FERTRON

USER MANUAL

MASS FLOWMETER

Directory

1 Summarization

Welcome to use LK series mass flowmeter produced by our company. LK series mass flowmeter is a new type of flow meter developed according to Coriolis force principle to directly measure the mass flow of fluid in closed pipelines.

Product features:

(1) Easy to install and use: no straight pipe section requirements, no rectifier device,no moving parts, simple maintenance, high range ratio.
(2) Direct measurement of medium variables:
medium massflow: and measurement tube vibration phase difference is proportional to.
Medium density: proportional to vibration frequency of measuring tube.
Medium temperature: measured by temperature sensor.
(3) Indirectly measure other variables of the medium,volume flow rate of the medium,concentration of the medium and other variables.

Examples of media suitable for LK series mass flow meters are as follows:

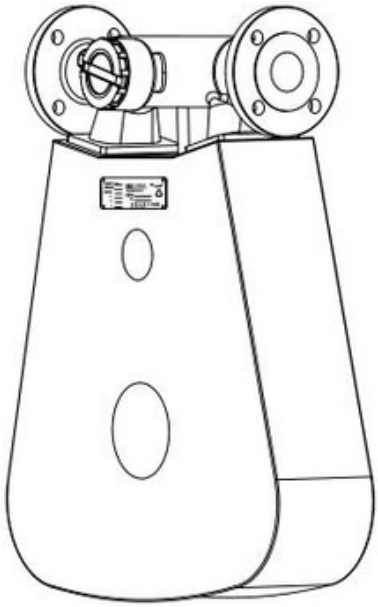
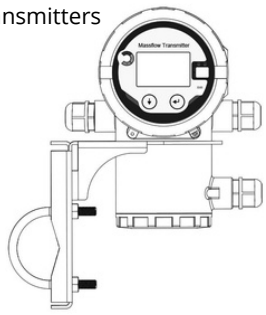
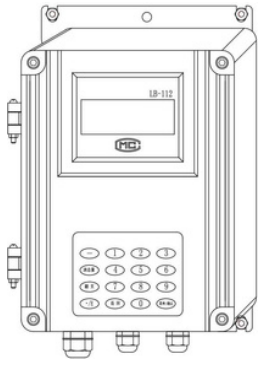
Food Industry: Dairy Products, Syrup, Chocolate, Edible Oil, etc.
Industry: cryogenic liquid (such as LNG), oil, grease, paint, acid, alkali, catalyst, etc.

Examples of LK series mass flowmeter application measurement occasions are as follows:

Material process control, measurement, material mixing ratio, batch measurement, gas volume measurement, etc.

Fast and changeable density measurement, product process diagnosis, product quality on-line inspection, on-line moisture content, etc.

LK series mass flowmeter consists of LK series sensors and LB series transmitters.

<table>
<tr>
<td>LK series
  </td>
<td>LB series transmitters
Scene type
 
Wall hanging type
  </td>
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(1) Flowmeasurement

The principle is shown in Fig 1.1, Fig 1.2 and Fig 1.3. Two ends of a bent pipe are fixed, and vibration force (according to the resonance frequency of the pipe) is applied to the pipe at the middle position of the two fixed points, so that the pipe vibrates at its natural frequency ω with the fixed point as an axis. When there is no fluid flow in the pipeline, the pipeline is only affected by external vibration force, and the vibration directions of the two halves of the pipeline are the same without phase difference. When there is fluid flow, influenced by the Coriolis force Fc of the medium particle flowing in the pipeline (the Coriolis forces F1 and F2 in the two half sections of the pipeline are equal in magnitude and opposite in direction as shown in Fig 1.1), the two half sections of the pipeline twist in opposite directions to generate a phase difference (as shown in Figs 1.2 and 1.3), which is proportional to the mass flow rate. The design of the sensor is to convert the measurement of Coriolis force into the measurement of phase difference between two sides of the vibrating tube, which is the working principle of Coriolis principle mass flowmeter.

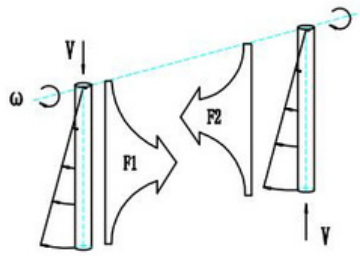

Fig 1.1

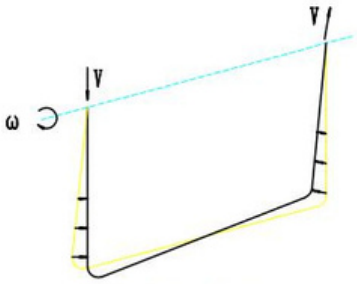

Fig 1.2

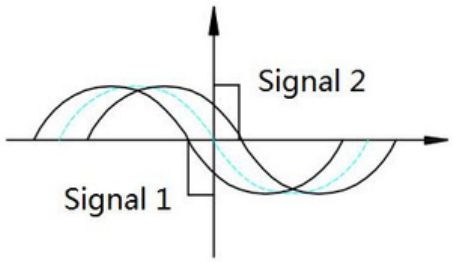

Fig 1.3

(2) Densitymeasurement

The measuring tube vibrates continuously at a certain resonance frequency, which varies with the density of the fluid. Therefore, the resonance frequency is a function of the fluid density, from which the corresponding density can be obtained.

(3) Temperaturemeasurement

The temperature sensor inside the sensor measures the real-time temperature of the medium.

3.1 Sensor naming rules

			LK—	XXX	X X	X	X	X	X
Caliber:	DN 1.5		001						
	DN 3		003						
	DN 4		004						
	DN 6		006						
	DN10		010						
	DN 15		015						
	DN 20		020						
	DN 25		025						
	DN 32		032						
	DN 40		040						
	DN 50		050						
	DN 80		080						
	DN100		100						
	DN150		150						
	DN200		200						
Temperature range:		-50~+125℃ Y		Y					
		-50~+180℃ N		N					
		-50~+245℃ H		H					
		-200~+80℃ L		L					
Accuracy:	Massflow:0.15%	Density:±0.002g/cm3			N				
	Massflow:0.5%	Density:±0.005g/cm3			B				
	Massflow:0.10%	Density:±0.002g/cm3			C				
Pressure rating:		4.0Mpa				N			
		10.0Mpa				B			
		35.0Mpa				C			
Process interface:		Flange					F		
		Screw thread					M		
		Clamp					K		
Contact liquid level material:		Measuring tube 316L, Other 304						4	
		316L						6	
		Titanium material Ti1						T	
		Harrington alloy						C	
Measurement applications:		General application							Z
		Heat tracing							B
		CNG							C
		LNG							L
		No precooling at low temperature							M

Note: *1. Temperaturerange:whencodenumberisY,thesensorandtransmitterareinstalled integrally, while the others are installed separately.*
2. DefaultflangestandardGB9112,sealingsurfacetype:plane(FF);Threadstandard M20X1.5 below DN4.

