IGTM Gas Turbine Meter

with electronic outputs and mechanical counter

Documentation and Technical Specifications

Gas - Measurement

EN ISO 9001 DNV Certified Company

vemm tec Messtechnik GmbH

General

The ***vemm tec*** IGTM (International Gas Turbine Meter) is a highly accurate flow meter, approved for custody transfer measurement, equipped with electronic pulse outputs and a mechanical counter. This document explains the dimensions, ranges, performance, calibration and outputs of the instrument. It details the installation, safety requirements and material specifications.

The IGTM measures gas volume flowing through an annular passage in the meter. The flowing gas volume is totalised on a local mechanical counter. In addition, low or high frequency pulse signals are generated to infer the gas flow and volume. The indicated gas volume is the actual volume flowing through the meter at the actual temperature and pressure. The IGTM is available in two models: CT and IM. The IGTM-CT is used for high accuracy and custody transfer applications. The IGTM-IM is an economically priced meter with a good accuracy.

Operation

The operation of the International Gas Turbine Meter is based on the measurement of the velocity of gas. The flowing gas is accelerated and conditioned by the meter´s straightening section. The straightening vanes prepare the gas flow profile by removing undesired swirl, turbulence and asymmetry before the gas flows to the turbine wheel. The dynamic forces of the flowing fluid cause the rotor to rotate. The turbine wheel is mounted on the main shaft, with special high precision, low friction ball bearings. The turbine wheel has helical blades that have a known angle relative to the gas flow. The conditioned and accelerated gas drives the turbine wheel with an angular velocity that is proportional with the gas velocity.

The rotating turbine wheel drives the index head with the eight digit mechanical counter via shafts and gears.

The volume and flow rate can also be indicated electronically. A proximity probe generates a signal at each passing blade of the turbine wheel. With the device-specific K-factor and the number of pulses the passed volume can be calculated. With the measured frequency the flow rate can be determined.

Sizes, Flow Rate and Flanges

The available nominal diameter of the IGTM gas turbine meter ranges from 50 mm (2") to 400 mm (16"). Other sizes are available on request.

The IGTM can be delivered with G rates ranging from G40 to G4000, which means that IGTMs are available for flow rates from 10 m³/h to 10 000 m³/h.
The relationship between G value and flow rate for each diameter is shown in table 3 on the last page of this brochure.

Carbon steel or stainless steel IGTMs can be manufactured either with ANSI flanges or with DIN flanges in the ranges:
ANSI 150RF - ANSI 600RF
PN 10 - PN 100

Ductile Iron (EN-GJS-400-18-LT; GGG 40) meter bodies are available in diameters from 50 mm (2") to 200 mm (8") and pressure class PN10 - PN16 and ANSI 125RF - ANSI 150RF.

Accuracy

Standard accuracy limits for CT-models are in accordance with the EC directives and many foreign regulations:

± 1% for 0.2 Q_{max} to Q_{max}
± 2% for Q_{min} to 0.2 Q_{max}

As an option for the CT model the accuracy limits can be improved to:

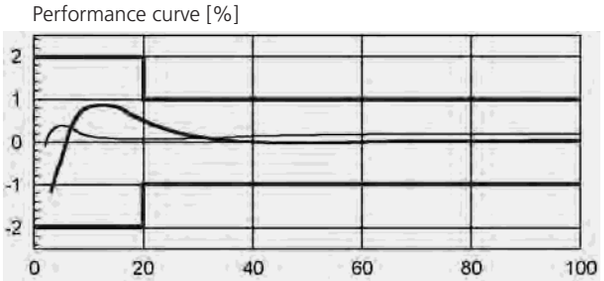
± 0.5% for 0.2 Q_{max} to Q_{max}
± 1% for Q_{min} to 0.2 Q_{max}

These limits are valid for the meter performance in ambient air. Usually, the performance is better at high-pressure applications.

On request we can offer meters according to your accuracy specification.

The repeatability of the ***vemm tec*** IGTM is better than 0.1%

Typical performance curves at different pressures are shown in picture 1.



Picture 1

Approvals

The IGTM is specifically designed in accordance with all relevant and published standards, like EC directives, EN 12261, AGA 7, ISO 9951, OIML R6, R32, and R137-1. Many national standards and laws are based on the above.

The IGTM-CT meter is approved for custody transfer in all EC (European Community) countries. Metrological approvals are also obtained in Brazil, Bulgaria, Hungary, Czech Republic, Romania, Algeria, Malaysia and China, others are in process.

Initial Verification and Calibration

Manufacturing is in compliance with the relevant European requirements.
Gas flow meters for custody transfer purposes usually should have an initial verification (legal calibration). This initial verification can be performed at the test installation at our factory, approved by German Weights and Measures (GN 5). This will result in a Verification Certificate, recognised by most Metrological Institutes.

