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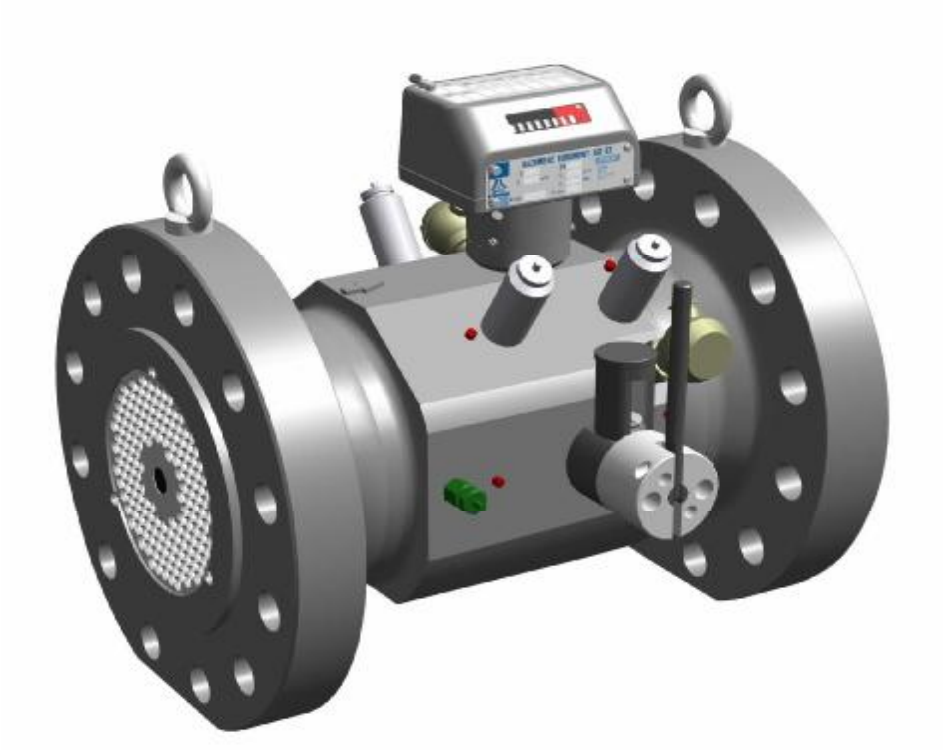
CGT-02 TURBINE GAS METERS

OPERATING AND MAINTENANCE INSTRUCTIONS



CGT/IU04/eng/04-06

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

Contents

I. DESIGN AND APPLICATION CONDITIONS

Design

CGT-02 Turbine Gas Meters are instruments 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 CGT-02 Turbine Gas Meters may be used for measurement of gases indicated in Table 1. Using the CGT-02 Turbine Gas Meters for measurement of other gases has to be agreed with the manufacturer. Maximum operating pressure for the CGT-02 Turbine Gas Meters is as follows:

- gas meters with PN16 connections - 1,6 MPa,
- gas meters with PN20 (ANSI150) connections - 2 MPa.
- gas meters with PN50 (ANSI300) connections - 5 MPa.
- gas meters with PN64 (ANSI600) connections - 6,4 MPa.
- gas meters with PN110 (ANSI600) connections - 11 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; gas temperature range is from -20°C up to + 60°C.

Application conditions of CGT-02 Turbine Gas Meters.

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

- certificate: KDB 04ATEX036,
- 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 the PED Directive 97/23/EC:

- certificate: 67/JN/2004-003/3,
- CE marking: CE 1433,
- maximum operating pressure: execution PN16 Pmax = 1,6 MPa; execution PN20 Pmax = 2 MPa; execution PN50 Pmax = 5 MPa; execution PN64 Pmax = 6,4 MPa; execution PN110 Pmax = 11 MPa.
- ambient temperature: -25° C ≤ Ta ≤ + 70° C
- harmonised standards: PN-EN 1515:2002 (U), PN-EN 10269:2002 (U), PN-EN 10222-1:2000, PN-EN 10222-3:2002, PN-EN 10222-4:2002, PN-EN 10222-5:2002, PN-EN 13445-6:2002 (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/19)

3. Conformity with the requirements of OIML R6, OIML R32, ISO9951, AGA7

European Type Approval CE

Metrological parameters Table 2
Operation position H – standard, (VD, VU – option, on request)

4. Conformity with other standards

PN-EN 12261:2003 (U), PN-92/M-54832.3
PN-M-54832-1/A1: 1995,
PN-EN 10208-2+AC:1999, PN-EN 10216-4:2003,
PN-EN 10250-2:2001, PN-EN ISO 898-1:2001,
PN-EN ISO 3506-1:2000, PN-EN ISO 3506-2:2000

PN-ISO 7005-1:1996, ZN-G-4005,

Table 1. Physical properties of most popular gases that may be measured with the CGT-02 Turbine 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	standarde 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
acethylene	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 metrological parameters of the CGT-02 turbine gas meters are shown in Table 2.

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

Gas meters create pressure losses in the installation. These values, for the CGT-02 gas meters, for the density ρ_0 = 1,2 kg/m^3, may be determined from the chart, 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, Table 1 [kg/m^3],

