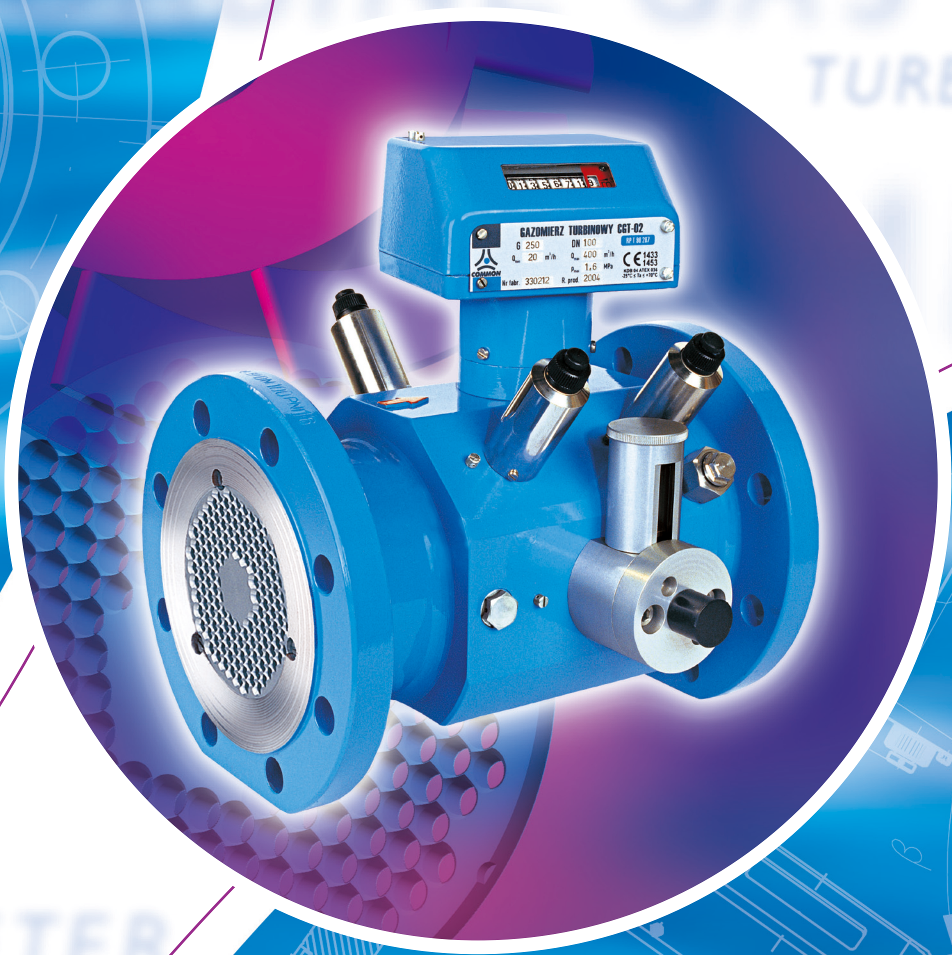
COMMON

TURBINE GAS METER



1 DESIGN AND FUNCTION

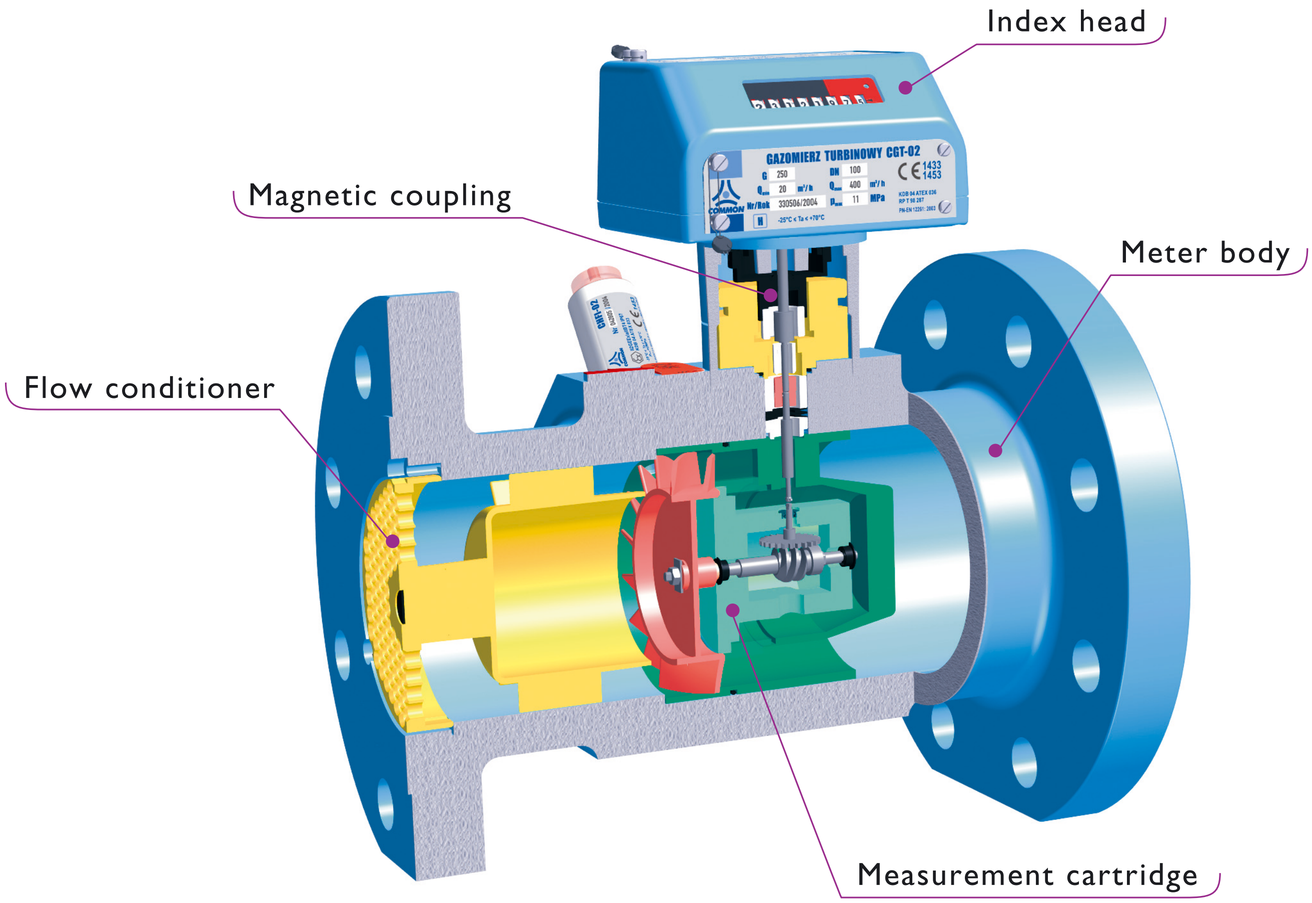
CGT series turbine gas meters are flow meters designed to measure quantity of gases.
The CGT series gas meters are applied in measurement systems where high accuracy is required:

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

The turbine gas meter measures the quantity of gas basing on the flow principle. The gas flows through an integrated flow conditioner, which distributes the flow proportionally in the annular slot and guides it to the turbine wheel. The wheel is driven by the gas flow, and the angular velocity of the rotation is proportional to the gas flow rate.

The energy consumption, perceived as pressure loss, is reduced to absolute feasible minimum due to the application of the flow conditioner, highest precision ball barings, most accurate tolerances of all measuring parts and their proper alignement.
The rotary motion of the turbine wheel is transferred mechanically by gear wheels, and the incorporated gas tight and hermetic magnetic coupling, to the index unit, which is mounted on the top of the body, and shows the operating volume on the totalizer.

The turbine wheel, as a standard, is made of aluminium. This allows to provide each CGT turbine gas meters with HF inductive pulse sensors. There are no extra costs due to the replacement of the turbine wheel.