Non-custody transfer meters can also be calibrated at our test installation. A Certificate of Conformity will be provided.

In both cases (initial verification or factory calibration) a certificate with the measured values can be issued.

On request we can also take care of a high-pressure calibration, performed at a certified installation.

Rangeability

The rangeability of gas turbine meters is laid down in the EC guidelines. The standard range of an IGTM DN 80 (3“) or larger is 1:20 (Q_{min}:Q_{max}). This range is the standard performance in ambient air conditions.

With small sizes (≤ DN80 or 3”), special designs or with low relative density gases (<0.6) the range may be restricted.

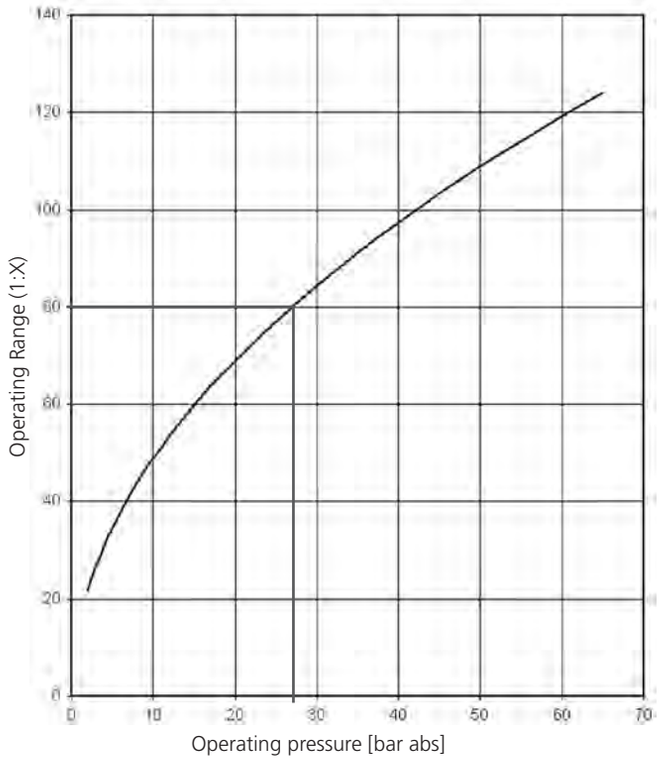
Meters with improved ranges of max. 1:50 are available. Please enquire.

At a higher pressure, the density of the gas increases and with an increasing density the available driving force at the turbine wheel increases. The larger force relatively decreases the influence of the bearing resistance and so decreases the minimum required flow Q_{min}. Because of this, the actual linear operating range increases. Using the following formula a new $Q_{min, m}$ can be calculated. The new range of the meter is between the new $Q_{min, m}$ and the unchanged Q_{max}.

Picture 2 shows this relationship.

$$Q_{min,\,m} = Q_{min}\sqrt{\frac{\rho_{air,\,b}}{\rho_b}\cdot\frac{p_b}{p_m}}$$

$Q_{min,\,m}$ = Min. flow rate at actual pressure [m³/h]
Q_{min} = Min. flow rate as specified (table 3) [m³/h]
$\rho_{air,\,b}$ = Density of air at standard conditions [1.293 kg/m³]
ρ_b = Gas density at standard conditions (table 1) [kg/m³]
p_b = Atmospheric pressure [1.013 bar]
p_m = Actual pressure at operating conditions [bar abs]



Picture 2

Example: At 28 bar the operating range improved from 1:20 to 1:80

Overload

The IGTM is designed to deal with over-ranging of at least 20% of Q_{max}. Any over-ranging must occur slowly and without pulsations.

Temperature Ranges

As standard the IGTM is designed to operate at temperatures between -10°C to 60°C. Special low and high temperature designs are available on request.

Pressure Loss

The pressure loss at actual flow and pressure can be calculated using the values from the table and the following formula. The pressure loss in ambient air is an important design parameter of the IGTM. The pressure loss is minimized as a result of the design of the internal flow conditioner and the shape of the channels upstream and downstream of the turbine wheel.

$$\Delta p_m \approx \Delta p_{air,\,r} \cdot\frac{\rho_m}{\rho_{air,\,b}}\cdot\left(\frac{Q_m}{Q_{max}}\right)^2$$

Δp_m = Pressure loss at flowing conditions [mbar]
$\Delta p_{air,\,r}$ = Pressure loss with ambient air [mbar]
ρ_m = Actual density at operating conditions [kg/m³]
$\rho_{air,\,b}$ = Density of air at standard conditions [1.293 kg/m³]
Q_m = Actual flow rate [m³/h]
Q_{max} = Maximum flow rate of meter (table 3) [m³/h]

Gas Types

The IGTM in its standard design can be used for all non-aggressive gases, such as natural gas, methane, propane, butane, city gas and fabricated gas, air, nitrogen, etc.

