COMMON

QUANTOMETER

1 DESIGN AND FUNCTION

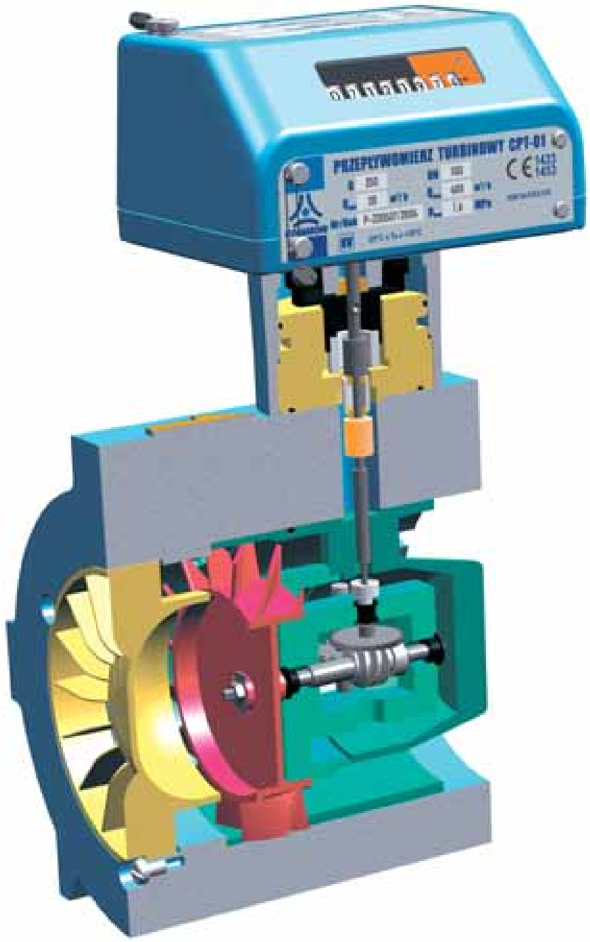
CPT Quantometers have been designed in order to provide our customers with reliable and inexpensive measuring instruments for secondary flow measurements.
Our great experience in designing and manufacturing of turbine and rotary gas meters resulted in the development of industrial quantometers.
Taking into account our customers' demands we created the instrument with excellent metrological characteristics and operating performance close to performances of the turbine gas meters designed for custody transfer measurements.
Other advantages of the CPT Quantometers are as follows: high quality, easy maintenance, wide range of external devices that can co-operate with the quantometers, e.g. volume correctors, data loggers, data transmission systems.
Due to that the CPT Quantometers are well accepted by our domestic and foreign customers.

The basic components of the CPT Quantometer are as follows:

- pressure resistant meter body
- inlet flow conditioner
- measuring cartridge with the turbine wheel
- magnetic coupling as the transferring element between measuring cartridge and the index
- index head

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 1: Physical properties of most popular gases that may be measured with the CPT Quantometer; density at 101,325 kPa and at 20°C

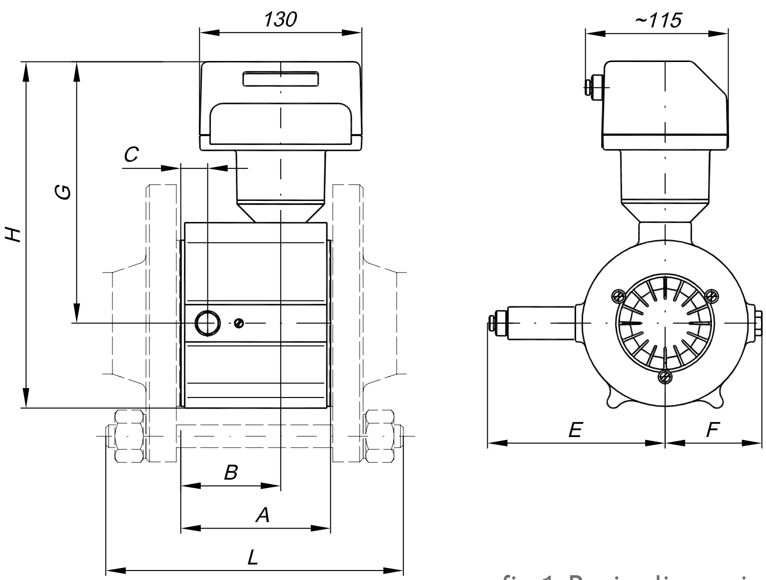


2 GENERAL TECHNICAL DATA

table 2:

DN mm	DN inch	G	Maximum flow Q_{max} [m³/h]	Minimum flow Q_{min} [m³/h]	LF pulse rate [m³/pulse]
50	2	40	65	6	0,1
		65	100	10	
80	3	100	160	8	1
		160	250	13	
		250	400	20	
100	4	160	250	13	1
		250	400	20	
		400	650	32	
150	6	400	650	32	1
		650	1000	50	
		1000	1600	80	10

- pressure rating: PN16, PN20, ANSI150
- nominal diameter: DN50 up to DN150 standard range, other on request
- meter bodies: aluminium
- flow: 6 to 1600 m^3/h other on request
- rangeability: 1:20 minimum at atmospheric pressure
  Some smaller size meters have reduced ranges.
- temperature range: gas temperature -20°C to +60°C
  ambient temperature -25°C to +70°C
- allowed medias: see table 1
- operating position: horizontal or vertical



		DN50	DN80	DN 100	DN 150
A	mm	100	120	150	180
B	mm	65	80	100	127
C	mm	18	21	29	50
E	mm	140	150	165	190
F	mm	65	77	91	116
G	mm	199	211	225	243
H	mm	252	278	305	351
Weight	kg	3,6	5,3	7,4	11,6
M16 bolt No x L		4 x 180	8 x 200	8 x 235	8 x 270

Note: No and lenght of bolts is for PN16 flanges only.

fig.1 Basic dimensions of CPT Quantometer

3 MEASUREMENT OUTPUTS

PRESSURE OUTPUT

The operating pressure (reference pressure) can be taken from the pressure tap, marked pr, located on one side of the meter body.

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)

HF1, HF2	LFI, HF3	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.

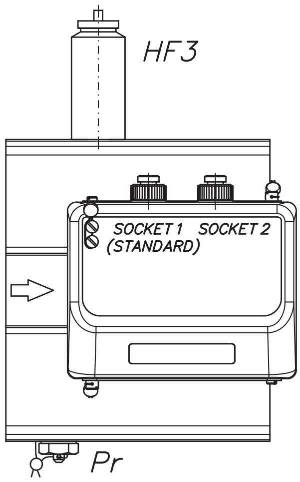


fig. 2 Location of measurement outputs (top view)

The CPT Quantometers may be provided with up to 7 pulse sensors:

LFK	– low frequency reed contact pulse sensor	LFK 1, LFK 2
LFI	– low frequency inductive pulse sensor	LFI 1, LFI 2
HF	– inductive pulse sensor in the index unit	HF 1, HF 2
HF	– inductive pulse sensor over the turbine wheel	HF 3
AFK	– anti-fraud reed contact	AFK

The turbine wheel, as a standard, is made of aluminium. This allows to provide each CPT Quantometer with one HF3 inductive pulse sensor. There are no extra costs due to the replacement of the turbine wheel.

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

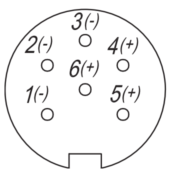


fig. 3 Pulse sensor pin numbering in sockets 1 and 2 installed in the index.
The sockets match the TUCHEL plug No C091 31H006 100 2

Pin No	HF over turbine wheel
3 - 4	HF 3

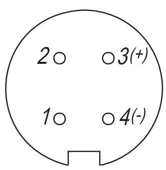


fig. 4 Pulse sensor pin numbering in socket of the HF3 pulse transmitter installed in the meter body.
The sockets match the TUCHEL plug No C091 31D004 100 2

