

Vortex Flowmeter

GT400C



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1. Product Description

GT400C vortex flowmeter is a kind of velocity flowmeter, based on Karman(Karman)vortex principle research and design, mainly used for the flow measurement of medium fluids in industrial pipelines, such as: gas, steam or liquid and other media flow control and measurement.

The GT400C vortex flowmeter can achieve the following functions according to the type selection: Measuring the temperature, pressure, instantaneous flow and cumulative flow of industrial pipeline fluid parameters and has pulse output, 4-20mA analog signal output, RS485 communication (Modbus RTU protocol), Hart protocol, Internet of Things GPRS and other functions.

Vortex flowmeter is widely used in heating, gas supply, chemical industry, environmental protection, metallurgy, textile, steel, medicine, paper making, drainage and other factories and mining enterprises to superheated steam, saturated steam, compressed air and general gases (oxygen, nitrogen, hydrogen, natural gas, gas, etc.) water and liquid (such as: water, gasoline, alcohol, dumb class, etc.) measurement and control.

2. Technical features

- Product body no moving parts, high reliability, long-term stability, simple structure and easy to maintain, the output of the sensor is pulse frequency, and its frequency is linear with the actual flow rate of the measured flow body, and the zero point has no drift, and the performance is very stable.
- The structure is diverse, with pipe type, insert type flow sensor and other forms, High accuracy, conventional liquid measurement accuracy of $\pm 1.0\%$, the measurement accuracy of gas is $\pm 1.5\%$, The pressure loss is small (about 1/4~1/2 of the orifice flowmeter), which belongs to the energy-saving flow meter, Flexible installation method, according to the field process pipeline, can be horizontal, vertical or different angle tilt installation,
- The circuit adopts a variety of protection modes, anti-surge, strong adaptability, High precision probe, piezoelectric vortex sensor, signal stability. the 316L stainless steel sensor housing has strong corrosion resistance and good intergranular corrosion resistance. it also has good corrosion resistance to alkaline solutions and most organic and inorganic acids.
- Long life lithium battery: equipped with 3.6V high poly lithium battery, with high storage energy density, service life of more than 1 year. Products high and low temperature adaptability, green environmental protection and other advantages. Wide measuring range, range ratio up to 1:10~20.
- Within a certain range of Reynolds number, the output signal frequency is not affected by the physical properties of the fluid and the change of components, the instrument coefficient is only related to the shape and size of the vortex generating body, and there is no need to compensate when measuring the volume flow of fluid conditions, and generally no need to re-calibrate the instrument coefficient after replacing the parts.

3. Product structure and operating principle

3-1. Product structure

The basic structure of the **GT400C** series vortex flowmeter is shown in Figure 1, which is mainly composed of the shell, vortex generator, flow sensor, temperature sensor, pressure sensor, shielding rod, integrator and other main accessories.

- 1.Integrator
- 2.Shielding Rod
- 3.Shell
- 4.Flange
- 5.Pressure sensor

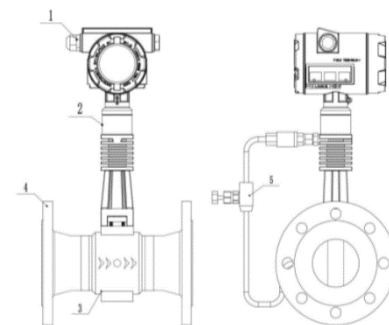
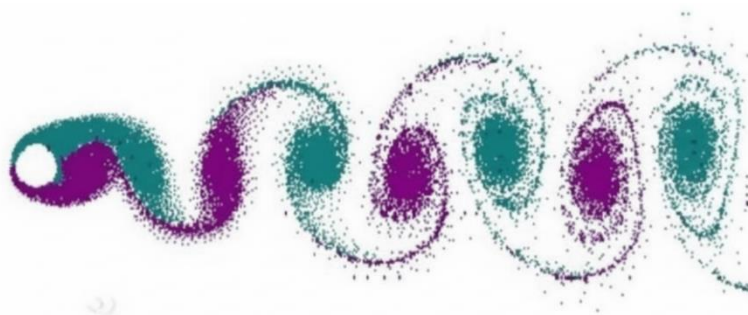


