www.bellflowsystems.co.uk

COMMON

# ROTARY GAS METER

P:CGR/E/10/00

# CGR



The rotary gas meters are positive displacement meters, designed to measure quantity of gas, for custody transfer mainly. The devices applied in the measured gas flow range from 0.2 up to 650 $m^3/h$ and the pressure range from 0.02 up to 16 bar. In special design, rotary gas meters are also applicable in higher pressure and flow ranges.The majority of applications are in regional or local gas stations. Especially for the industrial customers, the rotary gas meters are used as the satysfying all technical demands for a very precise measurement of gas, based on the wide measurement ranges and resistance against perturbations. With the housing in HTB version, the gas meters can be also applied in living areas.

COMMON

# 1 DESIGN AND FUNCTION

The gas flow through the rotary gas meter measurement chamber makes the two eight-shaped rotors to turn. The volume of gas, closed between the measuring chamber wall and rotor, is transported four times in one full cycle from the meter inlet to the outlet. The synchronising wheels set the rotors at the angle of 90° one to the other. The rotary motion of the rotor is transferred mechanically by gear wheels and the gas tight and hermetic incorporated magnetic coupling to the counter unit, which is mounted outside and shows the operating volume by the totalizer.
The measurement cartridge, as a separate unit, is fixed in the pressure resistant housing by means of Elastomere gaskets. The eventual possible small stresses of the housing, for example non aligned pipeline, have no influence on the rotary gas meter result of measurement.

Moreover, the measurement cartridge parts, independently of the applied housing material, are made of materials with close values of thermal expansion coefficients. That's why temperature stresses don't occur, which could cause the rotors jam in the small measuring gaps. It makes possible to reduce significantly gas leaks, which exist between the rotors and the measuring chamber inside walls, as well as measure reliably the small gas volumes with the demanded error ranges. It results in wide measuring ranges of our CGR rotary gas meters.

The CGR rotary gas meter consists of the following main components:

- pressure resistant housing
- measuring cartridge
- magnetic coupling as the transferring element between measuring cartridge and counter unit
- counter unit

All the serviceable and maintained parts, like totalizer, oil filling and draining holes, or oil level sight-glass, are located on the front side of the meter. It makes possible, to mount the meter on the inaccessible rear wall.

pict.1: CGR rotary gas meter

# 2 GENERAL TECHNICAL DATA

Table 1:

| G - Size | | Qmax [m³/h] | EU Qmin 1:20 [m³/h] | national Qmin [m³/h] | cycle Volume [dm³] | LF pulse ratio | national range-ability |
|---|---|---|---|---|---|---|---|
| **G16** | DN 40/50 | 25 | 1,3 | 0,2 | 0,229 | 0,1 | 1:130 |
| | | 25 | 1,3 | 0,3 | 0,316 | 0,1 | 1:80 |
| **G25** | DN 40/50 | 40 | 2 | 0,2 | 0,229 | 0,1 | 1:200 |
| | | 40 | 2 | 0,3 | 0,316 | 0,1 | 1:130 |
| | | 40 | 2 | 0,4 | 0,503 | 0,1 | 1:100 |
| **G40** | DN 40/50 | 65 | 3 | 0,3 | 0,316 | 0,1 | 1:200 |
| | | 65 | 3 | 0,4 | 0,503 | 0,1 | 1:160 |
| | | 65 | 3 | 0,6 | 0,823 | 0,1 | 1:100 |
| **G65** | DN 50/80 | 100 | 5 | 0,4 | 0,503 | 0,1 | 1:250 |
| | | 100 | 5 | 0,6 | 0,823 | 0,1 | 1:160 |
| | | 100 | 5 | 0,8 | 1,262 | 0,1 | 1:130 |
| **G100** | DN 50/80 | 160 | 8 | 0,6 | 0,823 | 1 | 1:250 |
| | | 160 | 8 | 0,8 | 1,262 | 1 | 1:200 |

