1. Product outline drawing

2. The functional purpose and scope of application of the product

HLDC type plug-in electromagnetic flow sensor (referred to as sensor) and HLDC type electromagnetic flow converter (referred to as converter) are matched to HLDC type plug-in electromagnetic flowmeter (referred to as flow meter) to measure the volume flow of various conductive liquids in the pipeline .

The sensor has the following characteristics:

◆ There are no moving parts in the sensor, with simple structure and reliable work.

◆ The plug-in structure can be easily installed and disassembled without stopping the water under low pressure or under pressure. Therefore, it is very suitable for the fluid measurement of existing pipelines and facilitates the maintenance and repair of instruments.

◆ The measurement accuracy is not affected by changes in physical parameters such as temperature, pressure, density, viscosity, and conductivity of the measured medium (as long as the conductivity is greater than 5μs/cm).

◆ The sensor has almost no pressure loss and extremely low energy loss.

◆ Compared with the general electromagnetic flowmeter, the manufacturing cost and installation cost are lower. Especially suitable for large and medium diameter pipeline flow measurement.

◆ Adopt advanced low frequency square wave excitation. The zero point is stable, the anti-interference ability is strong, and the work is reliable.

◆ Large flow measurement range. The full-scale flow rate in the measured pipe can be set arbitrarily from 1m/s to 10m/s, and the output signal has a linear relationship with the flow rate.

◆ The flowmeter not only has 0~10mA

◆DC or 4~20mA

◆DC standard current output, but also 1~5kHz frequency output

Because the flow meter (sensor) has the above-mentioned series of advantages, it has been widely used in the measurement and production process of conductive liquid flow in chemical industry, chemical fiber, metallurgy, fertilizer, papermaking, water supply and drainage, sewage treatment and other industrial sectors and agricultural irrigation water measurement. Automatic control. .

3. Product type and composition

The product type is plug-in. It is connected with the pipeline through an installation base, a ball valve, a compression nut and a positioning screw. The sensor measurement is divided into measuring tube type and planar electrode type two structural types. The measuring tube sensor is suitable for measuring clean medium; the plane electrode type is suitable for measuring the flow rate of liquid containing other impurities in the medium.

4. Main technical performance

4.1 Suitable for measuring pipe diameter:

200~2000mm;

4.2 Flow rate measurement range:

0~1 to 0~10m/s, the full scale is continuously adjustable in the range of 1~10m/s.

4.3 Measurement accuracy

When the full-scale flow rate>1m/s, ±1 5%.

4.4 Conductivity of measured medium:

More than 50μs/cm.

4.5 Work pressure:

1.6Mpa.

4.6 Electrode material:

Molybdenum-containing stainless steel 0Cr118Ni12Mo2Ti, Hastelloy c-276, titanium Ti, etc.

4.7 Material of measuring tube (measuring head):

ABS

4.8 The highest temperature of the measured medium:

ABS60℃

4.9 Shell protection level:

Comply with the relevant regulations of GB-08-84 standard IP68.

4.10 Sensor output signal:

0.209mVp-p/1m/s.

4.11 The maximum signal transmission distance between the sensor and the converter is 50m (for special requirements, please contact the manufacturer)

4.12 Flowmeter output signal:

DC current: 0~10mA load resistance is 0~1kΩ;

4~20mA load resistance is 0~500Ω;

Frequency: 1~5KHz load resistance is 250~1.2kΩ.

5. Working principle and structure

5.1 working principle

The sensor is actually a liquid flow rate measuring instrument. It is a flow rate measuring instrument based on the principles of Faraday's law of electromagnetic induction. Figure 1 is a schematic diagram of the basic working principle of the plug-in electromagnetic flowmeter.

Use a long rod to insert a small electromagnetic flow sensor into the specified position in the pipe to be measured. When the conductive fluid flows vertically through the working magnetic field of the sensor (when the converter provides the excitation current to the sensor, it will be used in the excitation system composed of the excitation coil). Generate a working magnetic field), which is equivalent to the movement of a conductor in a magnetic field. According to Faraday's law of electromagnetic induction, an induced electromotive force is generated at both ends of a conductor. This induced electromotive force is detected by a pair of electrodes

in contact with the fluid. The magnitude of the electromotive force is proportional to the magnetic induction intensity B, the distance between the two poles L, and the average flow velocity of the fluid. which is

E=B・L・V(Volt) ①

In the formula: E-induced electromotive force, volts;

B——Magnetic field strength, Tesla;

L——The distance between two electrodes, meters;

V——The velocity of the electromagnetic velocity sensor (that is, the velocity of the particle at the specified insertion point of the measured pipe), m/s

K-coefficient.

