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iMeter has agents and representatives worldwide. iMeter has a continuing program of product research and development. Technical specifications and construction may change due to improvements. This publication serves as general information only, and all specifications are subject to confirmation by iMeter.

B-iM-M3-1A-E



**Turbine Gas Meter Series iMTM-Q**

**FIT FOR PURPOSE,  
FIT FOR FUTURE BY INNOVATION**



### The Statement

*iMeter* continues to improve on gas metering and flow control equipment with innovative ideas, sophisticated technology and modular designs resulting in reduced purchase cost and a reduced cost-of-maintenance. This modular concept allows local manufacturing while maintaining legal metrology. *iMeter* encourages cross border joint production arrangements.

### Operating Principle

The operating principle is based on the measurement of the gas velocity. The flowing gas is accelerated and conditioned by the meter upstream straightening section. This straightening section conditions the gas flow by removing undesired swirl, turbulence and flow profile asymmetry, before it impinges on the turbine rotor. The dynamic forces of the fluid causes the turbine rotor to rotate. The turbine rotor is mounted on an axial shaft with high precision low friction stainless steel ball bearings.

The turbine rotor has helical blades and a known angle relative to the gas flow. The turbine rotor angular velocity is proportional with the gas velocity. The rotating movement of the turbine rotor and it's primary gear train, all fitted in a pressurized body, drive an externally fitted gear box. This 100% sealed gear box for the error adjustment. An exchangeable eight digit mechanical counter is fitted on top of the gear box. Standard LF pulse transmitters are fitted into the meter counter.

### Removable Meter Cartridge "RMC"

*iMeter* has developed a series of compact turbine gas meters, ranging from 2" up till 8" for pressures up till 16 bar. All meters are based on the same concept of the **Removable Meter Cartridge (RMC)** as used with the series iM-TM-CT. This unique feature enables the owner/operator to change the characteristics of the meter on-site. For each meter body, four types of RMC's are available to offer **maximum modular flexibility** in terms of minimum capacity, maximum capacity, pressure loss and G-rating.

If required, the cartridges can be pre-calibrated by certified test institutes, and thus upgrades in performance or functionality of the meters can be done easily and locally. The (re-)calibration of meters becomes a matter of hours, since cartridges can be exchanged on site with new pre-calibrated cartridges, reducing logistical efforts to a minimum and still keeping the quality and performance at the highest level. The weight of the **Removable Meter Cartridge** is clearly significantly lower than a complete meter, meaning that "courier" transportation of the cartridge can be done rapidly and safely without complex and time consuming packing and shipping arrangements.

The cartridge as well as the turbine wheel are machined from high quality aluminum to guarantee long term stability. Optional, the cartridge can be hard-coated (anodized) to overcome wear and corrosion of the flow channels caused by dirt and dust.

By the use of a special ring, to position the cartridge in the meter body, the cross-sectional area of the cartridge is significantly larger in comparison to conventional turbine meters.

This enables to manufacture these compact meters with an **extended maximum capacity (extended G-rating) another unique feature.** As, with most of the conventional meter manufacturers e.g. a 6" is available with typically a Qmax. of 1600 m<sup>3</sup>/h, the 6" *iMTM-Q* can handle a capacity of 2500 m<sup>3</sup>/h. The possibility to apply **one size (diameter) smaller** turbine meter will not only have a positive effect on the purchase price of the meter but will also allow to use smaller meter run piping, valves, etc. and thus will reduce the size of the metering station and its building significantly.

All the critical components, including the turbine rotor and primary gears, are housed in the cartridge (**RMC**), making the concept quite suitable for local production and assembly. Except for the **RMC**, the remaining parts like meter body, external gear box, index, etc. can be manufactured locally, if required, in accordance to local directives and quality standards. Since the high quality **RMC** is the actual measuring mechanism, and totally independent on the meter body tolerances, the end quality of a local produced and assembled turbine meter will still meet the highest quality requirements.

