protect against power failures.
- **Explosion protection**
The TME 400 is intrinsically safe and can be used in zones 1 and 2.
- **Outputs**
Pulse outputs HF and LF (variable), alarm output, current output (4-20 mA, optional).
- **Flow display**
- **Digital interface**
serial RS 485 interface for Modbus connection.

- **Storage of maximum value (Qm)**

- **Archive**

Integrated fail-safe parameter, event and measured value archive.

- **RMGView^{TME}**

Provided software for convenient parameterization and management of device and stored data.

TME 400-VCF

The TME 400-VCF (Volume Corrector Fiscal) combines all features of the TME 400-VMF with the benefits of a fully integrated custody transfer approved PTZ volume corrector according to European standard EN 12405. Pressure and temperature measurement are integrated directly into the meter.

Additional Features (VCF)

- **Volume corrector acc. to EN 12405**

Integrated fully-fledged compact volume corrector including digital pressure and temperature measurement.

- **Calculation of the K coefficient**

according to SGERG88, AGA8 GROSS M1 and M2 as well as AGA NX19.

- **Display**

Operating volume, standard volume, current and maximum flow can be displayed in measurement and standard condition.

- **Separate Terminal block**

Inputs for pulses, pressure and temperature can be sealed separately from the rest. The lithium battery can be exchanged without opening the case.

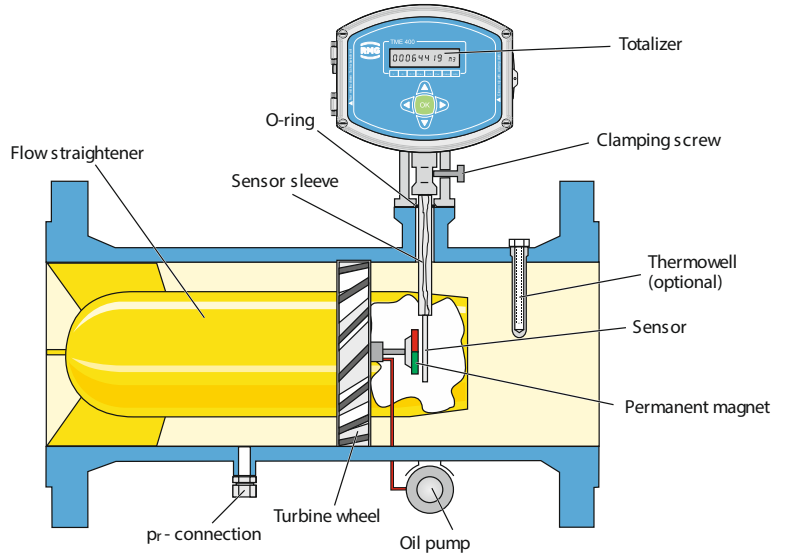
Method of Operation

With turbine gas meters the gas flow strikes a mechanically mounted turbine wheel and drives it. The rotational speed of the turbine wheel is proportional to the flow rate of the gas. Since the gas flows through an invariable cross section (annular gap of the turbine wheel), the flow velocity is also proportional to the volume flow.

TME 400-VMF and TME 400-VCF are based on the trusted RMG Turbine Meters series TRZ03. Dimensions and metrological performance are identical for both.

In the TME 400, a magnetic disk is mounted on the shaft of the turbine wheel, rotating at the same speed as the turbine wheel. A Wiegand sensor scans this disk and generates one electrical pulse per revolution which is transmitted to the electronic meter head. Each pulse is directly proportional to a certain volume flow. The meter can therefore display both the current flow (Q_M) and the total flowed volume (V_M).

Furthermore, the volume corrector integrated in the TME 400-VCF allows the calculation of the standard volume (V_B). In order to do this, the meter measures operating pressure and operating temperature in addition to the operating volume flow. From this, the standard volume flow can be calculated using a suitable equation of state together with the corresponding standard conditions. Then this value is summed up in the standard volume totalizer and stored in the data logger.



Electronic Totalizer

Possible connections for the electronic totalizer:

Connection	Type	U _{max}	U _{min}	I _{max}	T _{pulse}	f _{max}
Pulse output HF direct signal frequency	Transistor, open collector	30 V	4.0 V	30 mA	1 ms	250 Hz
Pulse output LF reduction programmable	Transistor, open collector	30 V	4.0 V	30 mA	20 ms 125 ms 250 ms	25 Hz
Interface	RS 485	10.5 V	6.0 V	200 mA	-	-
Switch input for stopping the totalizer	Switching contact	potential-free	-	-	-	-
Current output (option) Version with a current board	4-20 mA, 2 wires	30 V	12 V	23 mA	I _{min} 3.5 mA	Error < 0.5% of final value**

PRESSURE LOSS, TECHNICAL DATA

Nominal Diameter		Flow rate (max) Q _{max} m ³ /h	Δp mbar
mm	inch		
50	2"	100	6
80	3"	160	3
		250	7
		400	16
100	4"	250	3
		400	4
		650	11
150	6"	650	3
		1000	6
		1600	14
200	8"	1600	4
		2500	9
250	10"	1600	2
		2500	4
		4000	8
300	12"	4000	4
		6500	9

The pulse value for LF pulses can be programmed from 0.01 to 100 pulses/m³ with a maximum output frequency of 25 Hz.