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

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

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

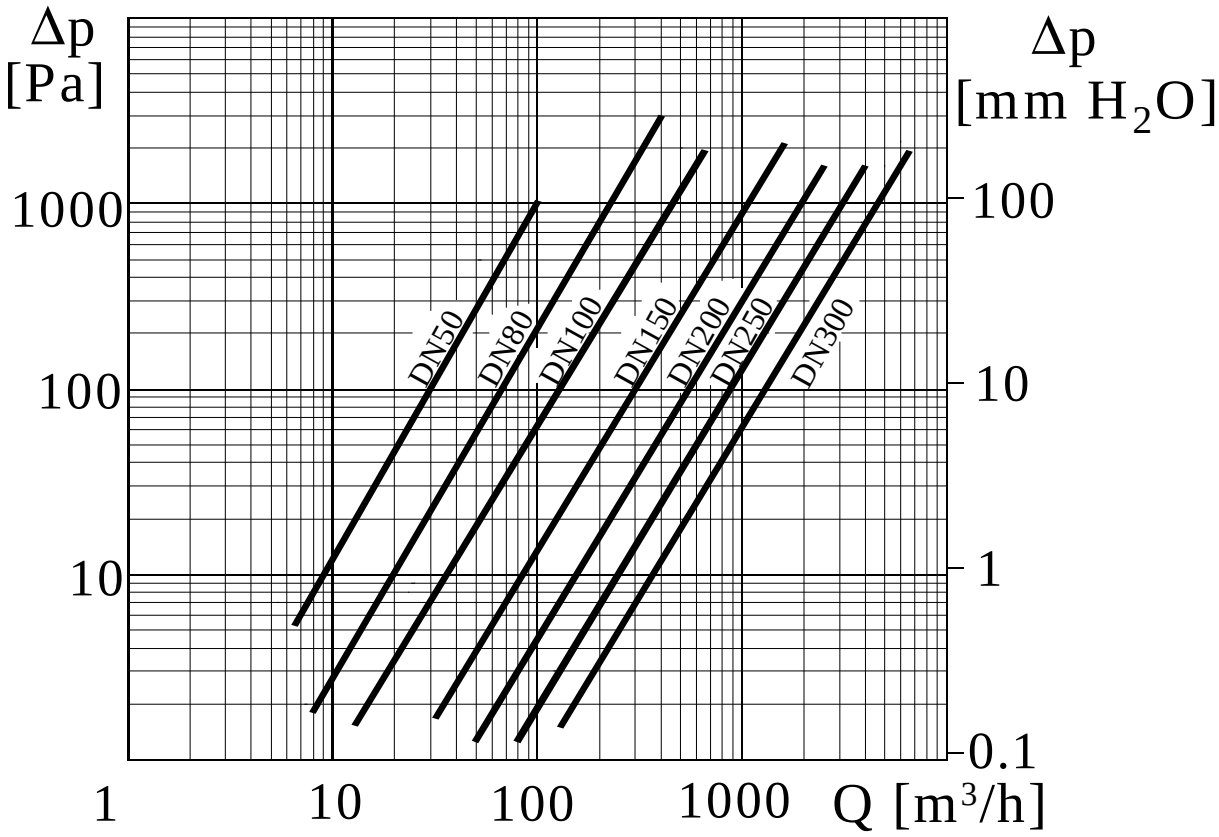


Fig.1. CGT-02 Turbine Gas Meter pressure loss;
gas density ρ_o = 1,2 kg/m^3

Table 2. Basic metrological parameters and digital code of CGT-02 Turbine Gas Meters DN50 , DN300

Nominal diameter	Gas meter size	Maximum flow Q_{max}	Minimum flow Q_{min} for pressure ranges 1.6; 2 MPa, and rangeability:			Minimum flow Q_{min} for pressure ranges 5; 6.4; 11 MPa and rangeability:				Gas volume for one LF pulse	Digital code* of the meter size
			1:10	1:20	1:30	1:5	1:10	1:20	1:30		
-	-	m^3/h	$[m^3/h]$	$[m^3/h]$	$[m^3/h]$	$[m^3/h]$	$[m^3/h]$	$[m^3/h]$	$[m^3/h]$	$[m^3/pulse]$	
DN 50	G 40	65	6	-	-	13	6	-	-	0,1	14....
	G 65	100	10	5	-	20	10	-	-		15....
DN 80	G 100	160	16	8	-	32	16	8	-	1	21....
	G 160	250	25	13	-	50	25	13	-		22....
	G 250	400	40	20	-	80	40	20	-		23....
DN 100	G 160	250	-	13	8	50	25	13	-	1	32....
	G 250	400	-	20	13	80	40	20	-		33....
	G 400	650	-	32	20	130	65	32	-		34....
DN 150	G 400	650	-	32	20	130	65	32	20	1	44....
	G 650	1000	-	50	32	200	100	50	32		45....
	G1000	1600	-	80	50	320	160	80	50	10	41....
DN 200	G 650	1000	-	50	32	-	100	50	32	1	55....
	G 1000	1600	-	80	50	-	160	80	50	10	51....
	G 1600	2500	-	130	80	-	250	130	80		52....
DN 250	G 1000	1600	-	80	50	-	160	80	50	10	61....
	G 1600	2500	-	130	80	-	250	130	80		62....
	G 2500	4000	-	200	130	-	400	200	130		63....
DN 300	G 1600	2500	-	130	80	-	250	130	80	10	72....
	G 2500	4000	-	200	130	-	400	200	130		73....
	G 4000	6500	-	320	200	-	650	320	200		74....

II. CONSTRUCTION AND OPERATION

The turbine gas meter operation is based on the proportionality of the rotational speed of the turbine wheel to the linear velocity thus to the flowing gas volume. Gas entering the gas meter (Fig. 2) is directed through the inlet flow straightener into the measurement assembly and causes rotations of the turbine wheel. The turbine wheel rotations are transmitted by means of gears and magnetic coupling into the index assembly. The index sums up the volume that has flown through the meter, and it is shown on the 8-digit counter. Proper performance of each CGT-02 Turbine Gas Meter is maintained only in the range of Q_{min} and Q_{max}, as determined in Table 2.

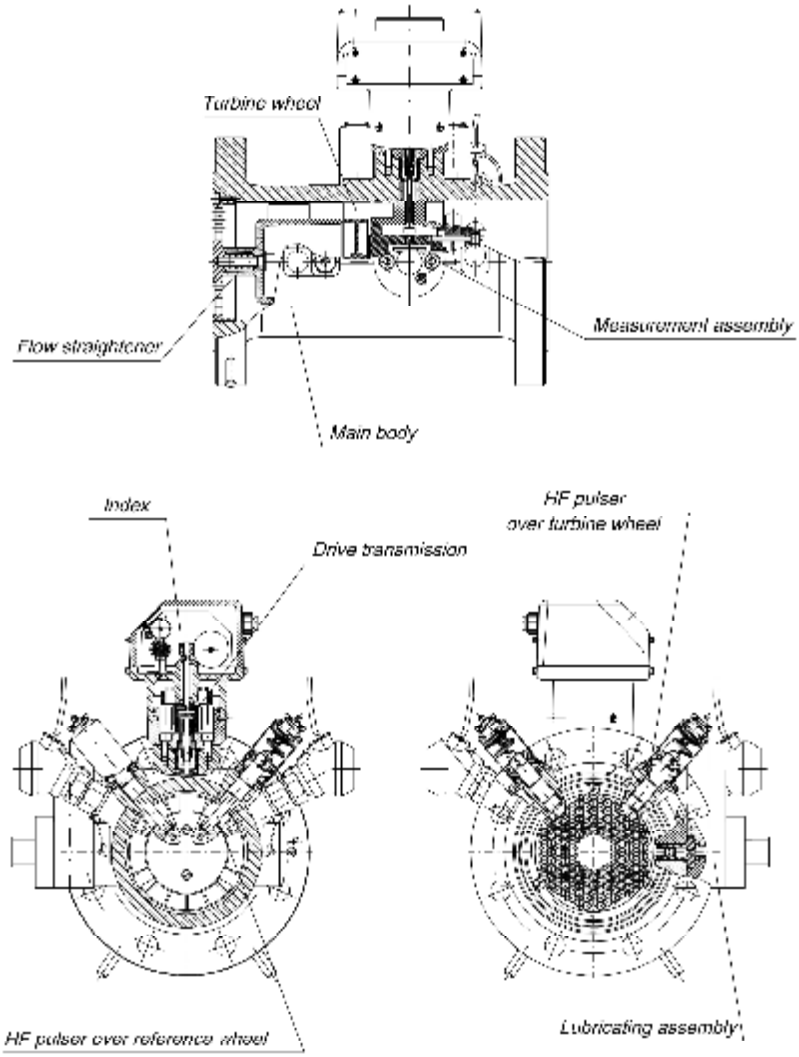


Fig.2. Construction of the CGT-02 Turbine Gas Meter

The CGT-02 Turbine Gas Meter (Fig. 2) consists of the following main assemblies:

Main body. The main body transfers all loads – those arising from gas pressure, as well as from the piping. The gas meter bodies from DN50 to DN 150, provided with PN16 and PN20 (ANSI150) flanges, may be executed in two versions: carbon steel or ductile cast iron. The bodies for PN50, PN64, PN110 (ANSI300, ANSI600) are made of carbon steel only. Welded steel bodies are always made for sizes DN200 and bigger. Each body is provided with two flanges made in accordance with PN-ISO 7005-1:1996. On request other applicable standards may be applied. The flange dimensions, as well as overall dimensions and approximate weights of gas meters, are given in Tables 3a and 3b, and in Fig. 14. The main body is provided with taps for the installation of HF transmitters, and taps for pressure and temperature sensors (see Section III).