### Low Weight Aluminum Meter Body

To overcome damage of the main bearings caused by shock loads, it is always recommended to transport turbine meters with trucks having a dedicated air suspension. Preferably the meters must be transported by a luxury car, however this is rarely common practice, simply due to the weight of the conventional steel body meters. Thus a better alternative is to use light weight materials (aluminium) for the meter body, to enable a secure transportation by a luxury car. Aluminium is already used in many countries where care and quality of transportation is not controllable due to bad road conditions in remote areas. The aluminium bodies are, in terms of strength, equivalent to the iron GGG40 meter bodies and are being certified to be suitable for all classes up to ANSI 150 or DIN PN 16. The hard anodized coating will give the meter body a superior protection against corrosion.

### Optimized Bearing Construction Including Axial Load Compensation

When, during transportation, the meters are subjected to shock loads due to bad road conditions, the initial inflicted damage to the bearings will already have a measurement effect without notice. The shock load in combination with the weight of the turbine wheel will cause impacts between the tiny balls and the inner/outer ring of the ball bearing. This is the starting point of an excessive wear, resulting in increased friction and consequently a shift in accuracy. Eventually these bearings will collapse. The use of low weight plastic turbine wheels is not considered as a serious engineering solution, not even with these compact meters, since their performance in relation to accurate measurement is very poor. In addition, the impurities within the gas will degrade the plastic wheel and thus





than the rear bearing to overcome the axial load) is positioned exactly in the vertical centre line of the turbine wheel, meaning that the resulting forces on the tiny rear bearing are eliminated. This is another unique feature and major improvement.

The initial certification of the meter is carried out with atmospheric air with a density of about 1,2 kg/m<sup>3</sup>. To be able to achieve a rangeability of at least 1:20, the bearings must be very small in order to reduce the mechanical friction. As the forces on the turbine wheel and thus the axial load on the bearings are proportional to the density of the gas measured, the axial load on the bearings is significantly higher when the meter is operated at higher pressures (at 8 bar natural gas conditions the density is already 5 time higher which also applies to the axial load on the front bearing).

Consequently the bearings will be overloaded when running at high capacities unless constructional provisions are being made. The **iMTM-Q** series meters are compensated for this density related additional axial load. This so called Axial Load Compensation (**ALC**) will compensate for the density related axial load on the turbine wheel by causing a slightly over pressure down stream the turbine wheel. This overpressure will push the wheel backwards against the direction of the gas flow and thus restricting the axial load acting on the main front bearing. Unfortunately this **ALC** could make the meter increasingly more sensitive for dirty gas, since dirt tends to accumulate in the area where the pressure is increased (near the front bearing). To solve this problem, iMeter has positioned the bearings, gears and shafts upstream the turbine wheel, meaning that the **ALC** works well eliminating the damaging effect of dirty gas on the condition of the bearings.

#### Dirt Protection And Full Flushing Oil System

Turbine meters, being equipped with commercially called "lubricated for life" bearings are not recommended at all – except in case of vertical installation – since dust within the gas will slowly accumulate over time and degrade the performance of the bearing and thus the accuracy of the meter. As clearly stated within the German Law, meters without lubrication must be re-calibrated at least once per 8 years, while meters fitted with lubrication require re-calibration only once per 12 years. Even with relatively clean gas as available in Germany, this limitation has shown to make sense. As a consequence of the global energy trade, and thus the expanding infra structure of the global pipe line network (with supplies from remote areas), the quality of the gas is changing rapidly and getting worse. For applications where the gas is not absolutely clean, conventional oil systems injecting oil into the bearings by means of an oil pump, are not sufficient enough. These conventional oil systems ensure only the "refreshment" of the oil but they will not flush the dirt/dust out of the bearings. For more severe conditions, the bearings have to be flushed too. Oil systems that not only refresh the oil but also flush the bearings and wet the rotating parts (gears and shafts) are widely used in all kind of applications (cars, compressors, etc.). As such the **iMTM-Q** series meters are equipped with a refreshing and flushing oil system whereby the oil is pumped into a reservoir in the bearing block (in which all the

bearings, shafts and gears are housed). A splash vane running at high speed (speed of the main shaft) "splashes" the oil through the bearing block, flushing, cleaning and wetting all the parts and surfaces. Tests with similar oil systems implemented on rotary meters, show a significant improvement of the meter's life time.

To improve the resistance against dirty gas even further, the **iMTM-Q** series meters have it's bearings mounted deep inside the bearing block only accessible through a labyrinth. This means that it is basically impossible for dirt particles to get into the bearings.