Pressure Loss

The pressure loss Δp stated in the table applies to natural gas at Q_{max} and 1 bar (a). From this, the pressure loss at measurement conditions can be calculated in accordance with the formula below.

Pressure loss as per the formula

$$\Delta p_m = \Delta p \cdot \frac{\rho_b}{0.83} \cdot p_m \cdot \left(\frac{Q_m}{Q_{max}} \right)^2$$

Δp_m = Pressure loss at measurement conditions (p_m, Q_m) in mbar

Δp = Pressure loss at Q_{max} with natural gas at 1 bar in mbar (see table)

ρ_b = Standard density of the gas in kg/m³

p_m = Pressure at meas. conditions in bar(a)

Q_m = Flow rate at meas. conditions in m³/h

Q_{max} = Maximum flow rate in m³/h (see table)

Example:

Air, nominal meter size DN 100, measuring range 20 - 400 m³/h, p_m = 1.01 bar (a),

ρ_b = 1.29 kg/m³, Q_m = 250 m³/h.

Take from the table: Δp = 4 mbar.

Hence the result using the above formula:

Δp = 2.5 mbar.

Technical Data

Explosion protection	II 2G Ex ia IIC T4 Gb
Degree of protection	IP 65
Ambient temperature	-25°C - +55°C
Medium temperature range	-20°C - +60°C
Temperature transmitter	PT 1000
Pressure ranges	0.8 - 2.5 bar(a) 0.8 - 6.0 bar(a) 2.0 - 10 bar(a) 4.0 - 20 bar(a)
Power supply	Standard lithium battery with 3.6 V (service life 6+ years) Service life of the standby battery with 24 V/DC external power supply via interface or current output 10+ years
Outputs	3 transistor outputs: - HF - LF (pulse width programmable) - Fault 4-20 mA analog output (only with external power supply), electrically isolated
Interface	RS 485 (Modbus protocol) / external power supply

FACTS, MATERIALS, APPROVALS

Measuring Accuracy

Error limits (standard):

+ 1.0% from Q_{min} up to $0,2 Q_{max}$

+ 0.5% from $0,2 Q_{max}$ up to Q_{max}

These limits (=1/2 x MPE acc to Class 1.0 of MID approval) apply for steady, swirl free flow at a pressure of 4 bars and above for a turn down ration of 1:20.

Below 4 bar the full MPE of approval applies. Better accuracy is available on request. TME 400-VMF/VCF allow further improvement of accuracy by an optional error curve linearization (polynomial approximation), which also is approved for custody transfer.

(MPE= Maximum permissible Error)

Types of Gas

The TME 400 standard design is suitable for all gases complying with DVGW Code of Practice G260. The materials used are appropriate for industrial gases and fuel gases, such as unmodified and modified natural gases, processed biogas and all non-corrosive gases. For corrosive gases, there are special designs available with PTFE lining, special material, special lubrication, etc.

H2 Readiness

Meters of type TME 400-VMF are technically suitable for H₂-concentrations up to 100%. Nevertheless due to the legal framework in Germany („PTB-Richtlinie TRG 19“) currently the use for custody transfer measurement is limited to a maximum H₂-concentrations of 10%.

Meters of type TEM 400-VCF are technically suitable for H₂-concentrations up to 10%.

Maintenance

All turbine meters up to and including the nominal size of DN 150 are fitted with permanently lubricated ball bearings and require no maintenance. From the nominal size of DN 200, the meters are fitted with a lubricator. Lubrication has to be performed in compliance with the operating instructions (see also lubrication instruction plate on the meter).

Materials

- Meter Body (Standard)

DN	PN				ANSI	
	10	16	25	40	150	300
50	3G/SG	3G/SG	3G/SG	3G/SG	3G/SG	SG
80	3G/SG	3G/SG	3G/SG	3G/SG	3G/SG	SG
100	3G/SG	3G/SG	SG	SG	3G/SG	SG
150	3G/SG	3G/SG	SG	SG	3G/SG	SG
200	3G/SG	3G/SG	SG	SG	3G/SG	SG
250	SG	SG	SG	SG	SG	SG
300	SG	SG	SG	SG	SG	SG

3G/SG: Cast Iron or Cast Steel (optional)

SG: Cast Steel

- Turbine wheel:

Standard: Delrin for DN 50 up to DN 200 for PN 10 / PN 16; Aluminum alloy elsewhere.