Figure 1 Vortex flowmeter product structure diagram

3-2. Operating principle

Vortex flowmeter The velocity flowmeter based on the Karman vortex principle can be used for the measurement and metering of conventional gases, vapors and liquids. Vortex flow sensor has high accuracy and relatively wide range ratio, and no moving parts in use, which can improve mechanical stability and reduce maintenance. Vortex street is almost unaffected by the temperature, pressure and composition of the medium when measuring the working condition volume, so it is easy to calibrate the instrument production, so vortex street flow sensor is widely used in production and life.

When a triangular column type vortex generator is set up in the fluid, regular vortices are produced alternately from both sides of the vortex generator. The vortices are called Karman vortices, and the vortices are arranged asymmetrically in the downstream of the vortex generator. Vortex street production according to the principle, through the generation of vortices, high sensitivity sensor to detect the number of vortices, the number of vortices generated in a certain range is proportional to the flow, so you can calculate the flow through the precision processor



Vortex flowmeter

$$Q = \frac{(3600F)}{K}$$

Q: The working volume flow rate of the measured medium is measured by the company in m³/h.

F: The frequency of the number of vortices generated by the body, the company in Hz.

K: Refers to the calculated or calibrated flow coefficient, which represents how many frequency signals are in each cube, which is generally derived from calibration.

Standard table method calibration coefficient K formula:

$$K = \frac{(\text{Checked table traffic } Q_{Be})}{\text{Standard table flow } Q_s} * K_{\text{coefficient}}$$

(This formula can also be used for flow correction)

4. Technical performance indicator

4.1 Basic parameters

Item	Specifications
Executive standard	JB/T9249-2015 Vortex Flowmeter Industry Standard
Nominal Diameter(mm)	15, 20, 25, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 500, 600
Nominal pressure (MPa)	DN15-DN200 4.0(>4.0 Agreement supply), DN250-DN300 1.6 (>1.6 Agreement supply)
Working condition	Medium temperature: normal temperature type: -45 ~ 100°C Medium temperature type: -45 ~ 250°C High temperature type: -45 ~ 330°C Ultra Temperature type: -45 ~ 450°C Ambient temperature: -20°C~55°C Relative humidity: 5% ~ 90% Atmospheric pressure: 86~ 106kpa
Body material	304 (Other materials supplied by agreement), Integrator housing: die-cast aluminum
Allowable vibration acceleration	Piezoelectric: 1.0g
Accuracy	±1%R, ±1.5%R;
Range	1: 20 ~ 1: 50
Supply voltage	sensor: DC 24V, Transmitter: DC +24V, Battery powered: 3.6V battery
Output signal	Pulse output: 4~20mA, current, control signal, RS485 (Modbus- RTU), Hart protocol, Thing of Internet GPRS, etc.
Pressure loss coefficient	Meet the JB/T9249 Standard $C_d \leq 2.4$
Explosion-proof mark	Intrinsic safety type: Ex iaII CT6 Ga Flameproof type: ExdII CT6 Gb
Protection grade	IP65
Electrical interface	Internal thread M20* 1.5 or Internal thread 1/2NPT
Applicable medium	gas, liquid, steam
Transmission distance	Three-wire pulse output type: $\leq 300m$, two-wire standard current output type (4~20mA) $\leq 1500m$; load resistance $\leq 500\Omega$; RS485/HART $\leq 1200m$.

4.2 Vortex accuracy level and type

Level of accuracy		1	1.5
Maximum influence error	$q \leq q < q_{max}$	±1.0%	±1.5%
	$q_{min} \leq q < q_t$	±2.0%	±3.0%
Note: Demarcation flow refers to $0.2q_{max}$			

4-3. Measuring range

Different gauges measure the flow range. the meter selection process must be based on the flow range. the most taboo is to select the meter according to the thickness of the pipeline. the biggest drawback of selecting a meter based on a pipe is that it is easy to cause measurement errors due to insufficient flow

The flow range determination of the vortex flowmeter is based on the working condition flow. Therefore, the meter selects the flow into the working condition flow and then compares the flow range table. As far as possible, the common flow is in the middle range of the meter measurement.

