Instromet®

TURBINE GAS METER
Q - SERIES

TURBINE GAS METER Q-SERIES

M-Q-13

E

GENERAL

The INSTROMET Q-Series turbine gas meter is a compact integrating flow meter for the measurement of gases. The volume of gas passing through the meter, at the operating pressure and temperature, is indicated on a counter in units of volume (m^3). The volume registered can be converted to a reference volume (Nm^3) by application of a volume integrator such as the INSTROMET electronic flow computers and volume correctors. If required, the line volume can be converted to mass by the use of a density transmitter and an INSTROMET flow computer.
The Q-turbine is based on proven INSTROMET technology and incorporates the results of over 25 years of experience. The Q-Series included the Q, QIC, and Q-75 turbine meters.

APPLICATIONS

The standard Q-turbine is widely used for the measurement of natural gas and other non-corrosive fuel and feedstock gases such as propane and butane. It is also used for other industrial gases such as air, nitrogen, carbon dioxide, hydrogen, etc. A special construction can be supplied for use with corrosive gases. Its compact size makes it particularly useful for applications in existing industrial installations such as the allocation of costs to different processes.

CONSTRUCTION

The main parts of the Q-turbine gas meter are:

1. Meter body,
2. Measuring mechanism and turbine wheel,
3. Inlet flow conditioner,
4. Mechanical drive and magnetic coupling to transfer the turbine wheel rotation to outside the pressure body,
5. Mechanical counter for registering the volume measured,
6. Oil lubrication system for the turbine wheel shaft bearings.

GENERAL TECHNICAL DATA

Pressure ratings	:	ANSI 125 to ANSI 600 and ND 10 to ND 100. Higher pressure ratings on request.
Nominal diameters	:	50 mm (2") to 600 mm (24"). Larger sizes on request.
Flow rates	:	Up to 25,000 m^3/h (900,000 cfh) (line conditions).
Measurement range	:	1 : 20 at atmospheric conditions*.
Installation	:	Up to 200 mm (8") both vertical and horizontal; over 200 mm horizontal only.
Repeatability	:	better than ± 0.1 %.
Measuring accuracy	:	Between q_{min} and 0.2 q_{max} ± 2 %**. Between 0.2 q_{max} and q_{max} ± 1 %**.
Temperature range	:	- 10° C to + 65° C / 15° F to 150 ° F. Other temperature ranges on request.

* *Some smaller size meters have reduced ranges.*
** *For uniform swirl free flow.*

