Annubar Flow Sensor

Manual

I. Overview of Annubar Flowmeter

Annubar flowmeter adopts the most advanced differential pressure flow measurement technology, and the engineering structure design fully conforms to the principle of aerodynamics. It is a sensing element that has reached an unparalleled degree of accuracy, efficiency and reliability.

1. Purpose of Annubar Flowmeter

Annubar flowmeter is suitable for high-precision flow measurement of gas, liquid and steam. Annubar is a differential pressure type, rate average flow sensor, which measures flow through the differential pressure generated by the sensor in the fluid. Annubar reflects the true flow rate of the fluid, with an accuracy of ±1.0 and a repeatability of ±0.1. The outstanding advantage of Annubar is that it outputs a very stable and non-pulsation differential pressure signal.

2. Design features of the probe

The probe with the cross-sectional shape of the bullet head can produce accurate pressure distribution and a fixed fluid separation point; the low pressure tapping holes located on both sides of the probe side and before the fluid separation point can generate a stable differential pressure signal and effectively prevent blocking. The internal integrated structure can avoid signal leakage, improve the strength of the probe structure, and maintain long-term high precision.

3. Anti-clogging design of Annubar probe

With its excellent anti-blocking design, Annubar flow probes completely get rid of the shortcomings of plug-in flow probes such as Annubar that are easy to block, and make the anti-blocking level of the average velocity tube flow probe reach an unprecedented height. The high pressure tapping hole of the probe will not be blocked by the front of the probe to form a high pressure zone, and the pressure is slightly higher than the static pressure of the pipeline, preventing particles from entering. Please note: The velocity of the fluid at the high pressure tapping hole of the probe is zero, and no objects will enter the tapping hole. When the machine is turned on, the fluid enters the elbow under the action of the static pressure of the pipe, and a state of pressure balance is quickly formed. When the pressure balance is formed, the fluid encounters high pressure at the inlet of the elbow, detours, and no longer enters the elbow.

4. The advantages of the probe

- Can measure a variety of media, a wide range of applications
- High accuracy, large range ratio
- The probe pressure hole is inherently anti-blocking
- The measurement signal is stable with little fluctuation

● Low permanent pressure loss of the pipeline

● Unique high-strength bullet-shaped single-piece dual-chamber structure

● Low installation cost, basically maintenance-free

● Online installation and maintenance

5. The characteristics of annubar average velocity tube flow sensor

● Stable signal

Annubar's low pressure tapping hole is located on the back two sides of the probe side, between the fluid and the probe separation point.

● Excellent long-term high precision

Annubar can ensure long-term stability of accuracy, this is because:

⑴. It is not affected by wear, dirt and oil.

⑵. There are no movable parts in the structure.

⑶. Designed to eliminate the occurrence of clogging. At the front of the probe, the high static pressure area surrounds the probe so that the high pressure tapping hole will not be blocked. The most important thing is that the low-pressure holes are taken on the back two sides of the probe side, and the fluid is slanted across the surface, which protects the low-pressure holes from being swept, and other probes are easy to block because their low-pressure pressure holes are in the accumulation of impurities. Low-pressure fluctuation area.

● Lowest installation cost

⑴. Only a few inches of line welding is required, and the installation is very simple and fast.

⑵. With special tools, online installation under pressure can be realized.

⑶. All valves and interfaces of various instruments only need simple assembly, which requires very low assembly costs.

● Very low operating cost

⑴. It is a non-shrinking throttling design. As a plug-in flow probe, Annubar has the lowest operating cost.

⑵. Annubar flowmeter only produces very low permanent pressure loss, typically less than 0.7KPa

⑶. The permanent pressure loss generated by an orifice element exceeds 14KPa

⑷. Compared with the orifice plate, the energy loss of Annubar is reduced by 95%.

● The continuous working Annubar basically eliminates the possibility of blocking, but in the following situations, Annubar should still pay attention to preventing blocking:

⑴. When the pressure pipe leaks, the high pressure balance area of the probe is destroyed, and particles with smaller diameters among impurities may enter the pressure hole.