For aggressive gases, like sour gas, biogas and oxygen, special designs are available with Teflon coating, special lubrication or special purging. See table 1, for detailed requirements for different type of gases.

Material of Construction

The materials of construction are listed in the table below.

Part	Material
Housing	Ductile Iron (EN-GJS-400-18-LT)
	Carbon Steel (Cast or Welded)
	Stainless Steel (on request)
Straightening Vane	Aluminium
Turbine Wheel	Aluminium
Metering Insert	Aluminium
Bearing Block	Aluminium
Bearings	Stainless Steel
Shafts	Stainless Steel
Gears	Stainless Steel or Synthetic Material
Magnetic Coupling	Stainless Steel
Index Head	Aluminium

Index Head

The standard index head can be equipped with the following options:

- Tropical version with ventilation
- IP 67 with silica gel
- High gas temperature version
- Special coating for aggressive environments.

The index head can be turned through 350° without violating the lead seal. An 8-digit non-resettable display shows the totalized volume. During the initial verification and calibration test the ratio of the adjustment gears is checked and (if necessary) adjusted.

Dependent on meter size one revolution of the last right hand wheel of the rolls of the index head can represent 0.1, 1 or 10 m^3. As standard, the index head is equipped with one low frequency Reed (contact closure) switch (1R1) that gives one pulse at one revolution of the last wheel of the counter.

As an option a Reed switch (1R10) can be provided that gives 10 pulses per one revolution of the last wheel of the counter. Every Reed switch is connected in series with a 100.0 Ohm resistance. A maximum of two Reed switches can be provided per meter.

In the index head also one high frequency sensor (HF3) is provided as standard. This proximity sensor provides a middle-high frequency signal generated by a rotating impulse-disk. The signal is intrinsically safe in accordance with the NAMUR (EN 50227) standard for intrinsically safe signals. A second (similar) sensor (HF4) can be installed in the index head as an option.

By installing optional HF sensors in the meter body, it is possible to sense each passing blade of the turbine wheel (HF1) and/or of the reference wheel (HF2). The detection is based on special proximity switches. The signal is intrinsically safe in accordance with NAMUR (EN 50227). The interface barriers between hazardous area and safe area must be suitable for the application and are available on request.

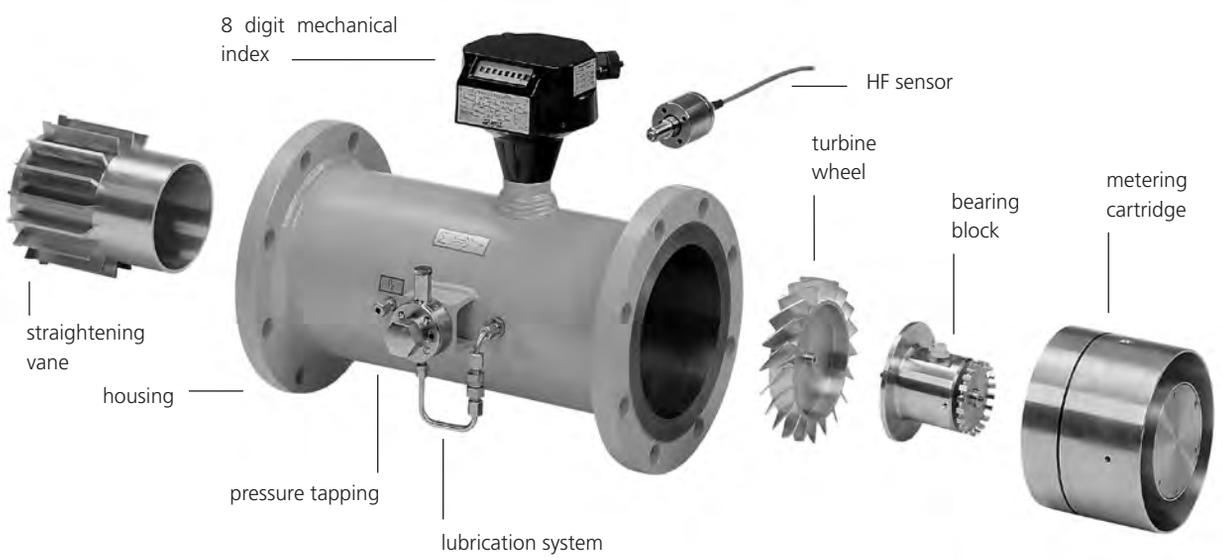
The ***vemm tec*** IGTM can be equipped with HF1/HF2 sensors only, without an index head. This option requires an electronic counter, a flow converter or a flow computer, to indicate actual and converted volume. For custody transfer purposes however, the index head is often a mandatory requirement.

