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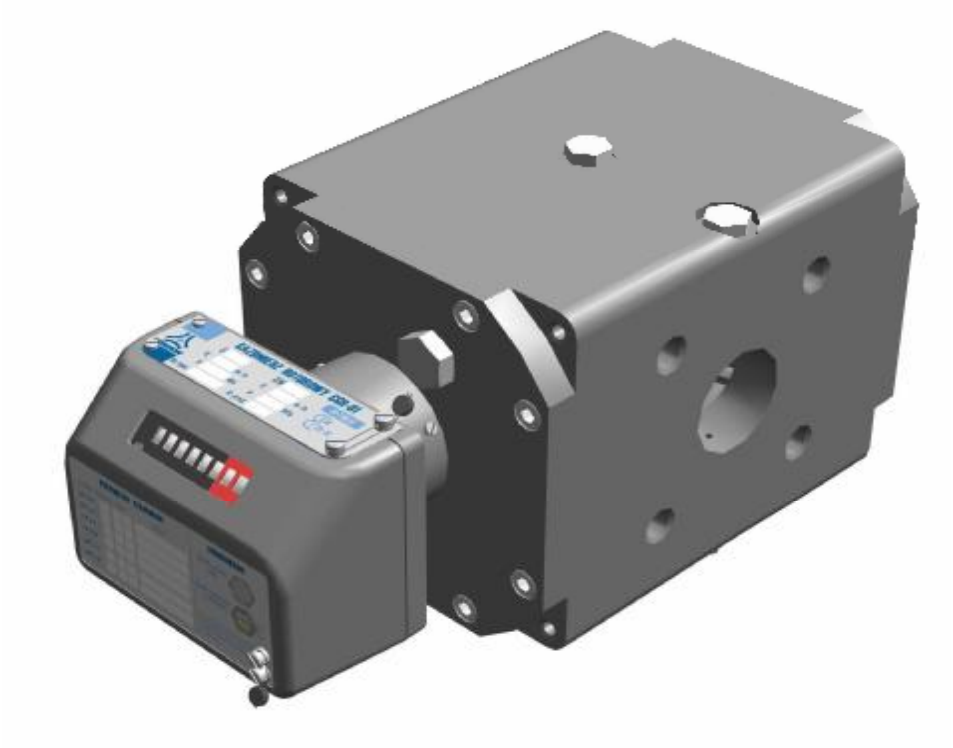
CGR-01 ROTARY PISTON GAS METERS

OPERATING INSTRUCTIONS



CGR/IU04/eng/01-07

PRIOR TO INSTALLATION AND START UP OF THE METER READ CAREFULLY THESE INSTRUCTIONS

Contents

I. DESIGN AND APPLICATION CONDITIONS

Design

CGR-01 Rotary Gas Meters are used for measurement of gas volume that flows through installation. Standard execution allows to install them in places where explosion hazard zones may occur (air and gas mixtures - class IIA and class IIB; with special execution – also class IIC). The CGR-01 Rotary Gas Meters may be used for measurement of gases indicated in Table 1. Maximum operating pressure for the CGR-01 Rotary Gas Meters is as follows:

- gas meters with PN16 connections - 1,6 MPa,
- gas meters with PN20 (ANSI150) connections - 2 MPa.

It is recommended to install the gas meters in compartments with stable temperature, but they are also suitable for outdoor installations. When installed outdoors they should be protected against direct influence of atmospheric conditions (in steel containers, cabinets, under roofs, shields, etc.). The meters may be used at ambient temperature range from -25°C up to + 70°C; the gas temperature range is from -20°C up to + 60°C.

Application conditions of CGR-01 rotary gas meters.

1. Conformity with the requirements of Directive 94/9/EC ATEX:

- certificate: KDB 04ATEX034,
- CE marking: CE 1453,
- application conditions: standard execution II 2G EEx ia IIB T4; special execution II 2G EEx ia IIC T4
- index housing protection: IP65,
- harmonised standards: PN-EN 13463-1:2003, PN-EN 50014:2002 (U), PN-EN 50020:2003 (U)

2. Conformity with the requirements of Directive 97/23/EC PED:

- certificate: 67/JN/2004-002/3,
- CE marking: CE 1433,
- maximum operating pressure: PN16 execution Pmax = 1,6 MPa, PN20 execution Pmax = 2 MPa.
- ambient temperature: -25° C ≤ Ta ≤ + 70° C
- harmonised standards: PN-EN 12392:2002 (U), PN-EN 1515:2002 (U), PN-EN 10269:2002 (U)
- other applied regulations: Requirements of Office of Technical Inspection Pressure equipment WUDT/UC/2003 (WUDT-UC-WO, WUDT-UC-WO-O/00, WUDT-UC-WO-O/01, WUDT-UC-WO-O/12, WUDT-UC-WO-O/19)

3. Conformity with other standards: PN-EN 12480:2004, PN-M-54832-4: 1994, PN-M-54832-1/A1: 1995, ZN-G-4010.

Table 1. Physical properties of most popular gases that may be measured with the CGR-01 Rotary Gas Meters - density at 101,325 kPa, and at 20^0 C

Gas or gas mixture	Chemical symbol (formula)	Density ρ [kg/m^3]	Density related to air	Gas meter execution
argon	Ar	1,66	1,38	standard IIB
nitrogen	N_2	1,16	0,97	standard IIB
butane	C_4H_{10}	2,53	2,1	standard IIB
carbon dioxide	CO_2	1,84	1,53	standard IIB
ethane	C_2H_6	1,27	1,06	standard IIB
ethylene	C_2H_4	1,17	0,98	standard IIB
natural gas	≈CH_4	ca. 0,75	ca. 0,63	standard IIB
helium	He	0,17	0,14	standard IIB
methane	CH_4	0,67	0,55	standard IIB
propane	C_3H_8	1,87	1,56	standard IIB
carbon monoxide	CO	1,16	0,97	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	standard IIB

Basic metrology parameters of the CGR-01 rotary gas meters are shown in Table 2.

This information is not to be regarded as a trade offer. Appropriate information may be obtained from authorised dealers or in Marketing Department.

Gas meters create a pressure loss in the installation. These values, for the CGR-01 Rotary Gas Meters, for the gas density ρ_0 = 1,2 kg/m^3, may be determined from the charts, Fig. 1.

At operating conditions the pressure drop Δp_{rz} [Pa] may be calculated from the following formula:

$$\Delta p_{rz} = \frac{r}{r_o} \frac{p_a + p}{p_a} \Delta p$$

where: ρ - gas density [kg/m^3], Table 1

p_a - atmospheric pressure ($p_a \cong 101$ [kPa]),

p - gauge pressure upstream the gas meter [kPa],

Δp - pressure loss at base conditions (Figure 1) [Pa].