Measurement assembly. Consists of the turbine wheel, inlet flow staightener and transmission gear. The turbine wheel is located in the axis of the gas meter and is provided with high precision ball bearings. The inlet flow straightener is placed upstream the turbine wheel in order to symmetrize the gas flow and to direct it onto the turbine wheel vanes. The transmission gear (worm gear and cylindrical gear) decreases the rotational velocity and transfers it to the magnetic coupling.

Drive transmission. Consists of the magnetic coupling together with the hermetic partition housing. The driving part is placed inside the partition housing and the driven part is placed outside the partition housing. The magnetic coupling transfers the drive from the gas meter pressurised part to the index. The driven part of the magnetic coupling may be equipped with a reference wheel that is the inductor of HF transmitters.

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

Lubrication assembly. The CGT-02 gas meters are provided with the lubrication system for periodic lubrication of the turbine wheel bearings (except for DN50 in standard execution). The system consists of the manually driven oil piston pump with the oil container (Fig. 3). The content of the oil container is $2 \cdot 10^{-5}$ m^3 [20 cm^3]. Other mechanisms of the gas meter are not lubricated externally; they are provided with self lubricated bearings. The lubrication system is vented and filled up with oil in the factory.

III. INDEX AND MEASUREMENT OUTPUTS

The measurement outputs of the CGT-02 Turbine Gas Meter consist of a mechanical index and electrical signal outputs. The body is provided with taps for installation of external HF transmitters, and taps for pressure and temperature measurement (option). These outputs enable the control of gas meter operation and connection of external equipment. The location of measurement outputs on the gas meter is shown in Fig. 3.

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

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

- two proximity inductive high frequency pulse 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 battery volume corrector 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 m^3 of gas is determined individually for each gas meter, and is indicated in the name plate.

A dash placed in the name plate instead of number of pulses, or lack of description, indicates that the appropriate pulse transmitter is not installed.

All pulse transmitters installed in the index head are connected to the 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 No C091 31H006 100 2. The "Tuchel" connection applied in the CGT-02 gas meters are IP67. Possible connections of transmitters with appropriate electrical signal sockets are given in Table 3.

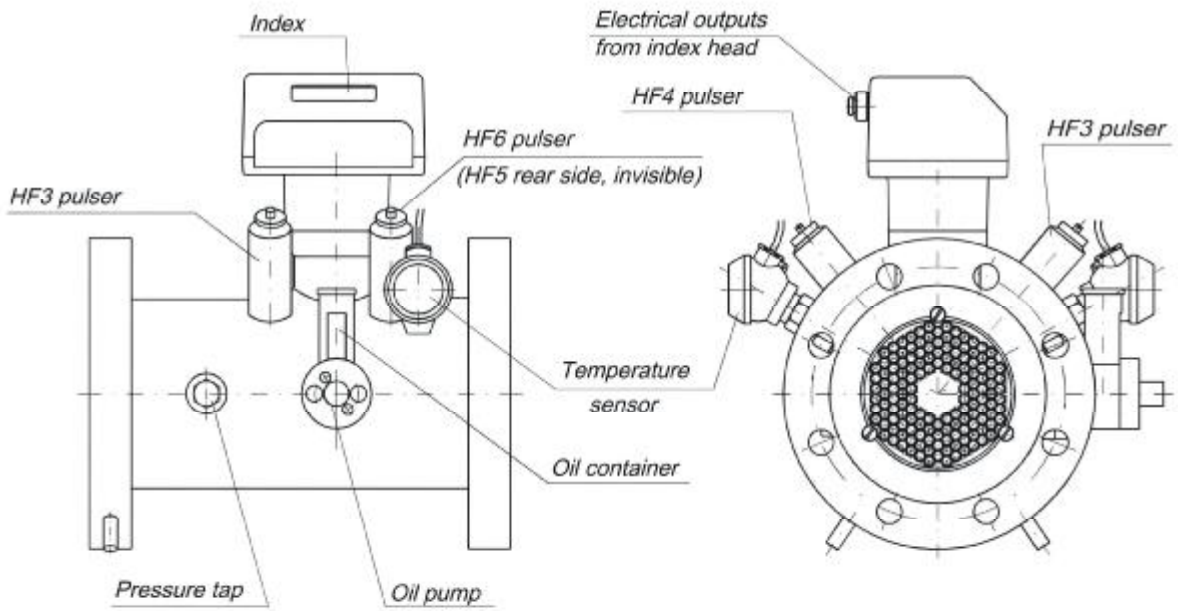


Fig.3. Location of measurement outputs in CGT-02 Turbine Gas Meters

Table 3. Possible connections of transmitters to electrical 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 the standard execution gas meters
P - recommended connection
O - optional connections

The CGT-02 Turbine Gas Meter in standard execution is equipped with one reed contact transmitter LFK1.

According to the application conditions the CGT-02 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), 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 applied pulse 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.

Depending on the transmitter state, (active or non active), a voltage drop on the 1 kΩ resistor occurs. 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.

Electrical outputs from HF transmitters installed in the gas meter body

High frequency transmitters may be installed in the gas meter body, over the turbine wheel or over the reference wheel which number of cogs corresponds to the number of turbine wheel vanes. The modulating element of the HF transmitter magnetic field is either the turbine wheel or the reference wheel. The transmitter is installed in the tap shown in Fig. 3. The tap is provided with M16 x 1,5 thread (Fig. 4).

INSTALLATION OF THE HF TRANSMITER IN THE GAS METER BODY REQUIRES HIGH ACCURACY. ALSO SPECIAL ELECTRONIC CONTROL DEVICES SHOULD BE USED. THEREFORE IT MAY ONLY BE PERFORMED BY THE MANUFACTURER OR BY THE AUTHORISED REPRESENTATIVE.

The CGT-02 Turbine Gas Meters may be equipped with maximum 4 proximity inductive HF transmitters:

- two HF transmitter over the turbine wheel,

- two HF transmitter over the refrence wheel.

The protection type of the transmitters should be at least ⟨Ex⟩ II 2G EEx ib IIC T5. These conditions are met by the following transmitters:

- HF type CHFI-02, manufactured by Common S.A. ⟨Ex⟩ II 2G EEx ia IIC T6
- HF type NJ1,5-10GM-N-Y07451, manufactured by Pepperl+Fuchs GmbH, ⟨Ex⟩ II 1G EEx ia IIC T6
- HF type Bi1-EH04-Y1, manufactured by Hans Turck GmbH, ⟨Ex⟩ II 2G EEx ia IIC T6

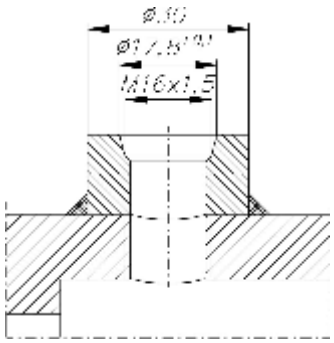


Fig.4. Tap dimensions of the high frequency transmitter.