3. *For cryogenic liquid applications (medium temperature < -50℃), its mass flow accuracy is 0.35%.*

Example: Sensor model code:

LK 0 2 5 N N N F 4 Z

Sensor diameter: DN25

Temperature range: -50 ~ +180℃

Accuracy: mass flow: 0.15%, Density: 0.002 g/cm3

Pressure rating: 4.0Mpa

Process interface: Flange

Contact liquid level material: Measuring tube 316L, Other 304

Measurement applications: General

3.2 Transmitter naming rules

LB series transmitters process measurement signals from sensors and display and output them to the outside.

Please refer to the transmitter instructions for detailed instructions.

		LB— X	X	X— X	X
Signal processing:	Analog signal processing	1			
	Digital signal processing	2			
Installation method:	Wall hanging type		1		
	Operating panel mounting type		2		
	Scene type		3		
Display Method:	Simplified Chinese Characters			2	
	English language			3	
Show input and output signals:					
• One frequency output, two discrete outputs, one 4-20mA current output, two discrete inputs, RS-485(Modbus RTU)					1
• One path of pulse/frequency/discrete output, one path of frequency/discrete output, one path of 4-20mA current output, one path of discrete input, RS-485(Modbus RTU)					4
• One path of pulse/frequency/discrete output, one path of 4-20mA current output, two paths of discrete input, RS-485(Modbus RTU)					5
• One path of pulse/frequency/discrete output, one path of frequency/discrete output, one path of 4-20mA current output, one path of discrete input, one path of 4-20mA current output +HART					6
• One path of pulse/frequency/discrete output, one path of frequency/discrete output, one path of 4-20mA current output, one path of discrete input, and other communication protocols					X
Power supply voltage:	AC: AC 220V (50 ~ 60Hz)				1
	DC: DC24V				2
	DC20-140V and AC80-264 V (50-60Hz)				3

4.1 Flow range

4.1.1 Liquid flow

Flow measurement error: ε=Ei%×flow+Eo, Measurementaccuracy: e=±(ε/flow)×100]%

Model	Caliber	Flowrange(t/h)	ZeroinstabilityEo(t/h)
LK－001	DN1.5	0－0.06	0.00001
LK－003	DN3	0－0.12	0.00002
LK－004	DN4	0－0.24	0.00004
LK－006	DN6	0－0.8	0.00006
LK－010	DN10	0－1.5	0.00011
LK－015	DN15	0－3	0.00022
LK－020	DN20	0－7	0.00053
LK－025	DN32	0－12	0.0009
LK－032	DN40	0－21	0.0014
LK－040	DN50	0－36	0.0025
LK－050	DN80	0－60	0.0041
LK－080	DN100	0－120	0.009
LK－100	DN150	0－210	0.013
LK－150	DN200	0－350	0.02
LK－200		0－750	0 0.05

4.1.2 Gasesflow

The gas flow rate is related to the medium pressure and density, and the gas flow rate range is about 1/5 of the liquid flow rate when selecting gas.

4.2 Accuracy

Massflow (liquid): ±0.10%,±0.15%,±0.50%

Massflowrate (gas): ±0.50%

Volumeflow (liquid): ±0.35%

Density: ±0.002g/cm3,±0.005g/cm3

Temperature: ±0.75℃

4.3 Temperature range

Medium temperature: -50~+125℃,-50~+180℃,-50~+245℃,-200~+80℃

Ambient temperature: -40~+60℃

4.4 Pressure class

Pressure classes of flow tubes: 4Mpa,10Mpa,35Mpa(other pressures need to be customized)

4.5 Explosion-proof protection level

Explosion-proofgrade Exib II CT3～T6Gb

Ex d ib II C T3~T6 Gb

Protection grades IP67

4.6 Structure and materials

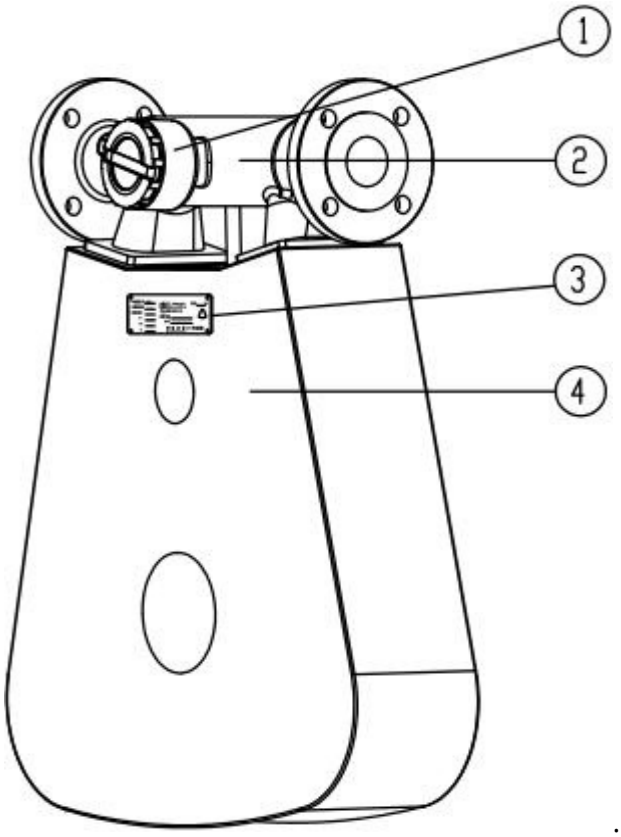

Figure 3.1

(1) junction box (2) Instrument body (3) sign (4) shell

Measuring tube: 316L,Titanium materialTi1,Harrington alloy (Other need customized materials, such as lining)
Instrument body: 304, 316L, Titanium material Ti1, Harrington alloy
Shell: 304,Titanium material Ti1, Harrington alloy
Junction box: Aluminum
Electricalconnector: M20×1.5(default),1/2"NPT

1. Examples of media suitable for mass flowmeter measurement are as follows:
Food Industry: Dairy Products, Syrup, Chocolate, Edible Oil, etc.
Industry: cryogenic liquid (such as LNG), oil, grease, paint, acid, alkali, catalyst, petroleum measurement, gas (such as natural gas), etc.

2. Security of media:
The corrosiveness of the medium, whether the medium and the liquid surface material of the flowmeter produce chemical reaction, and the instrument casing has certain corrosion resistance to the applicable site.