- pressure levels: PN 10 /16
  ANSI 150
  (HTB pressure range up to 4 bar)

- meter sizes: G16 up to G250 (G 400 under preparation)
  DN 40 up to DN 100

- meter bodies: Aluminium
  EN-GJS-400-15

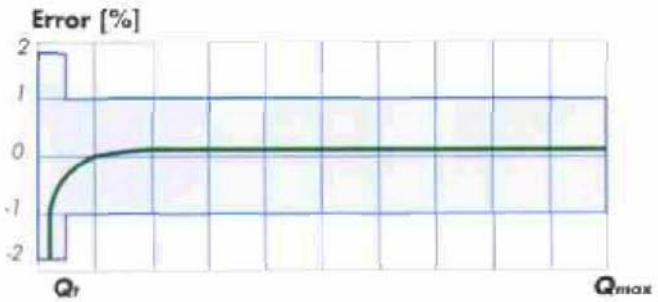
- flow rate: 0.2 up to 400 m3/h (up to 650 m3/h under preparation)

- flow directions: variable (by turning the meter, the counter unit and eventually by changing of the oil filling and oil draining screw)

- measurement ranges: EU certification 1:20
  dependent on the meter size up to 1:250 national

- upstream pipe — minimum 2 x DN;
meters meet the requirements of the OIML R32 89 Annex A.

- measurement accuracy: EC / PTB requirements and better.
guarantee at least: $Q_t - Q_{max} > \pm 1\%$
$Q_{min} - Q_t > \pm 2\%$




pict.2: Measurement error curve of the CGR rotary gas meter (Qt @ transitional flow)

- temperature range: gas temperature -10°C to +60°C
ambient temperature -25°C to +60°C

- allowed medias: see table 2.

Table 2:

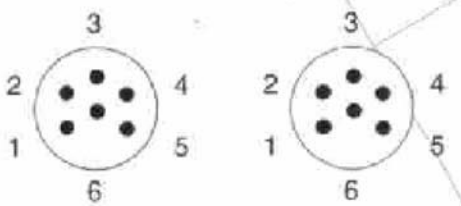
| Gas | Symbol | Density $\rho_n^*$ [kg/m³] | Density to air |
|---|---|---|---|
| Argon | Ar | 1,78 | 1,38 |
| Ethylene | $C_2H_4$ | 1,26 | 0,98 |
| Butan | $C_4H_{10}$ | 2,71 | 2,09 |
| Ethan | $C_2H_6$ | 1,36 | 1,06 |
| Netural | – | 0,83 | 0,64 |
| Helium | He | 0,18 | 0,14 |
| Carbon dioxyde | $CO_2$ | 1,97 | 1,53 |
| Carbonmonoxide | CO | 1,25 | 0,97 |
| Air | 1,29 | 1,00 | |
| Methan | $CH_4$ | 0,72 | 0,55 |
| Propan | $C_3H_8$ | 2,01 | 1,56 |
| Nitrogen | $N_2$ | 1,25 | 0,97 |
| Hydrogene | $H_2$ | 0,09 | 0,07 |

* ($\rho_n$ @ 1013.25 mbar and 273.15K)

# 3 COUNTER UNIT AND PULSE SENSOR

The mechanical counter unit indicates the actual volume of the measured gas at operating temperature and operating pressure. The counter unit is equipped with a low frequency (LF) Reed contact as a standard.
As a special design of the counter unit we can offer:

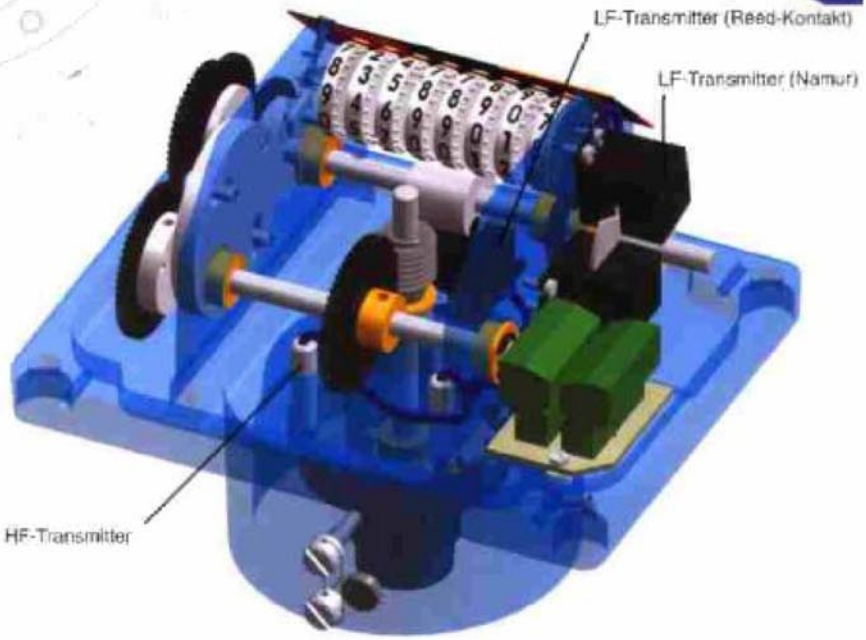
- LF-pulse sensor (NAMUR)
- HF-pulse sensor (NAMUR)




pict.3: Pulse sensor outputs in the counter unit

Plug pin connection example:
1-4:LF 2-5:LF or HF 3-6:HF
(other plug connection variants reserved)

The counter unit can be turned axially in 350° range. On request the counter unit could be carried out with a ventilation for condensate formation prevention.




*Pic. 4: Counter unit.*

- LF-Reed-contacts in the counter unit LF-pulse sensor (Reed-contact) (one LF-Reed-contact as a standard) LF-pulse sensor (Namur)
- LF-Inductive-pulse sensors in the HF-pulse sensor counter unit (NAMUR)
- HF-Inductive-pulse sensors in the counter unit (NAMUR)

The electrical pulse sensors can be connected by an admitted plug. The counter unit can be optionally equipped with doubled sensors and the sockets.

*Table 3:*

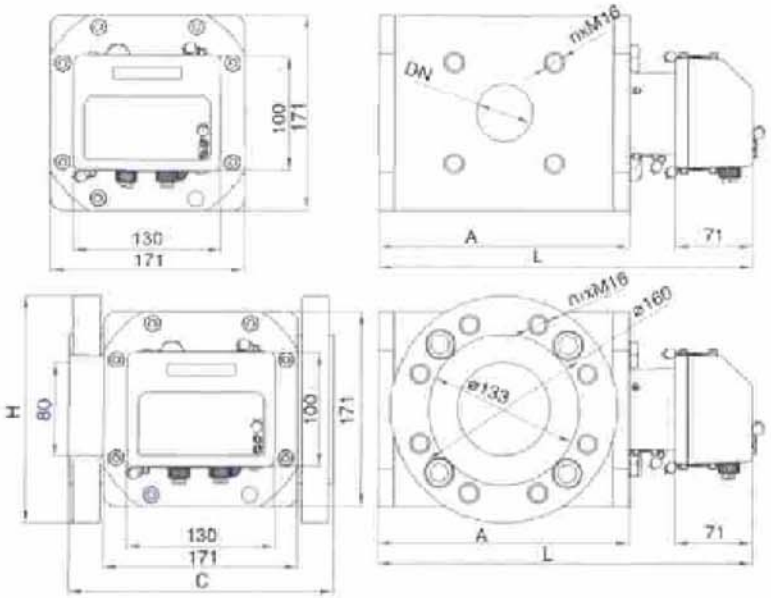
| | |
|---|---|
| **a) technical data of the Reed-contacts** | |
| switching voltage: | max. 30 V |
| switching current: | max. 100 mA |
| contact resistance: | 0.5 Ω |
| **b) technical data of the NAMUR-pulse transmitter** | |
| supply voltage: | 8 V |
| supply current (Low): | < 1.2 mA |
| supply current (High): | < 2.1 mA |
| load resistance: | ≤ 1 kΩ |

# 4 PRESSURE AND TEMPERATURE MEASUREMENT

The operating pressure or also named reference pressure can be taken from the $p_r$ point, located in the centre of the meter body.
For the measurement of the operating gas temperature, the meters can be optionally equipped with two temperature pockets.

