

Turbine Meters TRZ 03 and TRZ 03-K



TRZ 03



TRZ 03-K

OPERATING INSTRUCTIONS

Reliable Measurement of Gas



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Manufacturer Our customer service is available for technical queries

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Note Unfortunately, paper is not updated automatically, whereas technical development continuously advances. Therefore, we reserve the right to make technical changes regarding the representations and specifications of these operating instructions. The latest version of this manual (and other devices) can be downloaded at your convenience from our Internet homepage

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1. Introduction

1.1 Objective of the manual

The manual provides you with the information that is designed for trouble-free and safe operation.

The TRZ03 is state of the art and conceived and manufactured according to the recognized safety standards and guidelines. However, risks may arise during use that can be easily avoided by observing this manual. For this reason, you may only use the device as intended and in technically sound condition.



Warning

If the TRZ gas meter is not used for its intended purpose, warranty claims will be void.

1.1.1 Abbreviations

The following abbreviations are used:

ca.	cirka, approximately
as app.	as applicable
max.	maximum
MID	Measurement Instruments Directive
PED (DGRL)	Pressure Equipment Directive (Druckgeräterichtlinie)
min.	minimum

1.1.2 Symbols

The following symbols are used:

1, 2, ...	Marks steps within a work operation
..	

1.1.3 Layout of instructions

The following instructions are used:

Danger

This warning instruction informs you of potentially hazardous situations that can occur because of incorrect operation or human error. If these situations are not avoided, they can lead to fatal or severest injuries

Warning

This warning instruction informs you of possible hazardous situations that can occur because of incorrect operation or human error. If these situations are not avoided, they can lead to fatal or severe injuries.

Caution

This warning instruction informs you of possible hazardous situations that can occur because of incorrect operation or human error. If these situations are not avoided, they can lead to slight or minor injuries.

Notice

This warning instruction informs you of potentially hazardous situations that can occur because of incorrect operation or human error. If these situations are not avoided, they can result in material damage to the device or the vicinity.

This notice may also give to you tips on how to simplify your work. With this screen, you additionally receive further information on the device or the work process.

1.1.4 Using the turbine meter TRZ03

1.1.4.1 Safety instructions

Danger

Observe the following safety instructions!

Non-observance of these safety instructions can lead to a risk of life and limb and health of the person as well as damage to the environment or property damage.

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Note that the safety instructions in this operating instruction and on the device cannot cover all possible hazardous situations as the combination of different circumstances is impossible to predict. To simply follow the instructions specified may not normally be sufficient enough to ensure for correct operation. Always be observant and also consider the following:

- Before working with the device for the first time, read through this operating instruction and, in particular, follow the safety instructions carefully.
- The operating instruction warns against the residual risks for users, third parties, devices or other material assets. The safety instructions used refer to residual risks that cannot be avoided due to the design.
- Operate the device only in a sound state and when observing the operating instruction.
- Also observe the local legal accident prevention, installation and assembly guidelines.

Notice

Always keep the operating instructions within reach for use at the place of installation.

For safe operation, the safety instructions must be observed and followed.

The manufacturer is not responsible for any damage that result as a consequence of not observing the operating instruction.

⚠ Danger

Service and maintenance work or repairs that are not described in the operating instruction must not be carried out without previous consultation with the manufacturer.

Changes to the device are forbidden.

For safe operation, the technical specifications must be observed and followed. Performance limits must not be exceeded (*chapter 6 Specifications*).

For a safe operation, the device must only be used in the scope of its intended use.

Only use the listed set screws, bolts, nuts and gaskets or parts with similar characteristics for the installation of the meter in the pipeline (*chapter 1.14 Installing the device in the pipeline*) The device should only be used under the intended use for safe operation (*chapter 1.3 Overview, Function and Application*).

1.1.4.2 Hazards during commissioning

Initial start up

Initial start-up must only be carried out by especially trained personal (training by RMG) or by service personal from RMG.

Notice

After the initial start-up an inspection report shall be drawn up. This, the operation manual and CE declaration of conformity must always be accessible.

As far as possible all the sharp edges have been eliminated on the device. Nevertheless, when working on the personal protective equipment must be used, which must provide the operator.

Danger

Install the device TRZ03 in accordance with operating instructions. If the TRZ03 is not installed according to the manual, there is possibly an insufficient explosion protection.

The explosion protection expires!

Please take care during the installation to the flow direction marked on the housing by an arrow.

When staff carry out work without sufficient qualification, risks remain understated when working. Explosion or fire may happen. Perform the work only if you have the appropriate qualifications and you are an expert.

If you do not use the appropriate tools and materials, components may be damaged. Use tools that are recommended to you for the job in the operating instructions.

Mechanical installation

Mechanical installation must only be carried out by the respectively qualified specialist personnel.

Electrical installation

Installation on components must only be carried out by qualified electricians.

Mechanical and/or electrical installation

The specialist personnel require a training especially for working in potentially explosive environment. Specialist personnel are persons that can verify a training / further education according to **DIN VDE 0105, IEC 364** or a **similar national standard**.

Danger

The installation and removal of the TRZ03 or to the TRZ03 connected convertor may only be carried out in an explosion-free, de-pressurized atmosphere. It is important to pay attention to the descriptions of the operation manual during the installation process.

It is generally recommended to ask the RMG Service for any installation or removal.

After working on pressurized components, a control of leaks must be carried out.

All points above have to be considered for any repair and maintenance and in general, when an opening of the meter (convertor) is required.

Parts to lock the flanges, locking screws, fittings and check valves, oil supply and the pressure tap fittings, valves, HF pulse device, protecting pipe and rotating adapter may not be opened during operation.

1.1.4.3 Danger when using, servicing and maintaining

Operating personnel	The operating personnel are to use and operate the device within the scope of the intended purpose.
Maintenance personnel	Work on the device must only be carried out by specialist personnel that can carry out the respective work assigned to them as a result of their training, knowledge and experience as well as the applicable regulations. These specialist personnel are familiar with the legal guidelines for accident prevention and can evaluate and avoid possible risks by themselves.
Maintaining and cleaning	Maintenance and cleaning must only be carried out by the respectively qualified specialist personnel.

Danger

If staff carry out work without sufficient qualification, risks may be underestimated when working. Explosion or fire may happen. If work is carried out in hazardous areas on voltage supporting equipment, resulting sparks may cause an explosion.

Danger

If the unit is not cleaned in accordance with the operating instructions, the device may be damaged. Clean the unit only in accordance with the operating instructions.

When not using appropriate tools, components can be damaged. The explosion protection expires.

- Clean with a damp cloth!

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Danger

The TRZ 03 may only be used as intended!
(*chapter 1.3 Overview, Function and Application*).

Avoid any use of the TRZ03 as possible climbing aid or attachments of TRZ03 as possible handholds!

1.1.4.4 Specialized knowledge required

Notice

Persons working with or on the device must have the following knowledge:

- Training / education for working in potentially explosive environments.
- The ability to correctly assess dangers and risks when using the device.
- Possible dangers are, e.g., components under pressure or the result of incorrect installation.
- Recognize dangers that could be caused by the used flow medium.
- Training / education by RMG for working with gas measuring instruments.
- Education / instruction in all country-specific standards and directives to be observed for work that is to be carried out on the device.

1.1.5 Risk assessment and mitigation

The TRZ03 subjects to risks in its use, which were judged by qualified staff of the company RMG. Risks may arise due to high pressures, more rarely by too low. Even work outside the permissible temperature range can lead to danger. Invalid current and voltage values can trigger explosions in hazardous areas.

The risk assessment assumes that when installing or removing a turbine a draining and venting of the pipeline takes place. Thus, and only then no explosive gas mixture is in the pipeline.

Of course (*chapter 1.1.4.4 Specialized knowledge required*) only work by trained personnel are permitted, which is also trained to know proper tools and use only this.

These risks have been considered during the development phase and action were taken to minimize these risks.

Risk mitigation measures:

- All pressurized parts are designed in accordance to AD 2000 regulations, PED Annex 1
- The complete design being pressurized is verified by the TÜV Hessen
- All pressurized parts are made with material certificate; there is a traceability to the batch tracking of all pressurized parts
- The mechanical properties of all relevant pressurized components are checked by tensile testing, impact testing and hardness testing
- In addition, non-destructive testing was applied: X-ray and ultrasonic testing of the meter housing for defects in material, surface crack detection by magnetic particle and dye-penetration
- With pressure tests 1.5 times of the intended operating pressure the strength of the components were verified; leak test were carried out at 1.1 times of the intended operating pressure. Successful tests were marked
- The maximum operating pressure is stated on the nameplate of the device, as well as the temperature range. Operation of the device is only permitted within the indicated ranges.

⚠ Danger

For any work in an explosive atmosphere (all areas):

- The pulse output of the turbine meter has to be connected to intrinsically safe circuits, only.
- For maintenance and repair work only tool must be used, which is approved for Ex zone. 1
- Otherwise, work must be carried out only if there is no explosive atmosphere.
- Danger of ignition caused by impact or friction must be avoided.
- In hazardous areas, the wiring / installation must be performed by trained personnel in accordance to EN 60079-14 and according to national regulations
- Skilled persons are in accordance to DIN VDE 0105 or IEC 364, or comparable standards
- Use only trained and qualified personnel. Work on the measuring system may only be carried out by qualified personnel and must be checked by a specialist supervisor.
- Qualified persons are able to carry out such work. Qualification is valid due to their training, experience or through instruction and their knowledge of relevant standards, regulations, accident prevention regulations and plant conditions for the safety of people. It is essential that these people are able to recognize and avoid possible dangers.

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1.1.6 Validity of the manual

This manual describes the turbine meter TRZ03. The TRZ03 is only a part of a complete on-site system. Observe also the instructions of other components of the site system. If you find contradicting instructions, please contact RMG.

Notice

Make sure that the performance of the power connector corresponds to the data on the nameplate. Additionally, observe any existing national regulations in the country. Use cable suitable for the cable glands.

Danger

Perform the work only if you have the appropriate qualifications and you are a trained specialist.

1.1.6.1 Hazards during Operation

Please take care of the information provided by the plant manufacturer and/or plant manager.

1.1.6.2 Danger during operation in hazardous areas

Operate the device in perfect and complete condition.

When you perform technical modifications to the instrument, a safe operation can no longer be guaranteed.

Danger

Use the device only in the original condition. The TRZ003 may be operated in explosion zone 1, but only within the permitted temperatures (*chapter 1.10 Temperature ranges*).

1.1.6.3 Operator responsibility

Take care as plant manager that only sufficiently skilled personnel will work on the device. Ensure that all employees who handle the equipment have read and understood these instructions. Additionally, you are obliged to train staff on a regular basis and to inform them about any dangers. Ensure that any work carried out on the device is done by qualified personnel and checked by responsible specialists. You must establish clearly the responsibilities for installation, operation, troubleshooting, maintenance and cleaning.

Point out to your staff any risks involved when using the device.

1.1.7 Transportation

The device is packaged customized according to the transport requirements.



Warning

Risk of injury during transport

Any foot screws must be fitted, if they are used as transit protection against rolling and tipping. Take additional care that a rolling and tilting is safely prevented.

To lift the meter only the special lifting eyes / eye bolts may be used. Pay attention to the maximal loads for the lifting devices (*chapter 6 Specifications*) – don't exceed those. Make sure that the load is fastened securely before lifting. Do not stand under lifted loads.

During lifting and/or depositing the device may slip, tip over or fall. Disregarding the maximum load capacity of the lifting device, the device may fall down. For any people standing nearby, there is a significant risk of serious injury.

If the unit is supplied on a Euro pallet, the unit can be transported using a lift truck or a forklift. During the transport the meter has to be protected against shock or vibration.

The meter or its additionally mounted spool pieces are equipped with flanges that are protected with a sticker foil or blind plugs made of plastic. These must be removed completely before installation in the pipeline. Remaining rests of these protections may change the flow pattern and may result in a measurement error! For any transport e.g. for recalibration we ask you to use these protections.

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1.1.8 Delivery

Supplied number of parts may differ depending on the optional customer order. "Usually" the following is included in the scope of delivery:

Teil	Quantity
Turbine meter TRZ 03	1
1 small bottle of oil for lubrication	1
Manual	1
Test report	1



Calibration certificate	1
Certificat for - Strength 3.1 and - tightness	
...	...

1.1.9 Dispose of packaging material

Dispose the packing material in an environmentally friendly way in accordance to the national standards.

1.1.10 Storage

Avoid long periods of storage. Check the device after any storage for damage and functionality. Ask for a check from the RMG service after a storage period for the device of over one year. In this case please send the device to RMG.

Notice

**For storage, a dry and protected space has to be provided.
It is important to ensure that all open pipe pieces must be sealed.**

1.2 Structure of the manual

The introduction of this manual contains two parts. In the first part general guidelines are listed; the symbols used and structure of advices are given, but the risk assessment is also issued. In addition, it contains guidelines for the transport and storage of the TRZ03. The second part introduces the operation of TRZ03; there are basic standards listed; pressure and temperature ranges are given limiting the use of the TRZ03.

The second chapter describes the use of TRZ03. It explains how a high accuracy can be achieved. The third chapter describes various totalizer heads, their properties and connection options. The fourth chapter provides recommendations on how the current operation can be ensured. These include the accuracy influencing flow disturbances as well as regular lubrication of the bearings of the turbine meter.

The fifth chapter describes the marking of the TRZ03 and in the sixth the technical data of TRZ03 are summarized. The appendix includes details to the previous chapters, a summary of certificates and approvals.

1.3 Overview, Function and Application

The TRZ 03 turbine meters are flow meters which can be used for custody transfer metering. Or more precisely for measuring the volume at measurement conditions of non-aggressive gases and fuel gases. The TRZ 03-K turbine meter can only be used for secondary metering.