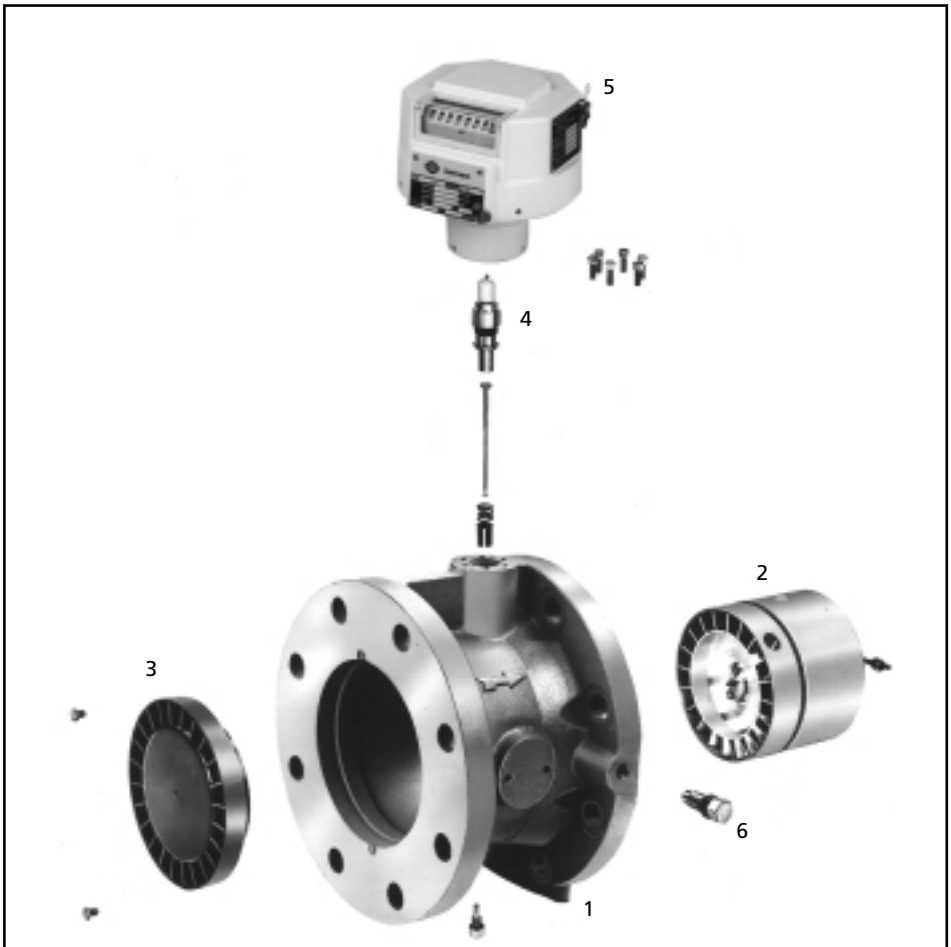


Figure 1.

OPERATING PRINCIPLE

The flowing gas enters the meter through a built-in flow conditioner **(1)** that conditions the flow profile and increases the gas velocity. The gas continues along the flow channel **(2)** and enters the turbine rotor. The turbine rotor blading **(3)** is designed with overlap to give complete guidance to the flowing gas and extract the maximum energy at low gas velocities. The turbine wheel's angular velocity is proportional to the average gas velocity flowing through the meter. The gas exits the turbine rotor through a flow ring **(4)** and an expanding exit channel to minimise pressure losses. The rotation of the turbine rotor is transmitted via a gear train **(5)** and transferred from the pressurised meter body to the counter **(7)** by a gas tight magnetic coupling **(6)**. The follower magnet of the magnetic coupling drives the counter to register volumes measured at the operating conditions.

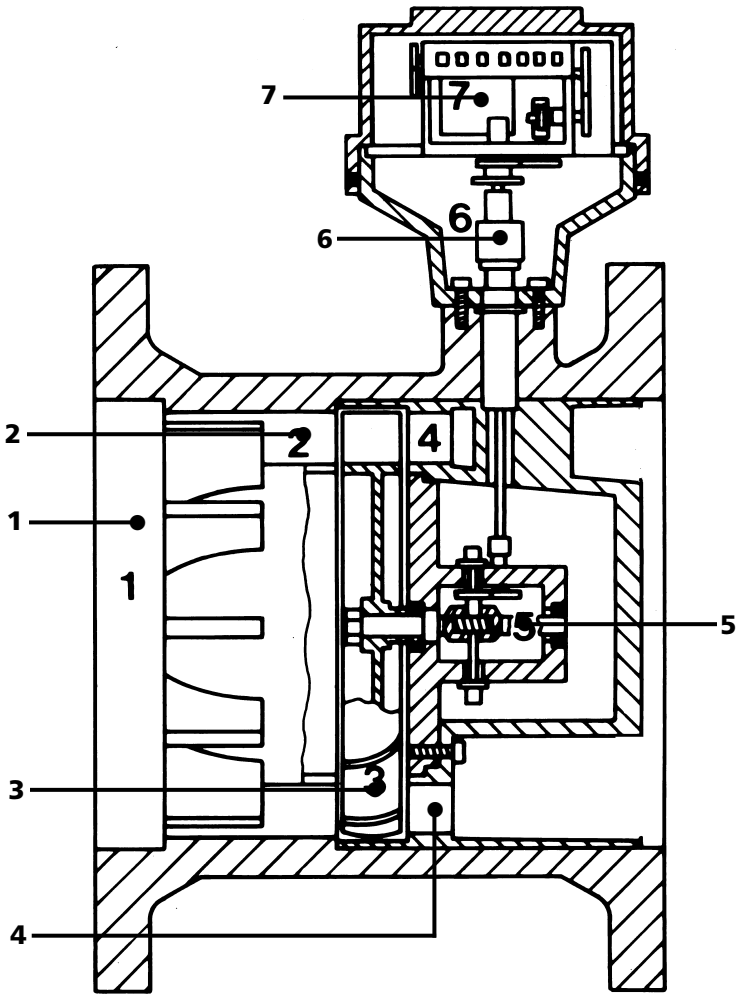


Figure 2.