# 5 DIMENSIONS

The main dimensions and the net weight of CGR rotary gas meters are shown in table 4 .




pic.5: Dimensions of the CGR rotary gas meter

*Table 4:*

| G size | 40 | DN 50 | 80 | n | n1 | A mm | C mm | H mm | L mm | Weight Al [kg] | Weight cast iron [kg] | cycle Volume [dm³] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| G 16 | + | + | | 4 | - | 165 | - | - | 248 | 10 | - | 0,229 |
| | + | + | | 4 | - | 184 | - | - | 267 | 12 | - | 0,316 |
| G 25 | + | + | | 4 | - | 165 | - | - | 248 | 10 | - | 0,229 |
| | + | + | | 4 | - | 184 | - | - | 267 | 12 | - | 0,316 |
| | + | + | | 4 | - | 225 | - | - | 308 | 14 | 25 | 0,503 |
| G 40 | + | + | | 4 | - | 184 | - | - | 267 | 12 | - | 0,316 |
| | + | + | | 4 | - | 225 | - | - | 308 | 14 | 25 | 0,503 |
| | + | + | | 4 | - | 295 | - | - | 378 | 19 | 31 | 0,823 |
| G 65 | | + | | 4 | - | 225 | - | - | 308 | 14 | 25 | 0,503 |
| | | + | | 4 | - | 295 | - | - | 378 | 19 | 31 | 0,823 |
| | | + | | 4 | - | 391 | - | - | 474 | 24 | 37 | 1,262 |
| | | | + | 8 | - | 295 | - | - | 378 | 19 | 31 | 0,823 |
| | | | + | 8 | - | 391 | - | - | 474 | 24 | 37 | 1,262 |
| G 100 | | + | | 4 | - | 295 | - | - | 378 | 19 | 31 | 0,823 |
| | | + | | 4 | - | 391 | - | - | 474 | 24 | 37 | 1,262 |
| | | | + | 8 | - | 295 | - | - | 378 | 19 | 31 | 0,823 |
| | | | + | 8 | - | 391 | - | - | 474 | 24 | 37 | 1,262 |
| | | | + | - | 8 | 295 | 240 | 200 | 378 | 24 | - | 0,823 |
| | | | + | - | 8 | 391 | 240 | 200 | 474 | 29 | - | 1,262 |

# 6 PERFORMANCE OF THE CGR ROTARY GAS METER

In principle a meter measures the quantity of gas flowing under given operating conditions (pressure and temperature). This volume is displayed at the counter as operating volume in $m^3$. The most important factor of the meter size selection is the expected minimum and maximum flow quantity under operating conditions. The nominal diameter should be defined in that way, that the flow velocity in a pipe of the same diameter will not exceed 20 m/s.
As generally, for custody transfer starting from an operating pressure of 1 bar the standard volume is used, for the meter size determination it is often necessary to convert the data from standard into operating volume. This could be done with the following formula:

$$V_b = V_n * k * \frac{p_n}{p_b} * \frac{T_b}{T_n} = V_n * Z * \frac{(t + 273)}{273 * (p_e + 1)}$$