All types of turbine meters measure the quantity of gas flowing through them in units of volume at prevailing pressure and temperature. Therefore, the units of volume are determined at flowing conditions. The volume of the gas flowing through is indicated by a mechanical totalizer in cubic meters at flowing conditions. In addition, the turbine meters can be fitted with HF or LF pulse transmitters and with reed contacts. In this way, pulses are obtained whose number is proportional to the volume which has flowed through. These pulses can be further processed by volume correctors.

The major differences between types TRZ 03 and TRZ 03-K are as follows:

TRZ 03

- Approved for custody transfer metering according to DIN 33800
- Installation length: 3 x DN
- Accuracy $\leq \pm 0.5\%$ (above 0,2 Q_{max})
- Blade monitoring system

TRZ 03-K

- For secondary metering
- Installation length: $\leq 1,5 \times \text{DN}$
- Accuracy $\leq \pm 1\%$ (above $0,2 Q_{\max}$)

The following applies to all meter types:

- Maximum operating pressure: 100 bar
(not for gas meters with a plastic turbine wheel)
- Meter sizes from G 40 to G 16000
- Measuring range 1:20 (MID); applying a high-pressure certification, a range of up to 1:160 is also possible (see data sheets)
- Connections in compliance with DIN or ANSI are available.
- Special designs for aggressive gases are available.
- Available for low temperatures ($< 10^{\circ}\text{C}$)
- All gas meters can be operated in any position up to the nominal diameter of DN 200.

The TRZ 03 and TRZ 03-K are used for measuring the volume at measurement conditions of non-aggressive gases and fuel gases. Measurements of aggressive gases are only permitted if the special designs are used which have been developed for this purpose.

The TRZ 03 und TRZ 03-K are approved for the use in explosive areas; the indication is:



II 1G Ex ia IIC T4 (HF sensors)

The corresponding conformity certificates for the LF und HF sensors can be found in the appendix.

Information about temperature limits are given in *chapter 1.10 Temperature ranges*.

The TRZ 03 meets the standards, guidelines and regulations:

⇒ *Chapter 1.6 Standards / Guidelines and the Annex*

These technical limitations you must comply with the TRZ03 for safe operation:

⇒ *Chapter 6 Specifications*

The device may only be operated with the following types of gases (*chapter 1.13 Using gas meters with different types of gases*). Only with these stated gases a safe operation is ensured:

- Gases of class 1
- Gases of class 2
- Gases of class 3

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The friction of the gas components must be within the limits in accordance with the EN 437:2009 for test gases.

The following instructions must be observed:

Notice

The RMG TRZ 03 und TRZ 03-K can be operated in any mounting orientation up to DN200, from the DN 250 is a horizontal orientation is required.

If a mounting orientation is specified when ordering, the meter has to be installed in this orientation.

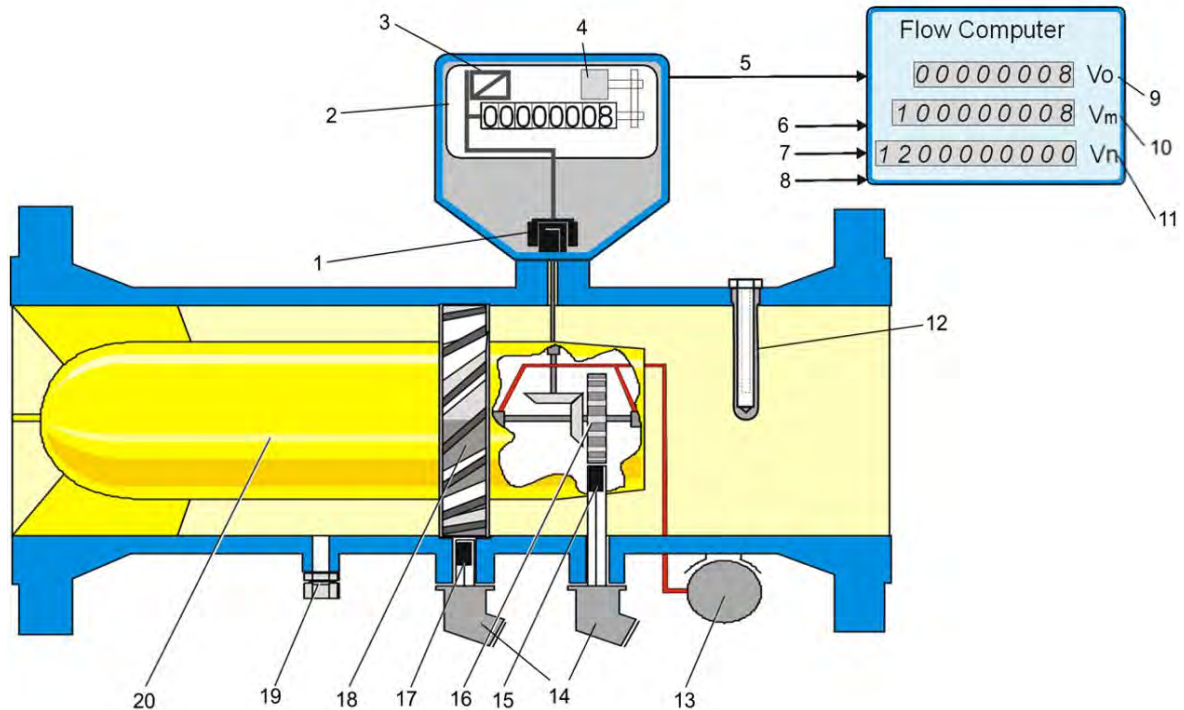
It is also important to ensure that the filling port of the lubricator faces upwards.

1.4 Method of operation

The method of operation of the mechanical turbine meter is based on the measurement of the gas velocity. The velocity of the gas flowing through the gas meter is increased in the flow straightener and the gas strikes the turbine wheel in a defined flow cross section. In the flow straightener, unwanted vortices, turbulences and asymmetries are removed or reduced. The turbine wheel is mounted axially, while the blades of the turbine wheel are arranged at a certain angle to the gas flow. Within the measuring range (Q_{\min} - Q_{\max}), the rotational speed of the turbine wheel is almost proportional to the mean gas velocity and, therefore, to the rate of flow. The number of rotations is a measure of the volume that has flowed through. The rotary movement of the turbine wheel is transmitted by a magnetic coupling to the unpressurized meter head. Downstream of the coupling, there is an HF pulse transmitter (HF 1) and gearing which reduces the rotational speed of the turbine wheel to match the mechanical totalizer. An LF pulse transmitter (slot-type initiator or reed contact) is located on the totalizer.

Figure 1: Sectional drawing of a turbine meter shows a sectional drawing of a turbine meter TRZ03. Downstream of the turbine wheel, a cam wheel (reference wheel) is located on the same shaft. Two HF sensors (proximity switches) generate a signal if a blade of the turbine wheel (HF 3) or a cam of the reference wheel (HF 2) passes them. In this way, two pulse sequences are generated which are out of phase. The generated pulses can be further processed for secondary volume measurements or flow measurements.

A counter with an integrated encoder (e.g. ENCO 08) processes the pulse sequences. The totalizer (Vo) can be transmitted digitally to a flow computer. The necessary pressure and temperature values can be recorded in the pressure connection (pressure) and via one (or more) temperature sensors in the immersion pocket.



- | | |
|---|--|
| 1 Magnetic coupling | 11 Vn (flow rate at standard conditions) |
| 2 Mechanical counter | 12 Thermowell for temperature sensor |
| 3 LF 1/2 MK (low frequency) | 13 Oil pump |
| 4 ENCO 08 transmitter for totalizer | 14 HF 2/3 (high frequency) |
| 5 Data transmission line | 15 High frequency pulse transmitter |
| 6 LF (low frequency) | 16 Reference wheel |
| 7 HF2d (high frequency) | 17 High frequency pulse transmitter |
| 8 HF3D (high frequency) | 18 Turbine wheel |
| 9 Vo (original counter) | 19 Pr connection (pressure) |
| 10 Vm (flow rate at measuring conditions) | 20 Flow straightener |

Figure 1: Sectional drawing of a turbine meter

1.5 Approvals

Type **TRZ 03** has been approved for custody transfer metering. The following approvals have been obtained:

- MID – approval number No. T10417

- DGRL2014/68/EU / (PED-approval) approval number

No. ISG-22-12-1980 (TRZ 03) and
ISG-22-12-1994 (TRZ 03-K)

Independent whether a turbine meter can be remotely read (via the encoder) it is fitted with a metrologically controlled mechanical index. The reading of this index is the measurement result that serves as the basis for billing.

Type **TRZ 03-K** has not been approved for custody transfer metering.

1.6 Standards / Guidelines

All RMG turbine meters have passed the disturbance measurements in compliance with OIML Recommendation IR-32/89, Annex A, with slight and heavy flow disturbances. Therefore, this meter design meets the requirements for installation in compliance with Technical Guideline G 13 Sec. 1. Test specifications are as laid down in PTB Testing Instructions, Vol. 29 and 30, Testing of volume gas meters with air under atmospheric and high pressure.

The RMG turbine meters of type TRZ 03 comply with EN12261, as well as to the MessEV MID (2014/32/EU).

1.7 Validity of meter proving

The turbine meters of type TRZ 03 which are suitable for custody transfer metering must be subjected to subsequent meter proving at regular intervals. The validity of meter proving is determined in the German Metering and Calibration Rules (MessEV, Edition 11, December 2014) with the following periods:

Turbine meters without lubricator	8 years
Turbine meters with flow range 65 m ³ /h to ≤ 4.000 m ³ /h	12 years
Turbine meters with flow range > 4.000 m ³ /h to < 16.000 m ³ /h	16 years
Turbine meters with flow range ≥ 16.000 m ³ /h	unlimited

Notice

For reverification the meter has to be removed and tested at a test rig.

1.8 Measuring ranges

The measuring ranges are between 10 and 25,000 m³/h (flowing conditions). A measuring range is specified for each meter size. It is limited by the minimum flow rate Q_{\min} and the maximum flow rate Q_{\max} (*chapter 6.1 Measuring ranges / Dimensions / Pressure classes TRZ03 (PTB) and 6.2 Measuring ranges / Dimensions / Pressure classes TRZ03-K*).

For types TRZ 03 this is the flow range where the gas meter must indicate correct values within the error limits specified by the German Metering and Calibration Rules.

Turbine meters of type TRZ 03 have measuring ranges up to 1:30 even under atmospheric pressure. If a high-pressure test is conducted in compliance with Technical Guideline G 71) (PTB), the measuring range can be extended to 1:50. Then the minimum flow rate Q_{\min} HP is the lowest test point during high-pressure testing. Types TRZ 03 may then be used for billing purposes within the specified HP flow and density ranges.

The measuring range of type TRZ 03-K is 1:16

1.8.1 Extension of the measuring range

In the range of $0.2 Q_{\max}$ to Q_{\max} , the measuring behaviour of turbine meters is determined by the aerodynamic conditions in the flow channel and the measuring cross section. By means of many series of tests conducted both under atmospheric pressure and under higher pressures and with an appropriate rating for such ranges, it is possible to achieve a deviation of the calibration curve under atmospheric conditions and under high-pressure conditions of < 0.5% in the flow range of $0.2 Q_{\max}$ to Q_{\max} .

In the lower flow range, the measuring behaviour is determined by the relationship between the gas flow driving the measuring wheel and the slowing-down torques due to drags (bearings and totalizer). The driving torques increase linearly with the density and quadratically with the velocity of the gas to be measured. Due to the physical conditions, the measuring range is therefore enlarged in relation to the

density. The lower flow limit shifts in the direction of smaller loads (see also table in *chapter 6.3* Q_{\min} depending on the operating pressure in natural gas). Use the formula below as approximate equation:

$$Q_{md} \approx Q_{\min} \cdot \sqrt{\frac{1,2}{\rho}} \quad (m^3 / h)$$

The density ρ can be determined with the following approximate formula:

$$\rho \approx (p_m + 1) \cdot \rho_n \quad (kg / m^3)$$

The influence of the temperature is not taken into account in this formula.

With:

Q_{md} : Minimum flow rate at flowing conditions

Q_{\min} : Minimum flow rate of the gas meter

p_m : Operating pressure in bar

ρ : Density in kg/m^3 (density of air at 20° C and 1,01325 bar $\approx 1,2 \text{ kg/m}^3$)

ρ_n : Standard density of the gas (standard density of natural gas $\approx 0,8 \text{ kg/m}^3$)

1.9 Accuracy of measurement

The following error limits apply within the permissible measuring range:

Measuring range:	Q_{\min} to 0,2 Q_{\max}	0,2 Q_{\max} to Q_{\max}
Calibration limit ¹⁾	$\pm 2 \%$	$\pm 1 \%$
TRZ 03	$\pm 1 \%$	$\pm 0,5 \%$
TRZ 03-K	$\pm 2 \%$ (DN 50, DN 80: $\pm 3 \%$)	$\pm 1 \%$ (DN 50: $\pm 1,5 \%$)

1) maximum error due to the German Metering and Calibration Rules

It will be checked whether these limits are observed. They also apply to the high-pressure range.