Option: Aluminum alloy for DN 50 up to DN 200 for PN 10 / PN 16

Approvals

EU type examination according to

- Measurement Instruments Directive MID 2014/32/EU as per certificate No.: T11741 /T11742
- Pressure Equipment Directive PED 2014/68/EU as per certificate No.: ISG-22-12-1978_Rev. F
- Explosion Protection Directive ATEX 2014/34/EU as per certificate No.: TÜV 17 ATEX 207566 X
Marking: II 2 G Ex ia IIC T4 Gb
- EMC-Directive 2014/30/EU as per
Test Report 1-5557/17-01-03_A

Recalibration Period (valid for Germany)

For TME 400-VMF:

As for mechanical Turbine Meters (8, 12 or 16 years, depending on size und bearing design).

For TME 400-VCF:

For the measuring unit apply the same periods as for mechanical Turbine Meters (8, 12 or 16 years, depending on size und bearing design).

For the electronic totalizer including temperature and pressure sensor the recalibration period of Electronic Volume Correctors (EVCs) applies (i.e. 5 years).

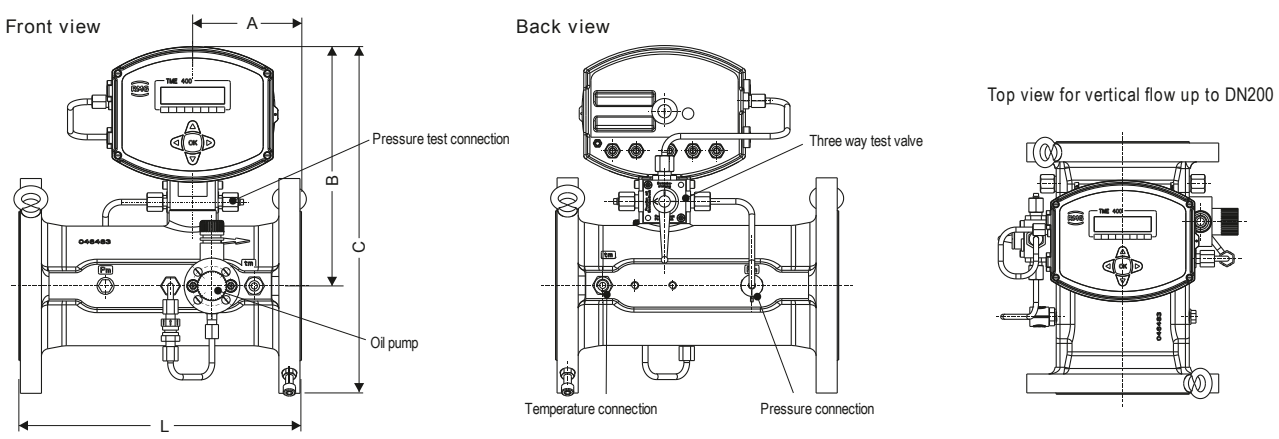
Separate recalibration of measuring unit and totalizer is acceptable.

MEASURING RANGE

DN mm	Meter Size	Q _{max} (m ³ /h)	Q _{min} (m ³ /h) 1:20	Q _t (m ³ /h) 1:20	Q _{min} , depending on minimum operating pressure p _{min} (bar)												
					1:30		1:50		1:80		1:100		1:120		1:160		
					Q _{min}	p _{min}	Q _{min}	p _{min}	Q _{min}	p _{min}	Q _{min}	p _{min}	Q _{min}	p _{min}	Q _{min}	p _{min}	
50	G 65	100	5 ²⁾	20	5 ¹⁾	3											
80	G 100	160	8 ²⁾	32	5	15	3.2	50									
	G 250	400	20	80	13	3	8	10	3.2	50							
100	G 160	250	12.5	50	8	3	5	25									
	G 250	400	20	80	13	3	8	10	5	25							
	G 400	650	32	130	20	3	13	4	8	10	6.5	15	5	25			
150	G 400	650	32	130	20	3	13	10	8	25	6.5	40					
	G 650	1000	50	200	32	3	20	4	13	10	10	15	8	25			
200	G 1000	1600	80	320	50	3	32	4	20	10	16	15	13	25	10	40	
	G 1600	2500	125	500	80	3	50	4	32	10	25	15	20	25	16	40	
250	G 1000	1600	80	320	50	3	32	10	20	25	16	40					
	G 1600	2500	125	500	80	3	50	4	32	10	25	25	20	40	16	60	
300	G 2500	4000	200	800	130	3	80	4	50	10	40	25	35	40	25	60	
	G 4000	6500	320	1300	220	3	130	10	80	25	65	40	55	40	40	80	

1) Measuring range 1:20
2) with p_{min} = 3 bar

TYPES OF CONSTRUCTION AND DIMENSIONS



DN (mm)	Dimension (mm)				Weight ¹⁾ (kg)
	L	A	B	C	
50	150	52	310	395	15
80	240	96	250	350	20
100	300	115	255	370	28
150	450	180	280	425	50
200	600	240	320	490	100
250	750	300	345	550	150
300	900	355	360	600	210

1) Approximate, valid for PN 10/PN16; Weights will differ for other pressure ratings.

