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+44 (0) 191 490 1547
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COMMON

ROTARY GAS METER

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ROTARY GAS METER CGR

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The rotary gas meters are positive displacement meters, designed to measure quantity of gas, for custody transfer or technical measurement applications. The devices are mainly applied for gas flow ranges from 0.2 up to 650 m³/h, and the pressure range up to 20 bar. Special design rotary gas meters may also be used in higher pressure installations.

The CGR Rotary Gas Meters are applied in measurement systems where high accuracy is required:

- transportation of natural gas
- primary and secondary measurements
- control metering of natural gas and non aggressive technical gases in industry
- flow measurement for technical purposes

The majority of applications are regional or local gas stations. Being a very precise instruments, resistant to disturbances and having a wide measurement range, the CGR Rotary Gas Meters satisfy all technical demands of customers.

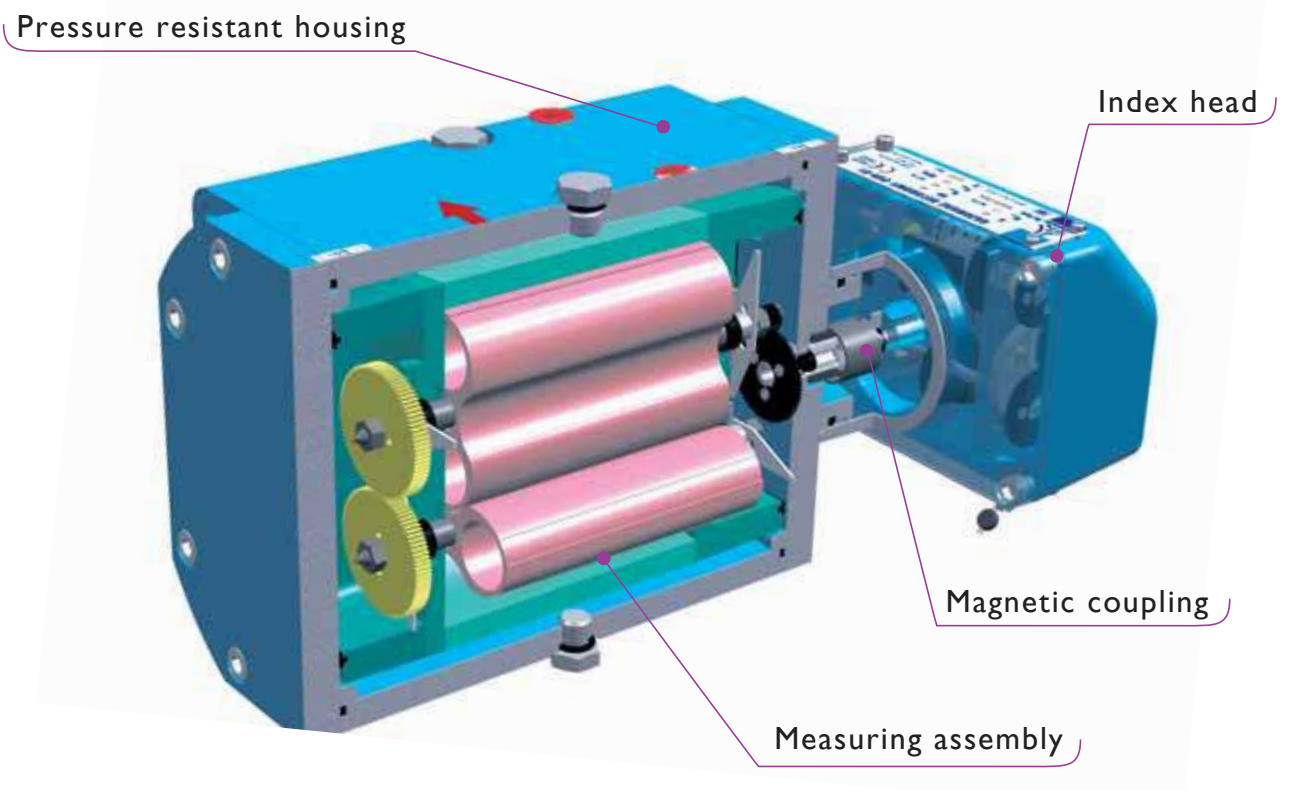
1 DESIGN AND FUNCTION

The gas flow through the rotary gas meter measurement chamber makes the two “8”-shaped rotors to turn. The volume of gas closed between the measuring chamber walls and rotors is transported four times in one full cycle from the meter inlet to the outlet. The timing gears set the rotors at the angle of 90° one to the other. The gear train, and the incorporated gas tight and hermetic magnetic coupling, transfers the rotor rotation to the index unit, which is separated in that way from the pressure tight housing. The actual volume of gas is indicated on the mechanical counter. The measurement cartridge, as a separate unit, is fixed in the pressure resistant housing by means of elastomere gaskets. Thanks to this, the possible stresses, e.g. arising from improperly aligned piping, have no influence on measurement results of the CGR Rotary Gas Meter. Moreover, the measuring cartridge elements are made of materials with carefully selected values of thermal expansion coefficients. This minimizes temperature stresses that could cause the rotor seizures. All above factors, together with the highest precision machining of parts allow to reduce small but necessary clearances between the moving rotors and the measurement chamber walls, what reduces gas leakages to minimum and results in very high accuracy and wide measuring ranges of our CGR Rotary Gas Meters.