The following options can be offered for pulse outputs.

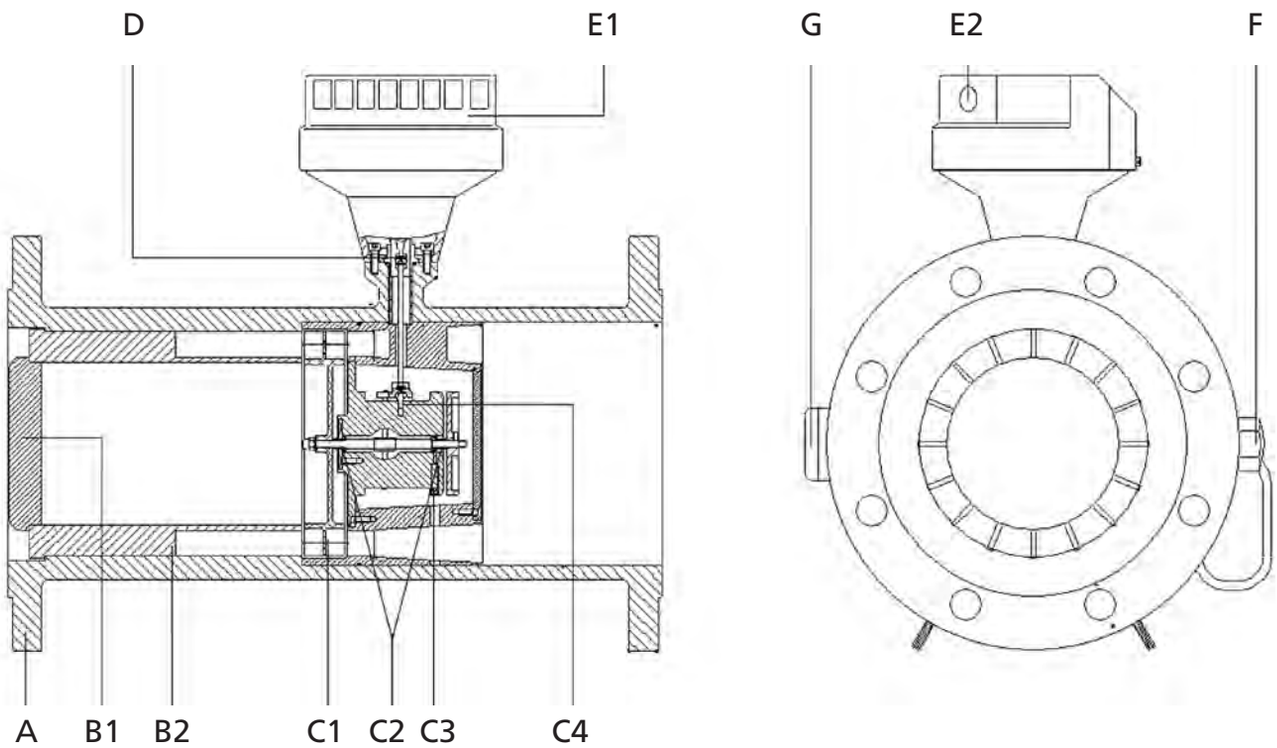
Code	Description	Max. frequency *	Remarks
1R1, 2R1	Reed switch	< 1 Hz	1R1 standard, 2R1 optional **
1R10, 2R10	Reed switch, freq. x 10	< 10 Hz	1R10 and/or 2R10 optional **
HF3, HF4	HF NAMUR sensor (in the index head)	< 200 Hz	HF3 standard, HF4 Optional
HF1	HF NAMUR sensor (at the turbine wheel)	< 4.5 kHz	Optional
HF2	HF NAMUR sensor (at the reference wheel)	< 4.5 kHz (equal to HF1)	Optional (only for IGTM-CT sizes 100mm (4") and up)

*) Maximum pulse frequency depends on meter size: please refer to table 3

**) A maximum of 2 reed switches can be supplied per meter



IGTM Gas Turbine Meter



A Pressure containing meter housing with end-flanges
B Flow deflector (straightening vane)
  B1 Central cone
  B2 Guiding vanes
C Metering insert cartridge with turbine wheel
  C1 Turbine wheel
  C2 Precision Bearings
  C3 Bearing block
  C4 Internal gears, shafts and axis
D Magnetic coupling (gas tight sealed)
E Index head with nameplates
  E1 Mechanical counter
  E2 Connector for Pulse transmitters [1R1; HF3 + options]
F Oil Pump
G High Frequency pulse transmitters [HF1; HF2]

Lubrication System

Each IGTM is standard equipped with a lubrication system. The oil pump is dimensioned according to the size of the meter.