4.3.1 Reference condition

1. Gas: normal temperature and pressure air, $t=20^{\circ}\text{C}$, $P=0.1\text{MPa}$ (Absolute pressure), $\rho=1.205\text{ kg/m}^3$, $\nu=15\times 10^{-6}\text{ m}^2/\text{s}$.
2. Liquid: water under normal temperature, $t=20^{\circ}\text{C}$, $\rho=998.2\text{ kg/m}^3$, $D=1.006\times 10^{-6}\text{ m}^2/\text{s}$.

Vortex flow meter working condition flow range table under reference conditions

Instrument caliber (mm)	Liquid Measuring Range (m^3/h)	Gas Measuring Range (m^3/h)
15	0.2~6	3 ~ 30
20	0.3~10	4 ~ 50
25	0.5~15	6 ~ 100
32	0.9~25	9 ~ 180
40	1.4~40	14 ~ 280
50	2~60	20 ~ 400
65	3.5~100	35 ~ 700
80	5~150	60 ~ 1,200
100	10~250	90 ~ 2,000
125	15~350	120 ~ 2,400
150	20~500	200 ~ 5,000
200	35~900	350 ~ 8,000
250	55~1,500	550 ~ 11,000
300	80~2,000	800 ~ 18,000
350	100~2,700	1100~24,000
400	140~3,500	1400~31,000
500	220~5,500	2300~49,000
600	310~7,900	3400~70,000

The working condition flow refers to the meter measuring the volume of the current medium passing through the pipeline. the medium is in the working state. for example, the gas can be compressed. when there is pressure in the pipeline, the volume after the gas is compressed is the working condition flow. the operating flow will change as the working environment changes.

standard condition flow refers to the volume of the medium at standard atmospheric pressure and 0° (or 20°), when the compressed gas is released into the volume of the standard environment. the standard traffic does not change in any environment.

The measurement of the vortex flowmeter is the working volume. only the temperature and pressure compensation can be used to obtain the standard volume. generally, when used for trade measurement, the gas is mainly used as the standard condition, and the steam is usually measured by mass.

$$Q_{\text{actual}} = Q_{\text{standard}} * (0.101325 / (P_{\text{gauge}} + 0.101325)) * (273.15 + T_{\text{temp}}) / 293.15$$

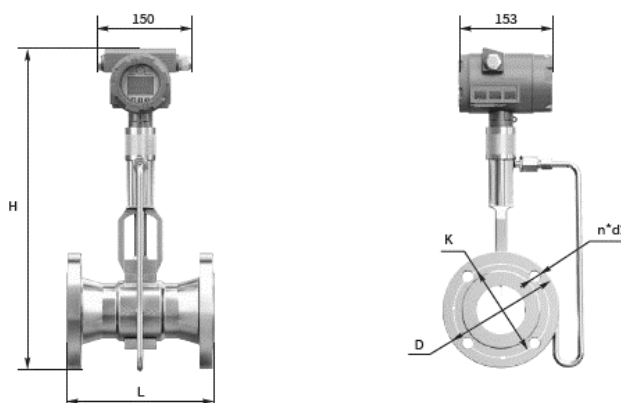
(Transformation formula of working condition between standard condition)

5. Product category and dimension

5.1 Product category

- The general field display vortex flowmeter integrates vortex flow sensor and flow integrator in one, the main performance indicators reach the domestic leading level, is the ideal instrument for petroleum, chemical, electrical, light industry, power heating and other industries.
- Temperature and pressure compensation vortex flowmeter is a vortex flow sensor and flow integrator in one, with temperature and pressure compensation function, the main performance indicators reach the domestic leading level, is the ideal instrument for petroleum, chemical, electrical, light industry, power heating and other industries.
- The split vortex flow meter is installed separately from the vortex flow sensor and flow integrator, and has the function of separate display, which can realize the high-altitude installation and low-altitude display, and provide convenience for high-altitude installation meter reading.