3. Pipeline pressure:
The pressure resistance level of the sensor shall conform to or be higher than that of the process pipeline design, and the sensor is prohibited from working in the overpressure range.

4. Temperature of medium:
Attention should be paid to the applicable temperature of the instrument when selecting the type. The temperature resistance of the detection elements in the sensor is certain, so as to prevent the instrument from being unable to be used normally due to the damage of the detection elements.

5. Protection requirements:
When using the instrument outdoors and in special occasions, whether the protection level of the instrument casing meets the use requirements shall be considered.

6. Explosion-proof requirements:
The explosion-proof level of the instrument shall conform to the safety standards of the use site, distinguish the safe side from the dangerous side of the explosion-proof site, and reasonably select the required explosion-proof type sensors and transmitters. (Note: When selecting general explosion-proof electrical equipment, it must be noted that the explosion-proof type is only related to explosive areas. For specific explosive areas, besides selecting the appropriate explosion-proof type, the level and
temperature level of explosive gas must also be considered).

7. Flow range:
First, the measuring range of flowmeter shall cover the flow range of the medium to be measured; Secondly, the measurement accuracy of the mass flowmeter includes zero instability, which affects the measurement accuracy at the lower limit (small flow), so the flow range of the medium to be measured is best selected within the optimal flow range of the flowmeter (20%-85% of the maximum flow of the
f lowm e te r).

8. Other relevant factors:
Including installation, maintenance, power supply, pressure loss and other factors of the instrument.

Sensor nameplate

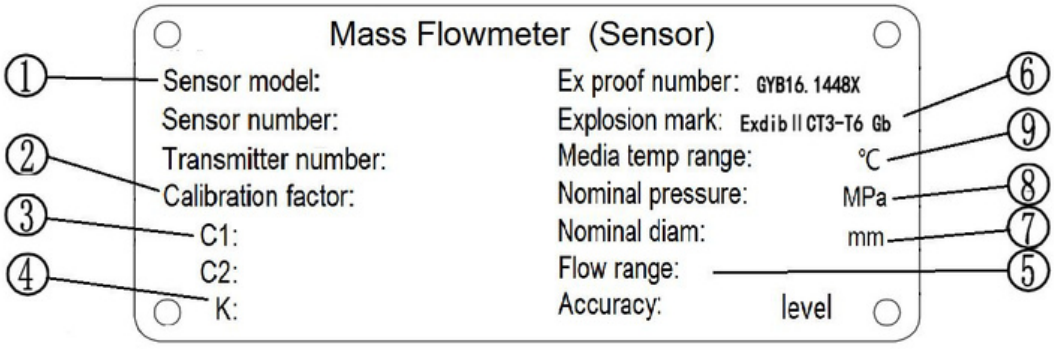

Figure 6.1

1. Sensor model:the caliber of the sensor can be known.
2. Calibration coefficient: The coefficient related to mass flow measurement is obtained by calibrating the sensor.
3. C1 and C2: coefficients related to density measurement.
4. K: K coefficient refers to the number of pulses emitted by the flow meter when a unit mass of fluid passes through the flowmeter, which is related to the flow corresponding to the highest frequency output by the transmitter (the maximum flow in the flow range).
5. Flowrange: Generally,it is the measuring range of the instrument. When the user specifies the flow corresponding to the maximum output signal of the transmitter, the upper limit flow of the flow range is the flow value corresponding to the maximum output signal.
6. Explosion-proofidentification.
7. Instrumentdiameter.
8. Pipelinepressure.
9. Temperaturerange.

Note: *LK-001 to LK-004 Nameplate the is figure 6.2.*

Sensor size and weight

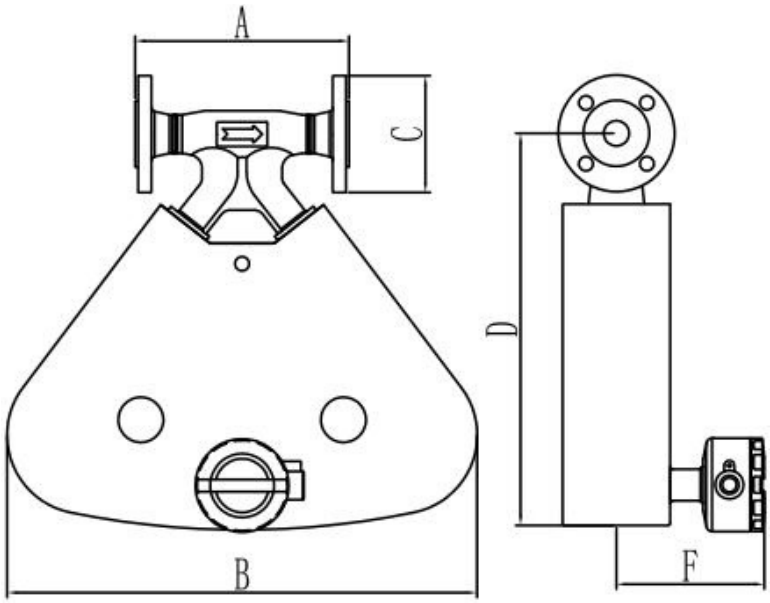

Figure 7.1 LNG Sensor

LNG sensor dimensions and weight:

Model Caliber A			D	F	weight (kg)
LK—006 DN6 162	DN6	162	210	120	4.5
LK—015 DN15 191	DN15	191	280	132	11
LK—025 DN25 211	DN25	211	393	146	15
LK—032 DN32 294	DN32	294	452	151	21
LK—050 DN50 442	DN50	442	654	166	40
LK—080 DN80 538	DN80	538	729	180	62
LK—100 DN100 570	DN100	570	796	220	64

Note: *1. Dimension A is the size when it is equipped with PN40 GB 9112 flange.*
2. The temperature range code of the sensor is L.