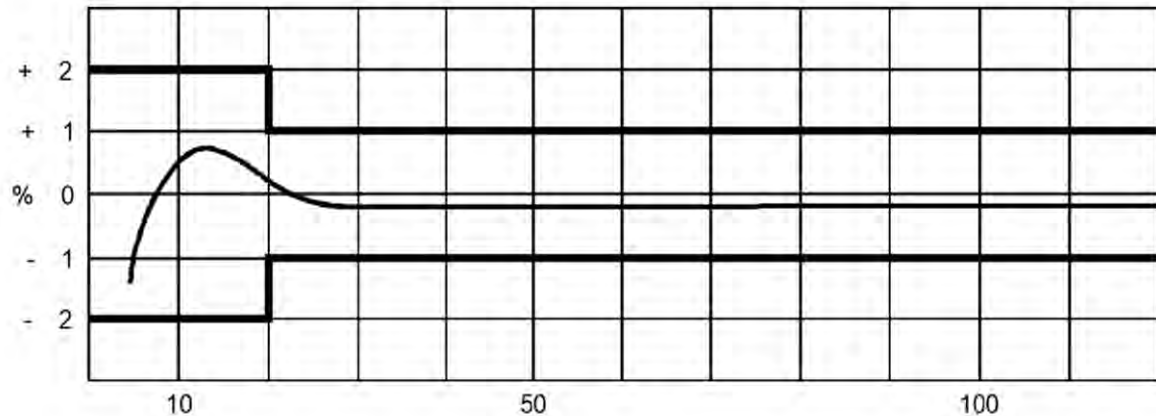


Figure 2: Calibration curve of a turbine meter

The reproducibility, i.e. the difference between the results of two measurements Under identical conditions, is as follows:

TRZ 03, TRZ 03-K: $\leq \pm 0,1\%$

1.10 Temperature ranges

For the standard designs of the turbine meters of types TRZ 03 and TRZ 03-K, the following temperature ranges are permitted:

MID:

-25°C to +55°C (TRZ 03 for custody transfer metering)

DGRL2014/68/EU (PED):

-20°C to +80°C (Spheroidal graphite iron)

-40°C to +80°C (cast steel)

ATEX:

-25°C to +70°C (T4)

Notice

For different values the lowest range applies.

1.11 Pressure loss

The pressure loss of RMG turbine meters has been reduced to a minimum thanks to modifications with regard to design. The measuring points for pressure loss are located 1 x DN upstream and downstream of the gas meter. The pressure loss is calculated using the following formula:

$$\Delta p = Z_p \cdot \rho_m \cdot \frac{Q_m^2}{DN^4}$$

where:

Δp	pressure loss	[mbar]
Z_p	pressure loss coefficient	
ρ_m	density	[kg/m ³]
Q_m	volume flow rate at measurement conditions	[m ³ /h]
DN	is the nominal diameter of the gas meter	[mm]

Device type	Z_p
Turbine meter TRZ 03 / TRZ 03-K	3000
Turbine meter TRZ 03 / TRZ 03-K G4000-45 DN300 G6500-45 DN400	3500
L1 perforated-plate straightener as per ISO/DIN	3150
L2 perforated-plate straightener as per ISO/DIN	6300
L3 perforated-plate straightener as per ISO/DIN	9450
LP-35 perforated-plate straightener as per RMG-Norm	1260
RB 19 tube-bundle straightener as per ISO/DIN	1260

The values for Z_p are approximate mean values. The exact value is calculated from the pressure loss, which is determined during testing the turbine meter.

Example of calculation of the pressure loss for a turbine meter with upstream perforatedplate straightener:

TRZ 03 in DN 150:

$Q_m = 650 \text{ m}^3/\text{h}$

$\rho_m = 1,3 \text{ kg/m}^3$ (natural gas)

From the table on the previous page you may find:

Z_p (TRZ 03) = 3000

Z_p (LP-35) = 1260

Calculation:

$$Z_{p(\text{total})} = 3000 + 1260 \\ = 4260$$

$$\Rightarrow \Delta p = 4260 \cdot 1,3 \cdot \frac{650^2}{150^4} \\ = \underline{\underline{4,2 \text{ mbar}}}$$

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1.12 Pressure tap

A pressure tap has been provided to connect the pressure transducer of a volume corrector or a pressure gauge to read the pressure at measurement conditions prevailing inside the gas meter. This pressure tap is identified by "p_r".

1.13 Using gas meters with different types of gases

Gas type	Symbol	Density at 0°C 1,013 bar	Meter housing	Comments
Acid gas			Special	Special measuring element
Air		1,29	Standard	
Ammonia	NH ₃	0,77	Standard	O-rings / lubrication
Argon	Ar	1,78	Standard	
Butane	C ₄ H ₁₀	2,70	Standard	
Carbon dioxid	CO ₂	1,98	Standard	Excepcion: food industry
Carbon monoxid	CO	1,25	Standard	
Ethan	C ₂ H ₆	1,36	Standard	
Ethylene (gaseous)	C ₂ H ₄	1,26	Standard	Special design
Freon (gaseous)	CCl ₂ F ₂	5,66	Standard	O-rings / lubrication
Helium	He	0,18	Standard	Reduced measuring range
Hydrogen	H ₂	0,09	Special	Reduced measuring range
Hydrogen sulphide (0,2%)	H ₂ S	1,54	Special	Special measuring element
Methane	CH ₄	0,72	Standard	
Nitrogen	N ₂	1,25	Standard	

Oxygen (100%)	O ₂	1,43	Standard	Special design
Pentane	C ₅ H ₁₂	3,46	Standard	
Propane	C ₃ H ₈	2,02	Standard	
Propylene (gaseous)	C ₃ H ₆	1,92	Standard	Special measuring element
Sulfur dioxide	SO ₂	2,93	Special	Special design
City gas			Standard	

1.13.1 Suitability and safety for natural gas containing H₂

The TRZ 03(-K) can be used in hydrogen-containing natural gas up to pure hydrogen. There are no safety-related concerns for this use.

Notice

In accordance with the German TR-G19 – the TRZ03 is suitable and approved for use in custody transfer applications – in natural gases with a maximum hydrogen content of 10 mol-%, with the accuracy specified in *chapter 1.9 Accuracy of measurement*.

Since there are currently no certified test rigs in Germany to calibrate meters with higher hydrogen-containing gases, an accuracy above 10 mol-% cannot be tested or certified.

Not custody transfer measurements are of course possible in natural gases with a hydrogen content above 10 mol%. However, a reduced measuring range must be taken into account if applicable. Please contact RMG for further information.

1.14 Installing the device in the pipeline

The units of RMG are equipped with flanges. The flange connections for the connected pipes must comply with the connecting dimensions of the flanges of the unit:

- ANSI-pressure levels: Flange in accordance with ASME B 16.5.
- DIN-pressure levels: Flange in accordance with DIN EN 1092.

Danger

Gas leakage for the wrong gaskets. If wrong flange gaskets are used for connecting turbine gas meters, gas mayflow through leaks resulting in an explosive gas mixture.

Poisoning and explosion hazard!

In addition, the stress of the flange is increased inadmissible when tighteningthe bolts.

Make sure that no flange gaskets are protruding into the pipe.

Pay attention to a save mounting / hanging-up of the TRZ03 during assembly toavoid the risk of bruising. Avoid having your fingers (or other body parts) between any openings and gaps that are moved together when tightening the flanges!

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Notice

When installing the meter, take care of the flow direction indicated by an arrow on the body.

Malfunction may be caused due to incorrect gaskets.

When wrong flange gaskets are used for turbine meters, which protrude into the pipe, the measurement accuracy may be affected.

Make sure that the flange gaskets on the sealing surfaces are not protruding into the pipe.

The stability of the flange connection for gaskets and bolts with certain material properties (see *chapter 2.2.4 Seals* and *chapter 2.2.5 Screws*) was proved to AD2000 regulations.

- Other screw / flange - variants were not verified.

2. Installation and Commissioning

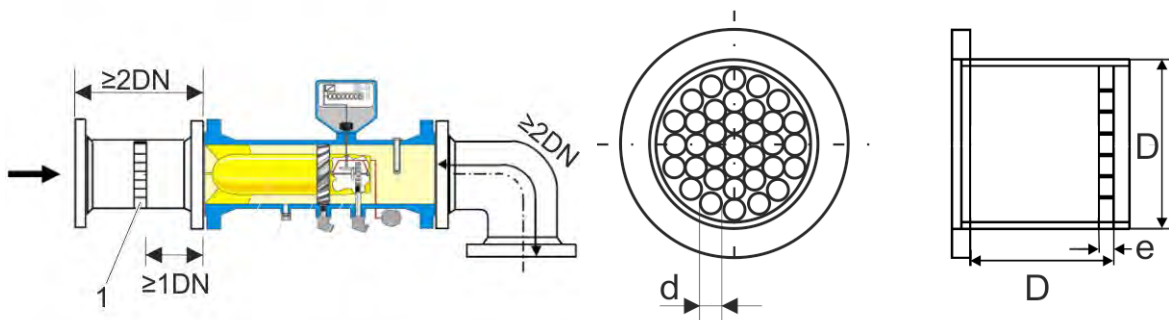
2.1. Installation

Notice

Any components affecting the gas flow must be avoided directly upstream of the turbine meter (see DVGW Guideline G 492II and PTB Guideline G13). An inlet pipe of a minimum of $2 \times \text{DN}$ is required upstream of the RMG TRZ 03 turbine meter. The inlet pipe must be designed as a straight pipe section of the same nominal diameter as the gas meter. If there is a heavy flow disturbance, it is necessary to use flow straighteners (see table on next page). A pipe or fitting (bend) of the same nominal diameter as the gas meter and an overall length of $2 \times \text{DN}$ must be installed downstream of the gas meter.

Temperature measuring instruments may only be installed at a distance of $1 \times \text{DN}$ or in the case of nominal diameters of $\geq \text{DN } 300$ at a minimum distance of 300 mm.

If there are flow disturbances (e.g. due to a gas pressure regulator) upstream of the inlet pipe, it is also necessary to use a perforated-plate straightener. You can use perforated-plate straighteners complying with ISO 5167-1 or of type RMG LP-35, the latter resulting in a pressure loss which is 2.5 times lower than that of the standardized flow straightener.



1 Perforated Plate Straightener

Perforated Plate Straightener LP-35

- The opening angle of reducers or expansion fittings installed upstream of a turbine meter of type TRZ 03 or TRZ 03-K must not exceed 30° .

In order to obtain precise measurement results, the turbine meter must be installed in the gas line in such a way that no seals protrude from the flanges into the pipeline.

Notice

A protective screen should be installed on the intake side of the gas meter to protect the turbine meter against any foreign particles possibly contained in the gas flow. The protective screen can be a perforated plate of sheet metal with a hole diameter of 3 mm which is available from RMG.

- The pm tap which is located on the RMG turbine meter is the pressure-measuring point which was used for taking the relevant pressure at measurement conditions during meter proving. This pressure-measuring point is used for connecting pressuremeasuring instruments such as flow computers or volume correctors. Other connection options (e.g. for temperature measurement) can be supplied on a pipe section on the output side of the gas meter.

Danger

Protect the turbine meter from damage caused by heavy flow variations, e.g. if the downstream pipeline system must be filled or blown off.

If it is necessary to do welding work on the gas line, such work can only be performed at a safe distance from the gas meter. Extreme temperatures prevailing in the gas line in the proximity of the gas meter can result in a permanent damage to the gas meter.

All electrical connections between the gas meter and the amplifiers or the flow computer must be carried out in compliance with the installation instructions. Make sure that these connections are intrinsically safe.

Any liquids remaining in the gas line after hydrostatic testing can damage the interior parts of the gas meter. If hydrostatic testing is necessary, the turbine meter must be replaced by a pipe section. Make sure that no liquid remains in the gas line upstream of the gas meter after hydrostatic testing.

2.2. Operating data

2.2.1 Threshold

Recommended threshold values for maximum service life and maximum accuracy:

Notice	
Maximum overload:	< 20% above Q_{\max} for a short time (< 30 sec)
Maximum flow or shock loads	< $0.01 \cdot Q_{\max}/\text{sec}$ 1% of Q_{\max}/sec e.g. starting up 0 - 100%: > 100 sec
Maximum pressure change:	< 0.1 bar/sec
Maximum flow pulsation:	< 5%
Particle size in the gas flow:	< 5 μm
Lubrication of bearings	See <i>chapter 4.2 Lubrication</i> . Lubrication intervals depend on the condition of the gas (condensate, rust or dust)
Vibration / mechanical shock:	< 1 mm/sec (vibration velocity)

These specified data must be determined and checked during commissioning, prior to filling and during the start-up and running-in phases of the gas meters. If more than one threshold value occurs at the same time, appropriate action must be taken in the station to improve the measuring conditions.

Notice
<p>The operator must record all measuring data (gas meter and operating data) during the whole period of operation in order to detect the causes of a possible destruction of the gas meter at an early stage and take corrective action in good time.</p> <p>Corrective action or reduction of the critical operating conditions can be achieved by the following measures for example:</p> <ul style="list-style-type: none"> • Start-up screens (mesh width < 0.15 mm) • Filters • Perforated plates (\varnothing 3 - 4 mm) protecting the gas meter • Valves with control drive mechanism (flow variation) • Non-return valves (pulsation and return flow)

2.2.2 Technical Guideline G 13

The installation conditions for new stations complying with TRG G 13 and the simpler installation conditions for RMG turbine meters are compared in the table below.