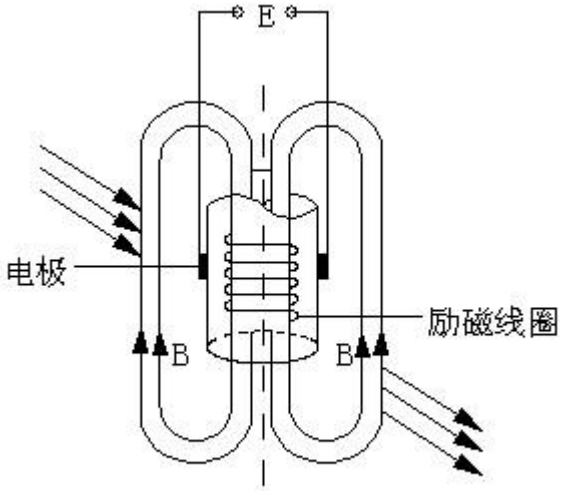


图1 工作原理

There are two methods for inserting the electromagnetic flow sensor to the specified insertion point. One is to insert it on the central axis of the pipe to be tested; the other is to insert it into the inner wall of the pipe at about 0.121D of the pipe. D is the diameter of the pipe. Generally, pipes smaller than DN400 can be inserted. inserted on the central axis of the pipe under test, then an electromagnetic flow sensor for measuring flow velocity sensor measuring the maximum pipe velocity, mean velocity of pipe should be the maximum flow rate multiplied by a coefficient K .

$$K=\frac{2n^2}{(n+1)(2n+1)}(\text{对光滑管道}) \qquad ②$$

In the formula: n is the Reynolds number index, which can be obtained by formula ③,

n=1.661gRD

Where: RD——Reynolds number of pipeline fluid.

$$K=\frac{1}{1-\frac{0.72}{\lg(0.2703\times\frac{K}{D}-\frac{5.74}{R_D^{a\cdot9}})}}(\text{对粗糙管道}) \qquad ③$$

In the formula, K-equivalent absolute roughness, the average height of the protrusions on the inner wall of the pipe.

Pipes larger than DN400 can be inserted at a distance of about 0.121D from the inner wall of the pipe. At this time, the flow velocity measured by the electromagnetic flow sensor is the average flow velocity, and the coefficient K=1. The flow rate of the pipe being measured can be expressed by the following formula

Q=B・V・A (m3/hour) ④

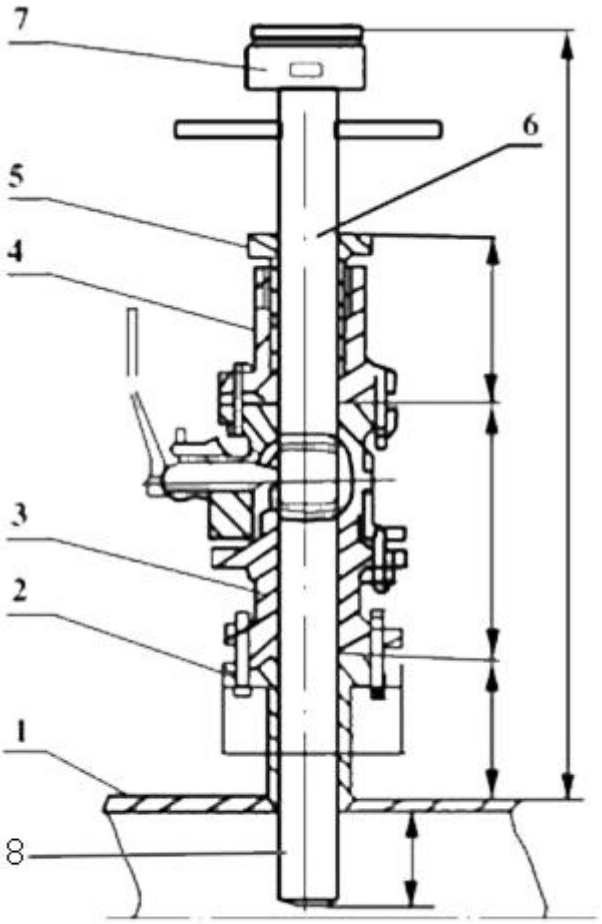
In the formula, A——cross-sectional area of round pipe, m². Substitute formula ① into formula ②, then

$$Q=\frac{E}{BL}A \qquad ⑤$$

Since the working magnetic field strength of the inserted electromagnetic flow sensor and the distance between the two electrodes have been determined at the time of manufacture, and the cross-sectional area of the pipeline to be measured is also obtained, the output electromotive force of the inserted electromagnetic flow sensor can represent the flow rate.