Permissible supply parameters of the above mentioned transmitters from intrinsically safe circuits, maximum inductance and internal capacitance of the transmitters are as follows:

- CHFI-02 Ui = 15,5 V, Ii = 52 mA, Pi = 169 mW, Li ≈ 40 μH, Ci = 28 nF.
- NJ1,5-10GM-N-Y07451 Ui = 16 V, Ii = 25 mA, Pi = 64 mW, Li = 50 μH, Ci = 20 nF.
- Bi1-EH04-Y1 Ui = 15 V, Ii = 60 mA, Pi = 80 mW, Li = 150 μH, Ci = 150 nF.

The application conditions and supply parameters are marked on the transmitter housing.

The transmitters are equipped with 4-pin „Tuchel”plugs No C091 31W004 100 2. The connecting cables should be provided with „Tuchel” sockets No C091 31D004 100 2. The transmitter is connected to pins „3” and „4” of the plug. The sketch of the transmitter connection with the measurement circuit is show in Fig. 5.

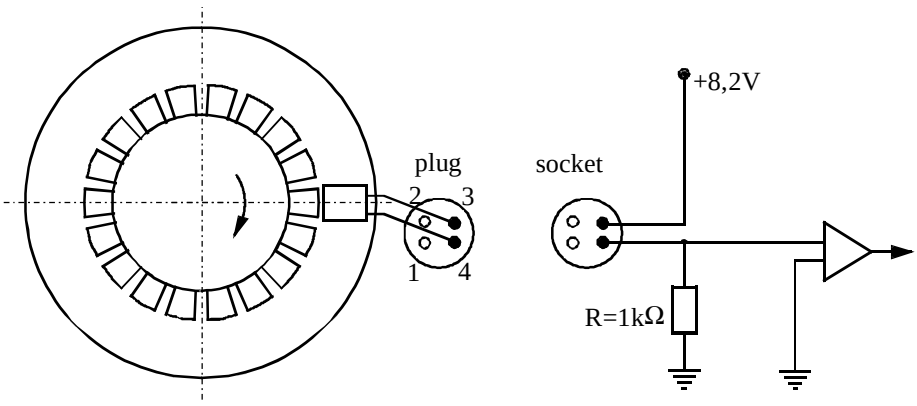


Fig.5. HF pulse transmitter connection sketch

The number of HF pulses per one cubic meter of gas is determined individually for each gas meter and is indicated in the name plate (Fig. 10) located on top of the index head**.**

A dash placed on the name plate instead of pulse number, or lack of description, means that the appropriate pulse transmitter is not installed.

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

Pressure measurement outputs.

Pressure measurement outputs (pressure pulse taps) are located on both sides of the main body (Fig. 3). The taps may be provided either with M12x1,5 thread (Fig. 6) or NPT 1/4 thread (Fig. 7). 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.

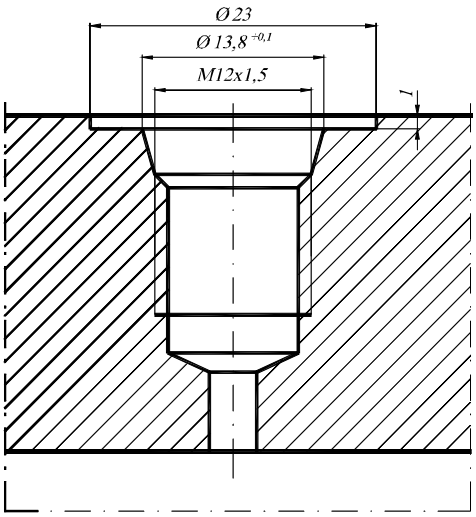


Fig. 6. M12x1,5 pressure measurement tap.

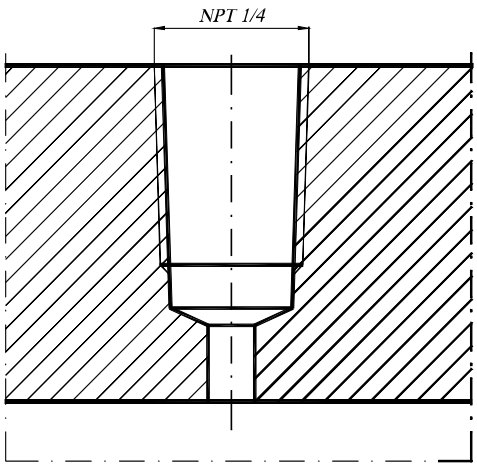


Fig 7. NPT 1/4 pressure measurement tap

Temperature measurement output.

Temperature measurement taps are located on both sides of the main body (Fig. 3). The taps may be provided with M14x1,5 thread (Fig.8), or NPT 1/4 thread (Fig. 9). By means of temperature pockets electrical thermometers or temperature transmitters may be installed in the taps. Unused taps are plugged.

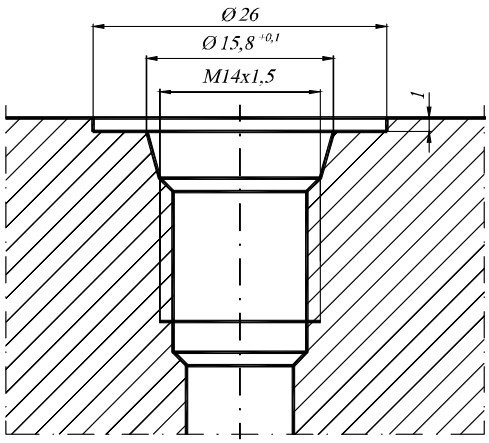


Fig. 8. M14x1,5 temperature measurement tap.

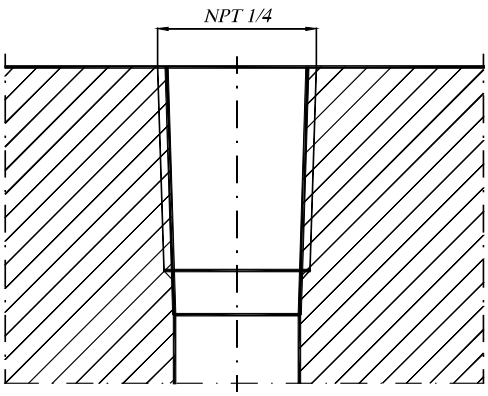


Fig. 9. NPT 1/4 temperature measurement tap

IV. MARKING AND LEGAL CALIBRATION (BADGING) OF THE GAS METERS

Basic specification of the gas meter, serial number and production year is shown in the nameplates (Fig.10 and Fig.11). 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 the main body (Fig. 12).