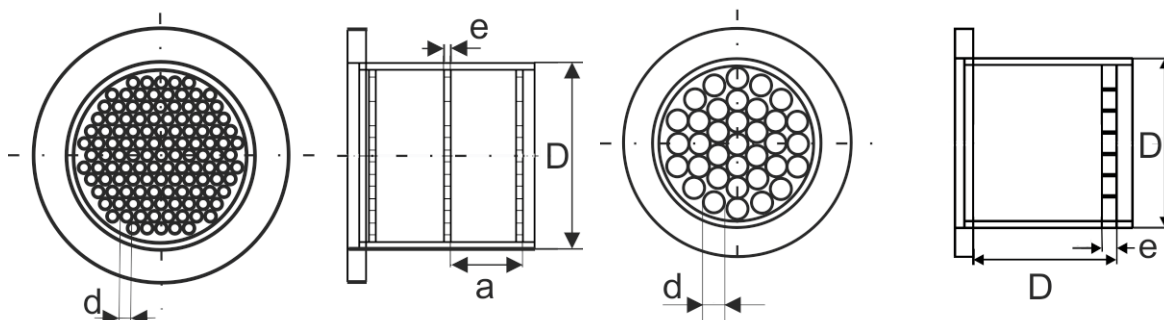
Type of flow disturbance	Installation conditions as per TR G13	Installation conditions for RMG gas meters Type TRZ03	Comments
None	Inlet pipe ≥ 5 DN Outlet pipe ≥ 2 DN	Inlet pipe ≥ 2 DN Outlet pipe ≥ 2 DN	The outlet pipe can also be designed as a bend.
	Inlet pipe ≥ 10 DN		Flow disturbances upstream of this inlet pipe need not be considered, if the requirement for an alternating and pulsating flow is fulfilled.
Bend	Inlet pipe ≥ 5 DN	Inlet pipe ≥ 2 DN	
Space bend	Inlet pipe ≥ 5 DN and additionally , 2 perforated-plate straighteners or one tube-bundle straightener	Inlet pipe ≥ 2 DN	
Gas pressure regulator with sound attenuator	Inlet pipe ≥ 5 DN	Inlet pipe ≥ 2 DN and additionally , 1 perforated-plate straightener	
Gas pressure regulator without sound attenuator	Inlet pipe ≥ 5 DN and additionally , 2 perforated-plate straighteners	Inlet pipe ≥ 2 DN and additionally , 1 perforated-plate straightener	
Diffuser	Inlet pipe ≥ 5 DN and additionally , 1 perforated-plate straighteners	Inlet pipe ≥ 2 DN	
Diffuser with swirling flow	Inlet pipe ≥ 5 DN and additionally , 2 perforated-plate straighteners	Inlet pipe ≥ 2 DN	

2.2.3 Perforated-plate straighteners

There are the following options for flow straighteners:

RMG L1 – L3 perforated-plate straighteners
complying with ISO 5167-1 and DIN 1952

RMG LP-35 perforated-plate
straightener



Features	ISO / DIN	L1 to L3	RMG LP-35
Hole diameter d	$d \leq 0.05 D$	$0.04 D$	$0.13 D$
Plate thickness e	$e \geq d$	$e = d$	$0.13 D$
Plate clearance a	$0.5 D \leq a \leq 1 D$	$0.5 D$	-
Opening ratio m	$0.2 \leq m \leq 0.4$	0.3	0.6
Pressure loss, dyn. Δp		$5 - 15 (c^2 \rho / 2)$	$2 - 15 (c^2 \rho / 2)$

In conjunction with RMG turbine meters, these flow straighteners fulfil the requirements of Technical Guideline G 13 and are approved under EU approval No. D 81 / 7.211.10 for turbine meters.

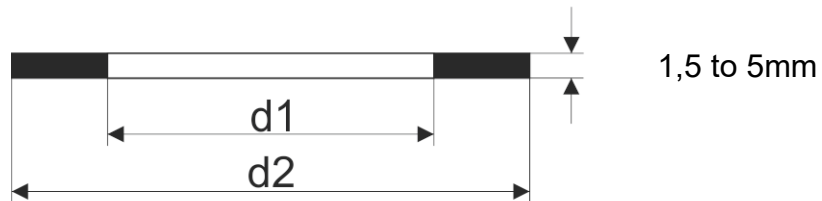
2.2.4 Seals

It must be guaranteed that flange seals of RMG turbine meters do not protrude from the flange into the gas line.

All seals approved as per AD2000-Regelwerk can be used depending on the requirements for stability and reliability.

- gaskets: $k_0 \times K_D = 20 \times b_D \mid k_1 = 1,3 \times b_D \text{ [N/mm]}$
- grooved seals: $k_0 \times K_D = 15 \times b_D \mid k_1 = 1,1 \times b_D \text{ [N/mm]}$
- spiral seals: $k_0 \times K_D = 50 \times b_D \mid k_1 = 1,4 \times b_D \text{ [N/mm]}$
- octagonal ring joint seal: $K_D = 480 \text{ N/mm}^2$

For recommended dimensions, see the tables below.



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Gaskets			PN 10	PN 16	ANSI 150	PN 25	PN 40
DN		d1	d2				
50	2"	77	107	107	105	107	107
80	3"	90	142	142	137	142	142
100	4"	115	162	162	175	168	168
150	6"	169	218	218	222	225	225
200	8"	220	273	273	279	285	292
250	10"	274	328	330	340	342	353
300	12"	325	378	385	410	402	418
400	16"	420	490	497	514	515	547
500	20"	520	595	618	607	625	628
600	24"	620	695	735	718	730	745

Grooved seals		ANSI 300 / ANSI 600		PN 64	
DN		d1	d2	d1	d2
50	2"	69,8	88,9	65	87
80	3"	98,4	123,8	95	121
100	4"	123,8	154,0	118	144
150	6"	177,8	212,7	170	204
200	8"	228,6	266,7	220	258
250	10"	282,6	320,7	270	315
300	12"	339,7	377,8	320	365
400	16"	422,3	466,7	426	474
500	20"	530,2	581,0	530	578
600	24"	631,8	682,6	630	680

Spiral seals		ANSI 300		PN 64		ANSI 600	
DN		d1	d2	D1	d2	d1	d2
50	2"	69,9	85,9	66	84	69,9	85,9
80	3"	101,6	120,7	95	119	101,6	120,7
100	4"	127,0	149,4	120	144	120,7	149,4
150	6"	182,6	209,6	174	200	174,8	209,6
200	8"	233,4	263,7	225	257	225,6	263,7
250	10"	287,3	317,5	279	315	274,6	317,5
300	12"	339,9	374,7	330	366	327,2	374,7
400	16"	422,4	463,6	426	466	412,8	463,6
500	20"	525,5	577,9	530	574	520,7	577,9
600	24"	628,7	685,8	630	674	628,7	685,8

2.2.5 Screws

The stability of the flange connection was verified using the screws listed in this section in combination with the seals listed in the previous section. Other screw / flange variants were not verified.

Temperature ranges for screws and nuts				
	-10°C to +80°C	-40°C to +80°C		
Pressure		Variante 1	Variante 2	Variante 3
up to and including 40 bar	Screws complying with DIN EN ISO 4014 made of material 5.6, Nuts complying with DIN EN ISO 4032 made of material 5-2	Screws complying with DIN EN ISO 4014 made of material 25CrMo4, Nuts complying with DIN EN ISO 4032 made of material 25CrMo4		
from 40 bar	Screw bolts complying with ANSI B1.1 made of material ASTM A193 Grade B7, Nuts complying with ANSI B1.1 made of material ASTM A194 Grade 2H	Screw bolts complying with ANSI B1.1 made of material ASTM A320 Grade L7, Nuts complying with ANSI B1.1 made of material ASTM A320 Grade L7	Screw bolts complying with ANSI B1.1 made of material 42CrMo4, Nuts complying with ANSI B1.1 made of material 42CrMo4	Anti-fatigue bolts complying with DIN 2510 made of material 25CrMo4, Nuts complying with DIN 2510 made of material 25CrMo4

Expansion bolts may only be used on devices within the scope of the Pressure Gauge Directive.

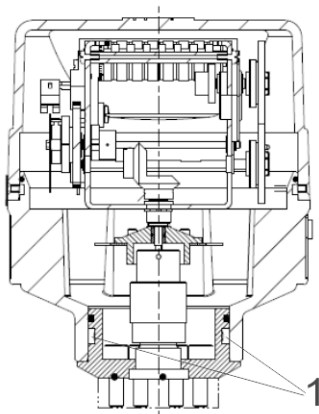
3. Types of totalizers

The RMG turbine meter TRZ 03 can be fitted with different totalizers.

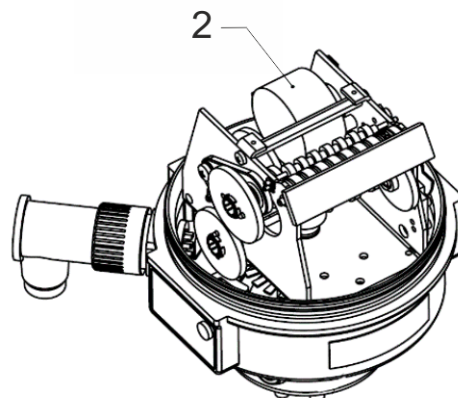
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3.1 Type „F“ meter head

The current standard design is type “F” meter head without mechanical drive shaft couplings. You can see this design in *Figure 3: Type “F” meter head*. Optionally, an ENCO 08 encoder can also be integrated in the meter head (see *Figure 1: Sectional drawing of a turbine meter*). In addition to the direct recording and display of the operating volume flow, this design allows digital transmission to a flow computer for calculating the standard volume flow rate. The necessary pressure and temperature values can also be recorded, as shown in *Figure 1: Sectional drawing of a turbine meter*.



1 Locking Screw



2 ENCO 08

Figure 3: Type “F” meter head

Notice

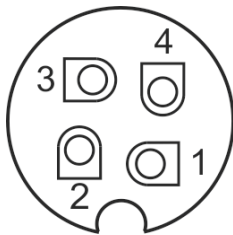
This design provides no options for connecting additional mechanical equipment.

The totalizer has the following features:

- LF pulse transmitter
 - Standard: reed-contact
 - Alternatively: inductive pulse transmitter
 - Option: up to two additional inductive LF pulse transmitters
- HF pulse transmitters are optionally available, pulse frequency approx. 100 Hz at Q_{\max}
- IP 65 Protection class
- Universal readable
- Totalizer unit and HF 1 pulse transmitter are easily replaceable on site.

Notice

The electrical connector must be covered by a cap closure or a connecting plug! Otherwise moisture may ingress into the meter head.



The ENCO-08 output connector is placed in the meter head. It is 3-pole and has the assignment:

- 1 – V_o (+)
- 2 – --- (not used)
- 3 – V_o (-)
- 4 – PE (protective earth)

3.2 Type “F-D” meter head

Design and features like in the case of the type “F” meter head but additional with a mechanical drive shaft in compliance with EN 12261 on the top side of the case.

The direction of rotation of the drive shaft (with view on the drive shaft) is clockwise.



Figure 4: Type “F-D” meter head

For dimensions and instructions for the connection see the description of the type “D” meter head (see below).

Notice

Especially note the maximum permissible torques (see the table below)!

Permissible torques (type “F-D”)

Nominal diameter	Sizes	Q _{max}	Q _{min} [m ³ /h]			M _{max} [Nmm]		
DN	G	m ³ /h	1:20	1:10	1:5	1:20	1:10	1:5
50	40	65	-	-	13	-	-	-
50	65	100	-	10	20	-	-	-
80	100	160	8	16	32	-	1,0	2,0
80	160	250	13	25	50	1,4	2,4	3,9
80	250	400	20	40	80	1,4	2,3	3,9
100	160	250	13	25	50	0,14	0,6	1,3
100	250	400	20	40	80	0,5	1,1	2,1
100	400	650	32	65	130	0,8	1,6	3,3
150	400	650	32	65	130	0,5	1,5	2,4
150	650	1000	50	100	200	1,3	2	3,3
150	1000	1600	80	160	320	11,5	15,7	37,3
200	1000	1600	80	160	320	11	15	37
200	1600	2500	130	250	500	11	15	37
250	1000	1600	80	160	320	11	15	37
250	1600	2500	130	250	500	11	15	37
250	2500	4000	200	400	800	11	15	37
300	2500	4000	200	400	800	11	15	37
300	4000	6500	320	650	1300	11	15	37
300	4000-45	6500	320	650	1300	11	15	37
400	4000	6500	320	650	1300	11	15	37
400	6500	10000	500	1000	2000	11	15	37
400	6500-45	10000	500	1000	2000	11	15	37
500	6500	10000	500	1000	2000	11	15	37
500	10000	16000	800	1600	3200	11	15	37
500	10000-45	16000	800	1600	3200	11	15	37
600	16000	25000	1300	2600	5000	11	15	37

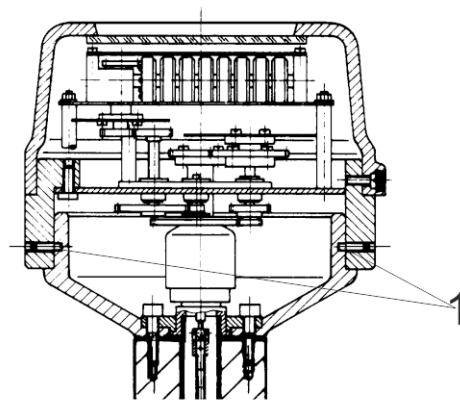
3.3 Type “A” meter head

The old standard design is type “A” meter head without mechanical drive shaft couplings.

Notice

This design provides no options for connecting additional mechanical equipment.

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1 Locking screw

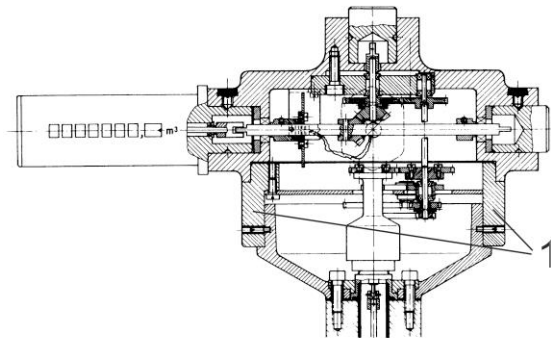
Figure 5: Type “A” meter head

The totalizer has the following features:

- LF pulse transmitter
 - Standard: reed-contact
 - Alternatively: induktive pulse transmitter
- HF pulse transmitters are optionally available, pulse frequency approx. 100 Hz at Q_{\max}

3.4 Type “D” meter head

Type “D” meter head provides two mechanical drive shafts where additional equipment, e.g. slip-on pulse transmitters, volume correctors, etc., can be attached under official supervision.