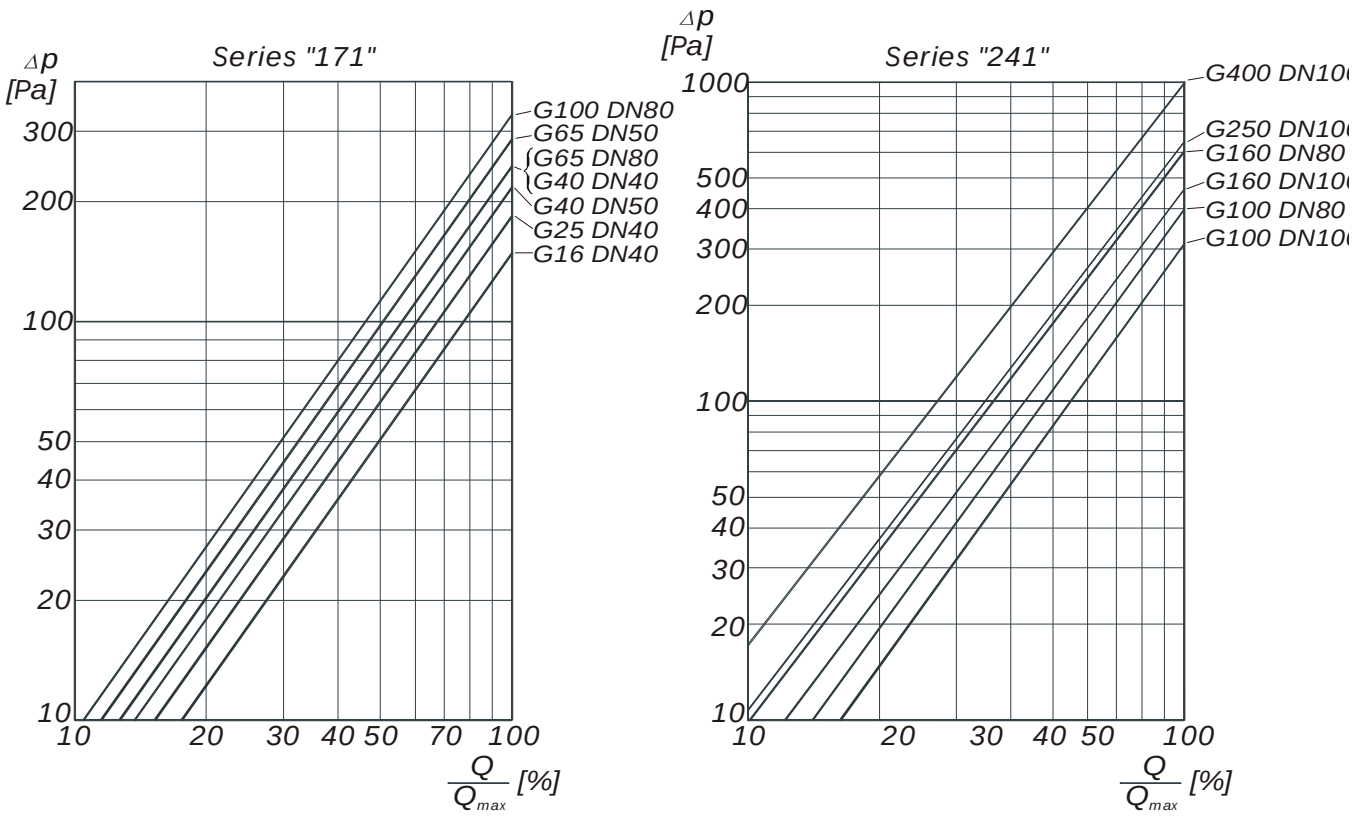


Fig.1. Pressure loss for CGR-01 Rotary Gas Meters;
gas density ρ_o = 1,2 kg/m^3;
basic meter version according to Table 3a.

Table 2. CGR-01 Rotary Gas Meters - basic metrology parameters and digital codes

DN (nominal diameter)	**G** (gas meter size)	**Q_{max}** (maximum flow)	**Q_{min}** (minimum flow - m^3/h)							**LF** (gas volume for one pulse)	**V** (cyclic volume)	Digital code of the gas meter	Flange to flange dimension
[mm]		[m^3/h]	rangeability							[m^3/pulse]	[dm^3]	[-]	[-]
			1:200	1:160	1:130	1:100	1:80	1:65	1:50				
40/50	16	25	-	-	0,2	0,25	0,3	0,4	0,5	0,01	0,229	02... / 12...	„171”
40/50	16	25	-	-	-	-	0,3	0,4	0,5	0,01	0,316	02... / 12...	„171”
40/50	25	40	0,2	0,25	0,3	0,4	0,5	0,6	0,8	0,1	0,229	03... / 13...	„171”
40/50	25	40	-	-	0,3	0,4	0,5	0,6	0,8	0,1	0,316	03... / 13...	„171”
40/50	25	40	-	-	-	0,4	0,5	0,6	0,8	0,1	0,503	03... / 13...	„171”
40/50	40	65	0,3	0,4	0,5	0,6	0,8	1,0	1,3	0,1	0,316	04... / 14...	„171”
40/50	40	65	-	0,4	0,5	0,6	0,8	1,0	1,3	0,1	0,503	04... / 14...	„171”
40/50	40	65	-	-	-	0,6	0,8	1,0	1,3	0,1	0,823	04... / 14...	„171”
50	65	100	0,5	0,6	0,8	1,0	1,3	1,6	2,0	0,1	0,503	15...	„171”
50	65	100	-	0,6	0,8	1,0	1,3	1,6	2,0	0,1	0,823	15...	„171”
50	65	100	-	-	0,8	1,0	1,3	1,6	2,0	0,1	1,262	15...	„171”
50/80	100	160	0,8	1,0	1,3	1,6	2,0	2,5	3,0	0,1	0,823	11... / 21...	„171”
50/80	100	160	0,8	1,0	1,3	1,6	2,0	2,5	3,0	0,1	1,262	11... / 21...	„171”
80/100	100	160	0,8	1,0	1,3	1,6	2,0	2,5	3,0	0,1	1,310	21... / 31...	„241”
80/100	100	160	0,8	1,0	1,3	1,6	2,0	2,5	3,0	0,1	2,020	21... / 31...	„241”
80/100	160	250	1,3	1,6	2,0	2,5	3,0	4,0	5,0	0,1	1,310	22... / 32...	„241”
80/100	160	250	1,3	1,6	2,0	2,5	3,0	4,0	5,0	0,1	2,020	22... / 32...	„241”
80/100	160	250	1,3	1,6	2,0	2,5	3,0	4,0	5,0	0,1	3,385	22... / 32...	„241”
80/100	250	400	2,0	2,5	3,0	4,0	5,0	6,0	8,0	1	2,020	23... / 33...	„241”
80/100	250	400	2,0	2,5	3,0	4,0	5,0	6,0	8,0	1	3,385	23... / 33...	„241”
80/100	400	650	3,0	4,0	5,0	6,0	8,0	10	13	1	3,385	24... / 34...	„241”

II. CONSTRUCTION AND OPERATION

Rotary piston gas meters are volumetric machines operating on the basis of proportionality of the revolution number of pistons to the real flow of gas that has flown through the gas meter at operating pressure and temperature. Gas entering the meter (Fig.2) fills the measuring chamber, and the pressure difference makes rotors to turn thus pumping the gas volume towards the outlet. The rotation is transferred by the gear transmission and the magnetic coupling to the index. The index mechanism sums up the volume that has flown through the gas meter and it is indicated on the eight digit counter.