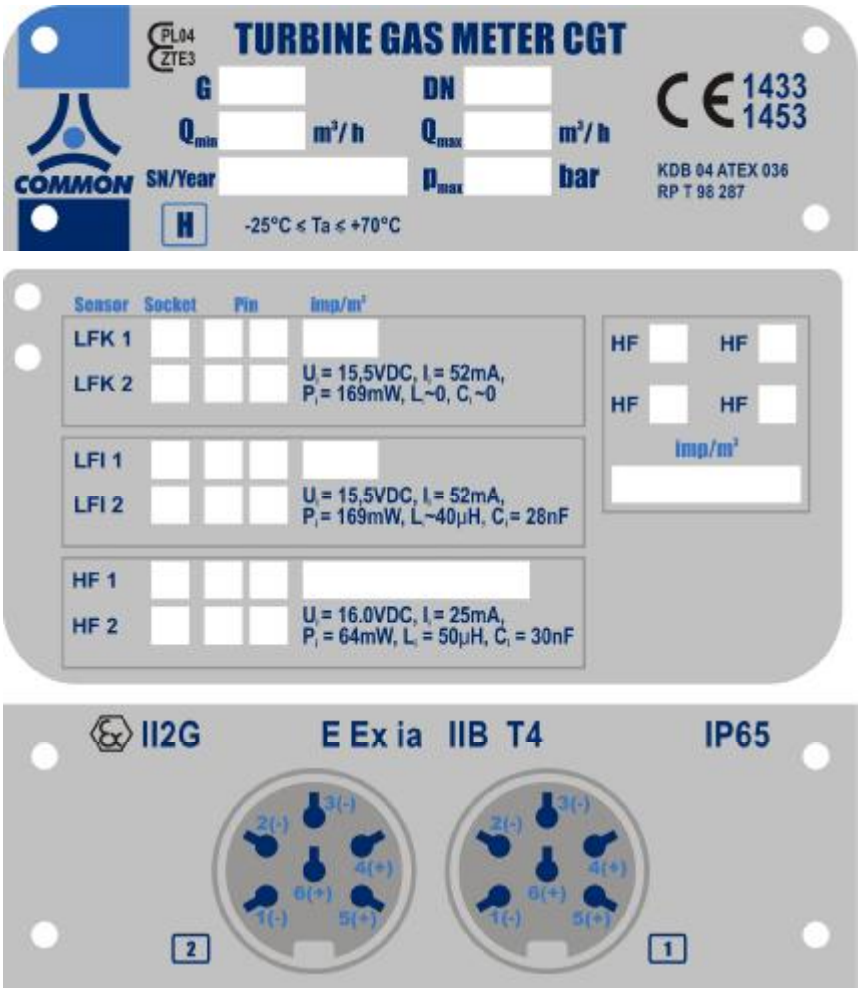


Fig. 10. Standard execution nameplates

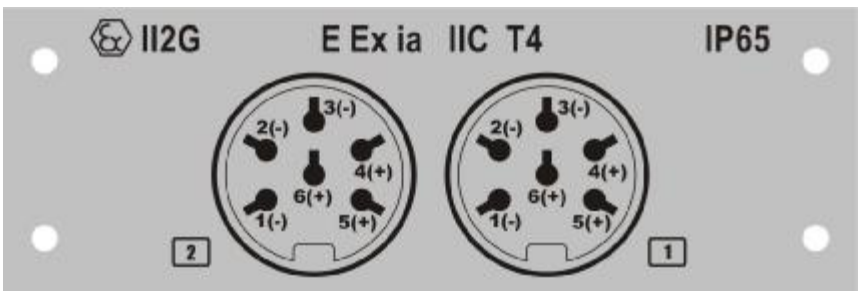


Fig. 11. Special execution nameplate

Fig.12. Information marks - flow direction, pressure and temperature measurement outputs.

Each gas meter calibrated for fiscal purposes in the authorised laboratory, according to local regulations, has to be marked with special seals. In accordance with the European Type Approval issued for the CGT-02 Turbine Gas Meters these seals have to be installed in the following places: 1, 2, Fig 13. The seals contain information on the calibrating laboratory, and the date when the calibration was performed.On client's request the calibration certificate may be issued.

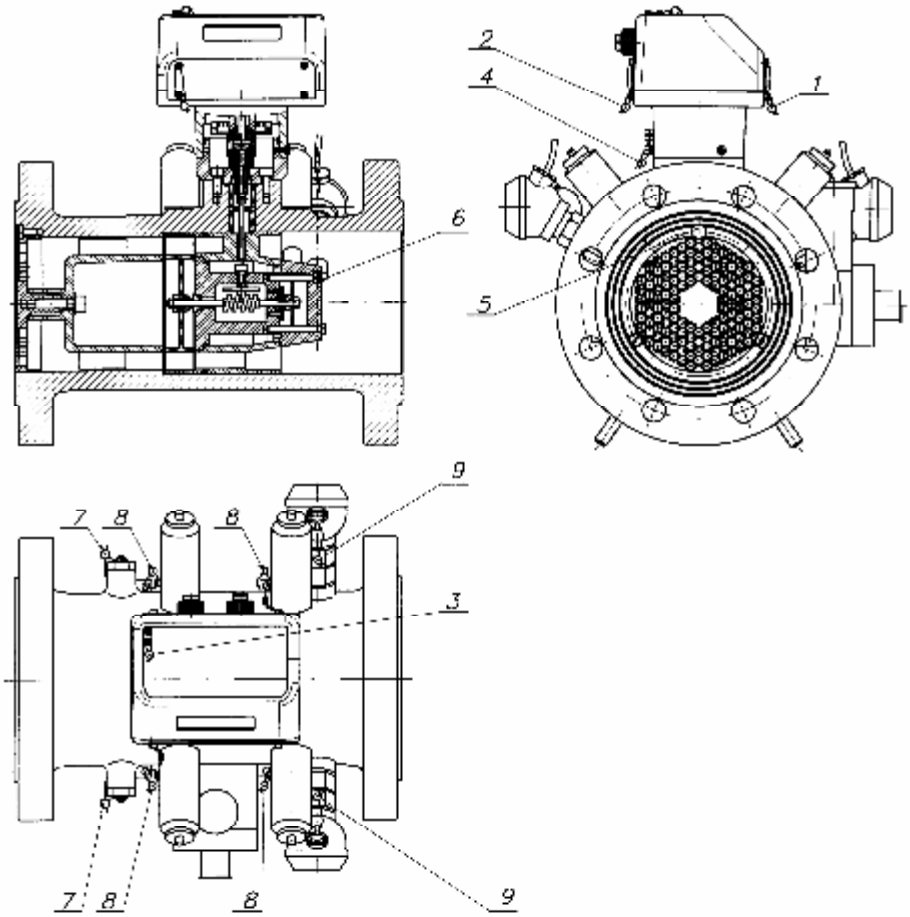


Fig. 13. Seal location on CGT-02 Turbine Gas Meters.

Connections that are not to be dismantled during the meter installation are protected with seals with the Office of Measures or Authorised Laboratory marking (Nos 3, 4, 5 and 6, Fig. 13).