1 Locking screw

Figure 6: Type “D” meter head

The totalizer has the following features:

- LFPulse transmitter
 - Standard: reed-contact
 - Alternatively: inductive pulse transmitter
 - Option: one additional inductive pulse transmitter
- HF pulse transmitters are optionally available, pulse frequency approx. 100 Hz at Q_{\max}
- Additional mechanical equipment can be connected.

Notice

The drive shaft couplings of the meter head (type “D”) can be used for connecting additional me-chemical or electronic measuring instruments. In this case, the total driving torque must not exceed the approved value. If no additional equipment is used, the drive shaft couplings are sealed.

The rotation rates of the drive shaft coupling depend on the meter size (see table).

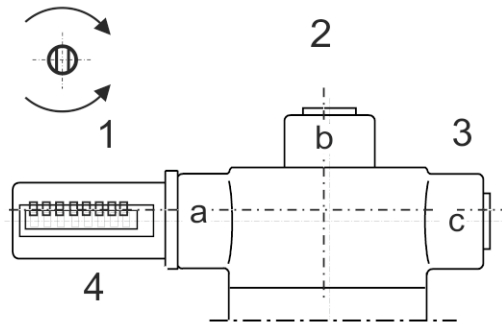


Figure 7: Direction of rotation of the drive shafts

- | | |
|------------------------------------|-----------------------|
| 1 Counterclockwise | 3 Clockwise |
| 2 Direction of rotation: clockwise | 4 Type „D“ meter head |

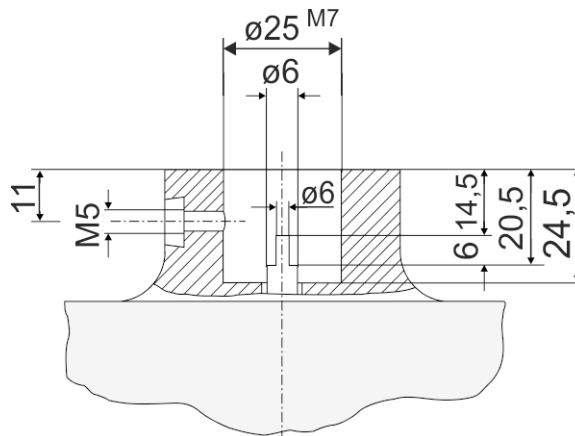


Figure 8: Dimensions of the drive shaft coupling

3.4.1 Connection of additional equipment

The drive shaft couplings of the meter head (type “D”) can be used for connecting additional me-chanical or electronic measuring instruments. In this case, the total driving torque must not exceed the approved value. If no additional equipment is used, the drive shaft couplings are sealed.



Warning

When selecting cables, it must be ensured that the permitted threshold values according to the EC type examination certificate of the relevant equipment are not exceeded.

3 Types of totalizers

Permissible torques (type “D” meter head)

Since the measuring range of turbine meters can be adversely affected by the torque of additional mechanically driven equipment, the permissible maximum torques in Nmm stated in the table below apply in relation to the flow range and the nominal diameter.

Sizes		Nominal dia. DN	Q _{max} [m³/h]	Q _{min} [m³/h]	M _{max} [Nmm]	P _{max} [bar]
G	40	50	65	13	--	100
G	65	50	100	10	--	100
				20	--	
G	100	80	160	16	1,0	100
				32	2,0	
				13	1,4	
G	160	80	250	25	2,3	100
				50	3,9	
				20	1,4	
G	250	80	400	40	2,3	100
				80	3,9	
				13	--	
G	160	100	250	25	0,6	100
				50	1,6	
				20	0,8	
G	250	100	400	40	1,4	100
				80	2,3	
G	400			32	0,8	
G	400	100	650	65	1,4	100
G	400			130	3,4	
G	400			32	0,6	
G	400	150	650	65	2,0	100
G	400			130	3,9	
				50	2,0	
G	650	150	1000	100	4,0	100
				200	9,8	
				80	16	
G	1000	150	1600	160	38	100
				320	90	
				80	16	
G	1000	200	1600	160	38	100
				320	90	
				80	12	
G	1000	250	1600	160	20	100
				320	36	
				0,05 Q _{max}	16	
≥	G 1600	200	2500	0,1 Q _{max}	39	100
				0,2 Q _{max}	98	

3.5 General

Notice

Additional equipment or additional measuring instruments can only be attached or removed under official supervision!

Before you connect additional equipment, make sure that the direction of rotation and the rotation rate of mechanical transmission coincide.

After you have loosened the two locking screws located on both sides of the meter head, you can turn all meter head designs (types A, D and F) through 350° to reach an optimum position for taking meter readings. To do this, you need an SW 2 hexagon socket wrench.

If work has to be done on the meter head, please make sure that the official seals are not damaged.

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3.6 Pulse transmitters

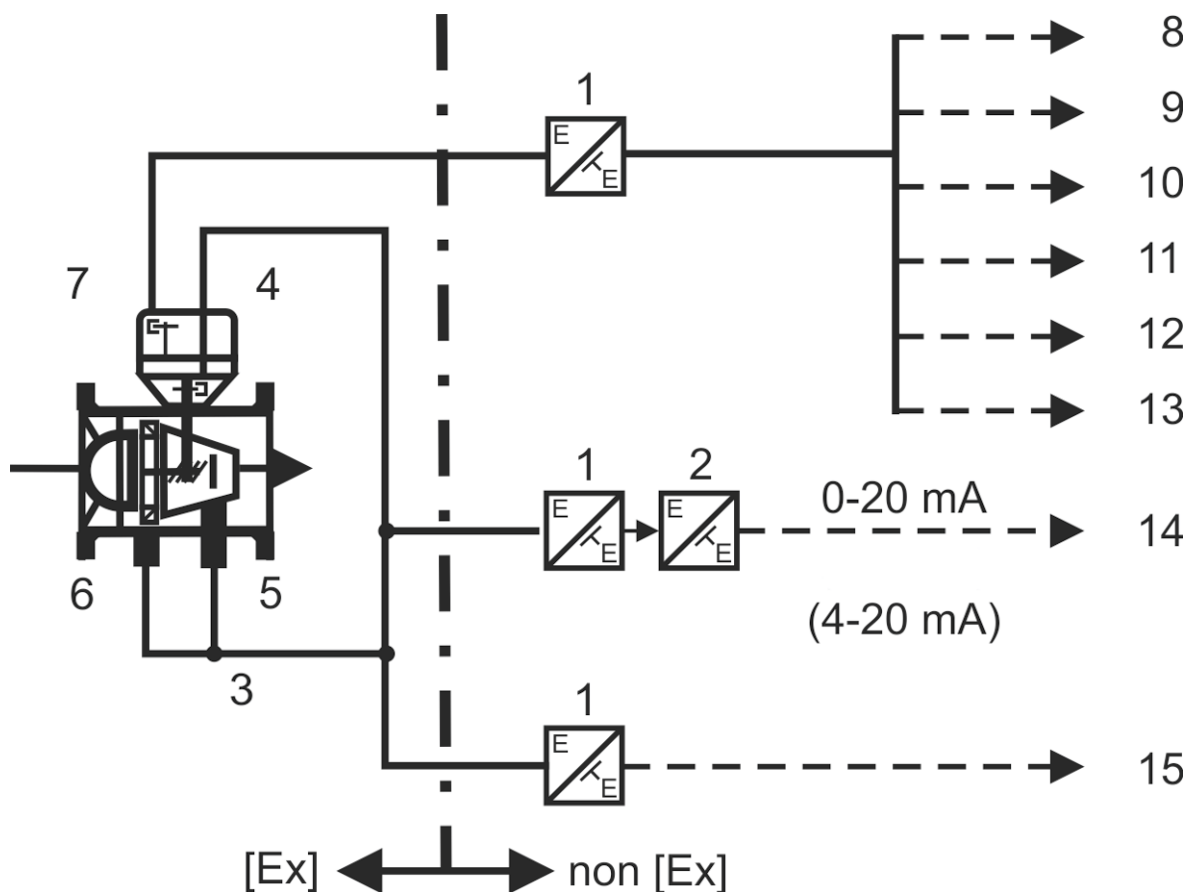
The TRZ 03 und TRZ 03-K K turbine meters provide different sensors which supply volume pulses in a variety of frequency ranges. These pulses can be further processed by volume correctors or remote totalizers, for example.

Notice

All pulse transmitters of the TRZ 03 have been approved for custody transfer metering.

3 Types of totalizers

The connection options are shown in the following illustration.



- | | |
|-------------------------------|---------------------------|
| 1 EEx i isolating amplifier | 8 Servo-actuator |
| 2 Digital-to-analog converter | 9 Volume corrector |
| 3 Blade monitoring system | 10 Gas flow recorder |
| 4 HF1 | 11 Remote totalizer |
| 5 HF2 | 12 Printer |
| 6 HF3 | 13 Maximum-value recorder |
| 7 LF | 14 Min./max. contact |
| | 15 Volume corrector |

Figure 9: Connection options of the TRZ 03



Danger



All pulse transmitters are intrinsically safe and must be connected only to intrinsically safe circuits if they are used in areas subject to explosion hazards.

The safety barriers must meet the requirements of the
II (2) G Ex ia IIC
type of protection!

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3.6.1 Connecting additional devices

The meter heads of the RMG TRZ 03 and TRZ 03K turbine meters are fitted with a reed contact as standard. The pulse value corresponds to the rotation rate U_a .

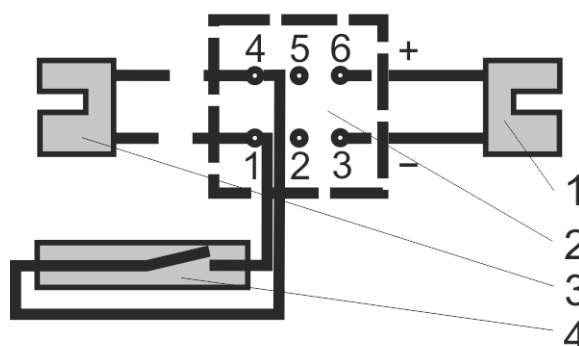
Notice

See the indicating plate on the meter head for exact frequency data.

The guide values are given in the tables in *chapter 6 Specifications*. The maximum pulse frequency is 0.3 Hz. Optionally, a slot-type initiator can be installed.

In applications where a higher resolution is required, an additional HF 1 pulse transmitter can be installed. Then the maximum pulse frequency will be of the order of approx. 300 Hz at Q_{max} . The connector pin assignments for the standard design with a reed contact (alternatively, with a slot-type initiator) are shown in the illustration below. Please also note the indicating plate on the meter head.

LF and HF 1



- | | |
|--|---|
| 1 Slot type initiator
HF ($f_{\max} = 300 \text{ Hz}$)
(NAMUR) | 3 Slot initiator
(Option, NAMUR)
LF ($f_{\max} = 0,3 \text{ Hz}$) |
| 2 Connector | 4 Reed-Contact
($f_{\max} = 0,3 \text{ Hz}$) |

Figure 10: Connector pin assignments for the HF 1 pulse transmitter

3.6.2 Pulse transmitters in measuring element (HF 2 and HF 3)

Notice

The higher-frequency flow signals from the HF 2 and HF 3 proximity sensors are used for control purposes and in conjunction with electronic flow computers suitable for custody transfer metering.

In the case of the HF 3 pulse transmitter, the pulses are picked off at the turbine wheel, while they are picked off at the reference wheel for the HF 2 pulse transmitter. The two wheels are arranged in such a way that two pulse series of the same frequency are generated which are out of phase by 180° .

Notice

The exact frequency is determined during meter proving and is stated on a supplementary data plate on the meter housing.

The guide values are listed in the tables on pages 37 through 39. The maximum pulse frequency is approx. 2100 Hz at Q_{\max} but depends on the meter size.

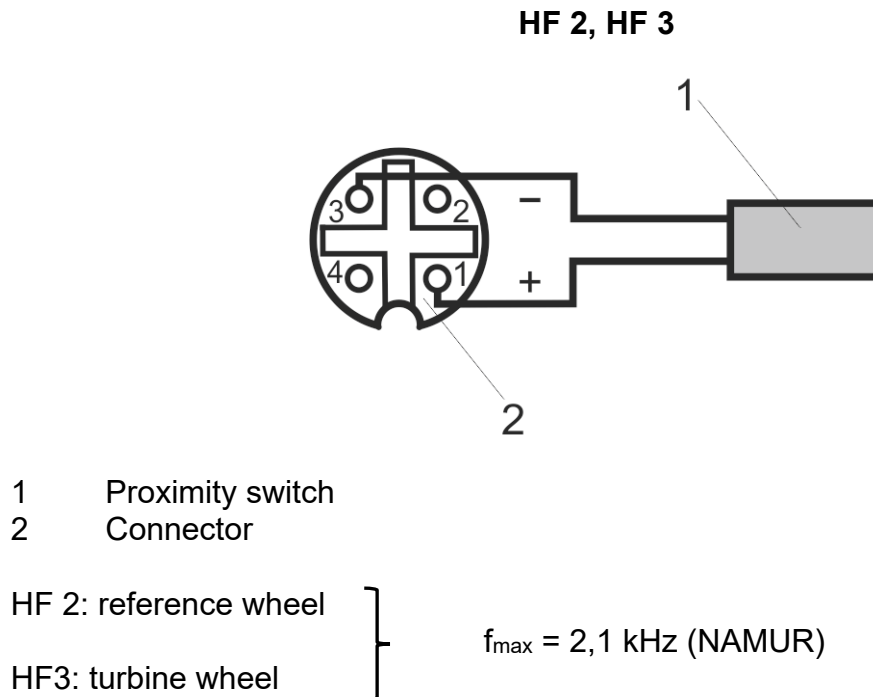


Figure 11: Connector pin assignments for the HF 2/3 pulse transmitter

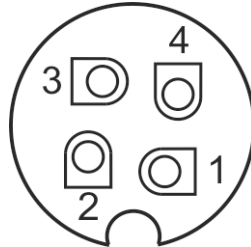
Connections are made by means of multi-pin connectors.