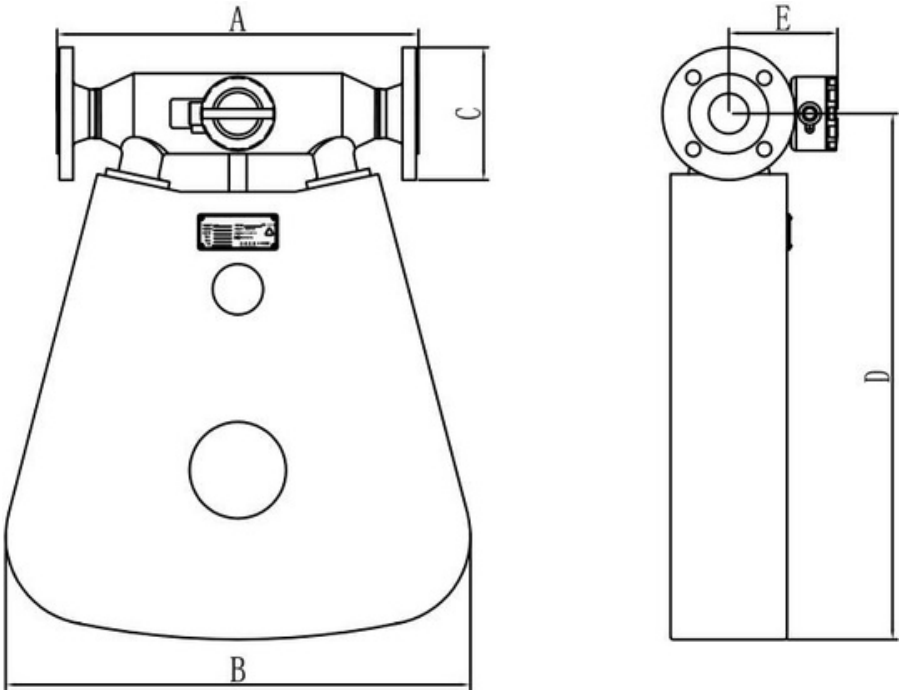

Figure 7.2 Sensor

Sensor dimensions and weight

MODEL	A	B	C	D	E	weight (kg)
LK—001 DN1.5	156	168	M20X1.5	128	120	3.5
LK—003 DN3	136	234	M20X1.5	165	120	3.5
LK—004 DN4	136	234	M20X1.5	165	120	3.5
LK—006 DN6	162	250	Φ90	210	120	4.5
LK—010 DN10	210	280	Φ90	254	120	10
LK—015 DN15	240	384	Φ95	300	120	11
LK—020 DN20	248	430	Φ105	392	120	12
LK—025 DN25	264	440	Φ115	410	124	15
LK—032 DN32	294	455	Φ140	452	124	21
LK—040 DN40	320	540	Φ150	536	125	25
LK—050 DN50	442	578	Φ165	654	135	40
LK—080 DN80	538	606	Φ200	729	145	62
LK—100 DN100	570	670	Φ235	796	152	64
LK—150 DN150	840	803	Φ300	934	178	150
LK—200 DN200	1063	907	Φ375	1175	230	300

(Table 7.2)

Note: *1. LK-001 to LK-004 thread matching standards M20X1.5 The remaining A dimensions are those for PN40 GB 9112 flange.*
2. The temperature range codes of sensors are N and H. See Table 7.3 for CNG dimensions.

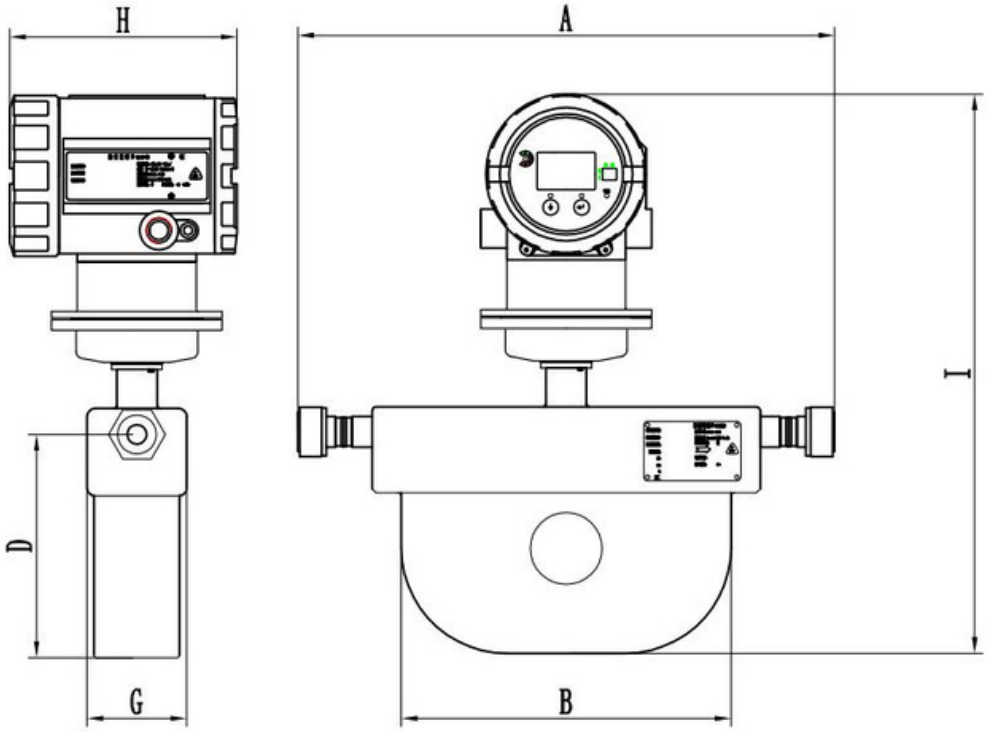

Figure 7.2 CNG flowmeter

CNG flowmeter overall dimensions and weight:

Model	Caliber	A	B	D	G	H	I	weight (kg)
LK—015	DN15	415	255	173	77	176	432	9.5

(Table 7.3)

Note: 1. When CNG flowmeter is installed separately, "I" dimension is 290 mm.
2. Process connection: Swagelok compatible size 12 VCO connection connector by default.