⑵. When the pipeline is stopped, due to molecular Brownian motion, small particles of impurities may enter the pressure hole.

⑶. The system is frequently turned on and off. At the moment when the high-pressure zone is formed, small particles may enter the pressure tapping hole. Over time, it may cause blockage of the probe.

⑷. The medium contains a large amount of tar, algae organisms, or contains fibrous substances, which may also cause blockage of the probe.

6. Application of new technology

The original Annubar with valve connector design has a new design concept, providing a new concept, built-in meter shut-off valve at the connector of the instrument.

(1). Make installation and maintenance easier.

(2). Reduce the number of assembly parts and reduce the cost of hardware connection. Fast installation system, fast insertion and removal.

● The sealed drive system can avoid damage to the components.

● It can be applied to the installation of multiple probes respectively, and all installations should not exceed 1 hour.

II.Parameters and applicable medium:

Performance indicators of Annubar flow measurement system

- Measurement accuracy: ±1
- Repeatability: ±0.1
- Applicable pressure: 0～40MPa
- Applicable temperature: -180℃～＋850℃
- Upper limit of measurement: depends on probe strength

- Measurement lower limit: depends on the minimum differential pressure requirement
- Range ratio: greater than 10:1
- Applicable pipe diameter: 38mm～9,000mm round pipe and square pipe
- Applicable medium: full pipe, unidirectional flow, single-phase gas, steam and liquid with viscosity not more than 10 centipoise.

Full-tube, unidirectional flow, single-phase gas, steam and liquid with a viscosity of no more than 10 centipoise. Annubar has a wide range of applications. It is widely used in the measurement of various gases, liquids and steam. The following are Typical application medium.

- Gas/liquid/steam
- Natural gas/cooling water/saturated steam
- compressed air / boiler water / superheated steam
- gas/demineralized water
- Gas Hydrocarbon/Liquid Hydrocarbon
- Hot air/Cryogenic liquid
- Furnace gas/Heat conduction liquid

III. Blocking design of Annubar flow sensor:

1. The unique design of the Annubar probe has completely got rid of the characteristics of the easy clogging and low accuracy of the previous average speed probes, making the measurement accuracy, repeatability and reliability of the primary source reach a new level.

2. When the machine is just turned on, the fluid enters the elbow under the action of the static pressure of the pipe, and a state of pressure balance is quickly formed. When the pressure balance is formed, the fluid encounters high pressure at the inlet of the elbow, detours, and no longer enters the elbow.

3. The high and low pressure holes of the Annubar flow sensor realize essential anti-blocking.

4. Under normal circumstances, dust, sand and particles are concentrated on the back of the probe under the action of vortex street force. This is why the autumn leaves are always behind the leeward house. The unique anti-blocking design of the probe-type flowmeter probe, coupled with the natural fall of gravity, prevents the entry of particles. This design essentially prevents blockage and can generate a very stable low-pressure signal.

5. The continuous working Annubar flowmeter fundamentally eliminates the possibility of blockage, but in the following situations, you should still pay attention to prevent blockage:

a. When the pressure pipe leaks, the high pressure balance of the probe is destroyed, and particles with smaller diameters among the impurities may enter the pressure hole.

b. When the pipeline is shut down, due to the Brownian movement of molecules, small particles of impurities may enter the pressure tapping hole.

c. The system is frequently turned on and off. At the moment when the high-pressure zone is formed, small particles may enter the pressure tapping hole. Over time, it may cause the probe to block.

d. The medium contains a large number of algae organisms, or contains fibrous substances, which may also cause blockage of the probe.

IV. Precautions for selection:

1. The mechanical size of the Annubar flowmeter is tailored to the size of the installation pipeline, and its measurement range is calculated and calibrated based on the flow data provided by the process. When selecting the type, be sure to provide the manufacturer with the correct flow data and pipe size. The pipe size includes the outer diameter and wall thickness. The flowmeter must be installed according to the standard to ensure that the measurement error of the entire measurement system is within the allowable range.