The CGR Rotary Gas Meter consists of the following main assemblies:

- Pressure resistant housing
- Measuring assembly
- Magnetic coupling
- Index head

All parts subject to servicing or maintenance, like mechanical counter, LF (HF) sockets, oil filler and drain plugs, oil level sight-glass, are located on the front side of the meter. Thanks to this, it is not necessary to access the back side of the CGR meter and then it could be located very close to a wall or other construction element what reduces the installation deep.



2 GENERAL TECHNICAL DATA

table 1:

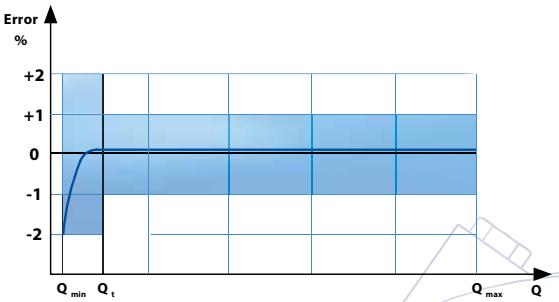
DN mm	G	Maximum flow Q_{max} [m³/h]	Minimum flow Q_{min} [m³/h] Rangeability 1:50	1:65	1:80	1:100	1:130	1:160	1:200	Version	V cyclic volume [dm³]	LF pulse rate [m³/pulse]
40/50	16	25	0,5	0,4	0,3	0,25	0,2	-	-	p	0,229	0,01
						-	-	-	-	w	0,316	
	25	40	0,8	0,6	0,5	0,4	0,3	0,25	0,2	s	0,229	0,1
								-	-	p	0,316	
								-	-	w	0,503	
	40	65	1,3	1,0	0,8	0,6	0,5	0,4	0,3	s	0,316	0,1
									-	p	0,503	
								-	-	w	0,823	
50	65	100	2,0	1,6	1,3	1,0	0,8	0,6	0,5	s	0,503	0,1
									-	p	0,823	
								-	-	w	1,262	
50/80	100	160	3,0	2,5	2,0	1,6	1,3	1,0	0,8	s	0,823	0,1
										p	1,262	
80/100	100	160	3,0	2,5	2,0	1,6	1,3	1,0	0,8	p	1,310	0,1
										w	2,020	
	160	250	5,0	4,0	3,0	2,5	2,0	1,6	1,3	s	1,310	0,1
										p	2,020	
										w	3,385	
100	250	400	8,0	6,0	5,0	4,0	3,0	2,5	2,0	s	2,020	1
										p	3,385	
	400	650	13	10	8,0	6,0	5,0	4,0	3,0	s	3,385	1

p – basic, recommended
s – high speed version, smaller sizes, higher possible rangeability, higher noise level
w – low speed version, bigger sizes, smaller possible rangeability, lower noise level

- pressure rating: PN16, ANSI150
- meter sizes: G16 up to G400
- nominal diameter: DN 40 up to DN 100
- meter body: Aluminium
- flow rate: 0,2 up to 650 m³/h
- flow directions: variable directions possible without any construction changes (see section 7: "Installation and operation recommendations")
- rangeability: up to 1:250, depending on the meter size
- temperature range: gas temperature -20°C to +60°C
  ambient temperature -25°C to +70°C
- allowed medias: see table 2

measurement accuracy: EU requirements and better guaranteed at least: $Q_t - Q_{max} < \pm 1\%$