To achieve the long life of the IGTM, regular lubrication is required. Typically, for clean gas applications, a 3-month interval between two lubrication services is recommended. Dirty gas requires a more frequent lubrication.

As an option the IGTM can be provided with lifetime lubricated bearings.

Surface Treatment and Painting

Before applying a corrosion-protective layer, each ductile iron IGTM meter body is shot blasted SA 2.5. Carbon steel bodies are mechanically treated. The standard color of the meter body is white (RAL 9001). Stainless steel bodies are supplied without coating. The color of the index head is black.

Alternative surface treatments like other colors, special coatings or zinc treatments are possible on request. These special treatments can improve the protection against corrosion.

Material and Safety Tests

All IGTMs are statically tested in accordance with the appropriate standards and customer requirements
- Hydro test at 1.5 x maximum operating pressure
- Air seal test at 1.1 x maximum operating pressure
- Material certificate per EN 10204 3.1.B
- CE-PED compliance: Directive 97/23/EN

A certification package can be ordered as an option.
Other tests like MID, TÜV certification, NDT and US testing and others are available on request.

Documentation

The IGTM gas turbine meter comes with an installation, operation and maintenance manual. An installation card is attached to each meter. We recommend that this card stays with the meter. Calibration certificates and material certificates can be provided as an option.
Depending on the order and the meter chosen, the optionally ordered certification package contains:
- 3.1 certificate with declaration of conformity
- Material certificates for pressure containing parts
- Welding test certificates (when applicable)
- Pressure test certificate
- Calibration certificates (as ordered)
- EEx certificates of the HF pulse transmitters

Installation

Normally the meters are installed with some straight upstream pipe lenght. However, the IGTM is equipped with an internal flow conditioner that takes care that the meter meets the requirements of EN 12261 and OIML. This allows the meter to be installed with minimum 2D upstream piping. For optimal performance, however, ***vemm tec*** recommends that the upstream section is 5D or more.

Fittings like valves, filters, control valves, reducers, T-pieces, bends, safety shut off valves in the upstream section should be preferably 5D or more from the meter inlet. In these cases the application of an upstream flow conditioner might be considered. This could be a tube bundle straigtener, straightening vanes, or other designs.

The down stream section of the meter should preferably be 3D or longer. The temperature probe should be installed in this section. Optionally a temperature probe can be installed in the meter body.

The meter is equipped for horizontal installation as standard. Meters ≤150mm (6") diameter can also be operated vertically. If required, please indicate vertical use on your order.

The gas flow must be free from liquids, dust and particles. These can damage the delicate bearings and the rotor. Also when dust collects over time it has an adverse effect on the metering accuracy. Non-clean gases should be filtered with a 5-micron particle filter.

Pulsating gas flow and vibrations should be avoided.

The meter axis should be identical to the upstream piping axis. Gaskets immediately upstream of the meter should not protrude.

The meters are preferably installed inside. When installed outside, the meter must be protected from direct sunlight and rain for the best performance.

Additional Instrumentation

The indicated volume will often be converted to volume at base conditions. Parameters for these conversions might be:

• Pressure

A pressure tapping enables the measurement of the static pressure near the turbine wheel. The pressure measurement point P_r (pressure at metering conditions), designated P_m in the latest standards, is located on the meter housing and is marked. The bore is 3 mm and perpendicular to the wall. Connection with 6 mm stainless (standard) tubing or larger is recommended.

• Temperature

The temperature measurement should preferably be located within 3 D downstream of the meter. No pressure reducing parts should be located between the temperature device and the meter. The temperature should be measured within the center third of the pipe.
As an option, your IGTM can be equipped with an integrated thermo-well.

• Actual density

When an actual density meter is used, the requirements for the pressure and temperature should be followed for the location of the density meter. The P_r point is the source of the gas sample for a density meter that should be located 3-5 diameters downstream of the gas turbine meter.

No devices that can influence the pressure or the temperature of the gas should be installed between a gas meter and the applicable temperature sensor and/or density meter.

Flow Converters and Additional Equipment

Vemm tec can provide you with flow converting devices, ranging from a converter with only basic features, to a sophisticated computer with features such as curve correction, valve control, gas chromatograph read-out and other customer specified functions.

We can also provide you with the additional equipment such as IS-barriers, F/I-converters, transmitters, filters, straightening vanes and meter tubes.

We will be happy to send you any further information.

Systems

Vemm tec has many years of experience with metering skids such as provers or pressure reduction stations. At your request we will be happy to offer meter runs and integrated systems.