5.2 Structure

The sensor is shown in Figure 2, mainly composed of measuring head (or measuring tube) excitation system, insertion rod, junction box, mounting base, sealing positioning mechanism, etc.



1.管道 2.连接法兰 3.球阀 4.连接法兰
5.封头 6.传感器 7.接线盒 8.测量系统

Measuring head (or measuring tube): The measuring head (measuring tube) is located at the mass point of the measured flow velocity in the pipeline, and is used to detect the flow velocity at that point. The measuring head (or measuring tube) is an end or pipe made of insulating material on which a pair of electrodes are installed. Except for the electrode tip or the inner wall of the measuring tube, other parts are insulated from the measured fluid.

Excitation system: The role of the excitation system is to generate a working magnetic field. It is composed of excitation coil and iron core. It is insulated and sealed into the insertion rod.

Insert rod: made of stainless steel material. The measuring head is fixed in the insertion rod. The excitation lead and the electrode lead are sealed with the measured medium through the insertion rod and connected to the junction box. The insertion rod is welded with a direction indicator rod to ensure that the working magnetic field, the flow rate and the electrode connection are perpendicular to each other during installation, which meets the requirements of Faraday's law of electromagnetic induction.

Junction box: The junction box is located on the upper part of the sensor. The wiring terminals in the junction box serve to connect the sensor and the converter to each other.

Mounting base: The mounting base is welded on the pipeline to be tested and used to connect with the mounting ball valve and insert the part of the electromagnetic flowmeter sensor.

Sealing mechanism: Composed of compression threaded seat, compression nut, rubber washer and positioning screw made of stainless steel. Used to seal and insert the electromagnetic sensor, so that it can withstand a certain working pressure.

6. Installation and use

6.1 Installation

6.1.1 Choice of installation environment

① Keep away from equipment with strong electromagnetic fields, such as large motors and large transformers.

②There should be no strong vibration in the installation place, and the pipeline should be firmly fixed. The ambient temperature should not change much.

③The installation environment should be convenient for installation and maintenance.

6.1.2 Selection of installation location

①The installation position must ensure that the pipeline is always filled with the fluid under test.

② Choose a place where the fluid flow pulse is small. That is, it should be far away from local resistance parts such as pumps, valves, and elbows.

③When measuring two-phase (solid, liquid or gas, liquid) fluids, choose a place that is not easy to cause phase separation.

④ Negative pressure at the measurement site should be avoided.

⑤ The diameter or circumference of the side pipe is easy to measure, and the ovality should be small.

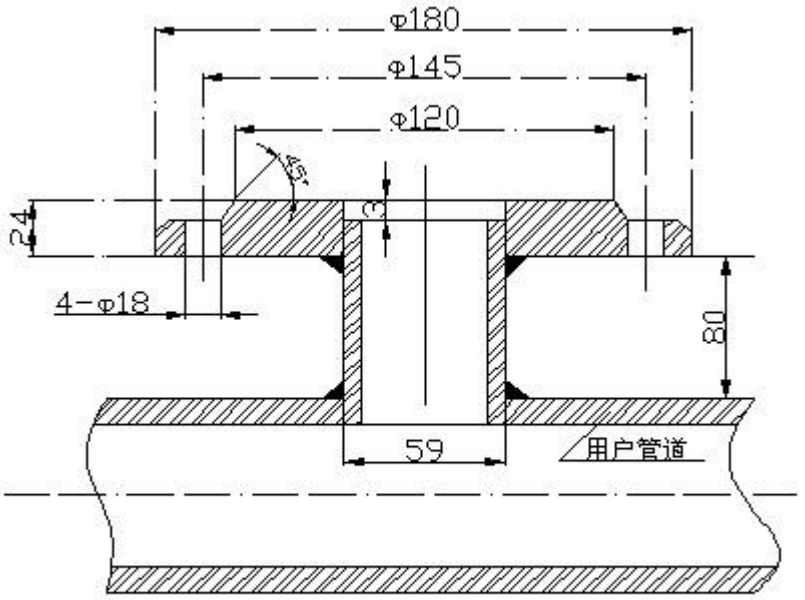


图3 安装底座的焊接

6.1.3 Length of straight pipe

The length of the straight pipe section on the upstream side of the sensor installation pipeline should be greater than or equal to 10D, and the downstream side should be no less than 5D. D is the diameter of the pipeline being tested.