MEASURING RANGE

The Q-turbine gas meter has a measuring range of 20:1 with air at atmospheric conditions. At higher operating densities, the range of the turbine meter will increase since more kinetic energy is available to overcome mechanical friction of bearings.

The following equation may be used for a rough estimate of the minimum flow rate of the meter for various operating conditions. The equation assumes ambient temperature and ideal gas behaviour (Z = 1).

$$q = q_m \sqrt{\frac{1.103}{p} \times \frac{1,29}{\rho}}$$

q = Minimum capacity under operating conditions.

q_m = Minimum capacity for meter accuracy - see table on page 5-6.

P = Operating pressure of the meter in bar absolute.

ρ = Density of the gas at atmospheric pressure - see table on page 7.

METER INDEX, PULSERS

Figure 3 : Multi Index

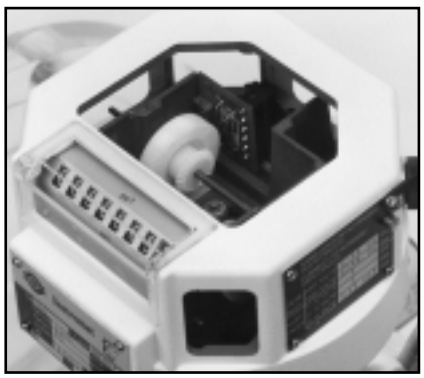


Figure 4 : LF Reed Contact

Figure 5 : HF Slot Sensor

Standard Multi-index :

The standard index is a multi-index as shown, fitted with a reed contact to provide a low frequency pulse (impuls values see page 5).

The impulse is accessed through an electrical connection. The counter is readable over a 90° field of vision and has 8 digits.

Possible Index Options :

- LF Double pulser (Reed contact)
- HF pulser (Slot sensor)
- HF double pulser (Slot sensor)
- HF / LF pulse combinations
- Mechanical drive (Type 25 H7 according to DIN 33800)
- Reverse current barrier
- Drying agent option (aluminium silicate)
- Tropical operation
- "Cryo" index extension to prevent icing problems in meters operating with sub-zero temperature gas
- Polyepoxy coated material - for corrosive environment

Connector Options :

Standard :

Pins 1 and 4 = LF Reed contact
Pins 3 and 6 = HF slot sensor

Additional connector combinations are indicated on the type plate.

HF PROXIMITY SENSOR - TURBINE WHEEL / REFERENCE WHEEL

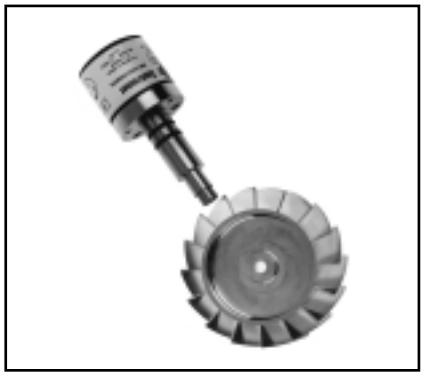


Figure 6 : HF Proximity Sensor

Each turbine gas meter with an aluminium turbine wheel can be fitted with a Reprox probe type pulse sensor. As each turbine blade passes the proximity sensor a pulse is produced, the number of which is proportional to the speed of the wheel and thus the quantity of gas can be determined (for pulse values see page 5-6).

In turbine meters of 6" and larger, a toothed reference wheel can also be fitted behind the turbine. A high frequency pulse can thus be obtained using a proximity sensor in a similar manner as the aluminium turbine wheel.