Normally, an LF pulse transmitter is connected to contacts 1 and 4, while a single HF 1 pulse transmitter is connected to contacts 3 and 6. Here the highest number is always (+).

High-frequency pulse transmitters which go with the turbine wheel (HF 2) or the reference wheel (HF 3) are usually connected to contacts 1 and 3 (for older devices 1 and 6).

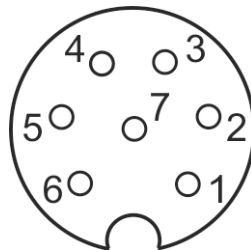
3.6.3 Connector pin assignments

Connector, 3-pins (HF2/HF3)
Produced by Binder (series 713)



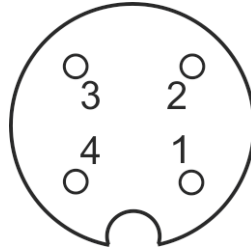
- 1 +
- 2 not used
- 3 - HF signal Namur
- 4 PE conductor

Connector, 7-pins
(meter head "F", HF2/HF3 for older devices),
Produced by Binder (series 693)



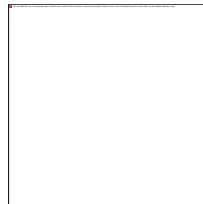
- 1 -
- 4 + LF signal reed or Namur
- 2 -
- 5 + optionally, LF or HF signal
- 3 -
- 6 + HF signal Namur
- 7 PE (screen)

Connector, 4 pins (for older devices)



- 1 -
- 2 + LF signal reed or Namur
- 3 not used
- 4 PE (screen)

Connector, 6 pins (for older devices) produced by Harting



- 1 -
- 4 + LF signal reed or Namur
- 2 -
- 5 + optionally, LF or HF signal
- 3 -
- 6 + HF signal Namur

Here the cable connector is depicted.
(Connecting part is provided by the customer.)

3.7 Specifications of the pulse transmitters

Elektrical data:

Reed-contact – Contact as make-contact element



max. switching voltage	20 V/DC
max. switching current	40 mA
max. conduct load	200 mW
f_{\max}	0,3 Hz

LF - slot-type initiator

Inductive proximity switch complying with DIN 19234 (NAMUR)



Supply voltage	7-9 V DC (with internal resistance $R_i = 1 \text{ k}\Omega$)
current if switch is not operated	$\geq 3 \text{ mA}$
current if switch is operated	$\leq 1 \text{ mA}$
f_{\max}	0,3 Hz

HF 1 – slot-type initiator

Inductive proximity switch complying with DIN 19234 (NAMUR)



Supply voltage	7-9 V DC (with internal resistance $R_i = 1 \text{ k}\Omega$)
current if switch is not operated	$\geq 3 \text{ mA}$
current if switch is operated	$\leq 1 \text{ mA}$
f_{\max}	300 Hz

HF 2/HF 3 – Näherungsinitiator

Inductive proximity switch complying with DIN 19234 (NAMUR)



Supply voltage	7-9 V DC (with internal resistance $R_i = 1 \text{ k}\Omega$)
current if switch is not operated	$\geq 3 \text{ mA}$
current if switch is operated	$\leq 1 \text{ mA}$
f_{\max}	2100 Hz

Notice

The power rating in terms of the intrinsic safety, refer to the added certificates (s. *Annex*)

3.8 Temperature measurement

In order to measure the gas temperature, a resistance thermometer can be used in a thermowell in a fitting downstream of the gas meter. It is recommended that a second thermowell, e.g. for a monitoring thermometer, be used. If such thermowells are not provided for in the meter housing, temperature measurement must be performed at a distance of up to 3 x DN or a maximum of 600 mm downstream of the turbine meter.

All turbine meters of types TRZ 03 and TRZ 03-K from the nominal diameter of DN 80 (3") upwards can be fitted with a thermowell for a PT100 resistance thermometer. Due to their short size, turbine meters of type TRZ 03-K cannot be fitted with a thermowell.

Notice

The measuring elements of the temperature sensors located outside the gas line must be appropriately insulated against the weather.

In order to achieve optimum thermal conduction, oil as a heat transfer liquid should be filled in the thermowells in any case.

Operating temperatures prevailing at outdoor metering stations in winter or at natural gas metering stations downstream of regulating stations are usually in the range of -5°C to +10°C. By comparison, higher operating temperatures prevail at metering stations located downstream of compressor stations.

3.9 Commissioning

3.9.1 Filling with oil

Notice

When the turbine meters are delivered, the lubricators do not contain any oil.

The oil pumps must not be filled with oil until they are at the installation site prior to commissioning!

A small bottle of oil is supplied with each gas meter. Then you have to perform an initial lubrication. For this see the detailed lubrication instructions in *chapter 4.2 Lubrication*.

3.9.2 Connecting the gas flow

Warning

Do not fill any downstream pipelines or station sections through the turbine meter. This may speed up the turbine wheel and lead to excessively high loads with resultant damage.

Notice

Short-time overload operation of 20% above the maximum flow rate Q_{\max} is permissible. Such load conditions should be avoided, however, since in most cases they cannot be controlled and exceed the officially approved limits for custody transfer metering. Moreover, such overloads reduce the service life of the gas meter.

Warning

The gas flow must be free of foreign particles, dust or liquids. Otherwise it is recommended that filters or separators be installed.

**Danger**

When commissioning this device, make sure that all cables are correctly connected and routed.

The housing must be completely closed.

When connecting and commissioning the pulse generators and the encoder, follow the specifications of the corresponding standards

- **DIN EN 60079-0 and**
- **DIN EN 60079-14**

4. Operation

4.1 Influences on the error of measurement due to operation

4.1.1 Intermittent operation



Warning

Rapid changes of the gas flow should be avoided, since the turbine wheel can follow these changes only with a certain delay due to its inertia. In this way, errors of measurement occur, in particular, if the gas flow is shut off.

Since in this case the turbine wheel slows down after the flow has stopped, a gas volume is measured which is always higher than that which has actually flowed through the gas meter.

In the supplement to PTB Guideline G 13, an instrument is stipulated which records the flow during the slow-down time of the turbine wheel for intermittent operation (i.e. if the gas flow is permanently switched on and shut off). If control signals of a shut-off valve are available, this volume can be recorded by a suitable data logger (if there is a TAZ 9 installed in an older station, this RMG device records the slow-down volume for custody transfer metering purposes with the TRZ 03).

4.1.2 Influence of pulsations

The gas flow must be free of shocks or pulsations. A gas metering station can be affected by flow pulsations, however, if the following equipment has been installed upstream or downstream in the system:

- reciprocating piston compressors
- rotary displacement meters
- gas pressure regulators lacking steadiness of operation
- pipes where no gas flows (siphons)

Volume flow pulsation is the decisive quantity for evaluating the performance of gas meters under the influence of pulsations. Volume flow pulsation is physically always associated with pressure variations.

The following relation is established in a first approximation:

$$\hat{Q}_{rel} \approx \hat{p}_{rel} \cdot \frac{DN^2}{Q} \cdot K$$

With:

\hat{Q}_{rel} : is the relative volume flow pulsation (peak-to-peak)

\bar{Q} : is the mean volumetric flow

\hat{p}_{rel} : is the relative pressure pulsation (peak-to-peak)

DN: is the nominal diameter of the gas meter

K: is a constant depending on standard density, velocity of sound, compressibility, pressure at base conditions, temperature, and station-specific parameters.

With this relation, it is possible to estimate volume flow pulsation on the basis of pressure pulsation, which can be measured more easily. Direct measurement of volume flow pulsation is preferable, however, since the results are more reliable. The crucial factor is the pulsation at the location of measurement.

4.1.3 Consequences

Notice

In the case of pulsating flow, the turbine meter shows a measured value which is too high.

Due to the pulse applied by the flow on the impeller which increases quadratically with the flow velocity, the resultant rotational speed is higher than the mean value of the flow velocity. The influence with high gas density is less but increases with a high mass moment of inertia (heavy impeller) or fast-running wheels.

The influence is less with high gas density but increases with high mass moment of inertia (heavy impeller) or fast-running wheels.



Warning

Furthermore, high pulsation amplitudes may result in premature wear of shaft bearings due to increased load.

4.1.4 Limiting values

Frequency ranges

- It is generally unlikely that measured values will be distorted in the frequency range above 100 Hz.
- In practice, it is hardly possible to initiate any significant flow variations at such frequencies.
- Disturbances are to be expected most frequently in the frequency range between 0.1 Hz and 100 Hz, since with typical station dimensions, the gas column can be expected to produce resonances. Flow variations with a high relative amplitude may occur.
- In the frequency range below 0.1 Hz, there is a quasi-steady flow which will not cause any distortion with the gas meters.

Pulsation amplitudes

Studies have shown that no disturbances are to be expected in the case of relative flow pulsations below 5% (peak-to-peak) and relative pressure pulsations of less than 0.1% to 0.5% (peak-to-peak).

These data should be regarded as approximate values depending on the flow rate and pulsation frequency involved.

4.2 Lubrication

4.2.1 Lubricator

For lubrication, either an oil gun or a permanently fitted oil pressure pump is used. The various designs are given in the tables below.

	Type of oilpump	Container volume	Delivered quantity
KO	Pushbutton pump	8 cm ³	0,114 cm ³ /stroke
GO	Lever pump	150 cm ³	1,5 cm ³ /stroke
DS	Permanent lubrication	--	--

	TRZ 03-K		TRZ 03	
	Pressure classes		Pressure classes	
DN	PN 10, 16 ANSI 150	PN 25, 40, 64, 100 ANSI 300, 600	PN 10, 16 ANSI 150	PN 25, 40, 64, 100 ANSI 300, 600
50	DS (KO) ¹⁾	KO	DS (KO) ¹⁾	KO
80	DS (KO) ¹⁾	KO	DS (KO) ¹⁾	KO
100	DS (KO) ¹⁾	KO	DS (KO)	KO
150	DS (KO) ¹⁾	KO	DS (KO)	KO
200	KO		DS (KO)	
250	KO	GO	GO	
300	GO		GO	
400	GO		GO	
500	GO		GO	
600	GO		GO	

¹⁾ Types in brackets are options

4.2.2 Specification for lubricating oils

Notice

For lubrication purposes, we recommend that you use only Shell Tellus S2 MA 10 or another lubricating oil with 2 to 4°E at 25°C in order to avoid damage to the shaft bearings. You can order your supply of lubricating oil from us in 1-liter containers under

Ref. No. 82.11.148.00 1 litre containment.

Shelf life of oil:

The shelf life depends on the operating conditions (e.g. UV light, humidity, etc.). In principle the oil suffers no quality loss during the first 3-4 years.

4.2.3 Initial lubrication

When the turbine meters are delivered, the lubricators do not contain any oil. The oil pumps must not be filled with oil until they are at the installation site prior to commissioning. A small bottle of oil is supplied with each gas meter.

Notice

For the initial lubrication more pump strokes are necessary than for the relubrications because first the oil pipes have to be filled with oil.

Pump	DN 50 – DN 200	DN 250 – DN 600
KO (pushbutton pump)	40 strokes	45 strokes
GO (lever pump)	-	10 strokes

4.2.4 Relubrication

Notice

The relubrication intervals are stated on an indicating plate on the meter housing. See also *chapter 4.2.5 Lubrication procedure*.

Example:

Re - Lubrication

At 3 month intervals, 2 strokes.
Lubricant: 2 - 4°E with 25°C
The containervolume of 0,15 litre
is for 3 years sufficient.
Supplementary info see operating instruction.

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Notice

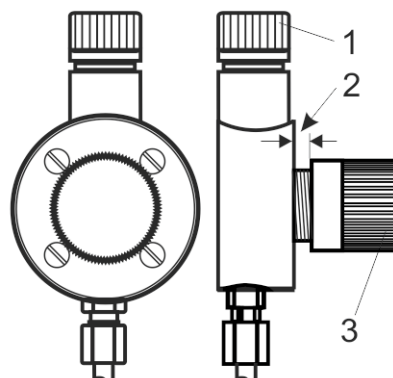
In the case of poor operating conditions, such as condensate forming because of water or hydrocarbon, or dust-laden gas, or service temperatures above 50°C, we recommend that lubrication will be performed at shorter intervals, even daily under extreme conditions (permanent building of condensate).

If the gas meter is operated under the above-mentioned conditions, it is likely that its service life will be reduced. If you have questions to the relubrication in such cases please contact RMG.

4.2.5 Lubrication procedure

Proceed as follows to fill and lubricate the pumps:

Pushbutton pump (KO)



- 1 Cover
- 2 Gap
- 3 Knurled cover

To fill with oil

- Unscrew cover.
- Fill with oil.
- Screw on cover again.