4 SELECTION OF CPT QUANTOMETER

In order to choose the proper size of the turbine quantometer the following operating condition parameters should be known: flow range $Q_{min\,m}$ and $Q_{max\,m}$, pressure range $p_{min\,m}$ and $p_{max\,m}$, gas temperature range $T_{min\,m}$ and $T_{max\,m}$.
Usually flow range is given at standard conditions: $Q_{min\,s}$ and $Q_{max\,s}$.
Base conditions (NPTconditions: base temperature and base 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:

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

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

$$Q_{min} \; (Q_{min\,C}) < Q_{min\,m} \qquad Q_{max} > Q_{max\,m}$$

where Q_{min} and Q_{max} – minimum and maximum flow, according to table 2.
The measurement range increases with increase of operating pressure. The corrected $Q_{min\,C}$ value decreases, and it may be calculated from the following formula:

$$Q_{min\,C} = Q_{min} \cdot \sqrt{\rho_a / \rho_m} \qquad \text{where } \rho_m = (p_m + 1) \cdot \rho_s$$

DEFINITION:

- $Q_{min\,m}$ = minimum flow at operating conditions [m³/h]
- $Q_{max\,m}$ = maximum flow at operating conditions [m³/h]
- $Q_{min\,s}$ = minimum flow at base conditions [Nm³/h]
- $Q_{max\,s}$ = maximum flow at base conditions [Nm³/h]
- $Q_{min\,C}$ = corrected minimum flow [m³/h]
- p_s = base pressure (according to national standards) [bar a]
- T_s = base temperature (according to national standards) [K]
- ρ_s = standard density of the gas [kg/m³], see table 1
- p_m = gauge pressure at operating conditions [bar g]
- ρ_m = density at operating conditions [kg/m³]
- ρ_a = standard density of air 1,2 kg/m³
- $p_{max\,m}$ = 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 $Z \approx 1$)

5 PRESSURE LOSS

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

To determine pressure losses at other, higher pressures, the following formula applies:

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

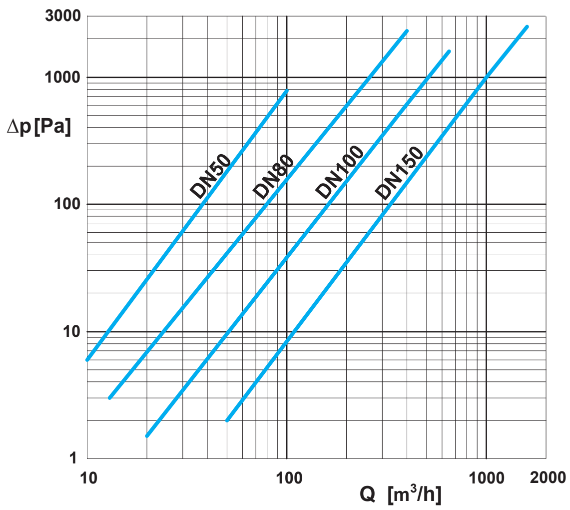


fig. 5 Diagram of pressure loss related to ρ = 1,2 kg/m³

DEFINITION:

Δp_1	=	pressure loss at p
Δp	=	pressure loss from the diagram, fig. 5
p_m	=	gauge pressure at operating conditions [bar g]
ρ_s	=	standard density of gas [kg/m³]
ρ_a	=	standard density of air 1,2 kg/m³
p_s	=	base pressure (1,01325 bar)

6 INSTALLATION AND OPERATION RECOMMENDATIONS

- Meters should be shipped in their original package to the place of installation.
- The measured gas should be clean, dry and free from solid impurities. It is recommended that the upstream pipe installation is to be equipped with a filter (10 micron).
- Prior to installation the upstream and downstream pipe flanges should be aligned properly.
- The gas flow should be in accordance with the arrow placed on the meter body.
- When used outdoors the meter should be protected against direct weather influence.
- When starting the gas flow through the installation, the valves should be opened slowly to ensure a gradual increase of pressure.

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

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