MEASUREMENT RANGE / PRESSURE LOSS / PULSE VALUES (METRIC)

pipe size mm (inch)	G-rating	measurement range (m^3/h) Qmin-Qmax *1	pressure loss at Qmax natural gas ρ=0,8 kg/m^3	m^3 per rev	LF pulses per rev		HF-index Hz at Qmax	No. of turbine blades	HF Signal reference wheel or turbine blade Hz at Qmax *2	Turbine wheel * 4	
					1	10				ALU	Delrin
50 (2")	G 40	13- 65	3	0,1	10	100	136	12	1700 * 3	●	○
	G 65	10- 100	6	0,1	10	100	210		2600 * 3	●	○
80 (3")	G 100	8- 160	3	1	1	10	105	12	1300 * 3	●	○
	G 160	13- 250	7	1	1	10	163		2000 * 3	●	○
	G 250	20- 400	17	1	1	10	149		1800 * 3	●	–
100 (4")	G 160	25- 250	2	1	1	10	98	16	1100 * 3	●	○
	G 250	20- 400	5	1	1	10	158		1750 * 3	●	○
	G 400	32- 650	13	1	1	10	143		1550 * 3	●	–
150 (6")	G 400	32- 650	3,5	1	1	10	151	20	1200	●	○
	G 650 ≤ 10 bar	50- 1.000	7	1	1	10	232		1800	●	○
	G 650 ≥ 10 bar	50- 1.000	7	1	1	10	133		1050	●	–
	G 1000	80- 1.600	16	1	1	10	213		1700	●	–
200 (8")	G 650	100- 1.000	1,5	10	0,1	1	55	20	750	●	–
	G 1000	80- 1.600	2,5	10	0,1	1	85		1200	●	–
	G 1600	130- 2.500	5,5	10	0,1	1	83		1050	●	–
250 (10")	G 1000	80- 1.600	1,5	10	0,1	1	88	24	800	●	–
	G 1600	130- 2.500	3,5	10	0,1	1	142		1300	●	–
	G 2500	200- 4.000	8,5	10	0,1	1	126		1200	●	–
300 (12")	G 1600	130- 2.500	1,5	10	0,1	1	48	24	800	●	–
	G 2500	200- 4.000	4	10	0,1	1	76		1300	●	–
	G 4000	320- 6.500	9	10	0,1	1	70		1200	●	–
400 (16")	G 2500	200- 4.000	1,5	10	0,1	1	160	24	650	●	–
	G 4000	320- 6.500	4	10	0,1	1	256		1050	●	–
	G 6500	500- 10.000	9	10	0,1	1	220		900	●	–
500 (20")	G 4000	320- 6.500	1,5	10	0,1	1	130	24	500	●	–
	G 6500	500- 10.000	4	10	0,1	1	210		850	●	–
	G 10000	800- 16.000	9	10	0,1	1	192		750	●	–
600 (24")	G 6500	500- 10.000	1,5	100	0,01	0,1	48	24	450	●	–
	G 10000	800- 16.000	4	100	0,01	0,1	75		700	●	–
	G 16000	1300- 25.000	9	100	0,01	0,1	68		650	●	–

* 1 : Measurement range 1 : 30 on request

* 2 : Indicated HF frequencies are approximate values

* 3 : HF sensor on reference wheel not available

* 4 : ● Standard Construction
○ Option / Special design for PN 10 / ANSI 125

A HF proximity switch or a HP calibration is only possible with aluminium turbine wheels.

Meters larger than 600 mm (24") and other variations to the above specifications are available by special request.

MEASUREMENT RANGE / PRESSURE LOSS / PULSE VALUES (IMPERIAL)

Pipe size (inches) cfh	Qmax cfh *1	Qmin cfh *1	Pressure loss at Qmax (inches water)	Cuft per rev.	LF pulses per rev.	HF index HZ at Qmax	No. of Blades	HF Reference Wheel or turbine blade Hz. at Qmax *2	Turbine Wheel *4	
									Alu	Delrin
2" Q	3,500	350	2.4	10	10	2,570	12	2600 *3	●	○
3" Q	10,000	1,000	4	100	100	2,080	12	1800 *3	●	○
4" Q	18,000	1,200	3.2	100	100	2,300	16	1550 *3	●	○
6" Q	35,000	1,750	4	100	100	1,780	20	1700	●	○
8" Q	56,000	2,800	1.8	1,000	1,000	1,190	20	1200	●	-
8" QIC	88,000	4,400	4.6	1,000	1,000	1,010	24	1050	●	-
10" Q	88,000	4,400	2.3	1,000	1,000	1,320	24	1300	●	-
10" QIC	140,000	7,000	4.5	1,000	1,000	1,180	24	1200	●	-
12" Q	140,000	7,000	0.8	1,000	1,000	1,230	24	1300	●	-
12" QIC	230,000	11,500	6.7	1,000	1,000	1,200	24	1200	●	-
16" Q	230,000	11,500	2.4	1,000	1,000	1,100	24	1050	●	-
16" QIC	350,000	17,500	5.2	1,000	1,000	870	24	900	●	-
20" Q	350,000	17,500	2.6	1,000	1,000	870	24	850	●	-
20" QIC	560,000	28,000	6.8	1,000	1,000	810	24	750	●	-
24" Q	560,000	28,000	2.2	1,000	1,000	700	24	700	●	-
24" QIC	880,000	44,000	4.4	1,000	1,000	630	24	650	●	-