5.2 Product dimensions and pressure level



Nominal diameter (DN)	Pressure level (MPa)	Length L (mm)	Flange outside diameter D (mm)	Height H (mm)	Centre distance K (mm)	Number of bolt hole (n)	Bolt bore diameter d2 (mm)
DN15	1.6	160	95	395	66	4	14
DN20		160	105	400	75	4	14
DN25		160	115	405	85	4	14
DN32		200	140	420	100	4	18
DN40		200	150	430	110	4	18
DN50		200	165	440	125	4	18
DN65		200	185	460	145	8	18
DN80		200	200	475	160	8	18
DN100		250	220	495	180	8	18
DN125		250	250	520	210	8	18
DN150		250	285	550	240	8	22
DN200		350	340	605	295	12	22
DN250		450	405	665	355	12	26
DN300		500	460	715	410	16	26
DN350		500	520	775	470	16	26
DN400		600	580	835	525	16	30
DN500		600	715	940	650	20	34
DN600		600	840	1045	770	20	36

6. Product installation and operation

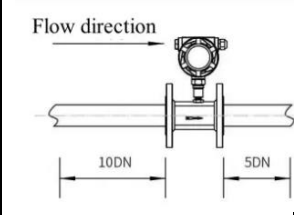
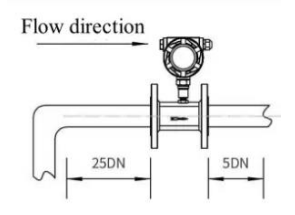
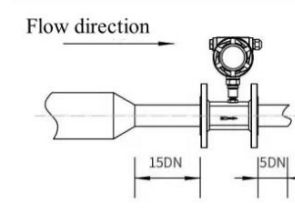
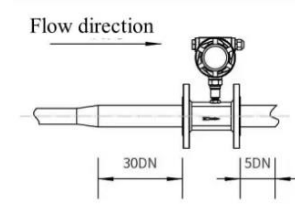
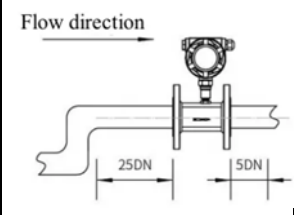
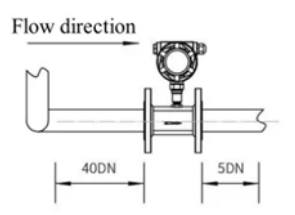
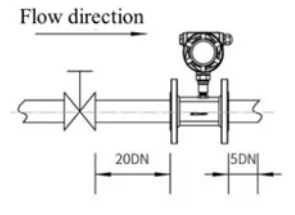
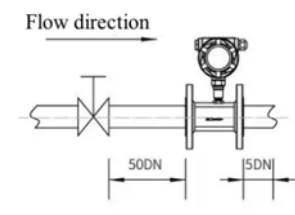
6.1 Flowmeter installation environment requirements

- Flowmeter should be installed indoors, if installed outdoors, it should be covered to prevent rain intrusion and sun exposure and affect the service life of the flowmeter (flowmeter wire shielding line to be made U-shaped, and finally into the case when the line is from the bottom up, to avoid rain along the way into the case inside),
- There should not be strong external magnetic field interference, strong current equipment, high frequency equipment around the flow meter, and avoid sharing power with these equipment,
- Do not share the power supply with the equipment that pollutes the power supply such as frequency converter and welding machine, and install the purified power supply if necessary,
- Avoid high temperature, cold, corrosive or extremely humid environment, such as installation must be done to protect the flow meter,
- Flowmeters should be avoided installed on pipelines with strong vibration. If it must be installed, pipe fastening devices must be installed in upstream and downstream 2D, and anti-vibration pads should be added to strengthen the anti-vibration effect,
- Adequate space should be left around the instrument installation point for installation wiring and regular maintenance.

Note: On-line welding is strictly prohibited!