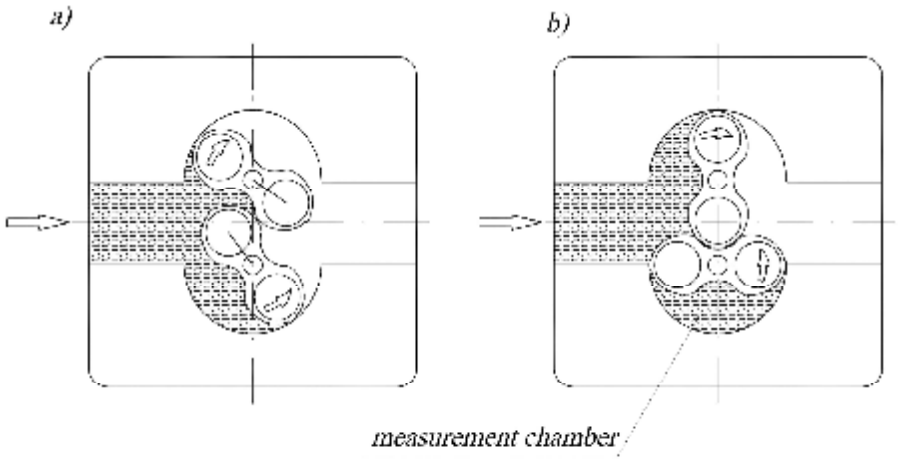


Fig. 2. Operating principle of rotary piston gas meters

The CGR-01 Rotary Gas Meters (Fig. 3) consist of four major assemblies:

External body. The external body assembly consists of the main body together with front and rear covers. The covers are fixed to the main body by means of screws and are protected with seals. The main body is provided with taps for pressure and temperature measurements, and two faying faces with openings for fixing the meter in the installation. The front cover is provided with the hermetic partition that separates the pressurised part from the surroundings, Oil filling plug and oil sight glass are also located in the front cover.

Measurement cartridge. The measurement cartridge is installed between the external body covers by means of elastomere gaskets. It consists of the measurement chamber where the pistons rotate, and two side chambers separated with internal covers. These covers are used for installation of ball bearings that support the pistons. Both side chambers are filled with oil that is used for lubrication of ball bearings and the measurement assembly gears. The bearings and gears are lubricated by oil mist created by rotating plates installed on piston shafts.

Drive transmission assembly. The drive transmission assembly is installed on the front cover and transfers piston rotary movements from the measurements assembly to the index, through the gas tight partition. The assembly consists of gears and magnetic coupling. The driven part of the coupling may be equipped with a high frequency signal transmitter inductor .

Index assembly. In order to drive the mechanical index, and inductors of low frequency transmitters, the consecutive reduction of the rotational speed is performed there (through the worm gear and cylindrical gear). The assembly contains also sockets for LF and HF electrical output signals.

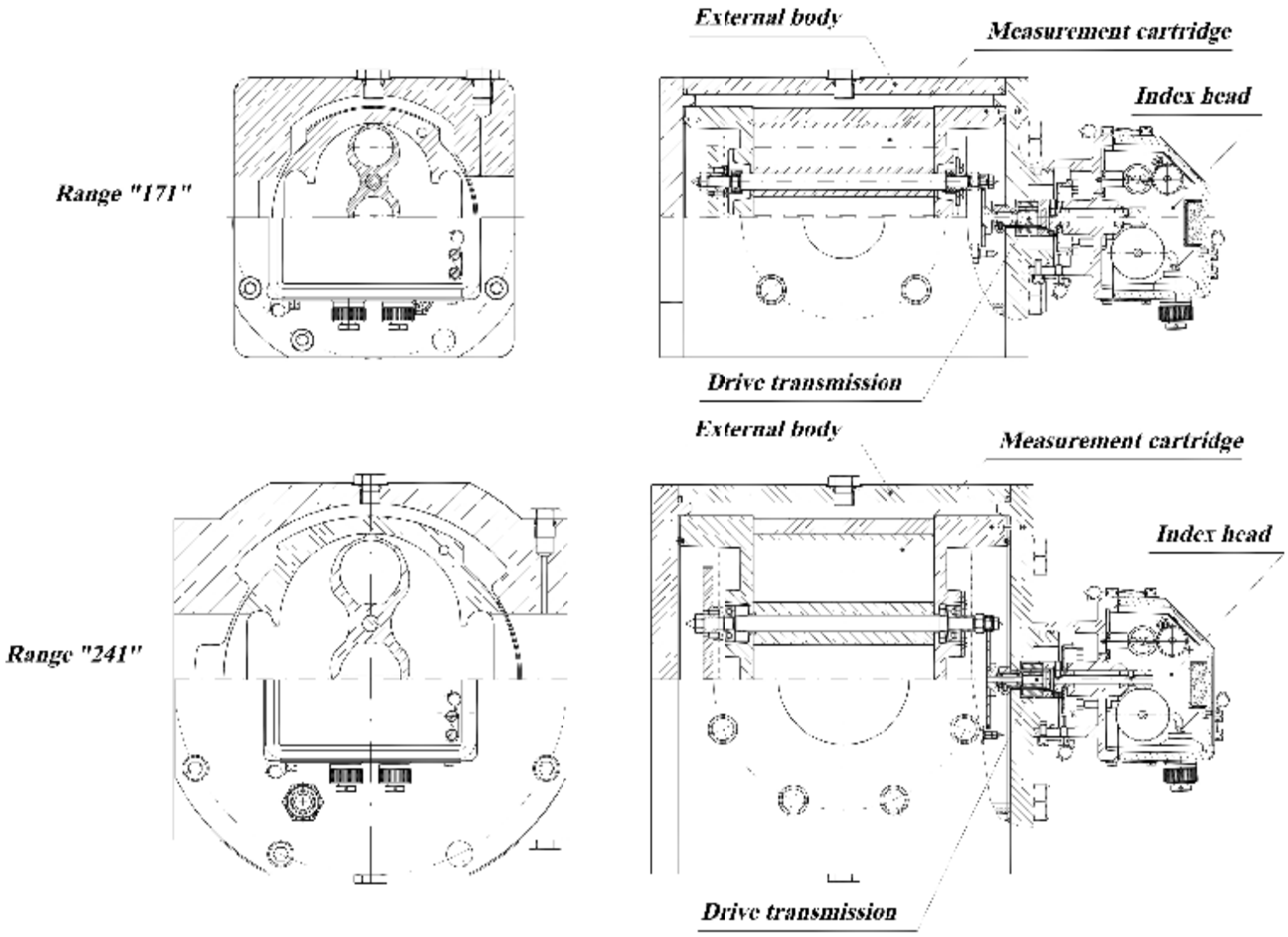


Fig. 3. Construction of CGR-01 Rotary Gas Meter.

III. INDEX HEAD AND MEASUREMENT OUTPUTS

The CGR-01 Rotary Gas Meter is provided with a mechanical counter with integrated electrical signal outputs, and taps for pressure measurement and optionally for temperature measurement. These outputs enable to control the gas meter operation and to connect the external equipment. The location of measurement outputs on the gas meter is shown in Fig. 4.

Mechanical counter is located inside the index unit and is visible through the polycarbonate sight glass. It enables direct reading of the gas volume flowing through the meter at operating conditions, i.e. at the actual pressure and temperature. The index head may be rotated by 345^{o} against its axis what enables reading of the index from any direction.