* 1 : Measurement range 1 : 30 on request

* 2 : Indicated HF frequencies are approximate values

* 3 : HF sensor on reference wheel not available

* 4 : ● Standard Construction
○ Option / Special design for PN 10 / ANSI 125

A HF proximity switch or a HP calibration is only possible with aluminium turbine wheels.

Meters larger than 600 mm (24") and other variations to the above specifications are available by special request.

MEASUREMENT OF VARIOUS GASES

Applicable to clean dry gases from -10° C to + 65° C / 15° F to 150° F. Other temperature ranges by special request.

S = Standard materials
T = Corrosion resistant coated body and internals (except plastic and stainless steel parts)
1) = Special O-rings
2) = Special lubrications
3) = Special turbine wheels
4) = Except food industry
5) = For super-critical Ethylene and Propylene use SM-RI-P
6) = For oxygen special conditions apply

Gas	Formula	Density at 0 ° C 1.013 bar (kg/m³)	Meter housing	Remarks
Natural Gas	CH_4	0.8	S	
Acethylene	C_2H_2	1.17	T	Teflon coated
Ammonia	NH_3	0.77	S	1) 2)
Argon	Ar	1.78	S	
Butane	C_4H_{10}	2.70	S	
Biogas	–	–	T	1) 2) 3)
Ethane	C_2H_6	1.36	S	
Ethylene	C_2H_4	1.26	S	1) 5)
Freon 12 (gas)	CCl_2F_2	5.66	S	1) 2)
Helium	He	0.18	S	higher Q_{min}
Carbon Dioxide	CO_2	1.98	S	4)
Carbon Monoxide	CO	1.25	S	
Air	$N_2 + O_2$	1.29	S	
Methane	CH_4	0.72	S	
Pentane	C_5H_{12}	3.46	S	
Propane	C_3H_8	2.02	S	
Proylene (gaseous)	C_3H_6	1.92	S	1) 5)
Sewer / Manure gas	–	–	T	1) 2)
Town gas	–	–	S	
Sulphide gas	–	–	T	1)
Nitrogen	N_2	1.25	S	
Hydrogen	H_2	0.09	T	higher Q_{min}
Oxygen (pure)	O_2	1.43	S	2) 6) special constr.
Sulpher dioxide	SO_2	2.93	T	1) special constr.

NOTE :

- For wet gas a special coating can be applied to the body's inside surfaces.
- For corrosive environment, external surfaces and index head can be coated.
- For higher or lower temperature special lubrication and materials can be supplied.

PRESSURE LOSS FORMULA

The average pressure loss (see table page 5 and 6) of the Q turbine meter using atmospheric natural gas with a relative density of 0.6 and measured at one (1) diameter upstream to one (1) diameter downstream of the meter on straight pipe of the same size as the meter.

The pressure loss across the Q-turbine meter for various gases and other operating pressures may be approximated from the following equation :

$$\Delta P_2 = \Delta P_1 \times \frac{\rho_0}{0.8} \times \frac{P_m}{P_{atm}} \times \left(\frac{q}{q_{max}}\right)^2 \quad [mbar]$$

ΔP_2 = Pressure drop at operating conditions
ΔP_1 = Pressure drop at q_{max} (see table)
ρ_0 = Density at 0° C and 1.013 bar (see table)
P_m = Operating pressure absolute
P_{atm} = Atmospheric Pressure 1.013 bara
q = Instantaneous flow rate
q_{max} = Max. Flow rate
d = Relative density of the gas (air = 1)

HOW TO ORDER

In order to provide the meter best suited for your application, please provide the following information :