Ordering Information

In order to quickly process your enquiry, we need the following information for adequate pricing and sizing:

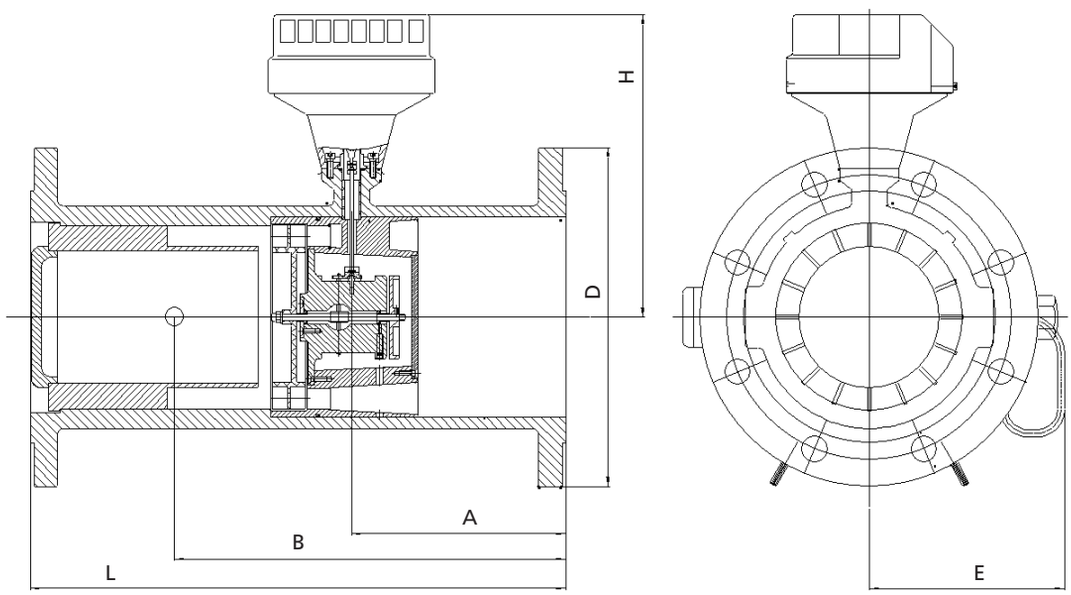
- Nominal pipe size in mm or inches for installing the meter
- Model: High accurate custody transfer type (CT) or industrial model (IM)
- Body material: Ductile iron, carbon steel or stainless steel
- Flow rate: Maximum, minimum (actual or standard cubic meter per hour, please specify); or G-size.
- Pressure: Maximum, minimum and normal operating pressure
- Temperature: Maximum, minimum and normal operating temperature
- Gas type, composition or analysis (if available)
- Relative density or base density (standard conditions)
- Flange connection, pressure rating and face type
- Output signals required (LF reed switch, HF at index head or HF at turbine wheel, dual pulse output)
- Installation conditions (Indoor-Outdoor, ambient conditions)
- Flow direction horizontal (left-right; right-left) or vertical (up-down; down-up)
- Optional services and additional equipment required (calibrations, barriers, flow correctors, filters, meter tubes)

Alternatively you can ask for our IGTM questionnaire.

Table 1
Gas types

Gas type	Symbol	Density @1.013 bar [kg/m³]	Meter housing	Notes
Acetylene	C_2H_2	1.17	Special	Aluminium parts Teflon coated
Air		1.29	Standard	
Ammonia	NH_3	0.77	Standard	O-Rings / Lubrication
Argon	Ar	1.78	Standard	
Biogas			Special	Special Internal
Butane	C_4H_{10}	2.70	Standard	
Carbon dioxide	CO_2	1.98	Standard	Except foodstuff industry
Carbon monoxide	CO	1.25	Standard	
City gas			Standard	
Ethane	C_2H_6	1.36	Standard	
Ethylene (gas phase)	C_2H_4	1.26	Standard	Special Internal
Flue gases			Special	O-Rings / Lubrication
Freon (gas phase)	CCl_2F_2	5.66	Standard	O-Rings / Lubrication
Helium	He	0.18	Standard	Special flow range
Hydrogen	H_2	0.09	Special	Special flow range
Hydrogen sulphur (0.2%)	H_2S	1.54	Special	Special Internal
Methane	CH_4	0.72	Standard	
Natural Gas		0.8	Standard	
Nitrogen	N_2	1.25	Standard	
Oxygen (pure)	O_2	1.43	Standard	Special Internal
Pentane	C_5H_{12}	3.46	Standard	
Propane	C_3H_8	2.02	Standard	
Propylene (gas phase)	C_3H_6	1.92	Standard	Special Internal
Sour gas			Special	O-Rings / Lubrication
Sulphur dioxide (0.2%)	SO_2	2.93	Special	Special Internal