$Q_{min} - Q_t < \pm 2\%$



Q_t – transition flow
Q_t = 0,1 Q_{max} for rangeability 1:50
Q_t = 0,05 Q_{max} for rangeabilities bigger then 1:50

Gas	Chemical symbol (formula)	Density ρ [kg/m³]	Density related to air	Gas meter execution
Argon	Ar	1,66	1,38	standard IIB
Butane	C_4H_{10}	2,53	2,10	standard IIB
Carbon dioxide	CO_2	1,84	1,53	standard IIB
Carbon monoxide	CO	1,16	0,97	standard IIB
Ethane	C_2H_6	1,27	1,06	standard IIB
Ethylene	C_2H_4	1,17	0,98	standard IIB
Helium	He	0,17	0,14	standard IIB
Methane	CH_4	0,67	0,55	standard IIB
Natural gas	-	~0,75	~0,63	standard IIB
Nitrogen	N_2	1,16	0,97	standard IIB
Propane	C_3H_8	1,87	1,56	standard IIB
Acetylene	C_2H_2	1,09	0,91	**special IIC**
Hydrogen	H_2	0,084	0,07	**special IIC**
Air	-	1,20	1,00	standard IIB

table 2: Physical properties of most popular gases that may be measured with the CGR Rotary Gas Meters - density at 101,325 kPa and at 20°C

3 MEASUREMENT OUTPUTS

PRESSURE AND TEMPERATURE OUTPUTS

Reference pressure (operating pressure) connection tap is located in the centre of the housing and is marked as “pr”. On the same side of the body there is another pressure tap for measuring the outlet pressure, if necessary. Same taps are also placed on the opposite side of the housing. For the measurement of the gas temperature, the gas meter can be optionally equipped with two temperature pockets located at the inlet side of the body. Same taps may be also placed on the opposite side of the housing.

PULSE SENSORS

The mechanical index unit indicates the actual volume of the measured gas at operating temperature and operating pressure. It can be rotated axially by 350° in order to facilitate the readings and enable easier connection of pulse sensor plugs.
The index unit is provided with one low frequency LFK reed contact pulse transmitter, as a standard. On request the index may be equipped with:
- LFI inductive pulse sensor (NAMUR)
- HF inductive pulse sensor (NAMUR)

HF	LFI	LFK, AFK
Ui = 16 V Dc	Ui = 15,5 V DC	Ui = 15,5 V DC
Ii = 25 mA	Ii = 52 mA	Ii = 52 mA
Pi = 64 mW	Pi = 169 mW	Pi = 169 mW
Li = 50 µH	Li ≈ 40 µH	Li ≈ 0
Ci = 30 nF	Ci = 28 nF	Ci ≈ 0

table 3: Permissible supply parameters of intrinsically safe circuits.