- Pipe diameter
- Gas flow quantity, min. and max.
- Gas flow direction
- Operating pressures, min. & max.
- Operating temperatures, min. & max.
- Ambient temperatures, min. & max.
- Type of gas
- Flange class, DIN or ANSI
- Type of Index - pulse options
- Proximity Switch(es) - Turbine, reference wheel
- High Pressure Calibration required
- Certificates required

LUBRICATION

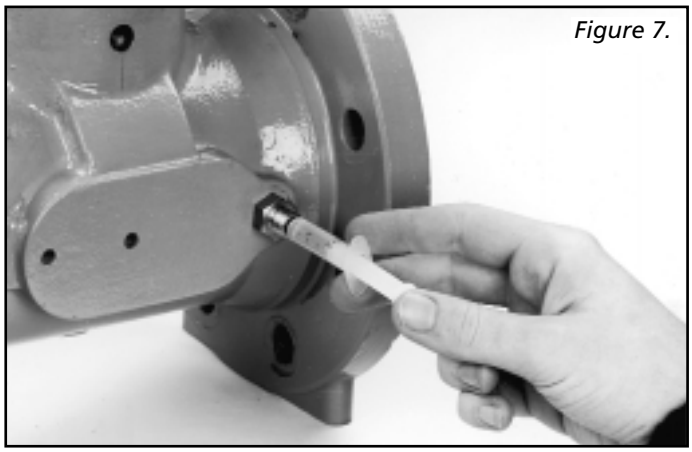


Figure 7.

Oil Injection-System

Supplied with 50 mm (2”) to 200 mm (8”) meters with a pressure rating of PN 10/16 and ANSI 125.

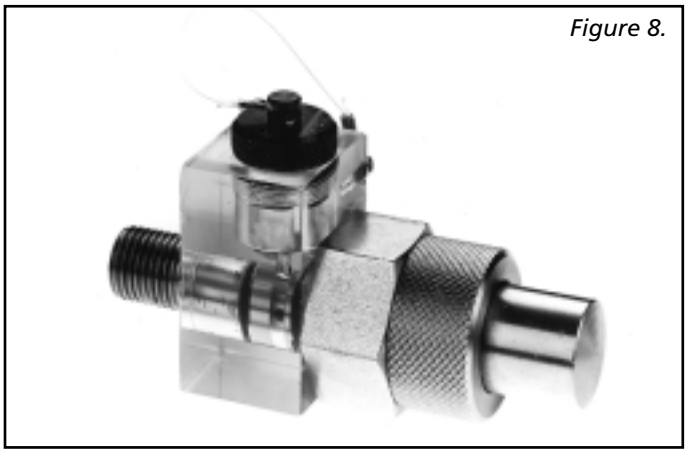


Figure 8.

Push Button Pump

Standard on 50 mm (2”) and 80 mm (3”) meters in pressure ranges above 16 Bar. 0.1 cc per push.

Figure 9.

Small Oil Pump

Standard on 100 mm (4”), 150 mm (6”) and 200 (8”) meters in all pressure ranges. 0.5 cc per stroke.

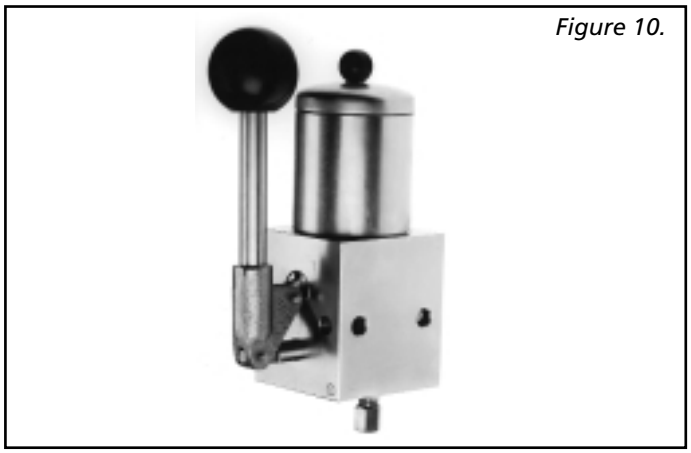


Figure 10.

Large Oil Pump

Standard on 250 mm (10”) meters and larger in all pressure ranges. 1 cc per stroke.