2 GENERAL TECHNICAL DATA

table 1

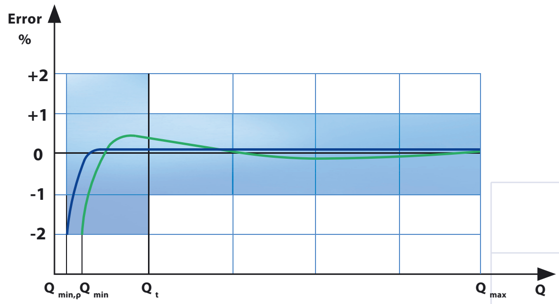
DN	G	Qmax	Qmin (at atmospheric pressure) for meters designed for 1.6 &2 MPa			Qmin (at atmospheric pressure) for meters designed for 5, 6.4, 10, & 11 MPa				LF values and approximate HF values		
			1:10	1:20	1:30	1:5	1:10	1:20	1:30	LF	HF1, HF2	HF3÷HF6
-	-	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	m³/h	pulse/m³	pulse/m³	pulse/m³
50	40	65	6	-	-	13	6	-	-	10	2610	94829
	65	100	10	5	-	20	10	-	-		2610	94829
80	100	160	16	8	-	32	16	8	-	1	1081	42563
	160	250	25	13	-	50	25	13	-		844	30652
	250	400	40	20	-	80	40	20	-		470	17059
100	160	250	-	13	-	50	25	13	-	1	1383	29309
	250	400	-	20	13	80	40	20	-		632	16782
	400	650	-	32	20	130	65	32	20		401	9719
150	400	650	-	32	20	130	65	32	20	1	302	7331
	650	1000	-	50	32	200	100	50	32		227	6873
	1000	1600	-	80	50	320	160	80	50	0,1	129	3910
200	650	1000	-	50	32	-	100	50	32	1	114	3113
	1000	1600	-	80	50	-	160	80	50	0,1	116	3167
	1600	2500	-	130	80	-	250	130	80		67	2025
250	1000	1600	-	80	50	-	160	80	50	0,1	58	2111
	1600	2500	-	130	80	-	250	130	80		58	2111
	2500	4000	-	200	130	-	400	200	130		34	1223
300	1600	2500	-	130	80	-	250	130	80	0,1	32	1181
	2500	4000	-	200	130	-	400	200	130		32	1181
	4000	6500	-	320	200	-	650	320	200		19	680
400	2500	4000	-	200	130	-	400	200	130	0,1	7	242
	4000	6500	-	320	200	-	650	320	200		7	242
	6500	10000	-	500	320	-	1000	500	320		7	285

- pressure rating: PN16 to PN110, ANSI150 to ANSI600 other rates on request
- nominal diameter: DN50 up to DN400 other on request
- meter bodies: cast iron or carbon steel details in table 4
- flow: 6 to 10 000 m³/h other on request
- rangeability: up to 1:30 at atmospheric pressure
  higher on request
- upstream pipe: minimum 2 x DN;
  meters meet the requirements of the OIML R32 89 Annex A
- temperature range: gas temperature -20°C to +60°C
  ambient temperature -25°C to +70°C
- allowed medias: see table 2
- operating position: horizontal or vertical

measurement accuracy: EU requirements and better
guaranteed at least: 0.2 Qmax – Qmax < ± 1%
Qmin – 0.2 Qmax < ± 2%

fig.2: Measurement error typical curve

- at low pressure (average 1 bar a) green curve
- at high pressure (over 5 bar a) blue curve



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 CGT turbine gas meters - density at 101,325 kPa and at 20°C

3 MEASUREMENT OUTPUTS

PRESSURE AND TEMPERATURE OUTPUTS

The operating pressure (reference pressure) can be taken from the pressure taps, marked pr, located on both sides of the meter body.
The meters can be optionally equipped with two temperature taps for the measurement of the gas temperature.