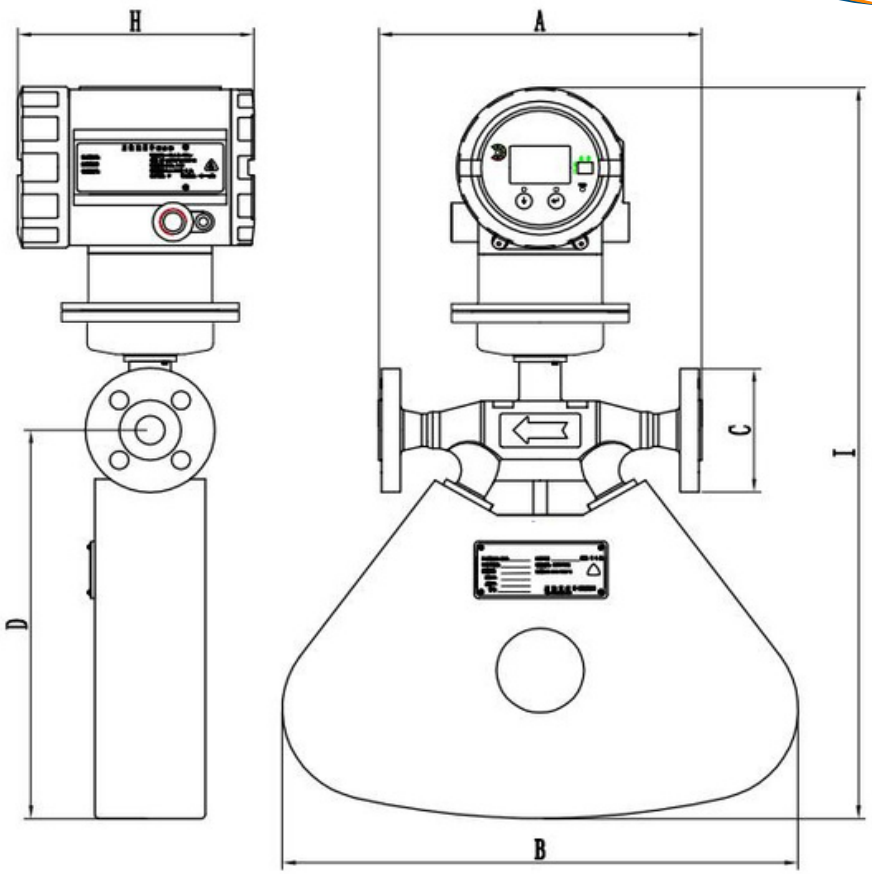

Figure7.4 Integrated flowmeter

Overall dimensions and weight of integrated flowmeter:

Model	Caliber	A	B	C	D	H	I	weight (kg)
LK—015	DN15	240	384	Φ95	300	176	565	14.5
LK—020	DN20	248	430	Φ105	392	176	655	15.5
LK—025	DN25	264	440	Φ115	410	176	680	18.5
LK—032	DN32	294	455	Φ140	452	176	725	24.5
LK—040	DN40	320	540	Φ150	536	176	812	28.5
LK—050	DN50	442	578	Φ165	654	176	934	43.5
LK—080	DN80	538	606	Φ200	729	176	1027	65.5
LK—100	DN100	570	670	Φ235	796	176	1096	67.5
LK—150	DN150	840	803	Φ300	934	176	1199	150
LK—200	DN200	1063	907	Φ375	1175	176	1520	330

(Table 7.4)

Note: *1. Dimension A is the size when it is equipped with PN40 GB 9112 flange.*
2. The temperature range code of the sensor is Y, and the CNG size is shown in Table 7.3.

8.1 Receiving confirmation,Transportation and storage

8.1.1 Receiving confirmation

During acceptance, please check the following points:

·Check whether the package and goods are damaged.

·Check whether the quantity and variety of goods are consistent with the order.

8.1.2 Transportation

The following points should be noted during transportation:

·Do not remove the original packaging during transportation.

·Do not remove the plastic protective cover on the process connection surface before installation, so as to avoid mechanical damage to the sealing surface during transportation and storage and prevent sundries from entering the measuring tube.

·When lifting the sensor with nominal diameter DN32-DN200, use a net-like soft rope to wrap around the process connection at both ends.

·Do not wrap the hanging rope around the sensor housing or junction box, and do not use a chain to avoid damaging the housing. During hoisting, the instrument shall be prevented from tilting or being impacted. Refer to the following figure for the correct hoisting position.

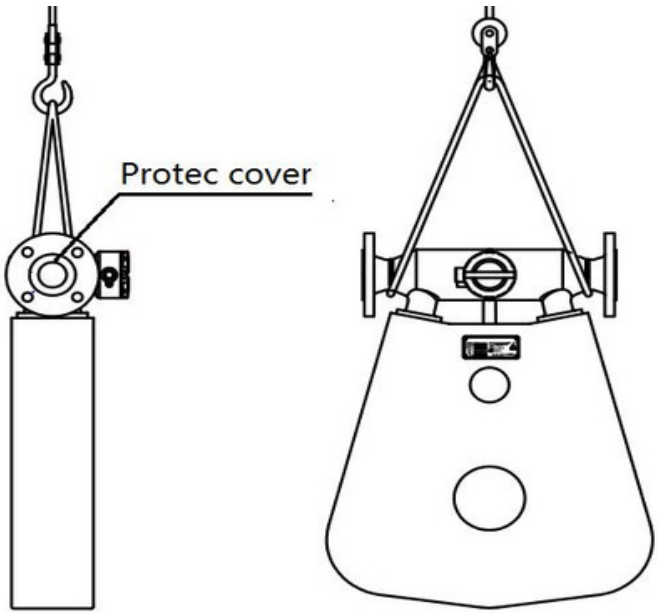

Figure 8.1

8.1.3 Storage

Please note the following points:

·The instrument shall be packed during storage and transportation to prevent impact. Its original packaging can provide optimal protection.

·The allowable storage temperature is-40 ~+80℃ (+20℃ is the best).

·Do not remove the protective cover at the process connection end before installation.

·Avoid direct sunlight during storage to avoid surface temperature rise.

8.2 Installation dimensions

See table 7.1, table 7.2, table 7.3 and table 7.4 for the overall dimensions of the sensor.

For the overall dimensions of the transmitter, please refer to the transmitter USER'S GUIDE.

8.3 Installation conditions

·No cavitation shall occur after installation of process pipelines or instruments.

·In order to protect the pipeline, it is recommended that when the sensor is too heavy, the process pipeline on both sides should have stable support near the flange (about 2~10 times the pipe diameter).

◦

8.4 Installation location

When air bubbles are entrained in the sensor measuring tube, measurement errors will occur, and the following installation positions should be avoided:

·The flowmeter is installed at the highest point of the pipeline, which will cause air accumulation.

·The flowmeter is directly installed at the outlet of the downward vent pipe.

The transmitter is installed in an area that is easy to operate and view, paying attention to waterproof and high temperature.