Table 2.1
Dimensions and weights



DN [mm] [Inch]	Size G	A [mm] CT	A [mm] IM	B [mm] CT	B [mm] IM	E [mm] CT	E [mm] IM	D [mm]	Height H [mm] CT	Height H [mm] IM	Total length L [mm] CT	Total length L [mm] IM	Pressure class PN or ANSI	Body material	Weight [kg] CT	Weight [kg] IM
DN 50 (2")	40 or 65	62	62	70	70	102	102	165	215	215	150	150	PN 10/16	Ductile Iron	11	11
						127	127	165	200	200			PN 10/16	Steel	24	24
						127	127	165	200	200			PN 25/40	Steel	24	24
						127	127	180	205	205			PN 64	Steel	24	24
						140	140	195	215	215			PN 100	Steel	33	33
						102	102	152	215	215			ANSI 150	Ductile Iron	11	11
						127	127	152	200	200			ANSI 150	Steel	24	24
						127	127	165	200	200			ANSI 300	Steel	20	24
						127	127	165	200	200			ANSI 400	Steel	24	24
						127	127	165	200	200			ANSI 600	Steel	24	24
DN 80 (3")	100 or 160 or 250	92	42	108	56	120	115	200	205	230	240	120	PN 10/16	Ductile Iron	17	15
							145	200	192	220			PN 10/16	Steel	26	28
							145	200	192	220			PN 25/40	Steel	26	32
							150	215	192	225			PN 64	Steel	32	37
							155	230	192	230			PN 100	Steel	35	37
							150	191	205	230			ANSI 150	Ductile Iron	25	15
							145	191	192	215			ANSI 150	Steel	24	25
							150	210	192	220			ANSI 300	Steel	28	30
							150	210	192	220			ANSI 400	Steel	29	30
							150	210	192	220			ANSI 600	Steel	29	30
DN 100 (4")	160 or 250 or 400	120	50	154	75	135	135	220	230	245	300	150	PN 10/16	Ductile Iron	27	24
						140	160	220	215	230			PN 10/16	Steel	24	42
						140	165	235	215	235			PN 25/40	Steel	39	48
						140	170	250	215	240			PN 64	Steel	42	55
						140	180	265	215	250			PN 100	Steel	48	62
						135	135	229	230	235			ANSI 150	Ductile Iron	25	24
						140	165	229	215	235			ANSI 150	Steel	36	48
						140	170	254	215	240			ANSI 300	Steel	43	57
						140	170	254	215	240			ANSI 400	Steel	43	57
						140	180	273	215	255			ANSI 600	Steel	50	60

Table 2.2
Dimensions and weights

DN [mm] [Inch]	Size G	A [mm] CT	A [mm] IM	B [mm] CT	B [mm] IM	E [mm] CT	E [mm] IM	D [mm]	Height H [mm] CT	Height H [mm] IM	Total length L [mm] CT	Total length L [mm] IM	Pressure class PN or ANSI	Body material	Weight [kg] CT	Weight [kg] IM
DN 150 (6")	400 or 650 or 1000	182	56	218	85	198	235	285	255	275	450	175	PN 10/16	Ductile Iron	45	30
						215	230	285	250	260			PN 10/16	Steel	45	62
						215	240	300	250	270			PN 25/40	Steel	40	70
						215	250	345	250	290			PN 64	Steel	74	102
						215	250	355	250	290			PN 100	Steel	90	110
						198	235	279	255	275			ANSI 150	Ductile Iron	50	30
						215	225	279	250	260			ANSI 150	Steel	63	60
						215	240	318	250	275			ANSI 300	Steel	70	84
						215	240	318	250	275			ANSI 400	Steel	80	84
						215	255	356	250	290			ANSI 600	Steel	100	110
DN 200 (8")	650 or 1000 or 1600	240	69	278	160	250	255	340	270	290	600	200	PN 10	Ductile Iron	76	92
							255	340		290			PN 10	Steel	78	92
							255	340		290			PN 16	Ductile Iron	76	92
							255	340		290			PN 16	Steel	78	92
							265	360		298			PN 25	Steel	90	108
							275	375		308			PN 40	Steel	100	122
							285	415		320			PN 64	Steel	125	163
							290	430		330			PN 100	Steel	160	176
							255	343		290			ANSI 150	Ductile Iron	80	96
							255	343		290			ANSI 150	Steel	83	96
							275	381		308			ANSI 300	Steel	106	128
							275	381		308			ANSI 400	Steel	135	128
							285	419		320			ANSI 600	Steel	155	190
DN 250 (10")	1000 or 1600 or 2500	300	125	353	168	270	270	395	285	285	750	300	PN 10	Steel	110	70
								405					PN 16	Steel	110	72
								425					PN 25	Steel	110	90
								450					PN 40	Steel	130	108
								470					PN 64	Steel	155	140
								505					PN 100	Steel	220	205
								406					ANSI 150	Steel	110	72
								445					ANSI 300	Steel	150	110
								445					ANSI 400	Steel	170	122
								508					ANSI 600	Steel	240	210
DN 300 (12")	1600 or 2500 or 4000	360	130	358	130	315	315	445	320	320	900	320	PN 10	Steel	120	96
								460					PN 16	Steel	130	100
								485					PN 25	Steel	150	124
								515					PN 40	Steel	180	160
								530					PN 64	Steel	240	180
								585					PN100	Steel	345	280
								483					ANSI 150	Steel	160	160
								521					ANSI 300	Steel	210	212
								521					ANSI 400	Steel	240	235
								559					ANSI 600	Steel	290	300
DN 400 (16")	2500 or 4000 or 6500	480	150	480	150	350	350	565	355	355	1200	400	PN 10	Steel	355	225
								580					PN 16	Steel	380	250
								620					PN 25	Steel	415	285
								660					PN 40	Steel	455	325
								670					PN 64	Steel	500	370
								715					PN100	Steel	600	470
								597					ANSI 150	Steel	432	280
								648					ANSI 300	Steel	450	320
								648					ANSI 400	Steel	500	370
								686					ANSI 600	Steel	590	460