where $k = Z / Z_n$

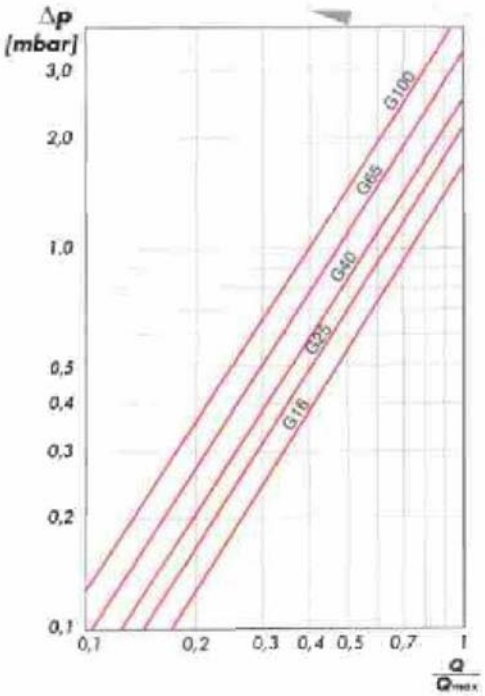
**Definition:**

$V_b$ =operating volume [$m^3/h$]
$p_n$ =standard pressure (abs.) [bar] (1.01325 bar)
$V_n$ =standard volume [$m^3/h$]
$p_b$ =operating pressure (abs.) at the rotary meter [bar]
$k$ =compressibility factor k
$p_e$ =operating over pressure at the rotary meter [bar] (fixed-term or calculation methods)
$T_n$ =standard gas temperature absolute [K] (273.15K) according GERG 88 or AGA NX 19)
$T_b$ =operating gas temperature absolute [K]
$Z$ =real gas factor
$t$ =operating gas temperature [°C]

Possible time limited and small overflows have no influence on the functionality.

# 7 PRESSURE LOSS OF THE CGR ROTARY GAS METER

The inevitable pressure loss during the gas flow through the meter is being determined under atmospheric conditions. The raise of pressure loss, which is connected to the resonance phenomenon occurring in some specific installations, can not be considered by following specified values and calculations.




pict.6: Diagram of pressure loss relating to $\rho = 1{,}2\ kg/m^3$

For determination of pressure loss at atmospheric and higher pressures, following calculation applies:

$$\Delta p_2 = \Delta p_1 * \frac{\rho_b}{\rho_n} * \left(\frac{Q}{Q_{p1}}\right)^{1,667} \quad [mbar]$$

**Definition:**

| | | | | | |
|---|---|---|---|---|---|
| $\Delta p_1$ | = | pressure loss at Q [mbar] | $\rho_n$ | = | standard density of the gas [kg/m³] |
| $\rho_b$ | = | operation density of the gas [kg/m³] | Q | = | real flow [m³/h] (for natural gas 0.83 kg/m³) |
| $\Delta p_2$ | = | pressure loss at Qmax [mbar] | Qmax | = | maximum flow [m³/h] |

# 8 INSTALLATION AND OPERATION RECOMMENDATIONS

- Meters should be shipped in their original package to the place of installation.
- Meters have to be protected from falls, direct influence of rain, snow or high humidity.
- Meters can be installed in horizontal or vertical position (counter unit is 350° rotatable).
  Attention should be paid that the oil sight glass is in the lower position.
- As fare as no guaranty is given, that the flowing gas is clean, dry and free from solid impurities, the upstream pipe installation has to be equipped with a filter (5 micron).
  Before putting into operation of new stations or pipelines, it is recommended to install a temporary sealing sieve or a cone sieve.

**Attention!** Pollution of gas can block the rotors abruptly and therefore damage the measurement cartridge, what results in blocking the gas flow.

- Before installation the exact alignment of pipe flanges upstream and downstream to the flange axe of the meter has to be secured.
- The meter will be delivered oil free. The meter is just to fill with oil after installation according to the operating instruction. Before disassembly, oil has to be drained off.
- The meter has to be installed horizontally and shock free, to guarantee running of the lubrication system.
- The CGR rotary gas meter has to be installed as possible in closed rooms.
  In outdoor installations a directweather protection should be used.
- When starting the gas flow through the installation, the valves should be opened slowly to ensure a gradual increase of pressure.

**Attention!** Abrupt valves opening or pressure loading can damage the measurement cartridge and rotors.