6.2 Instrument pipeline installation requirements

Vortex street flow meter has certain requirements for the upstream and downstream straight pipe section of the installation point, otherwise it will affect the flow field of the medium in the pipeline and affect the measurement accuracy of the meter. The length of the upstream and downstream straight pipe section of the instrument is required as shown in Figure DN, which is the nominal diameter unit of the instrument: mm

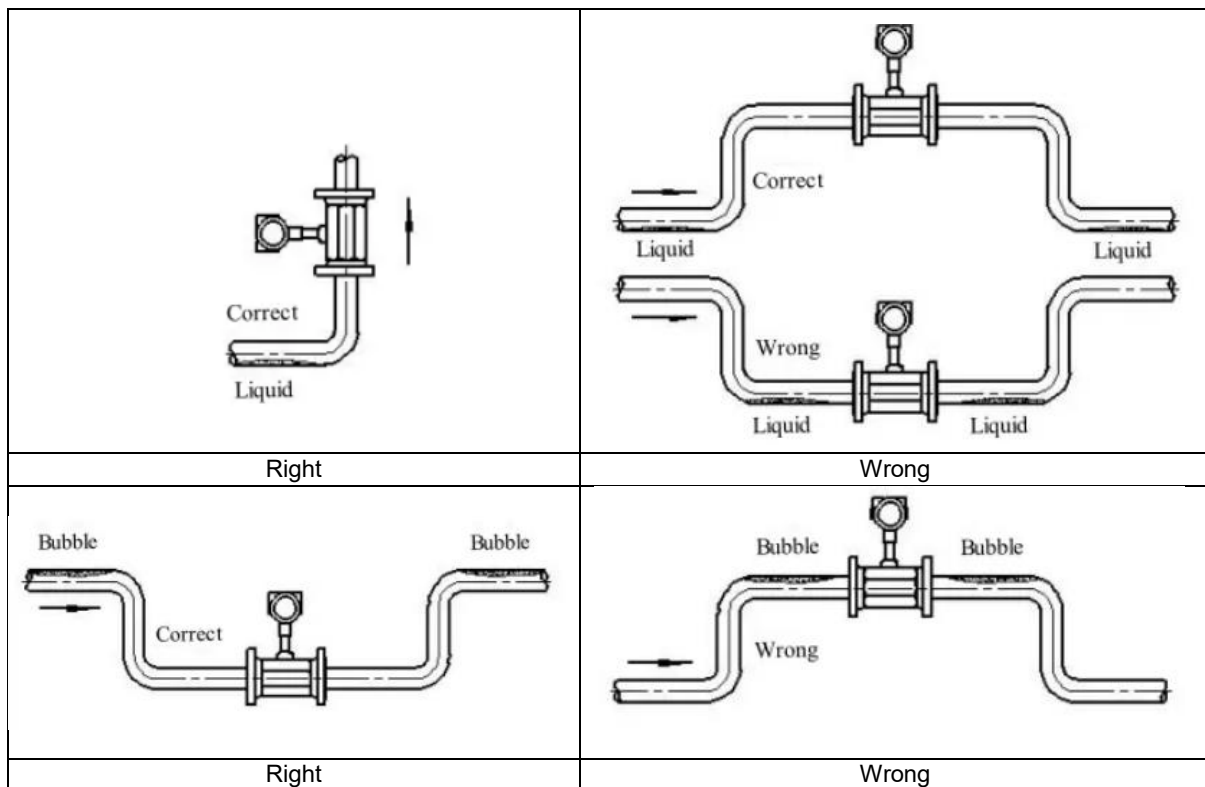
			
General pipeline	90° bend pipe	Concentric contraction full open valve	Joint pipe expansion
			
Two 90° elbows in the same plane	Two 90° elbows on different planes	Fully open the valve	Partially open valve

Note:

- As far as possible, the regulator should not be installed in the upstream of the vortex flow meter, but should be installed outside the downstream 10D of the vortex flow meter.
- The upper and lower pipe inner diameters should be the same. If there is any difference, the internal diameter D_p of the piping and the internal diameter D_b of the vortex meter should meet the following relationship: $0.98D_b \leq D_p \leq 1.05D_b$
- The upper and lower piping should be concentric with the inner diameter of the flow meter, and the difference between them should be less than $0.05D_b$.
- The gasket between the instrument and the flange shall not be convex into the tube during installation, and its inner diameter shall be 1-2mm larger than the inner diameter of the meter.
- Installation design of pressure and temperature measuring holes. when temperature and pressure transmitters need to be installed in the pipeline under test, the pressure hole should be set at 3-5d

downstream, and the temperature hole should be set at 6-8D downstream. D is the nominal caliber of the instrument, unit: mm.