THE LEGEAL CALIBRATION (BADGING) SEALS MUST NOT BE DAMAGED AS IT IS THE PROOF THAT THE GAS METERS HAS BEEN CALIBRATED AND MAY BE USED FOR FISCAL PURPOSES.

Pressure sensor taps (No 7), HF pulse transmitters (No 8), and, if necessary, temperature sensors (No 9), are provided with protective seals by the manufacturer, by the gas distributing

company or by the authorised installer. Besides the protective seals should be installed on un-used electrical signal output caps, and, if necessary, on the provided three way valve that is used for the connection with a volume corrector (see Section VIII).

Depending on local regulations 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. PACKAGING, TRANSPORTATION AND STORAGE

The gas meter is delivered in a factory package that secures the instrument during transportation and storage. DN50, DN80 and DN100 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. DN150. Bigger gas meters are placed on wooden palettes, and are protected with shaped styrofaoam inserts and cardboard shields. Appropriate information on the package content, as well as limitations on loading / unloading, is placed on the package.

The gas meters, for servicing or for re-calibration, 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 "Tuchel" plug No C091 31H006 100 2 that may be used for connecting a volume corrector or a data logger to the low frequency electrical output (if the volume corrector or data logger is not delivered as a set with the gas meter);
- 4-pin "Tuchel" socket No C091 31D004 100 2, if the gas meter is equipped with HF transmitter installed in the body;
- 0,25 l bottle with LUBRINA oil, if the meter is provided with the oil pump;
- Operating and Maintenance Instructions Manual

THE TURBINE GAS METER IS A PRECISE MEASURING INSTRUMENT AND SHOULD BE HANDLED WITH UTMOST CARE.

Following recommendations should be observed during transportation and storage:

1. The gas meters during transportation should be protected against falls, shocks, or strong vibrations (e.g. due to handling on improper trolleys).
2. The gas meters provided with oil pumps should be handled and stored so as to avoid oil spillages, i.e. the oil container cover should be directed upwards. If it is necessary to tilt the meter during installation it should be as short as possible (not more than 20 seconds).
3. Lifting the gas meters by means of the index housing is not allowed. Heavy meters are provided for such purposes with special lugs installed in flanges.
4. Special care should be observed during loading, unloading and manual transportation of high pressure gas meters as they are very heavy.
5. Factory installed covers or seals on the gas meters openings should be removed just befor the meter installation.

6. The gas meters during storing should be protected against direct atmospheric influence, and against humidity.
7. Special care should be taken not to destroy leaden seals placed during legal calibration. IF THE SEALS ARE DAMAGED THE LEGAL CALIBRATION, AS WELL AS THE GUARANTEE, MAY BECOME INVALID.
8. Lubrication of bearings during storing is not necessary.

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 name plate:

- maximum operating pressure [MPa], marked p_{max} ,
- maximum real flow [m^3/h], marked Q_{max} .
- permissible operation position:
  - H horizontal (standard execution),
  - VD vertical; flow from top downwards (option – on request),
  - VU vertical; flow from bottom upwards (option – on request).

It is permitted to operate the gas meter with flow bigger by 25% than the designed maximum flow within maximum 30 minutes.

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

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

The gas meter should be installed in piping of the 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 the standard PN-EN 12261:2003. Especially dangerous are forces transverse to the centre line of the gas meter. Gas meters with weight bigger than 50 kg should be supported so as they do not weigh down the installation.

When designing the place for the installation of the gas meter the dimensions given in Tables 3a and 3b, and in Fig.14, may be useful.

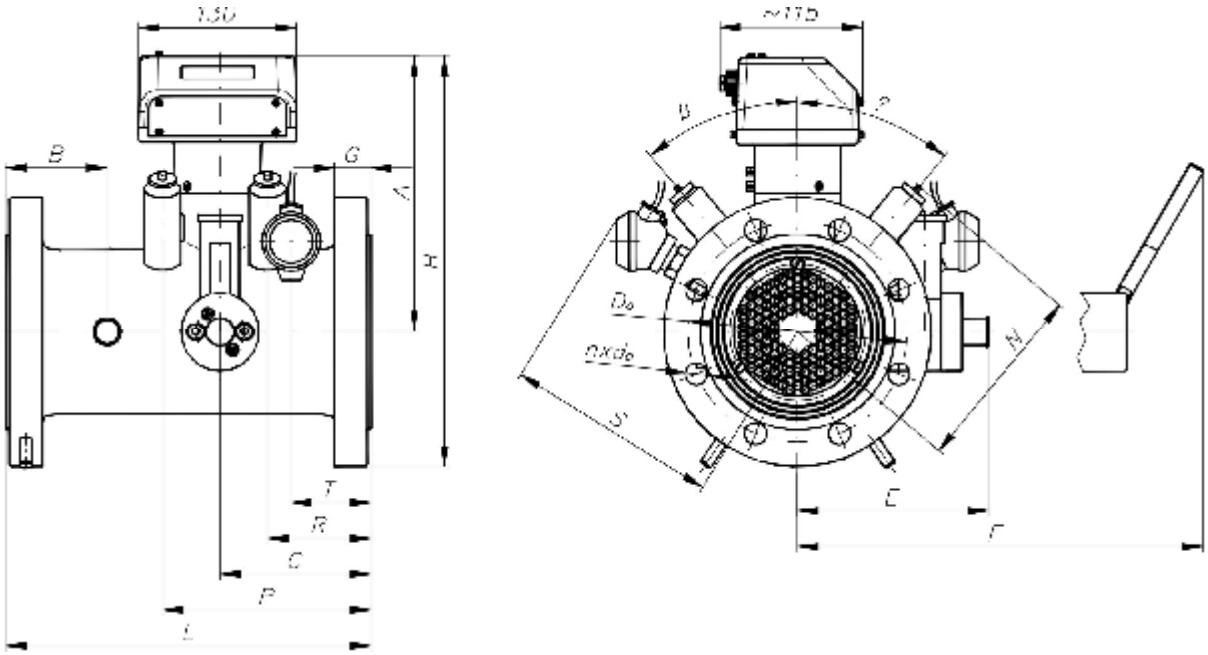


Fig.14. Basic dimensions of the CGT-02 Turbine Gas Meters.