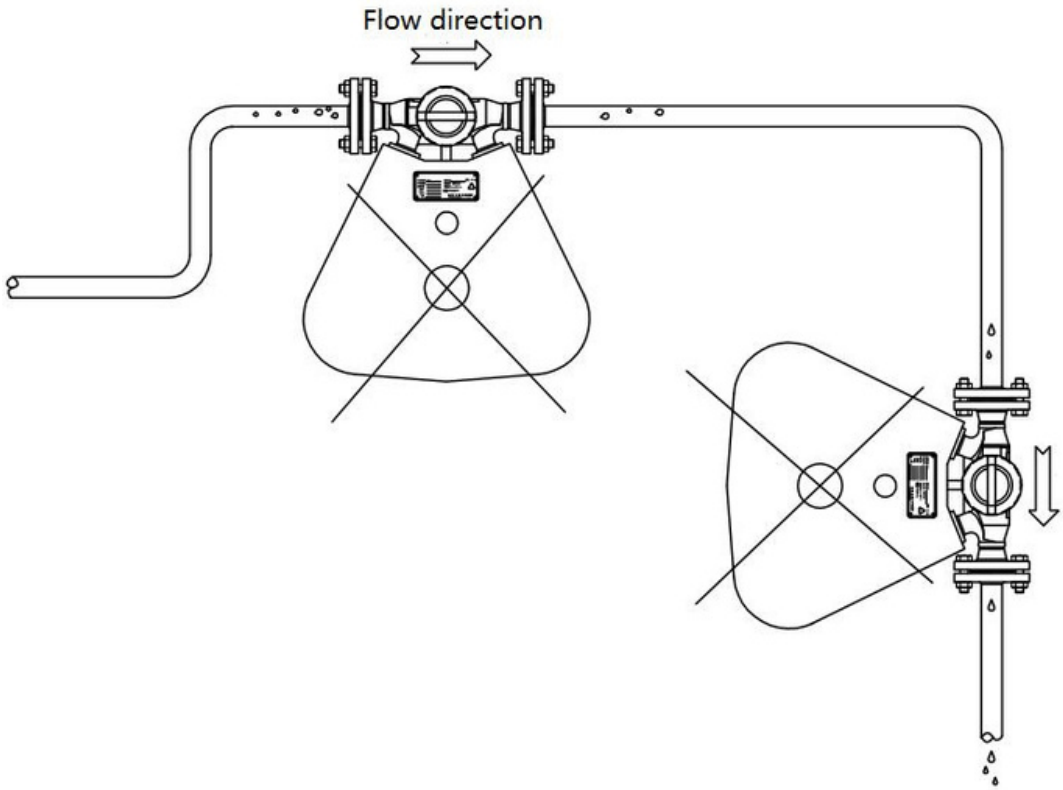

Figure 8.2

8.5 Istallation direction

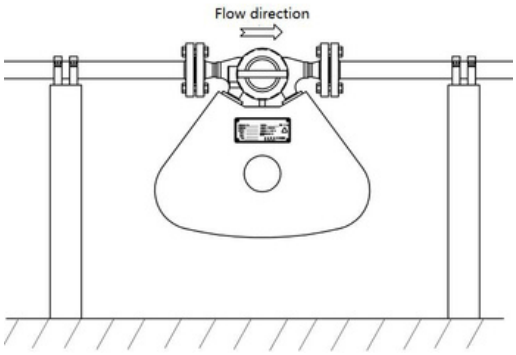

Figure 8.3

Recommended sensor installation methods:
In order to ensure the reliability of the measurement, the installation method of the instrument should be considered to The following factors:

(1) Whenthemassflowmetermeasuresliquid,itis recommended to install the housing downward. As shown in fig. 8.3, gas is prevented from accumulating in the sensor vibrating tube.

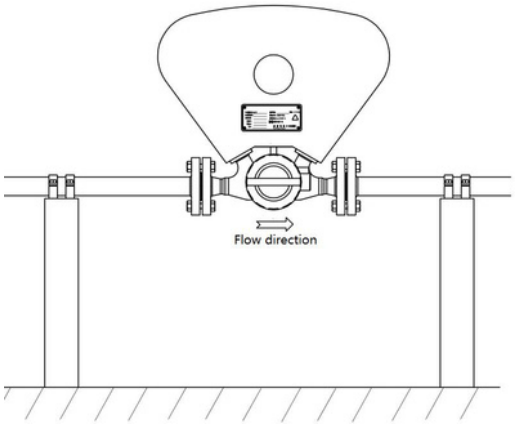

Figure 8.4

(2) Whenthemassflowmetermeasuresgas, it is recommended to install the shell upwards. As shown in fig. 8.4, prevent liquid from accumulating in the vibration tube of the sensor.

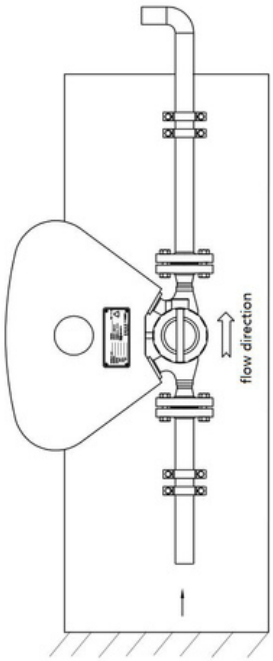

Figure 8.5

(3) When the measured medium is suspension,itis recommended that the sensor be installed like a flag. As shown in fig. 8.5, the flow direction of the medium flows through the sensor from bottom to top.

8.6 Installation schematic

Diagram Fig. 8.6 is a schematic diagram of installation. refer to fig. 8.1 when installing sensors for hoisting.