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 sensors (NAMUR)
- HF inductive pulse sensors (NAMUR)

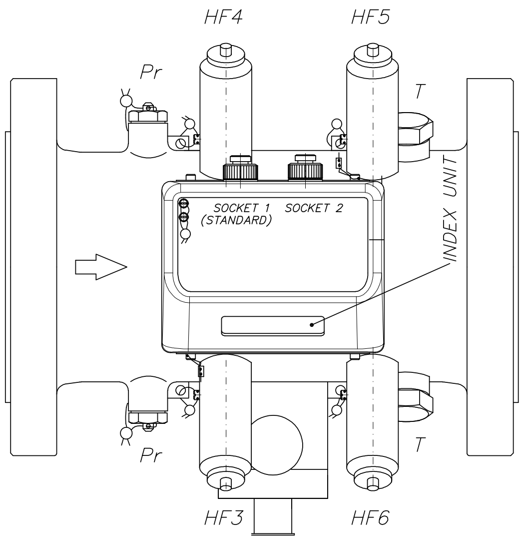


fig. 2. Location of measurement outputs (top view)

HF (index)	LFI	LFK
U_i = 20 V DC	U_i = 20 V DC	U_i = 15,5 V DC
I_i = 60 mA	I_i = 60 mA	I_i = 52 mA
P_i = 80 mW	P_i = 130 mW	P_i = 169 mW
L_i = 150 µH	L_i ≈ 350 µH	L_i ≈ 0
C_i = 150 nF	C_i = 250 nF	C_i ≈ 0

table 3: Permissible supply parameters of intrinsically safe circuits.

The CGT turbine gas meters may be provided with up to 10 pulse sensors for DN100 – DN300 and up to 8 pulse sensors for DN50 – DN80

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
HF	– inductive pulse sensor over the turbine wheel	HF3, HF4
HF	– inductive pulse sensor over the reference wheel	HF5, HF6
AFK	– anti-fraud reed contact	AFK

The sockets in the index match the TUCHEL plug no C091 31H006 100 2

fig. 3 Pulse sensor PIN numbering in sockets I and 2 installed in the index

	PIN	polarity	LFK 1		LFK 2		AFK		LFI 1		LFI 2		HF 1		HF 2	
Socket 1	1	-	S						O							
	4	+		S						O						
	2	-			O		P		P		O				O	
	5	+				O		P		P		O				O
	3	-					O						P			
	6	+						O						P		
Socket 2	1	-			P				O							
	4	+				P				O						
	2	-			O		O		O		P				O	
	5	+				O		O		O		P				O
	3	-											O		P	
	6	+												O		P

S - standard connection P - preferred connection O – alternative connection

The sockets of optional HF3, HF4, HF5, HF6 pulse sensors match the TUCHEL plug no C091 31D004 100 2. For connections, please use PIN 3 and PIN 4.

table 4: Permissible supply parameters of intrinsically safe circuits for HF3, HF4, HF5, and HF6.

HF3 HF4 HF5 HF6	Ui [V]	Ii [mA]	Pi [mW]	Li [µH]	Ci [nF]
CHFI-02	15,5	52	169	40	28
Bi3-EG12-RY1	20	60	200	150	150
Bi1-EG05-Y1	20	60	80	150	150
NJ08-5GM-N-Y07451	16	25	64	50	20