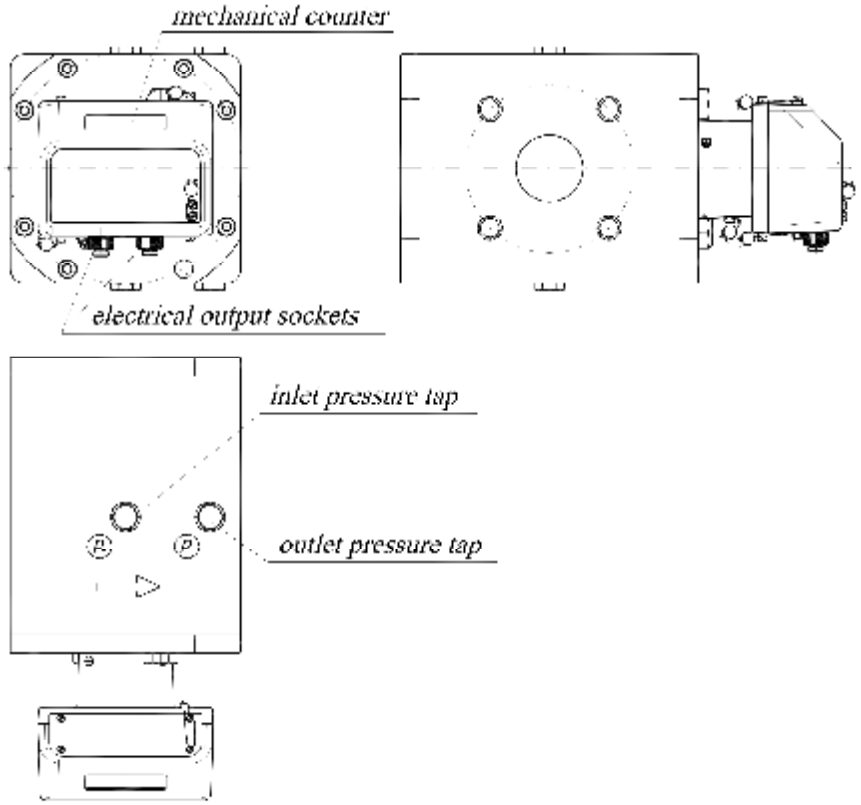


Fig. 4. Location of measurement outputs on the CGR-01 Rotary Gas Meter.

Electrical outputs from the index head. There are two types of the electrical signal outputs: LF - low frequency and HF - high frequency. The index head may be equipped with maximum two sockets and six pulse transmitters:

- two proximity inductive high frequency transmitters HF,
- two gap inductive low frequency transmitters LFI,
- two reed contact low frequency transmitters LFK.

The LFK reed contact transmitters are designed for the cooperation with the volume corrector that is located in the vicinity of the gas meter (up to 2 m). The inductive transmitters, LFI and HF, may send electrical signals for bigger distances (up to 200 m, depending on conditions). Because of higher current consumption they may cooperate only with power supplied volume correctors. Gas volume that corresponds to one pulse of the LF transmitter is given in Table 2.

Number of HF pulses for one cubic meter of gas is determined individually for each gas meter, and is indicated in the nameplate.

A dash placed in the nameplate instead of number of pulses, or lack of description, indicates that an appropriate pulse transmitter has not been installed

All pulse transmitters installed in the index head are connected to contacts of „Tuchel" C091 31N006 100 2 sockets. The sockets are located on the rear side of the index head. These sockets are to be used for connection of 6-pin "Tuchel" plugs C091 31H006 100 2. The "Tuchel" connection applied in the CGR-01 meters are IP67. Possible connections of transmitters with appropriate electrical signal sockets are given in Table 3.

Table 3. Possible connections of transmitters to electric output sockets.

	pin	polarity	LFK 1		LFI 1		HF 1		LFK 2		LFI 2		HF 2	
Socket 1	1	–	S		O									
	4	+		S		O								
	2	–			P				O		O		O	
	5	+				P				O		O		O
	3	–					P							
	6	+						P						
Socket 2	1	–			O				P					
	4	+				O				P				
	2	–			O				O		P		O	
	5	+				O				O		P		O
	3	–					O						P	
	6	+						O						P

S - connections for gas meters in the standard execution
P - recommended connection for full version
O - optional connections

The CGR-01 Rotary Gas Meter, as a standard, is provided with one reed contact LFK1 transmitter.

According to the application conditions the CGR-01 gas meter should be provided with transmitters of at least ⟨Ex⟩ II 2G EEx ib IIC T4 protection level. These conditions are met when the following pulse transmitters are used:

- HF type NJ0,8-5GM-N, manufactured by Pepperl+Fuchs GmbH ⟨Ex⟩ II 1G EEx ia IIC T6.
- LFI type CLFI-02 manufactured by Common S.A. ⟨Ex⟩ II 2G EEx ia IIC T6.
- LFK type CLFK-02 manufactured by Common S.A. ⟨Ex⟩ II 2G EEx ia IIC T6.

Permitted parameters of the intrinsically safe supply circuits (U_i ,I_i , P_i), and maximum inductance and internal capacitance (L_i , C_i)

HF	LFI	LFK
U_i = 16 V DC	**U_i = 15,5 V DC**	**U_i = 15,5 V DC**
I_i = 25 mA	**I_i = 52 mA**	**I_i = 52 mA**
P_i = 64 mW	**P_i = 169 mW**	**P_i = 169 mW**
L_i = 50 µH	**$L_i \approx$ 40 µH**	**$L_i \approx$ 0**
C_i = 30 nF	**C_i = 28 nF**	**$C_i \approx$ 0**

Rated operation parameters of used transmitters:

reed contact	**CLFK-02**:
rated voltage	U_n = 5÷15,5 V DC,
closed contact resistance	R_z = 500Ω ÷ 2 kΩ ,
open contact resistance	R_o > 100 MΩ ,
maximum switching frequency	f_p = 500 Hz .

inductive	**CLFI-02**	**NJ0,8-5GM-N**
rated voltage	U_n = 5÷15,5 V	U_n = 5÷16 V,
non active transmitter current	I_L < 1,2 mA ,	I_L < 1,2 mA,
active transmitter current	I_H > 2,1 mA ,	I_H > 2,1 mA,
load resistance	$R_n \leq$ 1 kΩ ,	$R_n \leq$ 1 kΩ,
maximum switching frequency	f_p = 200 Hz,	f_p = 5 kHz.

There is a voltage drop on the 1 kΩ resistor, depending on the transmitter state (active or non active). For the above mentioned transmitter current values (according to PN EN 60947-5-6:2002 the input voltage values may be as follows:

- non active state U_L < 1,2 V,
- active state U_H > 2,1 V.

The HF output is especially useful in order to control the changes of the gas flow.

Pressure measurement outputs.

Pressure measurement outputs (pressure taps) are located on both sides of the main body (Fig. 4). The taps may be provided either with M12x1,5 thread (Fig. 5) or NPT 1/4 thread (Fig. 6). The thread type is marked on the body. The pressure taps are used for connecting the pressure transmitters directly, or indirectly by means of a three way valve. Unused taps are plugged.

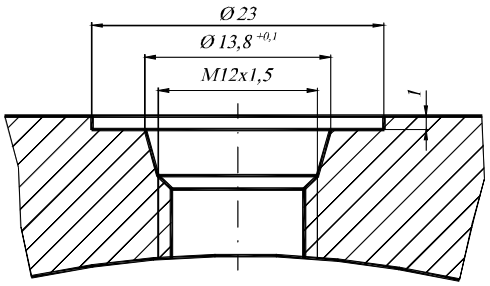


Fig. 5. M12x1,5 pressure measurement tap.

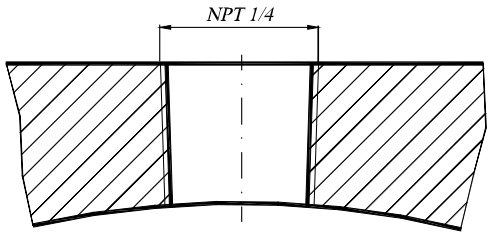


Fig 6. NPT 1/4 pressure measurement tap

Temperature measurement output.