To lubricate up to 50 bar

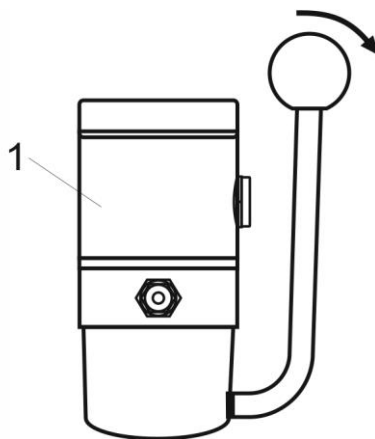
- Unscrew knurled cover
- Press pushbutton, which is now visible, once for each stroke (delivered quantity: 0,114 cm³/stroke)
- Screw on knurled cover again. Make sure you stop screwing as soon as you can feel a resistance and leave a gap of approx. 7 mm.

To lubricate meters over 50 bar:

- Loosen the knurled cover
- Screw on the pushbutton tightly, once for each stroke (delivered quantity: 0,114 cm³/stroke)
- Screw on knurled cover again. Make sure you stop screwing as soon as you can feel a resistance and leave a gap of approx. 7 mm.

Initial lubrication:	40 strokes	(up to DN 200)
	45 strokes	(from DN 250)
Relubrication:	6 strokes	(every 3 months)

Lever pump (GO)



1 Cover

Lever pump (GO) To fill with oil

- Pull off cover upwards
- (when using a lever pump with transparent container, unscrew cover).
- Fill in oil.
- Push on cover again tightly (or screw it on again).

To lubricate

- Move lever once for each stroke as far as it will go.
(delivered quantity: 1,5 cm³/stroke)

Initial lubrication:	10 strokes
Relubrication:	every 3 months
up to DN 400:	2 strokes
from DN 500:	3 strokes

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4.2.6 Maintenance instructions

RMG turbine meters are maintenance-free except that they require lubrication at regular intervals. Since all gas meters fitted with oil pumps are shipped with an empty oil storage tank, it is absolutely essential to fill the storage tank of the oil pump with oil and perform the initial lubrication before the gas meter is put into service (see section "Lubrication").

The operator should nevertheless check the turbine meter at regular intervals. In this connection, please refer also to DVGW code of practice G 495. (Gas pressure regulators for monitoring and servicing large-scale gas metering systems)

The gas meter should be checked for accuracy approximately every two years depending on whether it is possible or necessary to perform such checks. This can be done as follows:

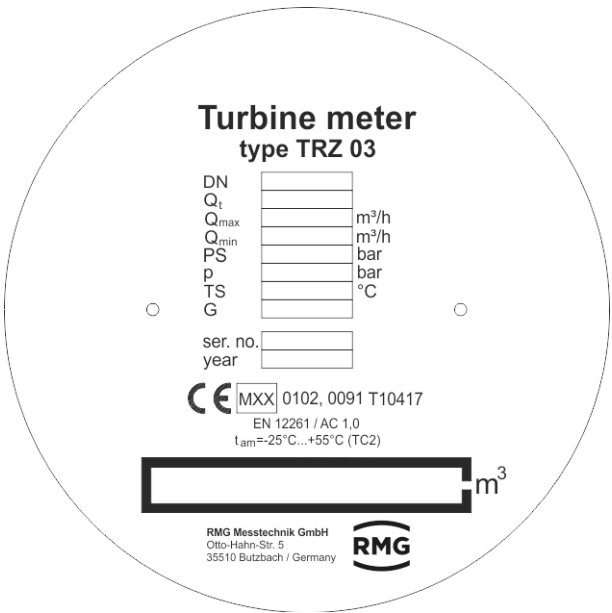
- In the station itself by connecting two gas meters in series.
- In an officially acknowledged testing laboratory for gas measuring instruments.
- In the factory.

(chapter 1.7 *Validity of meter proving*)

5. Labelling

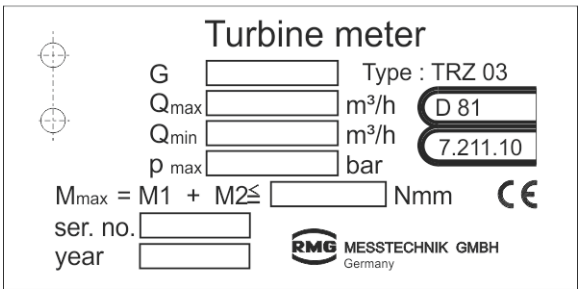
All important data which are necessary for operating the gas meter are stated on the plates which are affixed to the meter housing, totalizer or pulse transmitters.

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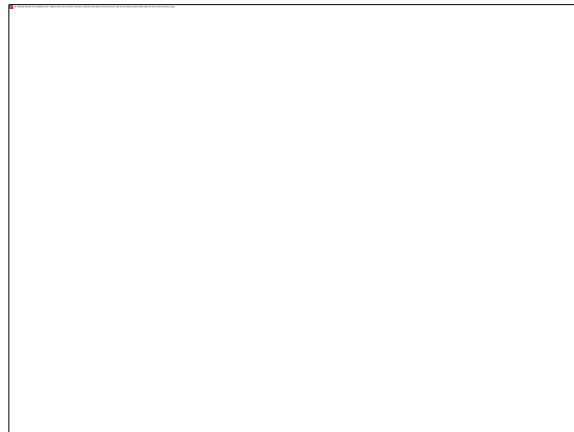


Main data plate of the TRZ 03 turbine meter with type “A” meter head

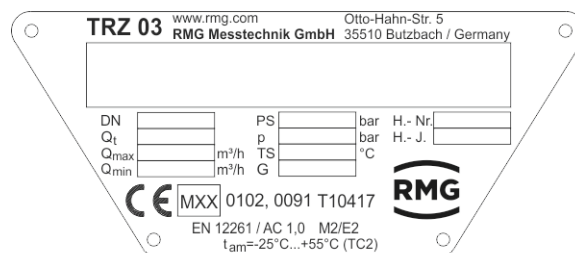
- TS: Permitted temperature range for meter housing (PED)
PS: Maximum permitted pressure for meter housing (PED)
t_{am}: Permitted temperature range for custody transfer metering (MID) “A”



Main data plate of the TRZ 03 turbine meter with type “D” meter head



Main data plate of the TRZ 03 turbine meter with type "F" meter head (PTB approval)

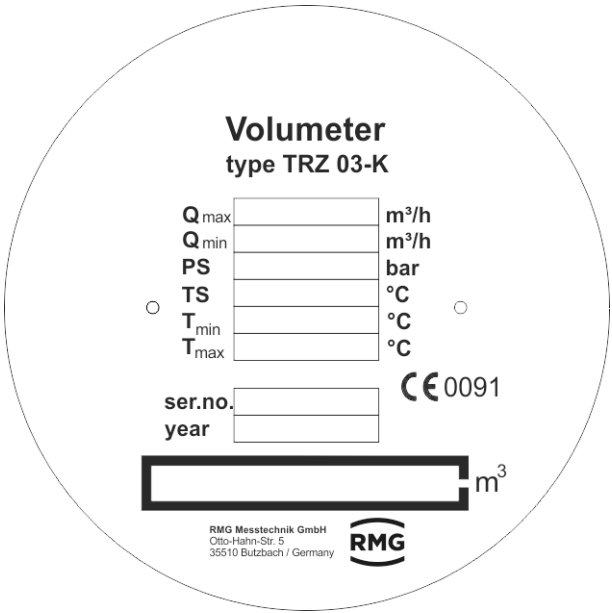


Main data plate of the TRZ 03 turbine meter with type "F" meter head (MID approval)

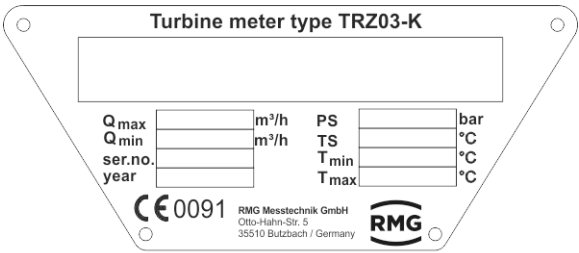
TS: Permitted temperature range for meter housing (PED)

PS: Maximum permitted pressure for meter housing (PED)

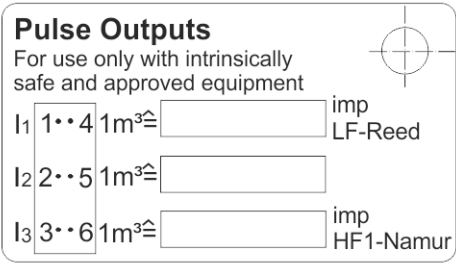
t_{am}: Permitted temperature range for custody transfer metering (MID) "F"



Main data plate of the volumeter with type “A” meter head



Main data plate of the volumeter with type “F” meter head



Built-in pulse transmitters, type “A”, “D” and “F” meter heads.
For use only with intrinsically safe and approved equipment.

Re - Lubrication

At 3 month intervals, 2 strokes.
Lubricant: 2 - 4°E with 25°C
The containervolume of 0,15 litre
is for 3 years sufficient.
Supplementary info see operating instruction.

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Indicating plate for relubrication of the main bearings

At 3-month intervals, 2 strokes. Lubricant: 2 - 4°E with 25°C. The containervolume of 0,15 litre is for 3 years sufficient. Supplementary info see operating instruction.

Re - Lubrication

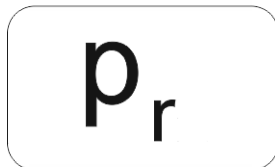
At 3 month intervals, 6 strokes.
Lubricant: 2-4°E with 25°C
The containervolume of 8 ml
is for 2½ years sufficient.
Supplementary info see operating instruction.

Indicating plate for relubrication of the main bearings

At 3-month intervals, 6 strokes. Lubricant: 2-4°E with 25°C. The containervolume of 8 ml is for 2½ years sufficient. Supplementary info see operating instruction.



Arrow indicating the direction of flow



Indication of the reference pressure tap

6. Specifications

6.1 Measuring ranges / Dimensions / Pressure classes TRZ03 (PTB)

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DN mm in	Size	Measuring range $Q_{\min}-Q_{\max}$ / m ³ /h		Ua m ³	Press. classes/Approx.				Dimensions mm			
		1:10/1:20	1:30		PN	kg	ANSI	kg	L	H	C	B
50 2"	G 40 G 65	13-65* ¹ 10-100* ²	-	0,1 0,1	10/16	13	150	13				
					25/40	21	300	13	150	210	60	160
					100	21	600	21				
80 3"	G 100	16-160	-	1	10/16	20	150	20				
	G 160	12.5-250* ²	-	1	25/40	25	300	25	240	230	96	180
	G 250	20-400* ²	-	1	100	34	600	36				
100 4"	G 160	12.5-250	-	1	10/16	25	150	30		240		
	G 250	20-400	-	1	25/40	32	300	35	300	260	120	200
	G 400	32-650	20-650	1	100	45	600	55		270		
150 6"	G 400	32-650	-	1	10/16	50	150	50		265		
	G 650	50-1000	32-1000	1	25/40	60	300	65	450	265	180	220
	G 1000	80-1600	50-1600	10	100	70/90	600	100		285		
200 8"	G 1000 G 1600	80-1600 125-2500	50-1600 80-2500	10 10	10/16	75	150	100		300		
					25/40	95	300	120	600	320	240	260
					64/100	150/160	600	160		320		
250 10"	G 1000	80-1600	-	10	10/16	100/110	150	110				
	G 1600	125-2500	80-2500	10	25/40	135/150	300	160	750	330	300	390
	G 2500	200-4000	130-4000	10	64/100	180/225	600	260				
300 12"	G 2500	200-4000	130-4000	10	10/16	138/150	150	155				
	G 4000	320-6500	200-6500	10	25/40	225/265	300	230	900	360	360	410
	G 4000 -45	320-6500	200-6500	10	64/100	275/290	600	310				
400 16"	G 4000	320- 6500	200-6500	10	10/16	200/290	150	350				
	G 6500	500-10000	320-10000	10	25/40	350/440	300	460	1200	400	480	450
	G 6500 -45	500-10000	320-10000	10	64/100	525/580	600	575				
500 20"	G 6500	500-10000	320-10000	10	10/16	560/610	150	620				
	G 10000	800-16000	500-16000	100	25/40	640/700	300	650	1500	450	600	490
	G 10000 -45	800-16000	500-16000	100	100	830/1060	600	1075				

600 24"	G 10000 G 16000	800-16000 1250- 25000	500-16000 800-25000	100 100	10/16	900/940	150	950				
					25/40	980/1075	300	1000	1800	500	720	540
					100	1230/1570	600	1600				

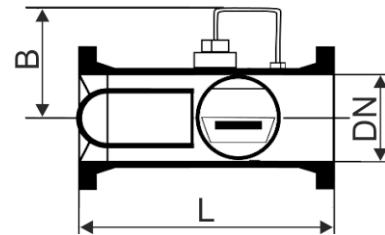
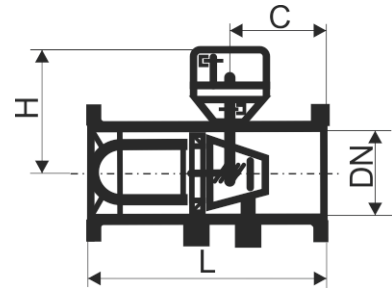
*¹ (Measuring range 1:5)

DN 500 and DN 600 only ANSI600RF
(other flanges only on request)

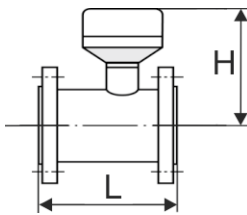
*² For DN50 / DN80 a measuring rang of 1:20 is only achievable for $p \geq 3$ barg

PN pressure classes complying with
DIN EN 1092,
ANSI pressure classes complying with
B16.5

The turbine meters of all pressure
classes can be fitted with a thermowell
to accommodate a resistance
thermometer.