#### One Twist And A Click Multi Functional Coupling

To eliminate restrictions to future upgrades both the **iMeter** turbine meters and **iMeter** rotary meters are equipped with a **hybrid magnetic coupling**. Using a special designed magnet inside the meter, the reading of the meter can be changed from "mechanical" (magnet is used to drive the follower magnet of the mechanical index) to "electronic" (magnetic field orientation is used to activate pulse wires for detecting the rotation, direction and position of the turbine wheel). The index and its functions can be exchanged with just "one twist and a click". This means that the most basic meter

version is already prepared for upgrades to a fully sophisticated electronic meter including conversion (PTZ) and communication features (GSM, ISDN, PSTN, Ethernet, etc.).

From a standardization point of view, the couplings of the **iMeter Series** turbine meters and the rotary meters are similar, meaning that all the mechanical and electrical features are also similar, thus reducing inventory and increasing modular flexibility to its fullest extent.

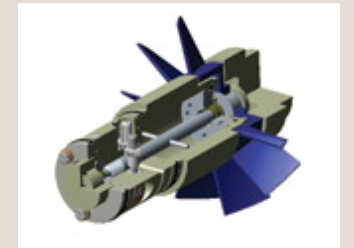
#### HF Sensor Combined With Isolated Thermowell

Optional, the **iMTM-Q** meters can be fitted with a High Frequency sensor. This sensor can also be fitted to the meter at a later stage, without removing the meter or the cartridge from the installation. The sensor is designed and approved in accordance with ATEX, FM and CSA. The generated output signal complies with EN 60947-5-6 / NAMUR. The unique housing of this High Frequency sensor is also suitable to be fitted with a thermo well to provide accurate temperature measurement. Since this thermo well is isolated from the meter body by means of O-rings, the traditional offset in temperature reading is eliminated.

#### The Advantages iMTM-Q

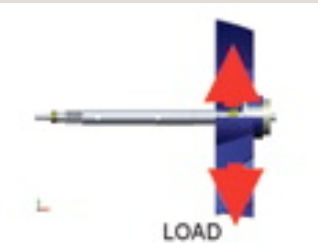
The advantages of the **iMTM-Q** are obvious:

- Reduced cost of production, resulting in a reduced product price.
- Reduced cost in station design allowing future customer increase in gas-demand with a simple **RMC** upgrade in G-rating within the same meter body and thus avoiding the expensive and complicated size increase of the meter runs using conventional turbine meters.
- Easy "on-site" maintenance by replacing the **RMC** with a freshly pre-calibrated new **RMC** of the same G-rating or alternative G-rating.
- Reduced cost of repair by removing and returning-for-overhaul,



#### Multi Stage Flow Conditioner

To guarantee superior meter accuracy even in non-ideal metering installations, the **iMeter** turbine wheel is positioned at the very rear end of the cartridge. This creates twice the length for straightening the incoming flow profile compared to the conventional compact turbine meters. Where conventional compact turbine meters do have just one (1) active stages of straightening, the **iMTM-Q** has three (3) straightening stages, despite its compact overall length.





#### Multi Functional Index

The standard index is an 8 digit mechanical index. The index is 100% sealed to avoid moisture condensates within the index. This 100% secure sealing will keep the index glass clean inside and will prevent the index for locking up due to frozen condensate or moisture during winter times. The index can be rotated 350 degrees.

The mechanical index contains a pocket that can hold different types of LF pick-ups such as reed switches, Wiegand sensors or fraud detection devices to generate maximum flexibility. This ability to change sensors quickly and easily, gives the meter maximum flexibility.



the RMC only, doing away with the long and thus unacceptable lead times for conventional meter repair and overhaul.

- Increased life time by using an oil system that just not only refreshes the oil in the bearings and lubricates all moving parts, but really flushes out all the dirt and dust.
- Reduced sensitivity to severe gas conditions by improved protection of the main bearings against dirt and dust.
- **Suitable for local manufacturing, assembly and production according to local directives and quality levels while still maintaining the highest reliability, performance and accuracy.**

#### Technical Data

##### Applications:

Medium: natural gas and other non-corrosive fuel and feedstock gases such as butane and propane, air, oxygen, nitrogen, carbon dioxide, hydrogen.

Industry: Gas supply, heating manufacturers, chemical industry.