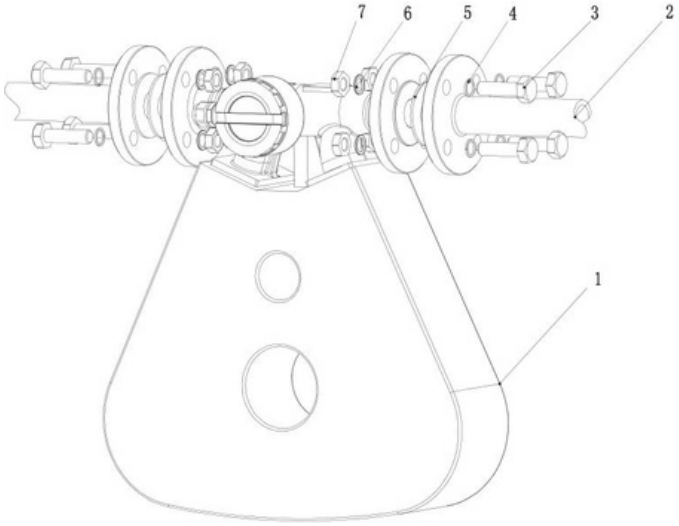

Figure 8.6 Installationdiagram

1-Sensor, 2-Pipe, 3-Screw, 4-Gasket, 5-Packing washer, 6-Spring pad, 7-Nut

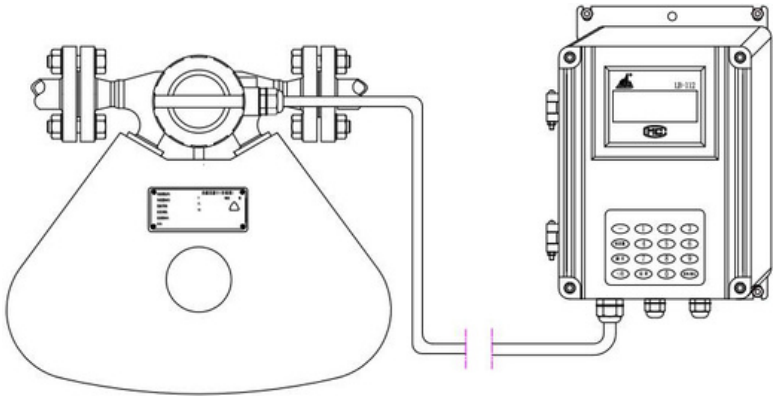

Figure 8.7 Remotewall-mounted installation form

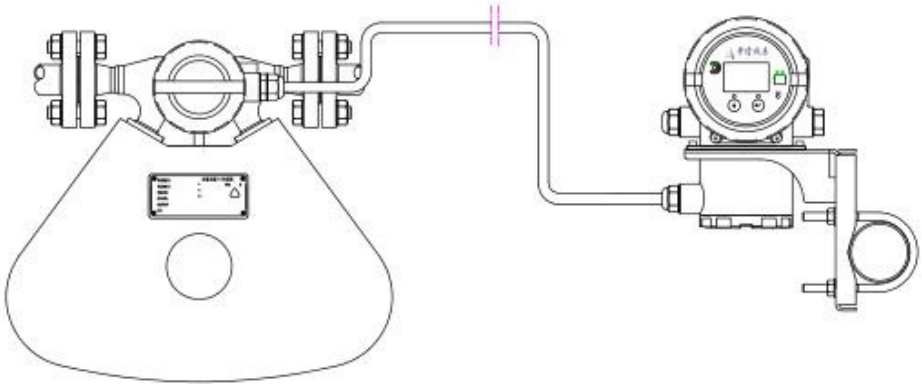

Figure 8.8 On the spot display of split Installation form

8.7 Other precautions for installation

(1) Installation location should avoid electromagnetic interference. The installation positions of sensors and transmitters and the laying of cables shall be as far away as possible from equipment that is easy to generate strong electromagnetic fields, such as high-power motors, transformer facilities, frequency conversion equipment, etc.

(2) Process piping should be centered,on both sides of the flange should be parallel. It is strictly prohibited to straighten the upstream and downstream process pipelines with the sensor, otherwise the measurement will be affected or even the sensor will be damaged. In addition, the process pipes on both sides should be provided with stable supports near the flange (about 2 ~ 10 times the pipe diameter) (as shown in figs. 8.3, 8.4 and 8.5).

(3) Sensor inlet side cannot install butterfly valve.

(4) On the upstream and downstream pipelines of the sensor,it is recommended to install stop valve and bypass to facilitate zero calibration, routine maintenance and ensure that the sensor can be in a full pipe state when not working. Use the regulating valve downstream of the sensor for flow control (as shown in Figure 8.9).

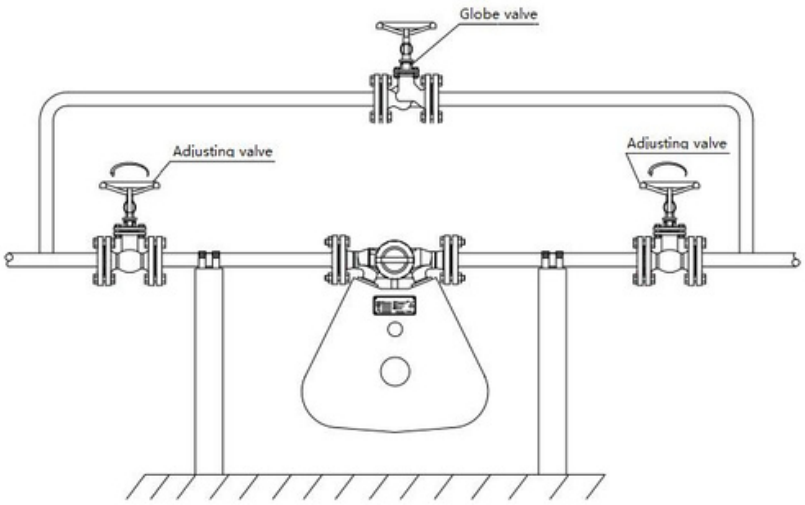

Figure 8.9

(5) When measuring the medium that is easy to vaporize,it is recommended to install apressure gauge downstream of the flowmeter to check the downstream pressure. If the downstream of the flowmeter needs to be expanded, it is recommended that the process pipe downstream of the flowmeter keep a certain distance from the flowmeter at the same caliber, and that a valve be installed downstream of the sensor to adjust the appropriate back pressure to prevent vaporization or cavitation. If the medium vaporizes or cavitates in the flowmeter, the measurement accuracy will be affected and the sensor will not work normally in severe cases (as shown in Figure 8.10).

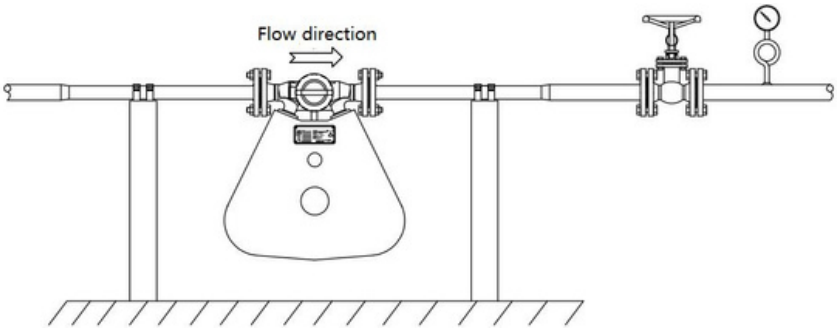

Figure 8.10

9.1 Wiring

When the sensor and transmitter are separately installed, they are connected by special signal cable. The default configuration of signal cable is 7m, and the length of signal cable cannot exceed 100m. Please refer to the wiring diagram of the transmitter manual for the connection between the transmitter and the signal line and the connection with the output port.

Sensor junction box is connected with signal cable. Figure 9.1 shows the structure of sensor junction box and signal cable.