4 DIMENSIONS AND WEIGHTS

Overall dimensions and weights of CGT turbine gas meters are shown in Table 4

fig.5 Dimensions of the CGT turbine gas meter

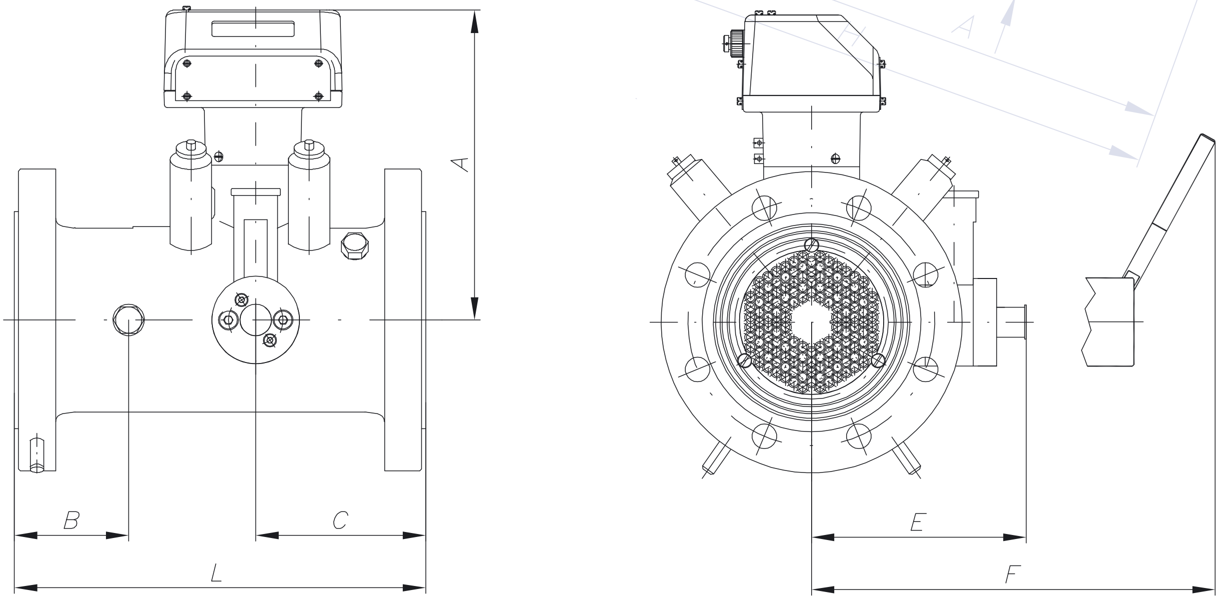


table 4

DN mm	Flange	body	L mm	A mm	B mm	C mm	E;F mm	weight kg
50	PN16	cast iron	150	198	42	58	150	9
	PN20/ANSI150							8
	PN16	steel						12
	PN20/ANSI150							11
	PN50/ANSI300							12
	PN63/64						216	15
	PN100							17
	PN110/ANSI600							13
80	PN16	cast iron	240	201	60	95	146	19
	PN20/ANSI150							18
	PN16	steel			80			24
	PN20/ANSI150							24
	PN50/ANSI300							27
	PN63/64						212	28
	PN100							32
	PN110/ANSI600							30
100	PN16	cast iron	300	215	101	124	157	24
	PN20/ANSI150							25
	PN16	steel						32
	PN20/ANSI150							34
	PN50/ANSI300							42
	PN63/64						223	39
	PN100							46
	PN110/ANSI600							52
150	PN16	cast iron	450	242	125	180	185	47
	PN20/ANSI150							46
	PN16	steel			155			64
	PN20/ANSI150							64
	PN50/ANSI300							80
	PN63/64						251	86
	PN100							96
	PN110/ANSI600							105

DN mm	Flange	body	L mm	A mm	B mm	C mm	E;F mm	weight kg
200	PN16	cast iron	600	265	212	240	202	70
	PN20/ANSI150							71
	PN16	steel						70
	PN20/ANSI150							71
	PN50/ANSI300							100
	PN63/64						268	115
	PN100							130
	PN110/ANSI600							140
250	PN16	steel	750	293	270	330	232	130
	PN20/ANSI150							130
	PN50/ANSI300							175
	PN63/64						298	190
	PN100							230
	PN110/ANSI600							250
300	PN16	steel	900	318	300	350	258	190
	PN20/ANSI150							200
	PN50/ANSI300							260
	PN63/64						324	270
	PN100							330
	PN110/ANSI600							340
400	PN16	steel	1200	354	500	400	387	350
	PN20/ANSI150							390
	PN50/ANSI300							480
	PN63/64							490
	PN100							610
	PN110/ANSI600							580

Size E is valid for: PN16, PN20, PN50, ANSI150, ANSI300
Size F is valid for: PN63/64, PN100, ANSI600

5 PRESSURE LOSS

The gas meter causes inevitable pressure loss. The value of pressure loss was determined for air at atmospheric conditions (density ρ_0 = 1,2 kg/m3), and is presented in figure 6.
Please use the following formula in order to determine the pressure loss Δprz [Pa] in operating conditions (different gases and pressures):

$$\Delta p_{rz} = \left(\frac{\rho}{\rho_0}\right) \cdot \left(\frac{p_a + p}{p_a}\right) \cdot \Delta p$$

DEFINITION:

ρ - gas density according to table 2 [kg/m^3],
p_a - atmospheric pressure ($p_a \cong$ 101 [kPa]),
p - gauge pressure before meter inlet [kPa],
Δp - pressure loss related to air (from fig 6) [Pa],
ρ_0 = 1,2 kg/m^3.