HIGH PRESSURE CALIBRATION FACILITY

Instromet can test meters at 8 bar (115 psi) pressure at their high pressure test facility at Utrecht, the Netherlands and provide certification of accuracy by the NMi (Dutch Bureau of Legal Metrology)

Depending on the season, this facility has a capacity up to 10,000 m^3/h (350,000 cfh).
If required, testing at higher pressure can be arranged.

Figure 11 :
Instromet Natural Gas High Pressure Calibration Facility in Utrecht, The Netherlands

DIMENSIONS AND WEIGHTS (METRIC)

Sizes mm (inch)	G-Rating	A	B	C	D	E	H	Body Material	Pressure rating	Wgt. kg.	Body Material	Pressure rating	Wgt. Kg
50 (2")	40 65	60	N.A.	150	195	N.A.	235	GGG 40 Steel	ND 10/16 ANSI 125/150 ND 10/16 ND 25/40 ND 64	10 10 20 20 23	 Steel	ND 100 ANSI 150 ANSI 300 ANSI 400 ANSI 600	26 18 20 20 20
80 (3")	100 160 250	30	N.A.	120	230	N.A.	250	GGG 40 Steel	ND 10/16 ANSI 125/150 ND 10/16 ND 25/40 ND 64	12 12 32 32 35	 Steel	ND 100 ANSI 150 ANSI 300 ANSI 400 ANSI 600	38 30 34 34 34
100 (4")	160 250 400	49	75	150	275	255	268	GGG 40 Steel	ND 10/16 ANSI 125/150 ND 10/16 ND 25/40 ND 64	19 19 35 40 45	 Steel	ND 100 ANSI 150 ANSI 300 ANSI 400 ANSI 600	51 40 49 49 58
150 (6")	400 650 1000	62	87	175	356	298	313	GGG 40 Steel	ND 10/16 ANSI 125/150 ND 10/16 ND 25/40 ND 64	28 28 59 68 94	 Steel	ND 100 ANSI 150 ANSI 300 ANSI 400 ANSI 600	99 56 78 78 100
200 (8")	650 1000 1600	69	100	200	430	338	353	GGG 40 Steel	ND 10 ND 16 ANSI 125/150 ND 10 ND 16 ND 25	42 42 42 88 88 100	 Steel	ND 40 ND 64 ND 100 ANSI 150 ANSI 300 ANSI 400 ANSI 600	112 143 160 90 120 120 152
250 (10")	1000 1600 2500	140	167	375	508	327	315	Steel	ND 10 ND 16 ND 25 ND 40 ND 64 ND 100	69 71 89 109 139 139	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	74 110 141 200
300 (12")	1600 2500 4000	172	224	450	585	352	338	Steel	ND 10 ND 16 ND 25 ND 40 ND 64 ND 100	92 102 120 157 195 302	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	136 182 214 264
400 (16")	2500 4000 6500	221	280	600	686	394	380	Steel	ND 10 ND 16 ND 25 ND 40 ND 64	200 230 260 310 360	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	250 310 340 430
500 (20")	4000 6500 10000	335	365	750	813	445	431	Steel	ND 10 ND 16 ND 25 ND 40	312 362 402 452	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	412 562 592 742
600 (24")	6500 10000 16000	350	380	900	940	495	482	Steel	ND 10 ND 16 ND 25	507 557 605	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	657 907 957 1107

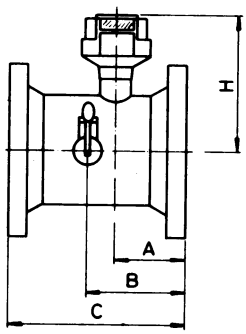
N.A. = Not Applicable GGG 40 = Ductile Iron

DIMENSIONS AND WEIGHTS (IMPERIAL)