##### Pressure ratings:

- Pressure ratings for PN10/16 and ANSI 150.
- Various flanges are available on request. (DIN Flanges, ANSI Flanges, JIS Flanges and others)

##### Nominal diameters:

50 mm (2") to 200 mm (8"). Larger sizes on request.

##### Measuring range:

20 : 1 minimum or better at atmospheric conditions up to 50 : 1 at higher densities.

##### Flow rates:

8 m<sup>3</sup>/h up to 4000 m<sup>3</sup>/h

**Repeatability:** better than 0,1 %

##### Measuring accuracy:

0,2 Q<sub>max</sub> to Q<sub>max</sub>: ± 1,5 % or better

Q<sub>min</sub> to 0,2Q<sub>max</sub>: ± 3 % or better

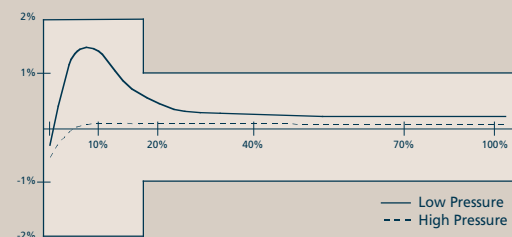
##### Temperature range:

Standard : -25°C to + 60°C

On request : -40°C to + 80°C

##### Typical Calibration Curve

The iMTM-Q turbine meters are all fitted with precise machined aluminum turbine wheels to provide the necessary stability to guarantee the accuracy over the entire pressure range.



#### Installation

Recommendations for installation:

The integrated multi stage flow straightener of the iMTM-Q turbine meter eliminates effects of flow disturbances, so called perturbations as defined in the ISO 9951 and consequently complies with the European and major International Directives and guidelines such as the OIML, ISO and DVGW. The design permits very compact M/R stations without sacrificing the meter's accuracy.

Gas pipes must be clean and free from foreign impurities such as sand, dirt, welding debris and other particles as well as liquid. In case of dirty gases, it is recommended to fit the meter with a automatic lubrication system and or a purge system.

With the new developed lubrication system it is possible to allow a relatively dirty gas flowing through the meter internal. In case of dirty gas, the lubrication system must be operated at an increased frequency to eliminate the effect of dirty gas on the meter bearings.

Although the axial compensation protects for sudden flow variations, it is recommended to pressurize the meter slowly to prevent over-speeding and consequently damaging the meter internal.

#### Calibration

iMeter series iMTM-Q or the RMC's are each supplied complete with a calibration certificate. The initial verification and the calibration are done at the iMeter factory on an NMI and/or PTB approved calibration bench. When a "pre-calibrated meter internal only" is supplied, the final verification and calibration will be done at the premises of the local assembly company, using a similar approved calibration bench.

High pressure calibrations at certified installations can be done as well, on customer's request.

#### Meter Data

Pipe Size mm (inch)	G-Rating	Measurement Range (m <sup>3</sup> /h) Q <sub>min</sub> -Q <sub>max</sub>	High Frequency (Hz)	2 x Low Frequency (Pulse/m <sup>3</sup> )	Overall Length (mm)	Pressure Rating	Body Material
50 (2")	G40	13-65	200-400	10	150	ANSI 150 DIN PN 10/16	Aluminium Carbon Steel
	G65	10-100		10			
	G100	13-160		1			
80 (3")	G100	16-160	200-300	1	120	ANSI 150 DIN PN 10/16	Aluminium Carbon Steel
	G160	25-250		1			
	G250	20-400		1			
	G400	32-650		1			
100 (4")	G160	25-250	200-300	1	150	ANSI 150 DIN PN 10/16	Aluminium Carbon Steel
	G250	20-400		1			
	G400	32-650		1			
	G650	50-1000		1			
150 (6")	G400	32-650	100-200	1	175	ANSI 150 DIN PN 10/16	Aluminium Carbon Steel
	G650	50-1000		0.1			
	G1000	80-1600		0.1			
	G1600	130-2500		0.1			
200 (8")	G650	50-1000	75-150	0.1	200	ANSI 150 DIN PN 10/16	Aluminium Carbon Steel
	G1000	80-1600		0.1			
	G1600	130-2500		0.1			
	G2500	200-4000		0.1			