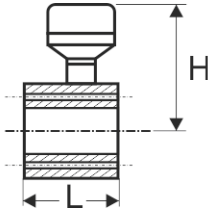


6.2 Measuring ranges / Dimensions / Pressure classes TRZ03-K

Nominal dia DN mm Zoll		Measuring range $Q_{min}-Q_{max}$ m ³ /h	U_a m ³	Pressure classes	L mm	H* mm	Weight App. kg	Housing design
50	2"	6-100	0,1	PN 10, 16, 25, 40 ANSI 150, 300, 600	150	212	10	Flanged-end design
80	3"	13-160 16-250 (25-400)	1	PN 10, 16, 25 ANSI 150	120	245	14	
100	4"	25-400 (40-650)	1	PN 10, 16, 25 ANSI 150	150	255	25	
150	6"	40-650 65-1000 (100-1600)	1	PN 10, 16, 25 ANSI 150	175	285	40	
200	8"	100-1600 160-2500	10	PN 10, 16, 25 ANSI 150	200	305	60	
250	10"	160-2500 (250-4000)	10	PN 10, 16, 25 ANSI 150	300	300	70	
300	12"	250-4000 (400-6500)	10	PN 10, 16, 25 ANSI 150	300	365	100	
400	16"	400-6500 (650-10000)	10	PN 10, 16, 25 ANSI 150	600	390	280	
500	20"	650-10000 (1000-16000)	10	PN 10, 16, 25 ANSI 150	750	445	500	
				PN 40, 64, 100 ANSI 300, 600	750	515	650	
600	24"	1000-16000 (1600-25000)	100	PN 10, 16, 25 ANSI 150	900	465	650	
				PN 40, 64, 100 ANSI 300, 600	900	580	850	

DN500 and DN600 only on request.

The details about pressure range, weights and dimensions must be agreed upon when ordering.

Nominal dia DN mm in		Measuring range $Q_{min}-Q_{max}$ m ³ /h	U_a m ³	Pressure classes	L mm	H* mm	Weight App. kg	Housing design
50	2"	6-100	0,1	ANSI 300, 600	80	212	15	Monoflange design 
80	3"	10-160 16-250 (25-400)	1	ANSI 300, 600	120	245	35	
100	4"	25-400 (40-650)	1	ANSI 300, 600	150	255	50	
150	6"	40-650 65-1000 (100-1600)	1	ANSI 300, 600	175	285	100	
200	8"	100-1600 160-2500	10	ANSI 300, 600	200	305	130	
250	10"	160-2500 (250-4000)	10	ANSI 300, 600	250	300	200	

DN 300 - 1000 on request

* Dimension "H" with built-in totalizer

(with attached totalizer: dimension "H" + 28 mm)

6.3 Q_{min} depending on the operating pressure in natural gas

Values for custody transfer metering, according to MID approval

68	DN [mm]	G- value	Q _{max} [m³/h]	Flow [m³/h] at p _{min} =1 bar ^[1]		Q _{min} [m³/h] depending on operating pressure p _{min} [bar(g)]													
				MR ^[2] 1:20		MR 1:30		MR 1:50		MR 1:80		MR 1:100		MR 1:120		MR 1:160			
				Q _t	Q _{min}	Q _{min}	p _{min}	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	65	100	20	5 ^[3]															
	100	160	32	8 ^[3]	5	15	3,2	50											
80	160	250	50	12,5	8	3	5	10	3,2	50									
	250	400	80	20	13	3	8	10	5	25									
100	160	250	50	12,5	8	3	5	25											
	250	400	80	20	13	3	8	10	5	25									
	400	650	130	32	20	3	13	4	8	10	6,5	15	5	25					
150	400	650	130	32	20	3	13	10	8	25	6,5	40							
	650	1000	200	50	32	3	20	4	13	10	10	15	8	25					
	1000	1600	320	80	50	3	32	4	20	10	16	15	13	25	10	40			
200	1000	1600	320	80	50	3	32	4	20	10	16	15	13	25	10	40			
	1600	2500	500	125	80	3	50	4	32	10	25	15	20	25	16	40			
250	1000	1600	320	80	50	3	32	10	20	25	16	40							
	1600	2500	500	125	80	3	50	4	32	10	25	25	20	40	16	60			
	2500	4000	800	200	130	3	80	4	50	10	40	25	35	40	25	60			
300	2500	4000	800	200	130	3	80	4	50	10	40	25	35	40	25	60			
	4000	6500	1300	320	220	3	130	10	80	25	65	40	55	60	40	80			
	4000-45	6500	1300	320	220	3	130	10	80	25	65	40	55	60	40	80			
400	4000	6500	1300	320	220	3	130	10	80	25	65	40	55	60	40	80			
	6500	10000	2000	500	335	3	200	10	125	25	100	40	85	60	63	80			
	6500-45	10000	2000	500	335	3	200	10	125	25	100	40	85	60	63	80			
500	6500	10000	2000	500	335	3	200	10	125	25	100	40	85	60	63	80			
	10000	16000	3200	800	535	3	320	10	200	25	160	40	135	60	100	80			
	10000-45	16000	3200	800	535	3	320	10	200	25	160	40	135	60	100	80			
600	10000	16000	3200	800	535	3	320	10	200	25	160	40	135	60	100	80			
	16000	25000	5000	1250	835	3	500	10	315	25	250	40	210	60	160	80			

^[1] $p = 1 \text{ bar}$; means atmospheric pressure

^[2] $MR = \text{Measuring range} = Q_{max} / Q_{min}$

^[3] $MR: 1:20$; for $p \geq 3 \text{ bar(g)}$

To get the Q_{min} , the high pressure value for defined values of the operating pressure and for other gas types you can calculate it using the formula in *chapter 1.8.1 Extension of the measuring range* or you can contact the RMG service.

6.4 Values for secondary metering for meters without MID approval

G	Q _{max} m ³ /h	Q _{min} LP ¹⁾ m ³ /h	Q _{min} , HP – natural gas m ³ /h								
			Operating pressure in bar _a								
			5	10	15	20	30	40	50	60	100
65	100	10 ²⁾	5	4	3	3	2	2	2	2	1
100	160	16 ²⁾	7	6	4	4	3	3	2	2	2
160	250	13	7	6	4	4	3	3	2	2	2
250	400	20	11	8	6	6	5	4	4	3	2
400	650	32	18	13	10	9	7	6	6	5	4
650	1000	50	28	20	16	14	11	10	9	8	6
1000	1600	80	44	31	26	22	18	16	14	13	10
1600	2500	130	72	51	42	36	29	26	23	21	16
2500	4000	200	111	78	64	55	45	39	35	32	25
4000	6500	320	178	126	103	89	72	63	56	51	40
6500	10000	500	277	196	160	139	113	98	88	80	62
10000	16000	800	444	314	256	222	181	157	140	128	99
16000	25000	1300	721	510	416	361	294	255	228	208	161

1) LP-standard measuring ranges 1:20 and 1:30 (on request)

2) Measuring range 1:10

To get the Q_{min}, HP value for defined values of the operating pressure and for other gas types you can calculate it using the formula in *chapter 1.8.1 Extension of the measuring range* or contact RMG.

6.5 Overview of the materials used



Designation	Material
Meter housing	GGG40, cast steel or welded steel *
Flow straightener	Delrin, aluminium or steel
Turbine wheel	Delrin or aluminium
Measuring element housing	Aluminium
Measuring element bearings	Aluminium and/or stainless steel
Ball bearings	Stainless steel
Shafts	Stainless steel
Gearing	Stainless steel or plastic
Magnetic coupling	Stainless steel
Meter head	Aluminium
Totalizer	Plastic
Meter board	Aluminium, die-cast zinc or brass

* The meter housing DN50 and DN80 can be made of round steel (solid material) for the lower pressure classes PN10, PN16, PN25, PN40 and ANSI150. Please contact RMG if necessary.

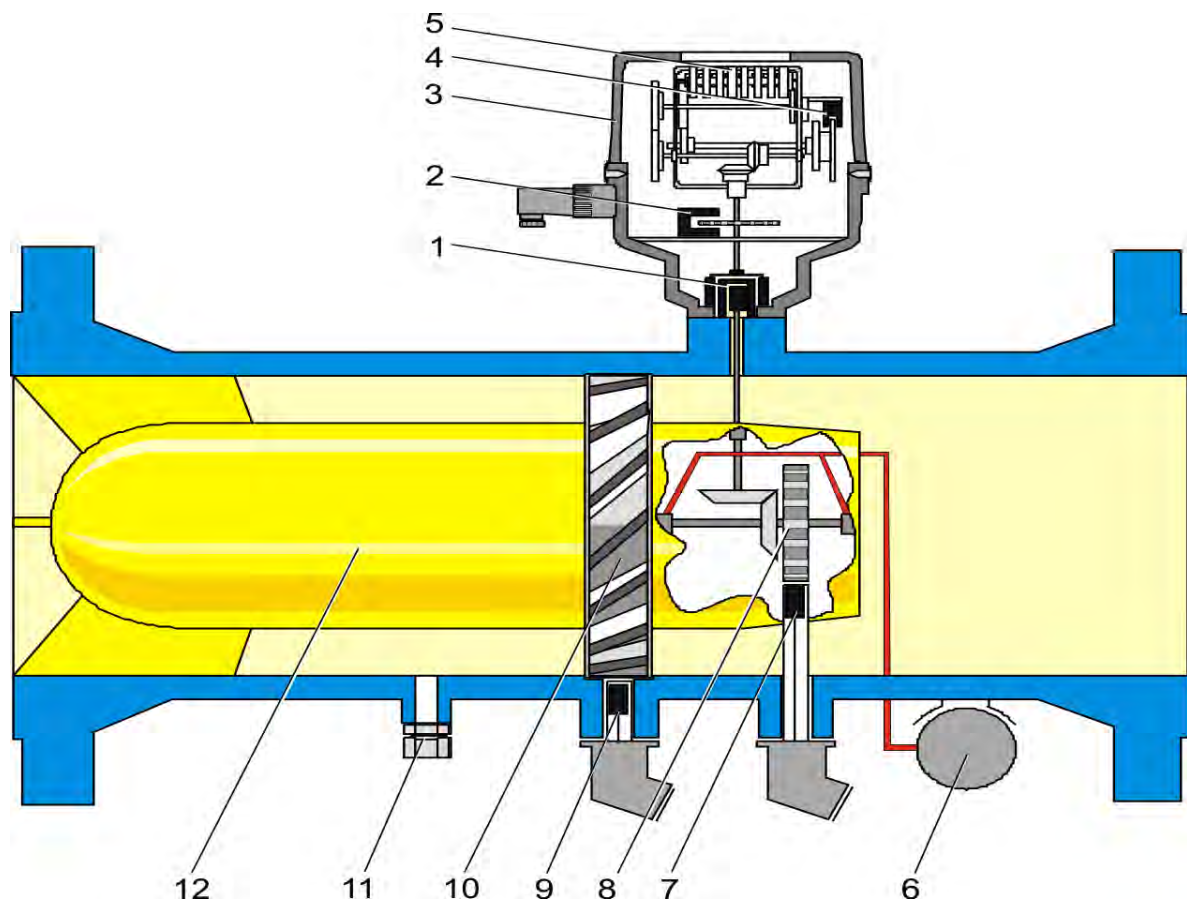
Annex

Certificates for LF-/HF-sensors and encoder

The transmitters used in the turbine meters have their own ATEX approval and are marked according to the following table.

Pulse transmitter type	Type of sensor	EC-Type examination Certificate according to directive 94/9/EG	Manufacturer	Annex
LF-pulse transmitter (LF)	Reed contact: 59140-010	Not required (passive component)	Hamlin IP22 4NX Diss, Norfolk England	A 1 page
HF-pulse transmitter (HF1)	Inductive proximity switch: N7S20A	BVS 08 ATEX E026 IECEX BVS 09.0016  II 1 G Ex ia IIC T* Ga	IFM electronic D-45127 Essen Germany	B 5 pages
HF-pulse transmitter (HF2 and HF3)	Inductive proximity switch: NF503A	PTB 01 ATEX 2192 IECEX PTB 08.0058  II 1 G Ex ia IIC T5 Ga	IFM electronic D-45127 Essen Germany	C 8 pages

* see the certificate below



- 1 Magnetic coupling
- 2 High-frequency pulse transmitter HF1
- 3 Meter head type „F“
- 4 Low-frequency pulse transmitter LF
- 5 Digital index
- 6 Oil pump
- 7 High-frequency pulse transmitter HF2
- 8 Reference wheel
- 9 High-frequency pulse transmitter HF3
- 10 Turbine wheel
- 11 p_r connection
- 12 Flow straightener

Figure 12: Sectional drawing of a turbine meter

Certificates

- EU-Declaration of Conformity TRZ 03
- EU-Declaration of Conformity TRZ 03-K
- EG-Baumusterprüfbescheinigung für NF- und HF-Sensoren
- EG-Baumusterprüfbescheinigung (1. Nachtrag) für NF- und HF-Sensoren
- EG-Baumusterprüfbescheinigung für NF- und HF-Sensoren
- EG-Baumusterprüfbescheinigung (1. Ergänzung) für NF- und HF-Sensoren
- EG-Baumusterprüfbescheinigung (2. Ergänzung) für NF- und HF-Sensoren
- EG-Baumusterprüfbescheinigung (3. Ergänzung) für NF- und HF-Sensoren
- EU-type examination certificate
- Production Quality Assurance Notification
- Certificate on Pressure Equipment Directive 2014/68/EU Modul D
- Certificate on the approval of a quality system
- EU-type examination certificate – production type Modul B according to directive 2014/68/EU TRZ 03
- EU-type examination certificate – production type Modul B according to directive 2014/68/EU TRZ 03-k

Contact

Subject to technical modification

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