Table 3a. Basic dimensions and weights of the CGT-02 Turbine Gas Meters

DN	Flanges	Body	L	H	A	B	C	E	F	G	N	P	R	S	T	α	β	Weight
mm			mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	°	°	kg
50	PN16/20	cast iron	150	286	203	42	58	150	-	21	~140	91	-	-	-	45	-	8
	PN16/20	machined carbon steel		286				150	-	15								9
	PN50/64			294				-	226	26								12
	PN110			286				-	226	32								17
80	PN16/20	cast iron	240	316	215	60	95	146	-	27	~150	137	-	-	-	45	-	18
	PN16/20	machined carbon steel		301	206	80		146	-	23								19
	PN50/64			306				-	222	30								26
	PN110			302				-	222	38								29
100	PN16/20	cast iron	300	340	229	101	124	157	-	30	~165	171	85	~172	66	40	60	23
	PN16/20	machined carbon steel		320	220			157	-	25					85		65	24
	PN50/64			338				-	233	34								40
	PN110			347				-	233	44								52
150	PN16/20	cast iron	450	400	256	125	180	185	-	33	~190	231	141	~197	110	35	55	47
	PN16/20	machined carbon steel		377	247	155		185	-	28					141		60	65
	PN50/64			409				-	261	43								80
	PN110			412				-	261	54								115
200	PN16/20	welded	600	441	270	212	240	202	-	35	~205	333	168	~212	168	30	55	70
	PN50/64			479				-	282	50								120
	PN110			481				-	282	62								160
250	PN16/20	welded	750	502	298	270	330	232	-	32	~225	425	258	~233	225	30	55	130
	PN50/64			534				-	308	55								195
	PN110			553				-	308	70								255
300	PN16/20	welded	900	554	323	300	350	258	-	38	~250	448	278	~257	245	30	55	190
	PN50/64			590				-	345	60								275
	PN110			604				-	345	73								360
	PN50			742						67								510
	PN110			777						92								650
	PN50			1026						74								1200
	PN110			1051						113								1500

Table 3b. Connections of the CGT-02 Turbine Gas Meters.

DN	Flanges	DZ	D0	d0	n
mm		mm	mm	mm	No.
50	PN16	165	125	18	4
	PN20	150	120,5	18	4
	PN50	165	127	18	8
	PN64	180	135	22	4
	PN110	165	127	18	8
80	PN16	200	160	18	8
	PN20	190	152,5	18	4
	PN50	210	168,5	22	8
	PN64	215	170	22	8
	PN110	210	168,5	22	8
100	PN16	220	180	18	8
	PN20	230	190,5	18	4
	PN50	255	200	22	8
	PN64	250	200	26	8
	PN110	275	216	26	8
150	PN16	285	240	22	8
	PN20	280	241,5	22	8
	PN50	320	270	22	12
	PN64	345	280	33	8
	PN110	355	292	29,5	12
200	PN16	340	295	22	12
	PN20	345	298,5	22	8
	PN50	380	330	26	12
	PN64	415	345	36	12
	PN110	420	349	32,5	12
250	PN16	405	355	26	12
	PN20	405	362	26	12
	PN50	445	387,5	29,5	16
	PN64	470	400	36	12
	PN110	510	432	35,5	16
300	PN16	460	410	26	12
	PN20	485	432	26	12
	PN50	520	451	32,5	16
	PN64	530	460	36	16
	PN110	560	489	35,5	20
	PN20	815	749,5	35,5	20
	PN50	915	813	42	24
	PN110	940	838	51	24

Impurities contained in gas and in the piping may cause damages to the measuring assembly and decrease the measurement accuracy. Therefore it is necessary to install the 10 μm filter upstream the gas meter (especially in case of heavy polluted gases). Prior to the installation it is recommended to clean the upstream piping 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 so 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 remainings 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.

The user of the gas meter should pay special attention to some risks 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 sweep away these impurities and in consequence 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. Nevertheless, 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.

Appropriate bolts and nuts are to be used for fixing the gas meter with piping flanges; they should meet the requirements described in the following standards: PN-EN 1515-2:2002, PN-EN ISO 898-1:2001, ZN-G-4008. Gaskets should be selected according to the nominal pressure and should be in accordance with applied flanges.

When selecting bolt lengths follow the information given in Tables 3a and 3b and make allowance for the gasket thicknesses.

For standard flanges with type „B" faces for p_{max}= 2 MPa flat gaskets may be used (according to PN-EN 1514-1:2001 or PN-EN 12560-1:2002), and for p_{max} > 2 MPa special gaskets (according to PN-EN 1514-4:2001 or PN-EN 12560-4:2002) are recommended

Unused electrical output sockets must be closed with factory supplied caps in order to protect them against corrosion and pollution.

The lubrication system of the CGT-02 Turbine Gas Meter is filled up by the manufacturer with LUBRINA oil**.** Prior to the start-up of the gas meter it is necessary to lubricate the turbine mechanism in accordance with the recommendations given in Section VII.

START-UP

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

1. The gas meter is installed with the valves 1, 2, 5 closed, and the by-pass valve 4 open. The vent valve 3 remains open after venting the installation.
2. Having tightened the bolts remove the 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 the 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.

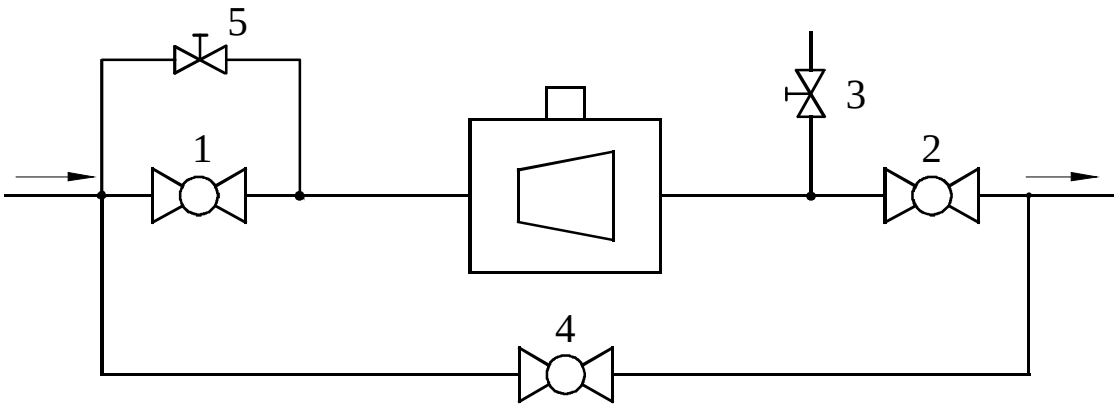


Fig. 15. Diagram of the measuring system with the by-pass valve

When removing the gas meter from the installation, proceed in the reverse order, i.e.:

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 measurement installation by means of the vent valve 3; pressure decrease should be not more than 30 ± 10 kPa/s.

In other 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 measurement turbine due to large pressure difference upstream and downstream the gas meter.

If during the usage of the gas meter ovechargings occur (i.e. Q_{max} may be overcome by more than 25 %), then it is recommended to instal orifices. The orifice should be installed downstream the gas meter at the distance of 5 to 10 nominal pipe diameters. The orifice plate size 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 appropriate orifices.

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. MAINTENANCE, FAULTS, REPAIRS

The CGT-02 Turbine Gas Meters may be provided with lubrication system of the turbine wheel assembly (it does not refer to DN 50 gas meters in standard execution). The only maintenance operation of the gas meter is periodical lubrication of bearings. The lubrication consists of pumping the oil portion from the oil container to the turbine wheel assembly. In case of gas meters designed for the operating pressure p_{max} = 1,6 MPa it is performed by pressing the piston located on the front side of the oil pump, under the cover. In case of gas meters designed for bigger pressures the oil pump is provided with a lever that acts on the piston (see Fig. 14, dimensions *E* and *F*). One full stroke of the piston (ca. 12 mm) pumps approx.. 1/3 cm^3 of oil.

For gases idicated in Table 1, it is necessary to lubricate the meter after the gas volume V [m3] has flown through the meter, as per Table 4, but no less than once a month. For refinery gases, biogas and other aggressive gases the lubrication should be performed once a week.