Temperature measurement taps may be located on both sides of the main body (Fig. 4). The taps may be provided with M14x1,5 thread (Fig.7), or NPT 1/4 thread (Fig. 8). By means of temperature pockets electric thermometers or temperature transmitters may be installed in the taps. Unused taps are plugged

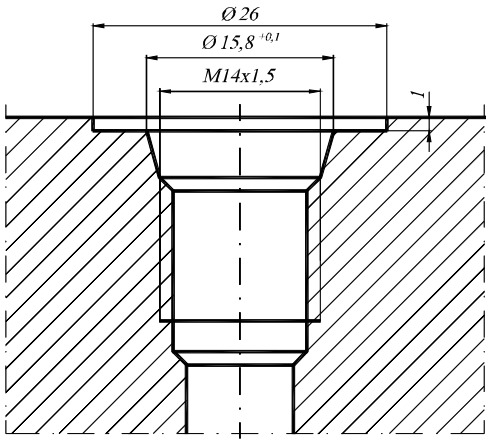


Fig. 7. M14x1,5 temperature measurement tap

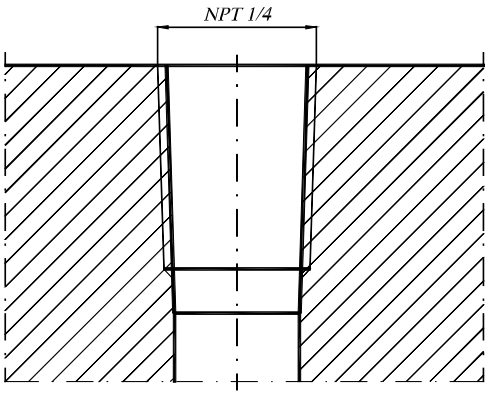


Fig 8. NPT 1/4 temperature measurement tap

IV. MARKING AND CALIBRATION OF THE GAS METERS

Basic information of the gas meter, serial number and production year are shown in the nameplates (Fig.9 and Fig.10). The plates are fixed to the index housing by means of screws. Two first digits of the serial number indicate the gas meter size code, according to Table 2. Information marks showing the flow direction, as well as pressure and temperature taps, are placed on top of the main body (Fig. 11).

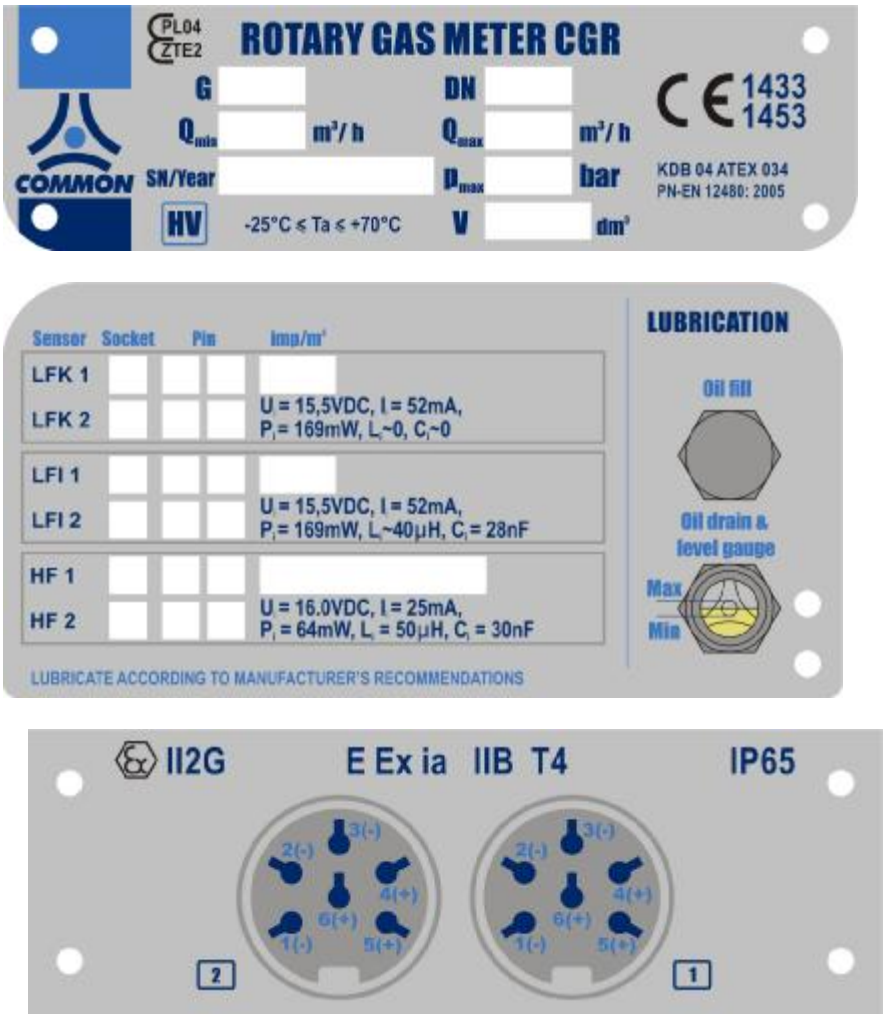


Fig. 9. Standard nameplates - execution„IIB”

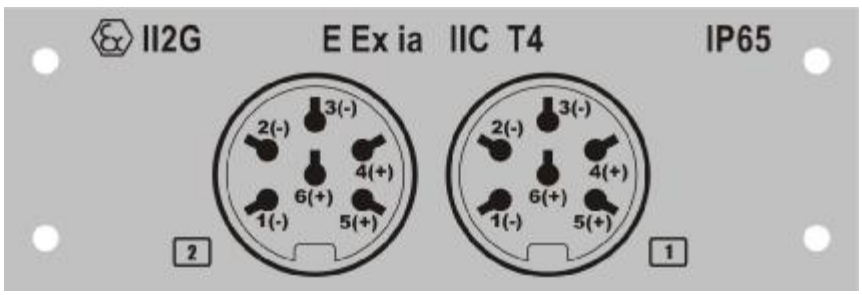


Fig. 10. Nameplates – special execution„IIC”

Fig.11. Information marks on flow direction, pressure and temperature measurement outputs.

Each gas meter calibrated for fiscal purposes in an authorised laboratory, according to local regulations, must be marked with special seals. In accordance with the European Type Approval issued by Central Office of Measures these seals have to be placed as follows: P1, P2, P3, P4, P5, P6 (Fig. 12).