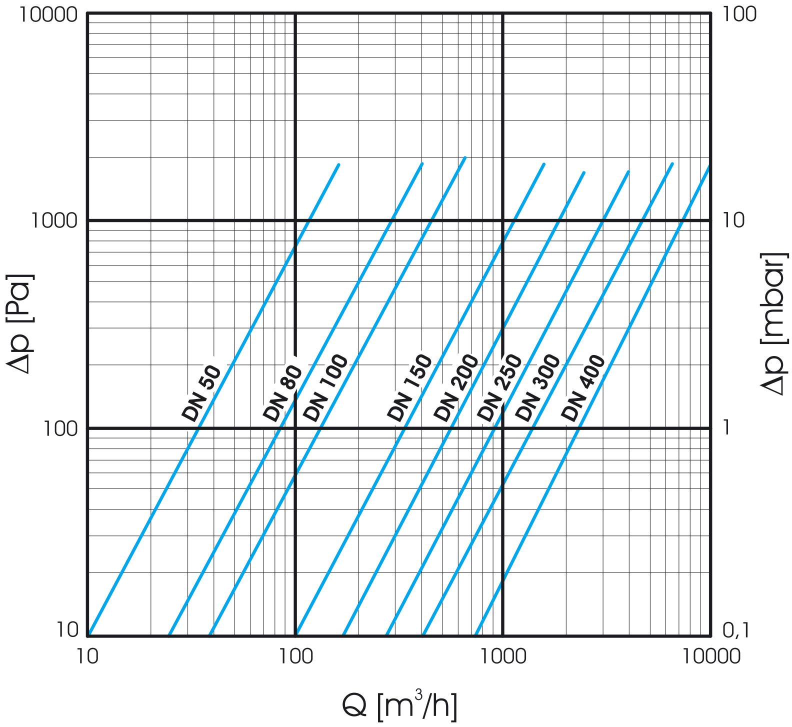
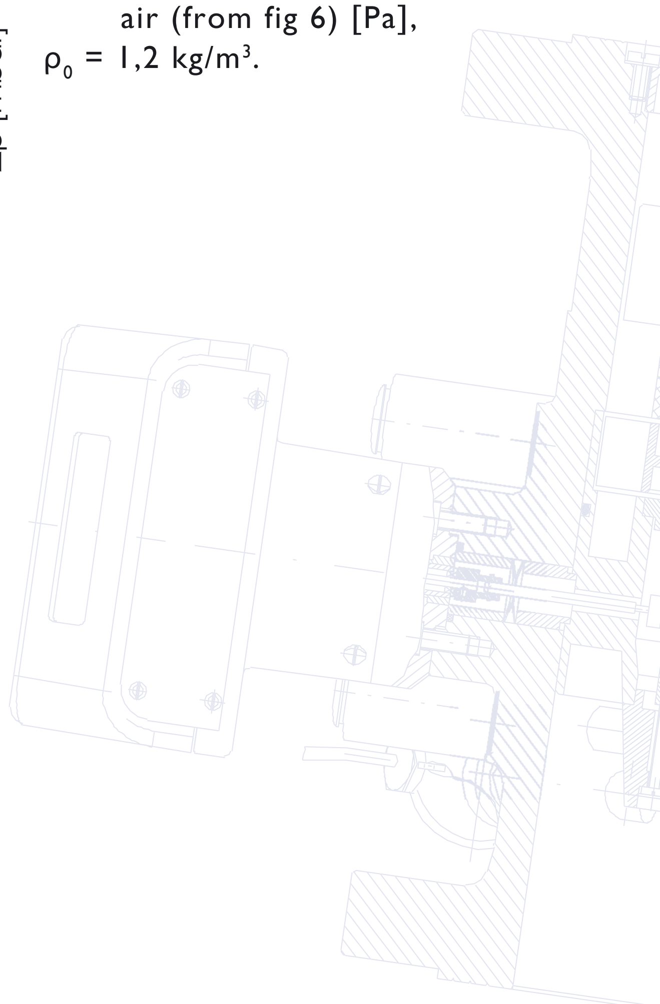


fig. 6 Diagram of pressure loss related to ρ_0 = 1,2 kg/m^3 (air).