2. The pipe in front of the detection rod sensor must ensure a straight pipe length of 7D to 9D (the data provided by various manufacturers vary from 3D to 30D) in order to make the liquid and gas (vapor) in the large pipe The flow velocity is as symmetrical as possible on the axis. Only in this way can we calculate the flow through the entire cross-section by measuring the flow velocity at several points. Otherwise, the flow velocity distribution of liquid and gas (vapor) in the large pipeline will be very complicated, and the fluctuation of the flow coefficient K will be large, and the measurement cannot be guaranteed. Degree. However, it is impossible to guarantee a long straight pipeline in the actual process design. The author believes that if a certain form of Annubar flowmeter is determined to be used, the supplier can discuss with the supplier to shorten the straight pipeline as much as possible under the premise of ensuring the repeatability of the system. The relevant data records, as long as the ratio of the measured

pipe diameter to the process pipe diameter is less than 1/10, the straight pipe length of the front pipe can be reduced to 3D～4D.

3. The total pressure hole of the detection rod sensor must face the flow direction, and the deviation should not exceed 7°. The detection rod should be inserted to the end along the diameter of the pipeline. For vertical pipelines, the detection rod can be installed at any position along the pipe circumference 360° on the horizontal plane of the pipeline. The high and low pressure pipes should be on the same plane; for horizontal pipes, they should be installed obliquely downwards during measurement. Whether the flowmeter can accurately measure and the length of its service life is directly related to whether it is installed correctly. Once the flowmeter is installed, the system error that affects the accuracy of the flowmeter will always accompany and it is difficult to eliminate from the software. The correct installation method can refer to the installation specification of differential pressure flowmeter, which will not be repeated here.

4. The detection rod is fixed on the pipeline through the joint. After the joint is tightened, the detection rod shall not be loose or leak. Pipeline vibration and fluid impact will loosen and fall off the fixed head of the detection rod, causing fracture and damage to the detection rod, affecting accurate measurement and causing economic losses.

V. Requirements for use:

1. The fluid to be measured should be filled with pipes and flow stable.

2. The fluid to be tested should be single-phase, and its phase state remains unchanged. For fluids with complex components, it can be used only when fluids with a single component are similar.

3. The ReD of the tested fluid under actual working conditions should be greater than 3×104.

4. The length of straight pipes before and after the sensor should be guaranteed.

5. It is better that the inner diameter of the pipeline is greater than 100 mm.

6. The inner surface of the 2D pipe in front of the sensor should be clean and smooth.

VI. Product maintenance instructions:

The Annubar flow sensor should be cleaned regularly during the overhaul of the process pipeline. There are many cleaning methods, such as blowing off the dirt accumulated in the detection tube with a gas source; cleaning with kerosene and soft wire to keep the pressure holes unobstructed. Possible causes of failures and clearing methods: No. Failure phenomenon Causes of clearing methods.

1. No differential pressure signal output: the high and low pressure valve is not opened, open the high and low pressure valve.

2. The high and low pressure balance valve is not tightened: tighten the balance valve.

3. The output of the differential pressure signal is too small: there is leakage in the pressure guiding system; carefully search and eliminate the leakage.

4. Improper selection of the secondary meter range: lower the upper limit of the differential pressure transmitter.

5. The differential pressure signal output is too large: the secondary meter range is not properly selected, the upper limit of the differential pressure transmitter is increased, the back pressure hole is blocked, and the uniform velocity tube is cleaned to remove the blockage.

VII. Operation and maintenance of Annubar flowmeter

1. Preparatory work before putting into operation

①The sensor is installed correctly:

After the sensor is installed on the pipeline, it must be carefully inspected before it is put into operation. It is required that the welding is firm, the direction is correct, strictly without leakage, and the insertion depth is appropriate.

②Instrument adjustment:

Sensor supporting instruments include differential pressure transmitter and intelligent flow totalizer (pressure transmitter and temperature transmitter may also be included). All must be inspected and adjusted before being put into use.

The measuring range of the meter must meet the requirements of the sensor and the measured medium.