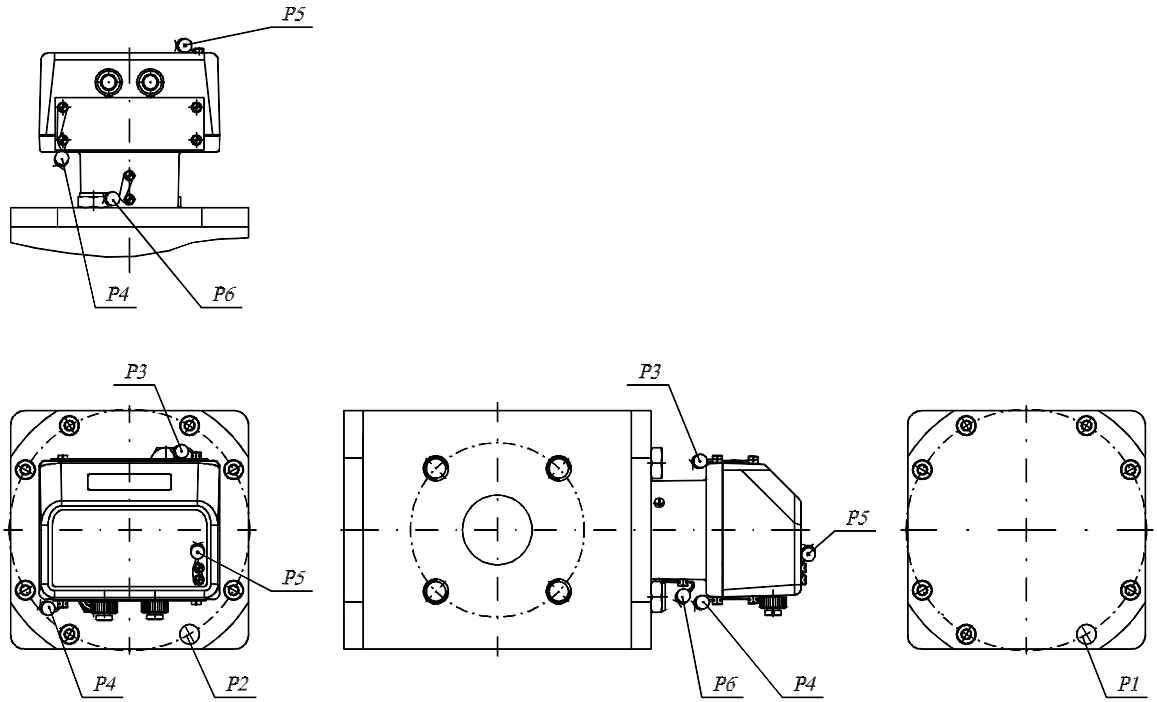


Fig. 12. Location of legal calibration seals.

The legal calibration seals must not be damaged as it is the proof that the gas meters has been calibrated and may be used for fiscal purposes

Depending on local regulation the meters need to be recalibrated after several years of operation. It is recommended to perform recalibration at COMMON S.A. or at authorized servicing company. The manufacturer can assure proper servicing of the meter, replacement of all necessary parts, if required, as well as adjustments and testing of meters in accordance with appropriate regulations.

V. PACKING, TRANSPORTATION AND STORAGE

The gas meter is delivered in a factory pack that secures the device during transportation and storing. The gas meters are packed in cardboard boxes and secured by means of shaped styrofoam inserts. The boxes are provided with special openings in order to facilitate handling of the gas meters. Appropriate information on the package content, as well as limitations regarding loading / unloading, is placed on the package.

The gas meters, for servicing or for recalibration, should be delivered to the factory in their original packages or other that provide at least the same protection during transportation as the original ones.

Each gas meter manufactured by COMMON S.A. is provided with the following accessories:

- 6-pin plug "Tuchel" C091 31H006 100 2 that may be used for connecting a volume corrector or a data logger low frequency electric output (if the volume corrector or data logger is not delivered as a set with the gas meter);
- 4-pin socket "Tuchel" C091 31D004 100 2 if the gas meter is equipped with HF transmitter installed in the body;
- 0,25 l bottle with LUBRINA oil;
- Operating Instructions Manual

The rotary gas meter is a precise measuring device and should be handled with utmost care.

Following recommendations should be observed during transportation and storing:

1. The gas meters during transportation should be protected against falls, shocks, or strong vibrations (e.g. due to handling on improper trolleys).
2. Lifting the gas meters by means of the index housing is not allowed.
3. Factory installed covers or seals on openings of the gas meters should be removed just before installation of the meter.
4. During storing the gas meters should be protected against direct atmospheric influence, and against humidity.
5. Special care should be taken not to destroy the leaden seals placed during legal calibration, the protective leaden seals and the installation seals. **IF THE SEALS ARE DAMAGED THE LEGAL CALIBRATION, AS WELL AS THE GUARANTEE, MAY BECOME INVALID AND THIS MAY CREATE FISCAL PROBLEMS WITH GAS SUPPLY COMPANY.**
6. There is no need to fill up the gas meter with oil during storage.

VI. INSTALLATION AND START UP

Prior to the installation of the gas meter check whether it has been selected properly, in accordance with the operating parameters of the system. In particular, attention should be paid to the following information contained in the nameplate:

- Maximum operating pressure [MPa], marked as p_{max} ,
- Maximum real flow [m^3/h], marked Q_{max}.

It is permitted to operate the gas meter with flow bigger by 25% than the maximum flow for no more than 30 minutes.

The CGR-01 Rotary Gas Meters may operate in four positions, as shown below (Fig 13 a, b, c, d):

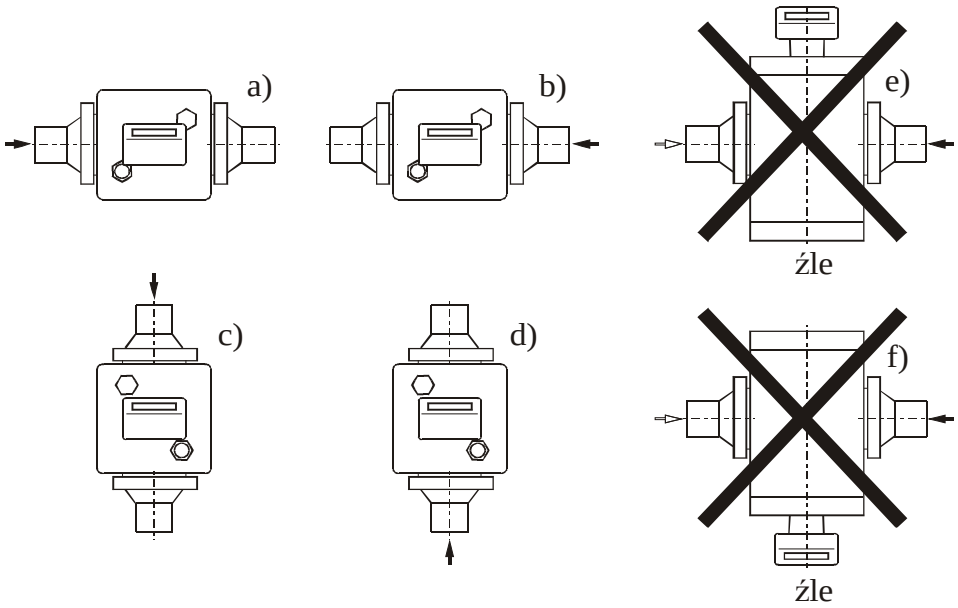


Fig. 13 Operating position of the CGR-01 Rotary Gas Meter.

It is not permitted to place the rotary gas meter in vertical position !
Fig. 13 e) and f)

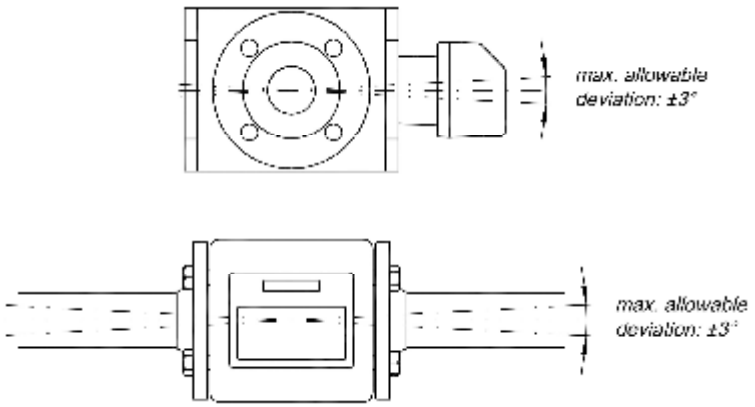


Fig. 14 Acceptable deviations from level of the rotary gas meters.