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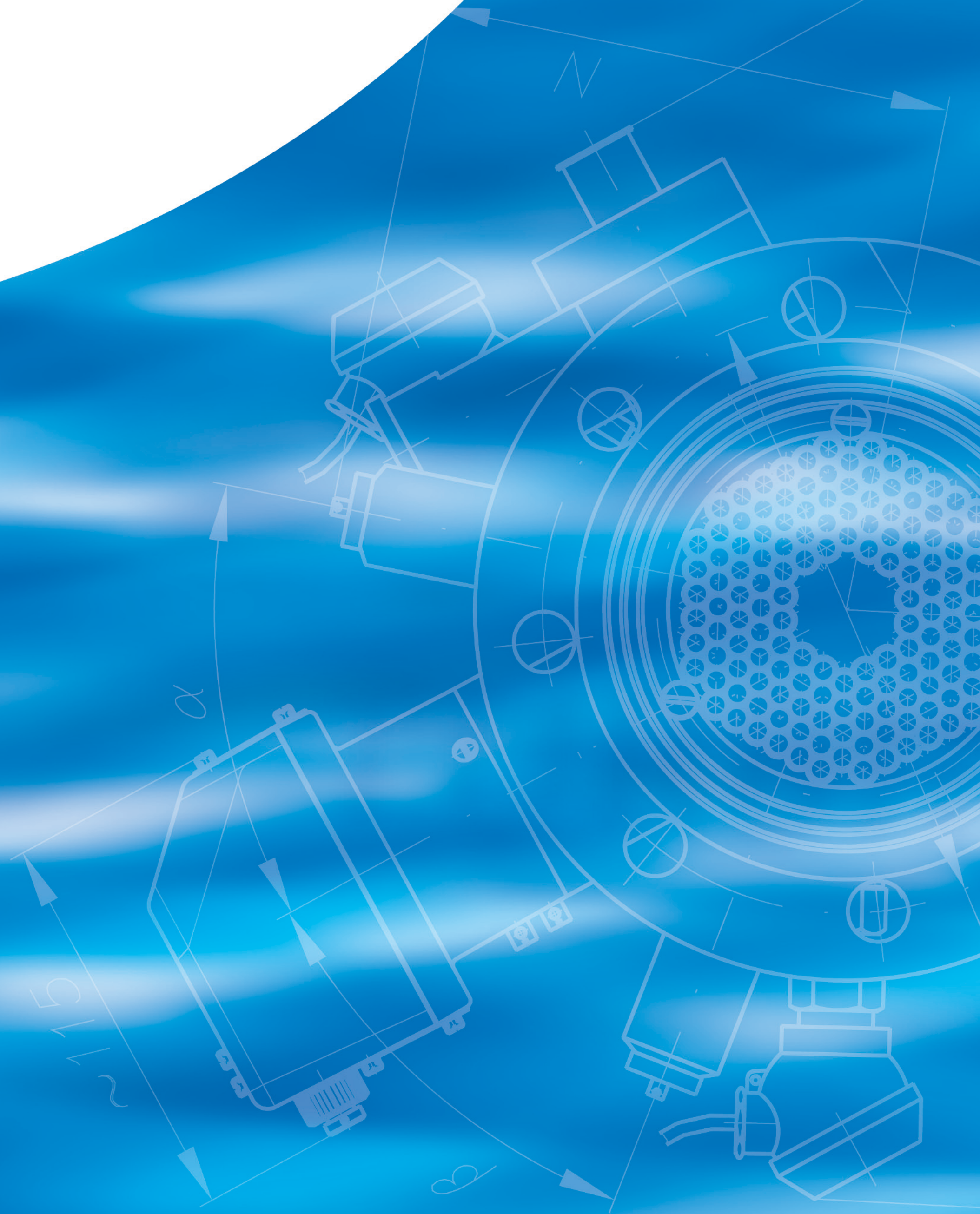

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