Sizes mm (inch)	Flow	A	B	C	D	E	H	Body Material	Pressure rating	Wgt. lbs.	Body Material	Pressure rating	Wgt. lbs.
50 (2")	3M 5M	2 3/8	N.A.	5 7/8	7 3/4	N.A.	9 1/4	GGG 40	ANSI 125 / 150	22	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	40 44 44 44
80 (3")	7M 11M 16M	1 3/16	N.A.	4 3/4	9 7/16	N.A.	9 13/16	GGG 40	ANSI 125 / 150	26	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	66 75 75 75
100 (4")	11M 16M 23M	1 15/16	2 15/16	5 7/8	10 1/16	10 1/16	10 9/16	GGG 40	ANSI 125 / 150	42	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	88 108 108 128
150 (6")	23M 38M 70M	2 7/16	3 15/16	6 7/8	14	11 3/4	12 5/16	GGG 40	ANSI 125 / 150	62	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	123 172 172 220
200 (8")	38M 60M 100M	2 11/16	3 15/16	7 7/8	16 15/16	13 5/16	13 7/8	GGG 40	ANSI 125 / 150	92	Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	198 264 264 335
250 (10")	60M 100M 150M	5 1/2	6 9/16	14 3/4	20	12 7/8	12 3/8				Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	163 242 311 441
300 (12")	100M 150M 250M	6 3/4	8 13/16	17 11/16	23	13 7/8	13 5/16				Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	300 401 472 582
400 (16")	150M 250M 350M	8 3/4	11	23 5/8	27	15 1/2	14 15/16				Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	551 683 750 948
500 (20")	250M 350M 600M	14 9/16	15 3/4	29 1/2	32	17 1/2	16 15/16				Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	908 1239 1305 1636
600 (24")	350M 600M 900M	17 5/16	17 3/4	35 7/16	37 7/16	19 1/2	19				Steel	ANSI 150 ANSI 300 ANSI 400 ANSI 600	1448 2000 2110 2440

N.A. = Not Applicable GGG 40 = Ductile Iron

DIMENSIONS



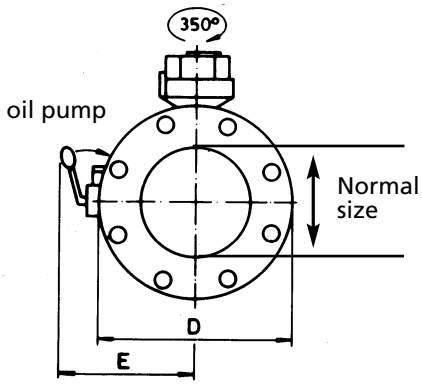


Figure 12.

MATERIAL SPECIFICATIONS

Body :	Meter with DIN Flanges : Connection DN 50 - DN 200, PN 10/16 Ductile Iron GGG 40 Connection DN 50 DN 600, PN 10 - PN 100 Steel [DN 50, (2") - flangeless] Meter with ANSI Flanges : Connection DN 50 - DN 200, (2" - 8") ANSI 125 Ductile Iron GGG 40 Connection DN 50 - DN 600, (2"- 24") Steel [DN 50, (2") - flangeless] ANSI 150 - ANSI 600 Meter bodies are constructed in accordance with many pressure vessel codes. The standard construction is in accordance with the Dutch Stoomwezen code.
Turbine Wheel :	Meters sized 150 mm (6") and smaller with a working pressure to 10 bar (ANSI 150) can be fitted with either an aluminium or a Delrin turbine wheel. An aluminium turbine, machined from solid stock, is standard for all other sizes and pressures. Special coated wheels for biogas measurement are also available.

Surface Coating :	Ductile Iron : Phosphate, primer, top coat Steel : Sand Blasting, primer, top coat
Bearings :	Stainless Steel
Shafts :	Stainless Steel
Magnetic Coupling :	Ferroxdure magnets in stainless steel
Screws and bolts :	Stainless Steel
Meter Module :	Aluminium
O-rings :	Viton
Gears :	In contact with gas : Delrin and stainless steel, in the index : Delrin
Oil Pumps :	Chrome Plated Brass or Steel
Index Head :	Aluminium

Note :
Special materials available on request. The internals can be coated for service with corrosive gases.

FURTHER INFORMATION

Publications by INSTROMET :

- Turbine Gas Meter Handbook.
- P-Meter Handbook (Ethylene).
- Q - 75 Turbine Gas Meters - Installation and Maintenance Instructions.
- Systems Handbook.
- Regular Station Handbook.

International Reference Material :

- AGA Report No. 7, Measurement of fuel gas by turbine meters.

Sales Offices:

In Argentina:
INSTROMET S.A.

In Australia:
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