The gas meter should not be installed in the lowest position of the installation as it is possible that condensate and other impurities may collect there.

The rotary gas meters should be installed in closed compartments or under appropriate shields. It is not permitted to expose the gas meters to rainfalls or snowfalls, or pollution with other substances (e.g. dust).

The gas meter should be installed in piping of appropriate nominal diameter. Proper alignment of the gas meter and pipe flanges should be secured, in accordance with appropriate regulations in the gas industry. The piping system should not exert pressure on the gas meter bigger than determined by appropriate standards, e.g. PN-EN 12480:2004.

When designing the place for the installation of the gas meter the dimensions given in Tables 3a and 3b, and in Fig.15, may be useful.

Table 3a. Basic dimensions and weights of the CGR-01 meters.

	DN				n	A	B	L	Weight at V_{cykl}	
	40	50	80	100		mm	mm	mm	kg	dm^3
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 version;
w – low speed version (bigger sizes, lower noise level),
s – high speed version (lover sizes, higher noise level).

Table 3b. Size K (diameter of bolt circle)

	DN40	DN50	DN80	DN100
PN 16	110	125	160	180
PN 20 (ANSI 150)	98,5	120,7	152,4	190,5

Impurities contained in gas and in the piping may cause damages to the measuring assembly and impair the measurement accuracy. Therefore it is necessary to install a 10 μm filter upstream the gas meter (especially in case of heavy polluted gases). Besides, prior to the installation, it is recommended to clean the piping upstream the gas meter, and to provide a cone sieve before the gas meter. The cone sieve may be removed after 1 – 2 months of operation. If the cone sieve is not removed than it is necessary to maintain it regularly and control the pressure drop. If the cone sieve is clogged it may get damaged by the gas pressure, and the remains may seriously damage the gas meter.

The manufacturer is not liable for any damages of the gas meter due to improper filtration of the flowing gas.

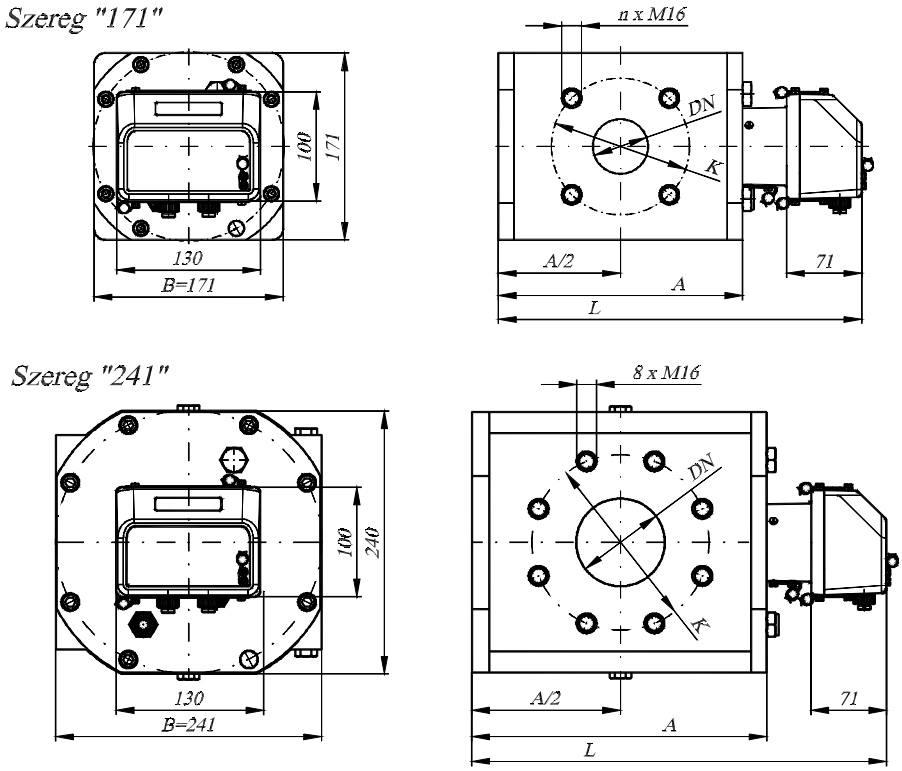


Fig. 15. Basic dimensions of the CGR-01 Rotary Gas Meter.

The user of the gas meter should pay special attention to some dangers related to gas flow changes. If for a longer time after commissioning the flow in the piping was relatively low the impurities (e.g. weld spatters) remain upstream the gas meter. When the flow increases the flowing gas may take these impurities and as the result the gas meter may get damaged. Due to that the cone sieves are very practical solution when the new installation is reaching its designed output. In any case, the user should protect the gas meter against mechanical damages.

Prior to the installation of the gas meter it is necessary to check whether it is oriented properly, i.e. whether the arrow located on the body indicates the proper flow direction

The gas meter should be fixed with the piping flanges by means of the delivered set screws M16x70 or bolts M16x45 (mechanical class - 5,8). Gaskets should be selected according to used flanges and depending on the nominal pressure.

When tightening the screws the torque of 160 Nm should not be exceeded!

Having installed the gas meter and prior to putting it into operation, it should be filled up with oil. The manufacturer recommends **Lubrina L12** oil (viscosity ca. 12 mm^2/s at. 20^0C). Isoflex PDP10 oil is recommended for gases indicated in Table 1. When filling the oil for the first time and each time when refilling, please control the oil level. The oil level in the gas meter should be so as it is visible in the sight glass between the lines MIN and MAX, Fig. 16.

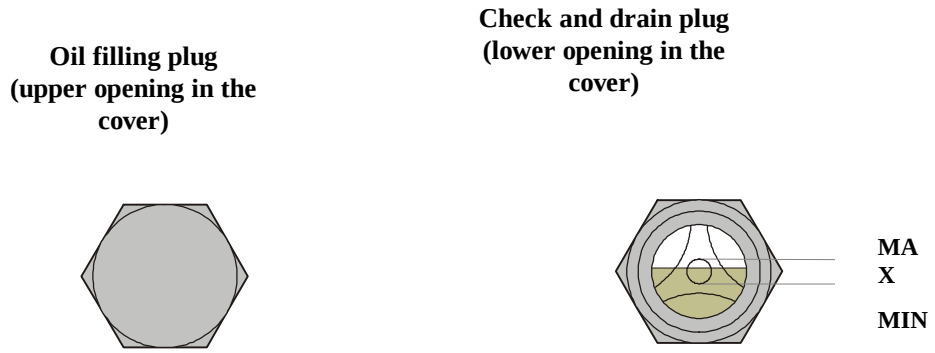


Fig. 16. Oil filling and drain plugs.

Quantity of oil - – depending on the meter size and installation position (Fig 13.):

position	range „171”	range „241”
„a” or „b”	30 ml	50 ml
„c” or „d”	50 ml	85 ml

Refilling of oil between Min and Max – depending on the meter size and installation position (Fig 13.):

position	range „171”	range „241”
„a” or „b”	10 ml	20 ml
„c” or „d”	15 ml	30 ml

Gas meters that are used for gases other than those mentioned in Table 1 should be lubricated with other oils. In such a case the oil grade should be agreed with the gas meter manufacturer!