- The meter can be mounted horizontally, vertically or at an Angle on the pipe
- When measuring gas, the instrument is installed in the vertical pipe, and the gas flow direction is unlimited. However, if the pipe contains a small amount of liquid, in order to prevent the liquid from entering the meter measuring pipe, the air flow should be bottom-up, as shown in Figure(IV)a.
- When measuring liquids, in order to ensure that the tube is filled with liquid, the liquid flow side should be ensured from the bottom up when the meter is installed in the vertical or inclined pipe. If the pipe contains a small amount of gas, in order to prevent the gas into the meter measuring pipe, the meter should be installed at the lower part of the pipe, as shown in Figure(IV)b.
- When measuring high temperature and low temperature media, attention should be paid to insulation measures. the high temperature inside the converter (inside the meter head housing) should generally not exceed 70°C. Low temperature is easy to cause condensation inside the converter, reduce the insulation impedance of the circuit board, and affect the normal operation of the instrument.



6.3 Installation steps for insertion vortex flowmeter

1. Open a round hole slightly less than $\phi 100\text{mm}$ on the pipe with gas welding, and clean the burrs around the round hole to ensure the smooth rotation of the probe
2. Weld the flange provided by the manufacturer at the round hole of the pipeline, requiring the axis of the flange to be perpendicular to the axis of the pipeline
3. Install the ball valve and sensor on the welded flange
4. Adjust the lead screw to make the insertion depth meet the requirements (ensure that the center axis of the probe and the center axis of the pipeline coincide), and the flow direction must be consistent with the indicating arrow on the direction label
5. Tighten the screws on the gland evenly. (Note: the tightness of the gland determines the degree of sealing of the instrument and whether the lead screw can rotate)
6. Check whether each link is completed, slowly open the valve to observe whether there is leakage (need to pay special attention to personal safety) if there is leakage, please repeat step 5 and 6.

7. Ordering model selection

Code		Description	
GT400C series		Vortex Flowmeter	
Nominal diameter		XX	DN10~DN600
Power supply		A	220V AC
		D	24V DC
		V	3. 6V Lithium-ion battery
Accuracy		E	0.75
		A	1.0
		B	1.5
Type		P	General type
		EX	Explosion-proof type
Output		1	Pulse output-three -wire system
		2	4~ 20mA current output-two -wire system
		3	RS485 communication, Modbus protocol (four-wire system)
		4	Hart protocol
		5	4G

Code		Description	
DTRLUGB		Vortex Flowmeter	
Meter type		1	Flange
		2	Flange card assembly
		3	Threaded connection
		4	Clamp connection
		5	Simple insertion
		6	Ball valve insertion
		X	
Medium		L	Liquid
		G	Gas
		S	Steam
Material	Sensor probe	04	SUS304
		16	SUS316L
	Ball valve	N	Not included.
		04	SUS304
		16	SUS316L
		Compensation method	
P	Temperature compensation		
T	Pressure compensation		

Max. Temperature	T0	-45 ~150°C
	T1	-45 ~250°C
	T2	-45 ~350°C
	T3	-45 ~400°C
	T4	-45 ~500°C
	T5	-190 ~60°C
Pressure Level	P1	1.6 MPa
	P2	2.5 MPa
	P4	4.0 MPa
	P6	6.0 MPa
	P10	10.0 MPa
	P16	16.0 MPa
	P25	25.0 MPa
Connection	T	Thread
	A	ANSI flange.
	D	DIN flange.
	J	JIS flange.
	O	Other
Structure Type	I	Integrated type
	R ()	Remote separated (5): 5meter cable (10): 10meter cable