For example, the maximum flow rate of the air to be measured is Qmax=5000m3/h, and the maximum differential pressure generated by the sensor is calculated as ΔPmax=0.6Kpa, then the measuring range of the differential pressure transmitter should be adjusted to 0~0.6KPa, and the corresponding output is 4~20mADC current signal.

For general-purpose flow totalizers, the totalizer should be programmed and configured in advance according to the real-time flow range, differential pressure range, medium density, temperature, pressure, flow calculation requirements, etc., so that the totalizer can correctly calculate and display the flow .

③The instrument wiring is correct:

Sensors, differential pressure transmitters, flow totalizers, etc. constitute a measurement system. The power cords of the supporting meters, the signal output and input lines between the meters, the control and alarm wiring, etc., are connected to the wiring board (also called terminal There are clear marks on the board), which must be confirmed and selected for use. The wiring of the instrument must be checked repeatedly before putting it into operation. In order to make preparations before putting it into operation, in addition to carefully reading the "Annubar Flowmeter Instruction Manual", you should also read the "Differential Pressure Transmitter Instruction Manual", "Intelligent Flow Totalizer Instruction Manual" and other materials, and follow The instructions guide the work.

2.Installation requirements

2.1. The sensor inserts its detection rod into the process pipeline. In addition to the total pressure hole should be facing the direction of the flow rate during installation, it must be ensured that the sensor detection rod is perpendicular to the axis of the process pipeline. The allowable positional angular pressure deviation is shown in Figure 1.

The angle between the center of the total pressure hole of the sensor and the axis of the pipeline should be less than 7°

The sensor detection rod is inserted to the bottom along the diameter of the pipe, and its angular deviation is

less than 7°

The vertical pipeline sensor can be installed at any position along the pipe circumference 360 on the horizontal plane of the pipeline. The high and low pressure impulse pipes should be on the same plane, as shown in Figure 2(a);

When measuring liquid, the installation should be inclined downward as shown in Figure 2(b);

When measuring gas vapor, the installation should be inclined upward as shown in Figure 3(c).

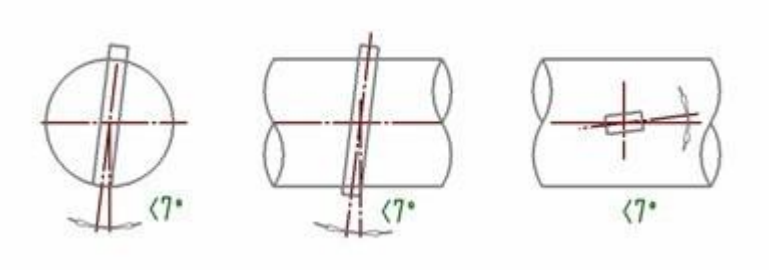

Figure 1. Sensor installation position deviation diagram

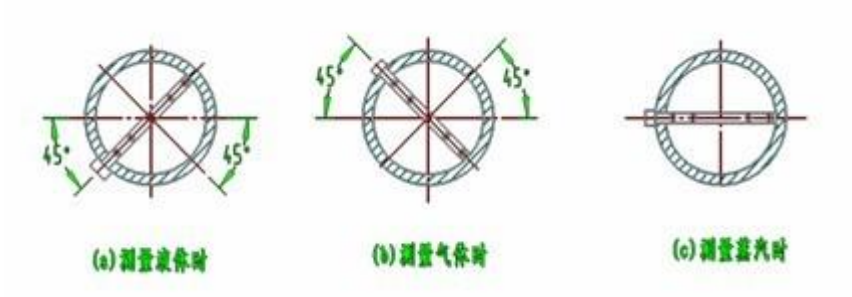

Figure 2. Installation directions of different media

2.2. Straight pipe section

Since the sensor is based on the velocity-area method, it adopts the approximate integral theory and uses more points to describe. The distribution equation is established under fully developed speed distribution conditions.

Therefore, in order to obtain an ideal distribution, there must be a certain length of straight pipe before and after the sensor (see the table below)

Note: (1) "D" in the table is the inner diameter of the pipe.