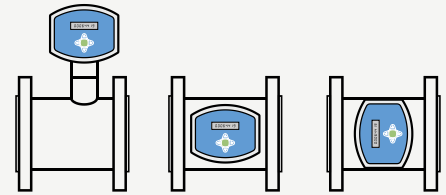
INSTALLATION OPTIONS, ARCHIVES, SOFTWARE

Options for Installing the Totalizer

With the **TME 400-VMF** the meter head can be mounted standing or lying as well as rotated about the vertical axis.

For **TME 400-VCF** the meter head is mounted standing in any case due to the pulse piping required.

For both the TME 400-VMF and the TME 400-VCF the remote totalizer option for a separated mounting of the meter head in a distance of max. 10 m from the meter body is available.



Archives

Parameter changes, meter readings and events are stored in the archives. For the TME 400-VCF additionally measured values are stored.

The memory depth is in each case:

- Parameter archive (sealable) 300
- Parameter archive (free access) 300
- Event archive 200
- Periodic archive 9000
- Daily archive 100
- Monthly archive 25

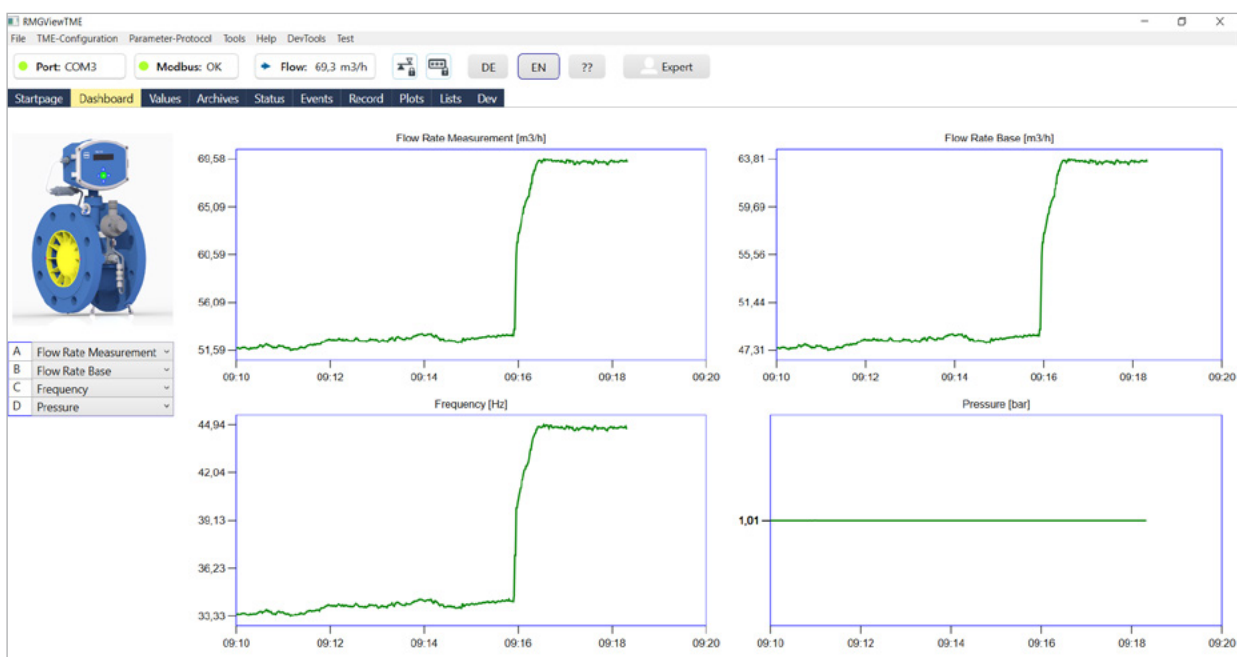
The measuring period can be set to 15, 30 or 60 minutes.

Operating software RMGView^{TME}

The provided RMGView^{TME} software allows direct access to the measuring electronics with a PC. The most important functions are:

- Readout of all parameters
- Change of parameters (with open calibration switch)
- Graphical display of measured values
- Creating test certificates and data sheets and their output in pdf format
- Reading out the archives
- Export of parameters and archive data in Excel readable format

The software is easy to use and all the data is displayed systematically in clearly arranged tables. It is also possible to combine selected measured values and parameters in user-defined tables.





ONE STEP AHEAD

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