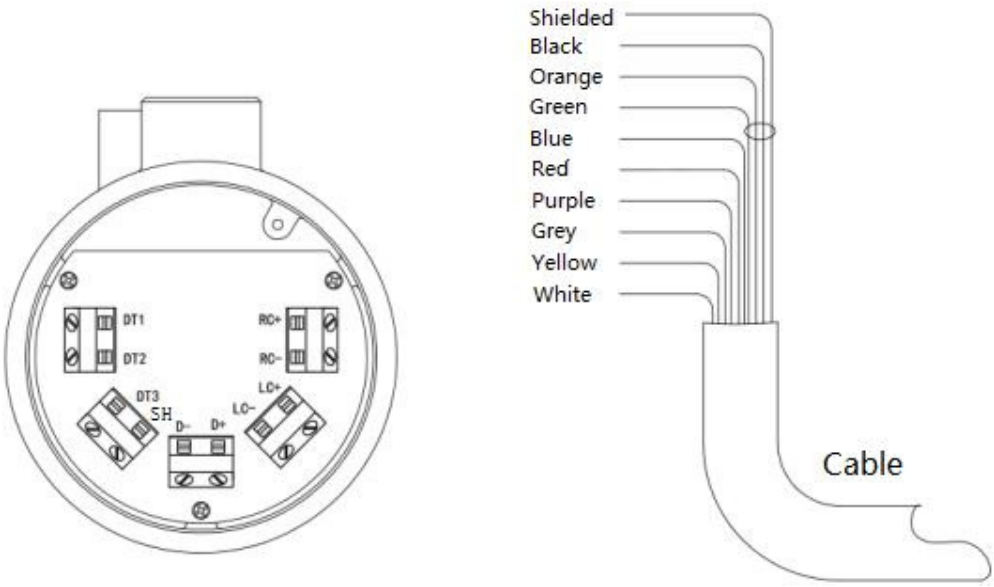

Figure 9.1

GroupL(leftdetection): WhitetoLC+, YellowtoLC-, Shieldwiresiscutoff.
GroupR(rightdetection): GraytoRC+, PurpletoRC-, Shieldwiresiscutoff.
GroupD(drive): RedtoD+,BluetoD-,Shieldwiresiscutoff.
GroupT(temperature): GreenandOrangeareconnectedtoDT3andDT2,
Black is connected to DT1,
LB-112 and LB-122 shield wires are connected to SH,
Other types of transmitters are connected to cut off shield wires.

Note: *The incoming line shall be sealed, and the junction box shall not leak air or water.*
The sensor housing should be grounded nearby, and the cross-sectional area of wires should not be less than 1mm².

9.2 Zerocalibration

In order to ensure the measurement accuracy of flowmeter, zero point calibration shall be carried out after the sensor is installed. The method is as follows:

The sensor is filled with medium and flows for more than 5 minutes, the transmitter is electrified and preheated for more than 20 minutes, the sensor is not abnormal, and the transmitter displays normal, zero calibration can be considered. During zero calibration, the upstream and downstream valves shall be closed without leakage. Perform zero calibration after the fluid in the sensor is stable. Generally, the valve should be closed for 3 ~ 5 minutes before zero calibration.

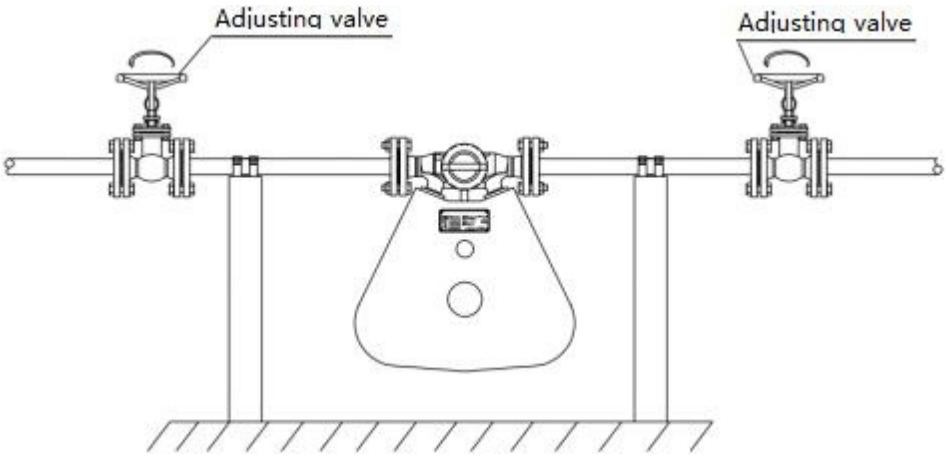

Figure 9.2

Note: *The sensor must be filled with medium.*
Zero calibration must ensure that the medium in the sensor does not flow.

10 Failure and Maintenance

The following repair methods are used for sensor failures:

1 The sensor does notwork
The inspection steps are as follows:
(1) Whether the transmitter is displayed, check whether the transmitter is powered.
(2) Whether the sensor and transmitter are connected correctly, check whether the wiringis correct, ensure the color and logo are consistent, and the connection is firm and reliable.
(3) Measure whether there is voltage in the drive and detection. Use multimeter voltage millivoltto measure whether the voltage value of the left and right detection coils of the sensor is greater than 70mv, whether the voltage is consistent, the voltage of the drive coil is greater than 200mV, and the voltage
value fluctuates±2mv.
(4) When the transmitter is powered off, measure the resistance value of the drive and detection,and use multimeter resistance 200Ω to measure whether the resistance of the left and right detection coils of the sensor is greater than 70Ω and whether the resistance is consistent; Whether the resistance of the drive coil is greater than 9Ω.

2 The sensor is notworking properly
(1) Whether the installation and use ofthe instrument meet the technical requirements,suchas pipeline vibration, installation location, installation method, etc., and make rectification to meet the requirements.
(2) Whether the sensor and transmitter are connected correctly and reliably, check whether the wiringis correct, and ensure that the colors and signs are consistent, and the connection is firm and reliable.
(3) Whether the inside of the sensor is filled with medium, and the pipeline flows through the sensor,so that the medium is filled with the pipeline and the sensor.
(4) Whether there are bubbles in the medium, remove or reduce bubbles, such as in stalling exhaust valve upstream, outlet back pressure, etc.
(5) Whether there is any impurity in the vibrating tube of the sensor, remove the sensor from the tube, and flush out the impurity (sand, particles, etc.) deposited in the vibrating tube with water.

11 Return to factory for repair

Before repairing or calibrating the flow meter and returning it for various reasons, the following steps must be performed:

1 Attacha complete"repair form" and "decontamination statement" for transportation,inspection and repair.

2 Remove all residues,and pay special attention to the sealing groove and other parts where medium may remain.

3 Package the instrument to facilitate transportation and prevent the instrument from being damaged during transportation.

Note:

·The instrument must be cleaned of hazardous media before repair, such as media penetrating into cracks or diffusing through plastic parts.

·If the instrument is not cleaned, it may cause personal injury (such as burns) or require further cleaning, and the expenses incurred therefrom will be borne by the user of the instrument.

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