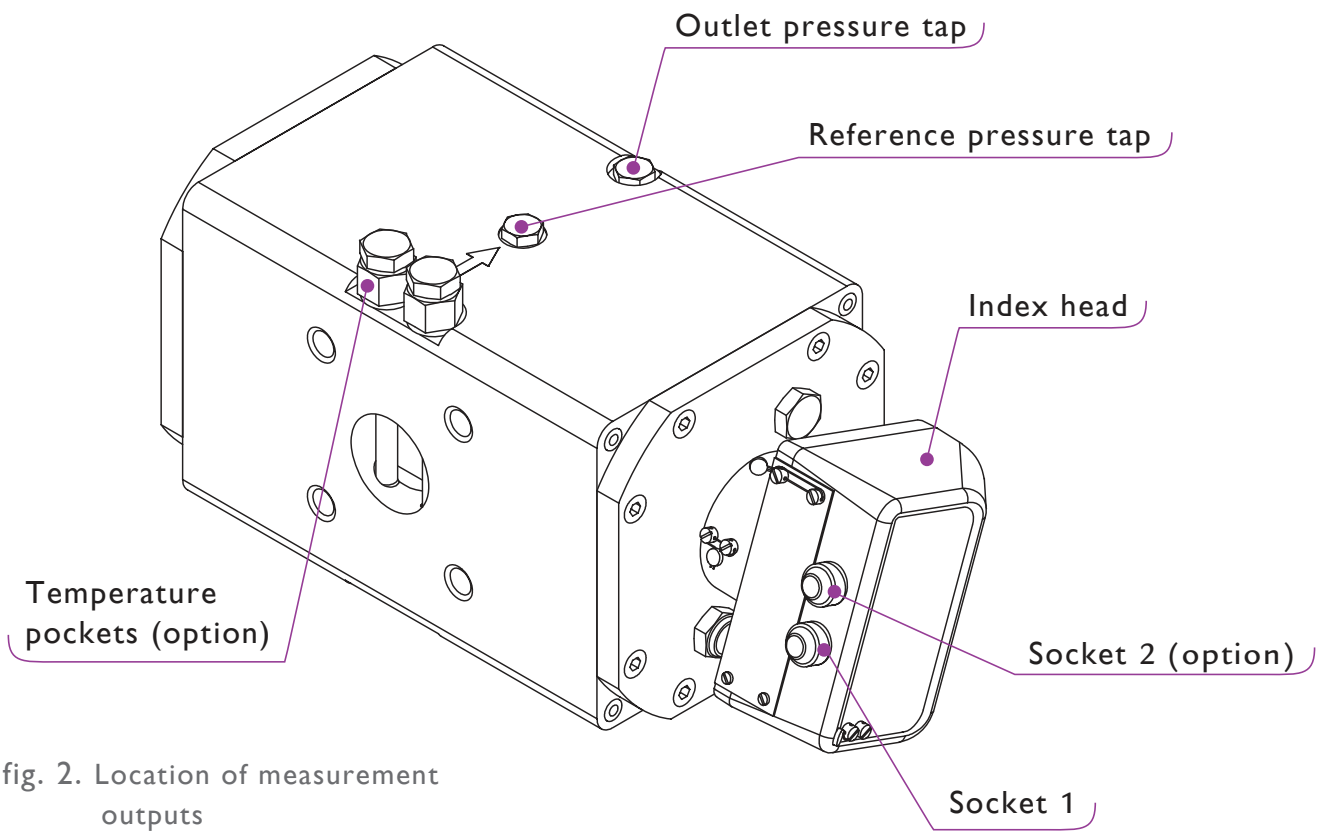
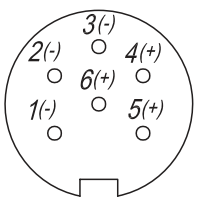


fig. 2. Location of measurement outputs

The CGR Rotary Gas Meters may be provided with up to 6 pulse sensors.

LFK	– low frequency reed contact pulse sensor	LFK1, LFK2
LFI	– low frequency inductive pulse sensor	LFI1, LFI2
HF	– inductive pulse sensor in the index unit	HF1, HF2
AFK	– anti-fraud reed contact	AFK

fig. 3 Pulse sensor pin numbering in sockets 1 and 2 installed in the index head



Pin No	Socket 1 pulse sensors	Socket 2 pulse sensors
1 - 4	LFK 1 (standard)	LFK 2
2 - 5	LFI 1	LFI 2
3 - 6	HF 1 or AFK	HF 2

The sockets match the TUCHEL plug No C091 31H006 100 2

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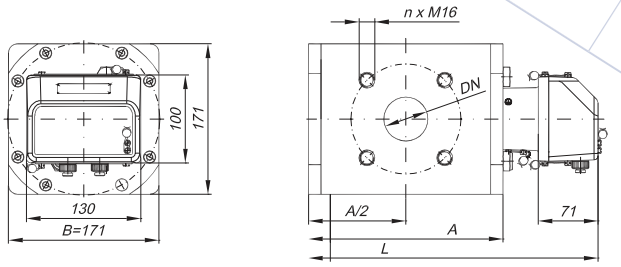
4 DIMENSIONS

The main dimensions and weights of the CGR Rotary Gas Meters are shown in table 4.

Series “171”



Series “241”