In the case of insufficient pipeline sections, the upstream should account for 70% of the total length of the pipeline, and the downstream should account for 30%. At this time, a stable indication can be given, but the accuracy will decrease.

No.	Annubar flow sensor installation location	Upstream side A			Downstream side B
		With rectifier	Without rectifier		
			Same plane	Different plane	
1	There is a 90° elbow or tee	6D	7D	9D	3D
2	There are two 90° elbows in the same plane	8D	9D	14D	3D
3	There are two 90° elbows in different planes	9D	19D	24D	4D
4	Change of pipe diameter (contract or expand)	8D	8D	8D	3D
5	Partially open gate valve, ball valve or other throttle valve	8D	8D	8D	3D

3. Putting into operation of the flowmeter

①The measurement system is closed:

The preparations for commissioning have been completed, the measured medium is filled with the process pipeline and the sensor measurement system is temporarily closed. At this time, the balance valve of the three-valve group should be in the open state, and the high-pressure valve P l and the low-pressure valve P2 should be closed. The supporting instrument is in the power supply state, and the warm-up is about 15 minutes.

②The measurement system is on:

After the meter warms up, turn on the measurement system. Open the Pl valve and P2 valve on the three-valve group, the balance valve is still open. At this time, the differential pressure transmitter has been filled with the measured medium (gas or liquid), the drain valve on the transmitter is opened, the dirty liquid or gas is quickly discharged and then closed. Then close the balance valve on the three-valve group, and the transmitter enters the differential pressure measurement state. The output signal current I△P corresponding to the differential pressure △P can be calculated from the signal current value (mA) to calculate the differential pressure △P value (KPa). The flow totalizer also enters the working state, showing the measured medium flow.

If the above work is smooth and the flowmeter works normally, the commissioning work will be completed and delivered to production.

4. Maintenance of flow meter

The Annubar flowmeter requires less maintenance and the Annubar integrated sensor is maintenance-free. The daily maintenance of the matching secondary instrument is very small, and only some daily maintenance such as zero point inspection and range inspection are required. However, for some occasions, when the use conditions of the measured medium deviate greatly from the design conditions, some field parameter corrections are required.

Cite several situations as follows:

①Occasion where the production process is discontinuous and stops and starts. Attention should be paid to flowmeter maintenance. When the production process is stopped, the balance valve of the three-valve group should be opened, the high pressure valve P l and the low pressure valve P2 should be closed, and the differential pressure transmitter should be in a state of no differential pressure input. When the production process resumes, P1 and P2 should be opened again. Close the balance valve, and the differential pressure transmitter restores the differential pressure input measurement state.

②For some measured media with high dust content, such as crude gas (not cleaned), industrial water (containing sand), moist gas (containing dust), etc., when it is expected to block the pressure tapping hole of the probe, it should be purged regularly . The blowing method uses compressed air into the sensor to blow back to blow off the dust particles attached to the high-pressure hole and the low-pressure hole to prevent clogging. Each purge time does not exceed 30 seconds. During this time, the pressure leading pipe leading to the differential pressure transmitter should be closed, and then reopen after the purge is completed. In some occasions where compressed air is not allowed to blow in, such as high-temperature gas, steam can be used for blowing.

③The possible causes and clearing methods of failure are shown in the following table:

No.	Failure phenomenon	Causes	Clearance method
1	No differential pressure signal output	1. The high and low pressure valve is not open	1. Open the high and low pressure valve
		2. The high and low pressure balance valve is not tightened	2. Tighten the balance valve
2	Differential pressure signal output is too small	1. There is leakage in the pressure guiding system	1. Search carefully and eliminate leaks
		2. Improper selection of secondary meter range	2. Lower the upper limit of the differential pressure transmitter
3	The differential pressure signal output is too large	1. Improper selection of secondary meter range	1. Increase the upper limit of the differential pressure transmitter
		2. The back pressure hole is blocked	2. Clean the sensor and remove the blockage