Gas - Measurement

Table 3
IGTM gas turbine meter: technical specifications

The indicated frequency values and k-factors of HF1/HF2 and HF3/HF4 are for information only. The final values will be mentioned at the meter´s nameplate and in the calibration certificate.

Nominal diameter [mm] [inch]	Size rating G	Q_{max} [m³/h]	Q_{min} (standard flow range) [m³/h]	Rotating speed turbine wheel @ Q_{max} [min-1]	Turbine wheel blade angle	Turbine wheel number of blades	Max. frequency HF1/HF2 approx. [Hz]	Max. frequency HF3/HF4 approx. [Hz]	Max. frequency 1R1 Reed [Hz]	k-factor HF1/HF2 approx. [Imp/m³]	k-factor HF3/HF4 approx. [Imp/m³]	k-factor 1R1 Reed [Imp/m³]
DN 50 (2")	G 40	65	13	8900	45	16	2800	80	0,18	155000	4400	10
	G 65	100	10	13700	45	16	4300	120	0,28	155000	4400	10
DN 80 (3")	G 100	160	16	6200	45	16	1900	50	0,04	42200	1200	1
	G 160	250	13	9600	45	16	2900	80	0,07	42200	1200	1
	G 250	400	20	8900	30	16	2600	70	0,11	23500	670	1
DN 100 (4")	G 160	250	13	4300	45	16	1200	60	0,07	17000	800	1
	G 250	400	20	6900	45	16	1900	90	0,11	17000	800	1
	G 400	650	32	6500	30	16	1700	80	0,18	9400	440	1
DN 150 (6")	G 400	650	32	3400	45	20	1100	70	0,18	6280	360	1
	G 650	1000	50	5200	45	20	1700	100	0,28	6280	360	1
	G 1000	1600	80	4800	30	20	1600	60	0,04	3570	135	0,1
DN 200 (8")	G 650	1000	50	2200	45	20	790	40	0,03	2840	150	0,1
	G 1000	1600	80	3500	45	20	1300	70	0,04	2840	150	0,1
	G 1600	2500	130	3100	30	20	1100	60	0,07	1510	80	0,1
DN 250 (10")	G 1000	1600	80	2000	45	24	830	60	0,04	1870	135	0,1
	G 1600	2500	130	3100	45	24	1300	90	0,07	1870	135	0,1
	G 2500	4000	200	2900	30	24	1200	90	0,11	1110	80	0,1
DN 300 (12")	G 1600	2500	130	1900	45	24	780	60	0,07	1120	80	0,1
	G 2500	4000	200	3000	45	24	1300	90	0,11	1120	80	0,1
	G 4000	6500	320	2800	30	24	1200	130	0,18	660	75	0,1
DN 400 (16")	G 2500	4000	200	1600	45	24	610	60	0,11	550	55	0,1
	G 4000	6500	320	2600	45	24	990	100	0,18	550	55	0,1
	G 6500	10000	500	2300	30	24	1300	130	0,28	470	50	0,1

vemm tec Messtechnik GmbH
Gartenstrasse 20
14482 Potsdam-Babelsberg
Germany
Tel. +49 (0) 3 31 / 70 96 274
Fax +49 (0) 3 31 / 70 96 270
E mail: info@vemmtec.com
Internet: http://www.vemmtec.com