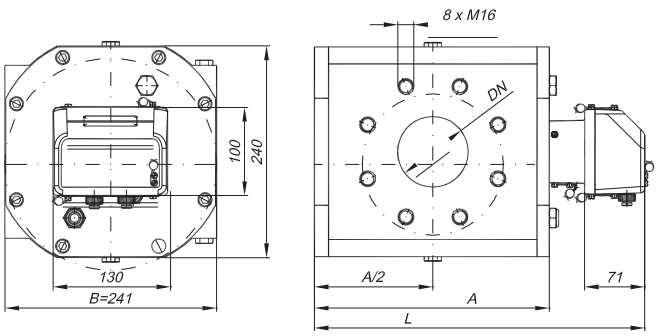


fig.5 Dimensions of the CGR Rotary Gas Meters

table 4

	DN				n	A	B	L	Weight	Cyclic volume
	40	50	80	100		mm	mm	mm	kg	dm³
G16p	+	+			4	165	171	277	10	0,229
G16w	+	+			4	184	171	296	12	0,316
G25s	+	+			4	165	171	277	10	0,229
G25p	+	+			4	184	171	296	12	0,316
G25w	+	+			4	225	171	337	14	0,503
G40s	+	+			4	184	171	296	12	0,316
G40p	+	+			4	225	171	337	14	0,503
G40w	+	+			4	295	171	407	19	0,823
G65s		+			4	225	171	337	14	0,503
G65p		+			4	295	171	407	19	0,823
G65w		+			4	391	171	503	24	1,262
G100s		+			4	295	171	407	19	0,823
G100p		+			4	391	171	503	24	1,262
G100s			+		8	295	171	407	19	0,823
G100p			+		8	391	171	503	24	1,262
G100p			+	+	8	249	241	356	25	1,310
G100w			+	+	8	314	241	421	31	2,020
G160s			+	+	8	249	241	356	25	1,310
G160p			+	+	8	314	241	421	31	2,020
G160w			+	+	8	439	241	546	42	3,385
G250s				+	8	314	241	421	31	2,020
G250p				+	8	439	241	546	42	3,385
G400s				+	8	439	241	546	42	3,385

p – basic, recommended

s – high speed version, smaller sizes, higher possible rangeability, higher noise level

w – low speed version, bigger sizes, smaller possible rangeability, lower noise level

5 SELECTION OF CGR ROTARY GAS METER

In order to choose the proper size of the rotary gas meter the following operating condition parameters should be known:

- flow range $Q_{min\ m}$ and $Q_{max\ m}$ [m^3/h]
- pressure range $p_{min\ m}$ and $p_{max\ m}$ [bar a]
- gas temperature range [K]

Usually flow range is given at standard conditions: Q_{minN} and Q_{maxN} [Nm^3/h]. Base conditions (NPT conditions: normal temperature and normal pressure) are country specific.
The following formula is to be used when converting standard flow cubic meters per hour into actual flow at operating conditions:

$$Q_{min\ m} = Q_{min\ s} \cdot Z \cdot \frac{p_s}{p_{max\ m}} \cdot \frac{T_{min\ m}}{T_s} \qquad Q_{max\ m} = Q_{max\ s} \cdot Z \cdot \frac{p_s}{p_{min\ m}} \cdot \frac{T_{max\ m}}{T_s}$$

DEFINITION:

$Q_{min\ m}$ = minimum flow at operating conditions [m^3/h]
$Q_{max\ m}$ = maximum flow at operating conditions [m^3/h]
$Q_{min\ s}$ = minimum standard flow [Nm^3/h]
$Q_{max\ s}$ = maximum standard flow [Nm^3/h]
p_s = base pressure (according to national standards) [bar a]
T_s = base temperature (according to national standards) [K]
$p_{max\ m}$ = maximum operating pressure [bar a]
$p_{min\ m}$ = minimum operating pressure [bar a]
$T_{max\ m}$ = maximum operating temperature [K]
$T_{min\ m}$ = minimum operating temperature [K]
Z = real gas factor at operating conditions (for PN16 $Z \approx 1$)

The gas meter size should be chosen (using actual flow at operating conditions) according to the following formula:

$$Q_{min} < Q_{min\ m}$$
$$Q_{max} > Q_{max\ m}$$

where Q_{min} and Q_{max} – minimum and maximum flow, typical for the selected gas meter.

6 PRESSURE LOSS

The inevitable pressure loss during the gas flow through the meter is determined at the atmospheric conditions.

To determine pressure losses for other gases and higher pressures, the following formula applies:

$$\Delta p_1 = \left(\frac{\rho}{\rho_a}\right) \cdot \left(\frac{p+p_s}{p_s}\right) \cdot \Delta p$$