Table 4. Recommended number of strokes (n) of the lubrication pump

G	V	n	G	V	n
	[m^3]	strokes		[m^3]	strokes
G100	100.000	6	G1600	1.600.000	20
G160	160.000	6	G2500	2.500.000	20
G250	250.000	9	G4000	4.000.000	25
G400	400.000	9			
G650	650.000	12			
G1000	1.000.000	12			

After each lubrication it is necessary to check the oil level in the container; the oil level should be visible through the transparent wall of the container. For refilling it is necessary to use Lubrina oil, delivered by Common S.A. For DN 80 gas meters it is recommended to use Lubrina L 12 oil, viscosity approx. 12 mm^2/s (cSt) at 20^0 C; for bigger gas meters it is recommended to use Lubrina L 23, viscosity approx. 23 mm^2/s .

For gases mentioned in Table 1 it is allowed to use the following oil susbstitutes: Isoflex PDP10 for DN 80, Isoflex PDP38 or Aeroshell Fluid 12 for DN>80.

GAS METERS THAT ARE USED FOR GASES OTHER THAN THOSE MENTIONED IN TABLE 1 SHOULD BE LUBRICATED WITH OTHER OILS. IN SUCH CASES THE OIL GRADE SHOULD BE AGREED WITH THE GAS METER MANUFACTURER!

Dust and another impurities shoud 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 occurs (e.g. uneven run, stoppage of index, 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. IS NOT ALLOWED TO PERFORM REPAIRS BY THE USER!

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

VIII. AUXILIARY EQUIPMENT

In order to convert the gas volum from operating into basic conditions it is often required (or recommended) to use electronic volume converters. Common S.A. is also the manufacturer of such devices, e.g. CMK-02 Volume Correctors and CRI-02 Data Loggers. On requests COMMON S.A. may deliver these devices, and install them at client's site. Examples of such installations are shown in Fig.16 and Fig. 17.

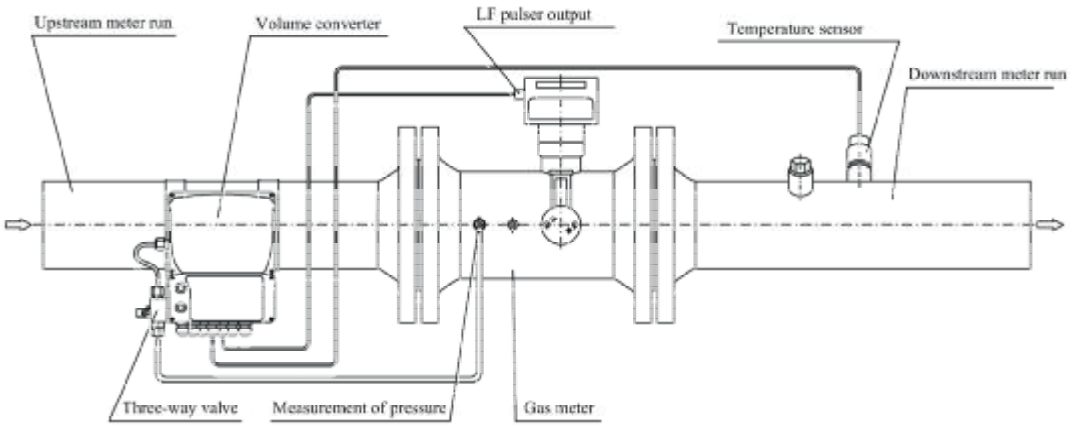


Fig 16. CGT-02 turbine gas meter assembly with the CMK-02 volume corrector (the volume corrector is installed on the upstream pipe)

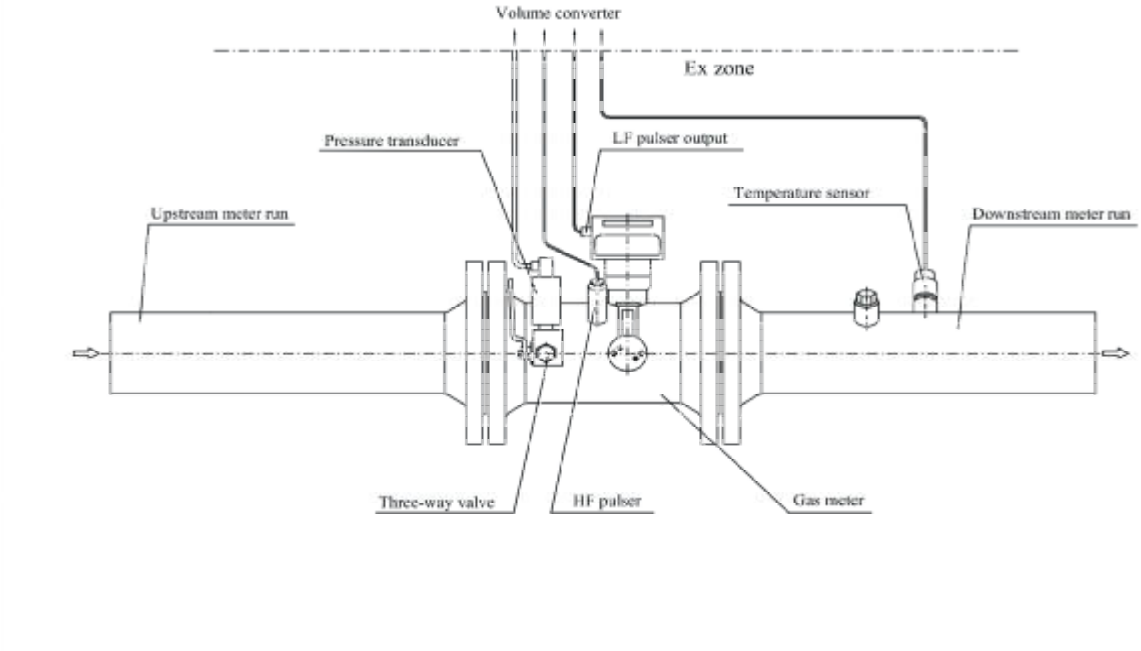


Fig.17. Connection diagram of the volume correction assembly installed outside the explosion hazard zone (Ex Zone), 230 V power supplied

The volume corrector needs three input signals:

- flow (from the low frequency or high frequency pulse transmitter),
- pressure,
- temperature.

The pressure signal is taken from the pressure tap. It is recommended to take the pressure signal via the CKMT Three-way Valve (Fig. 18) that enables to isolate the pressure sensor, and as the result to disassemble and inspect this sensor. There is no need to stop the gas flow through the gas meter.

Fig. 18. CKMT Three-way Valve

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

The temperaure signal is taken from the temperature sensor installed in an appropriate temperature pocket in the downstream pipe (behind the gas meter), see Fig. 17, or in the temperaure tap on the meter body.

It should be kept in mind that all connections of additional equipment to the gas meter cause that the installation seals get damaged. Therefore such works may be performed by the representaive of the gas supply company or by the manufacturer. Unused electrical output sockets must be closed by means of factory caps in order to protect them against corrosion and dirt.