In order to start up the gas meter properly following recommendations should be observed (typical installation with the by-pass, Fig.15):

1. The gas meter is installed with the closed valves 1, 2, 5, and the by-pass valve 4 open. The vent valve 3 remains open after venting the installation.
2. Having tightened the bolts remove air from the installation by opening the valve 5. This must be done in accordance with appropriate local regulations. The valve 3 remains open.
3. Having removed the air from the installation close valve 3 and pressurise the installation. Observe that the pressure increase is no greater than 30 ± 10 kPa/s.
4. When the index does not indicate any flow (it means that the pressure is equal in the installation), close the valve 5.
5. First, open the valve 1 and next the valve 2.
6. Having fully opened the valve 2, the by-pass valve 4 is to be closed.

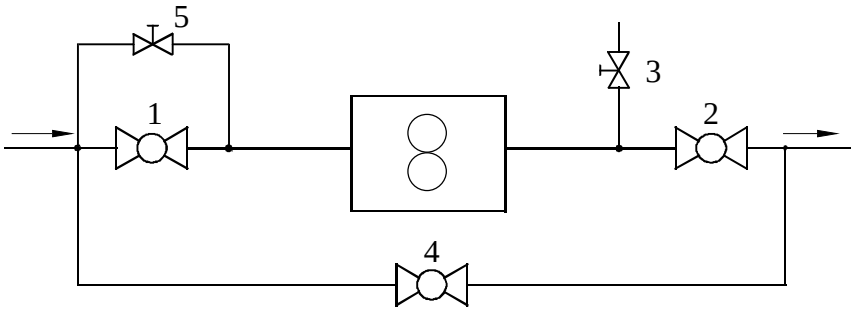


Fig. 17. Diagram of the metering system with the by-pass valve

When removing the gas meter from the installation, proceed as follows:

1. First, open the by-pass valve 4,
2. Consecutively, close the valve 2, and next the valve 1.
3. Release the pressure from the metering installation by means of the vent valve 3; pressure decrease should be not more than 30 ± 10 kPa/s.

WARNING!
Prior to removing the gas meter from the installation, drain the oil !

In other installation cases the procedure should be similar, i.e. open and close the gas flow through the gas meter very slowly. Sudden increase of flow caused by abrupt opening of valves may bring about damages to the pistons due to large pressure difference upstream and downstream the gas meter.

If during the usage of the gas meter overcharges occur (i.e. Q_{max} may be overcharged by more than 25 %), then it is recommended to install orifices. The orifice should be installed downstream the gas meter at the distance of 5 to 10 nominal pipe diameters. The orifice plate opening is determined individually, depending on the nominal pipe diameter, flow, pressure and temperature of the gas. On customer's demand COMMON S.A. may provide the appropriate orifice.

After installation of the gas meter check whether indications of the index are proper. Each drum of the index should rotate freely, and after one full turn it should move the next left drum by $1/10^{th}$ of its rotation.

VII. MAINTENACE, FAILURES, REPAIRS

The CGR-01 Rotary Gas Meters are provided with the lubrication system for the internal gears and piston bearings. Other gas meter mechanisms are provided with self lubricated bearings. Therefore the only necessary maintenance activity is to control the oil level, and refill it, if necessary. For refilling Lubrina L12 oil should be used. This is a special synthetic oil designed for the CGR-01 rotary gas meters

Refilling of oil should be carried out only when the gas flow is stopped and when the pressure is relieved!

Dust and another impurities from the gas meter surface should be removed from the gas meter surface by means of cloth soaked with water and soap solution. Solvents or another chemical agents are not allowed.

If during operation of the gas meter any abnormality occur (e.g. uneven run, stoppage of mechanical counter, higher noise level, rattling, oil leakages) the gas meter should be removed from the installation and sent for repair.

REPAIRS OF THE GAS METERS MAY BE PERFORMED ONLY BY THE MANUFACTURER OR BY AUTHORISED PERSONNEL.
THE USER IS NOT ALLOWED TO PERFORM ANY REPAIRS!

After repairs when legal calibrations leaden seals were removed it is necessary to recalibrate the meter.

VIII. AUXILIARY EQUIPMENT

Due to requirements of tariffs it is often required (or recommended) to use electronic devices in order to convert the gas volume from operating conditions into base conditions. COMMON S.A. manufactures also such devices, e.g. volume correctors CMK-02 or CTK-02, and data loggers CRI-02. On requests COMMON S.A. may deliver these devices, and install them at client's site. Examples of such installations are shown in Fig. 18.

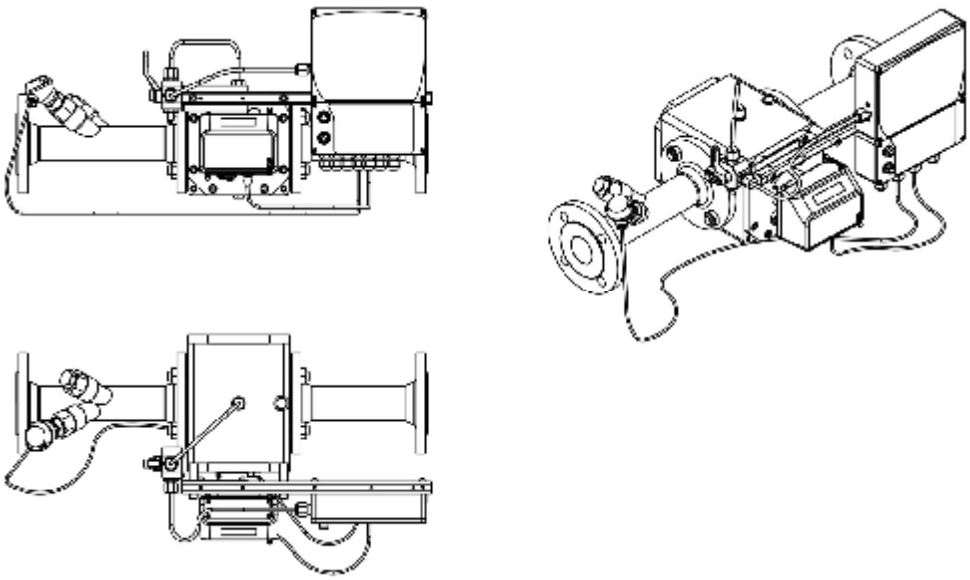


Fig 18. CGR-01 Rotary Gas Meter assembly with the CMK-02 Volume Corrector (the corrector is installed on the gas meter)

The volume corrector needs three input signals: the flow (from the low frequency or high frequency pulse transmitter), the pressure, and the temperature. The pressure is taken from the pressure tap. It is recommended to use the CKMT three way valve (Fig. 18) that enables to cut off the pressure to the pressure sensor, and to disassemble and to inspect this sensor.

Fig. 19. CKMT three way valve

The valve handle is secured by means of the installation seal. Opening or closing the valve is permitted only when agreed with the representative of the gas supply company. Afterwards the handle is sealed again with the installation seal.

The temperature signal is taken from the temperature sensor installed in an appropriate temperature well in the upstream pipe (in front of the gas meter), see Fig. 18, or in the temperature tap in the meter body.

Please remember that connecting the additional equipment to the gas meter causes that the installation seals get damaged. Therefore such works may be performed by a representative of the gas supply company, or by the manufacturer or his representative. Unused electrical output sockets must be secured by means of factory caps in order to protect them against corrosion and dirt.