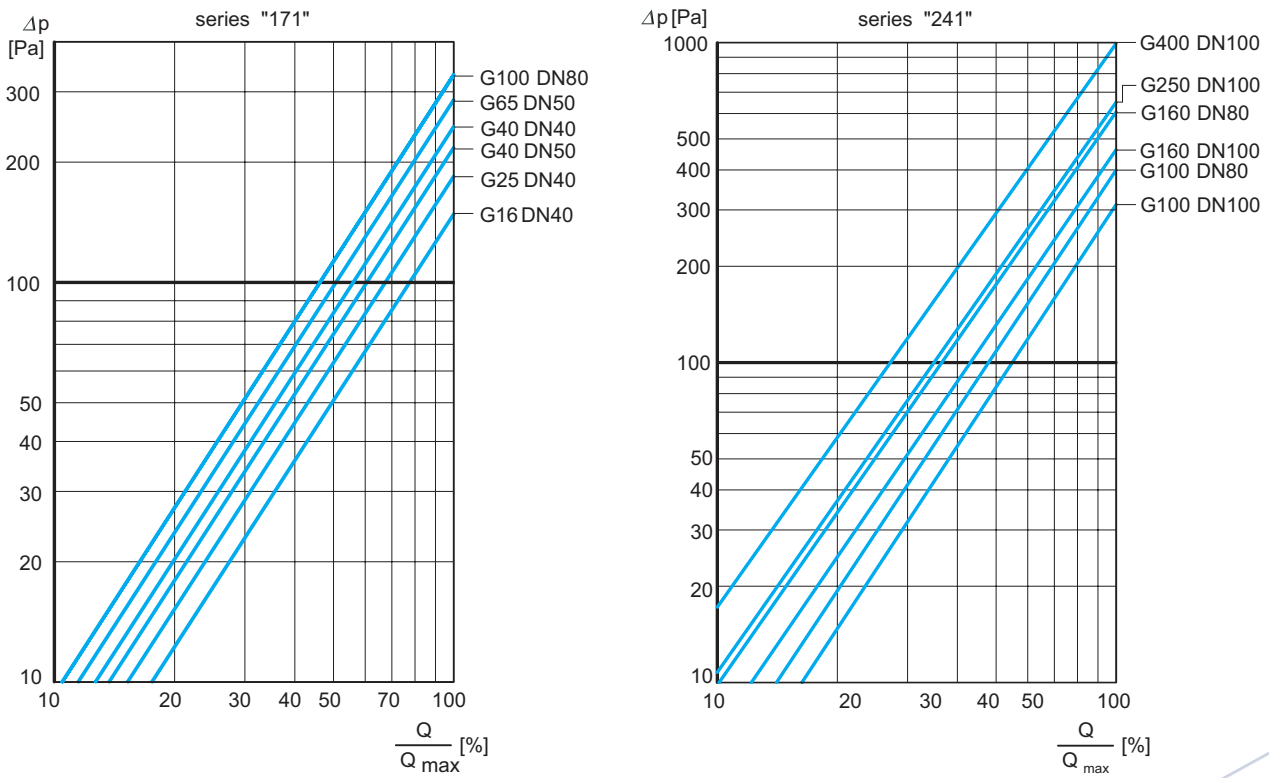


fig. 6 Diagram of pressure loss related to ρ = 1,2 kg/m³

DEFINITION:

Δp_1 = pressure loss at p
Δp = pressure loss from the diagram, fig. 6
p = gauge pressure [bar]
ρ = standard density of gas [kg/m³]
ρ_a = standard density of air (1,2 kg/m³)
p_s = base pressure (1.01325 bar)

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7 INSTALLATION AND OPERATION RECOMMENDATIONS

- Meters should be shipped in their original package to the place of installation.
- Meters have to be handled with care and be protected from falls, direct influence of rain, snow or high humidity.
- Meters can be installed in horizontal or vertical position (index head may be rotated by 350°).
- The upstream pipe installation have to be equipped with a gas filter (10 micron accuracy is recommended). Before putting into operation new stations or installations, it is recommended to install a Top Hat filter or a temporary cone sieve strainer.

ATTENTION! Heavy polluted gas can block the rotors abruptly. Therefore damages to the measurement cartridge may occur what results in blocking the gas flow!

- To assure proper work of the lubricating system, the meter has to be installed in horizontal position, and any mechanical shocks during the installation are not permitted.
- It is recommended to install the meter in closed compartments, if possible. When installed outdoors a protection against direct weather influence should be used.
- The piping should be executed so as to avoid unnecessary stresses acting on the meter.
- When starting the gas flow through the installation, the valves should be opened slowly to avoid gas impingement which could damage the meter.

ATTENTION! If valves are opened abruptly, or pressure increase takes place in a short time it may happen that the measurement cartridge will get damaged.

ALWAYS REMEMBER TO START UP THE METERS IN A PROPER WAY!

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COMMON S.A.
ul. Aleksandrowska 67/93
91-205 Łódź, Poland

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