6.1.4 Flow control valve and regulating valve

The flow control valve should be installed on the pipe under test on the upstream side of the sensor, and the flow control valve should be installed on the downstream side of the sensor. When measuring, usually the flow control valve should be fully open.

6.1.5 Welding of the mounting base

The welding of the installation base and the tested pipeline is shown in Figure 3. The technical requirements for welding are as follows:

① The axis of the pipe of the mounting base 63 and the axis of the pipe under test are perpendicular to each other. The included angle is

②Flat welding with stainless steel electrode. After welding, ensure that the flange end face is parallel to the pipe axis, the welding seam is firm, and it can withstand the pressure of 1.6Mpa without leakage.

③The opening size of the tested pipe is consistent with the outer diameter of the through hole of the mounting base.

6.2 Sensor installation

6.2.1 Inspection of the sensor before installation

a Before installation, use an alcohol cotton ball or a clean gauze cloth to gently wipe off the grease and dust on the surface of the sensor's measuring head. But do not damage the electrode surface and insulating materials with hard objects.

b Check the sensor with a multimeter before installation, and meet the following technical indicators:

①Excitation coil resistance check: Use a multimeter to measure the resistance between the "X and Y" terminals in the junction box, which is about 40 . If the measured resistance is infinite, the coil is open; if the resistance is zero, the coil is short-circuited.

②The resistance between the electrodes and the terminals: the terminals "A, B" in the junction box are zero for one of the two electrodes in the measuring head or measuring tube. If one is infinite or all are infinite, both are faulty.

③Insulation resistance check: the resistance between the excitation coil, signal terminal and insertion rod is infinite. The resistance of terminal C to the insertion rod is zero . Use a multimeter to measure the resistance between terminals "A, B" and "C" and "X, Y" and "C", and the resistance between the terminal pair "C" and the insertion rod is zero. The resistance between the terminals "A, B" and the terminals "X" and "Y" is infinite.

If the measurement is inconsistent with the above, please contact our factory.

6.3 Measurement of the inner diameter of the tested pipeline

6.3.1 When the inner diameter of the pipeline can be measured, a vernier caliper or steel tape can be used to measure at least four diameters in the pipeline with approximately equal angles to each other. If the difference between two adjacent diameters is greater than 0.5%, the number of purchases is doubled, and the arithmetic mean of the diameters is taken as the pipe diameter.

6.3.2 When the inner diameter of the pipe cannot be measured directly, the inner diameter can be calculated by measuring the pipe circumference and wall thickness

$$D = \frac{L - l}{\pi} - 2e \qquad ⑥$$

Where: D——inner diameter of the pipe under test, in meters; L——outer circumference of the pipe, in meters; l—perimeter correction value, in meters; e—pipe wall thickness, in meters.

Using this method, the outer surface of the pipe should be carefully removed from the rough part. If there is any high point such as the weld, the correction value of each high point calculated by the following formula should be subtracted from the measured value of the circumference:

：$L=\frac{8}{3}a(\frac{a}{D})^{1/2}$ ⑦

In the formula: a——high point height; D——pipe inner diameter.

6.4 Installation of the sensor

6.4.1 Clean up welding slag and burrs on the mounting base of the tested tube.

6.4.2 Turn off the upstream flow control valve or use low pressure water supply.

6.4.3 Install the DN50 ball valve on the mounting base as shown in Figure 3. Note that the long cavity of the ball valve faces upward. Check whether the ball valve can be fully opened and closed. If there is any problem, repair it. Install the compression threaded seat, compression nut and rubber sealing ring on the ball valve. Loosen the positioning screw and the compression nut, and insert the sensor insertion rod into the pipe under test through the ball valve. The insertion depth is calculated by 6.4.4 and measured by a vernier caliper or a steel tape measure. After meeting the requirements, tighten the compression nut and the positioning screw. At the same time, note that the direction of the sensor direction indicator rod should be consistent with the fluid flow direction.

6.4.4 Use a vernier caliper or steel tape to measure the distance between the sensor electrode and the direction indicator pole. Suppose the measured length of the sensor electrode and its direction indicator pole is H. For D≤400mm, the insertion depth can be calculated by the following formula. The insertion depth E can be calculated by the following formula:

$$E=H-0.5D$$

For D>400mm diameter,

$$E=H-0.121D$$

When you need to find out the insertion depth more accurately, the following formula can be used to calculate the pipe diameter direction and the distance Y from the inner wall to the measuring point

$$Y=(\frac{2n^2}{(n+1)(2n+1)})^2\times R$$

In the formula, R——pipe inner radius. Insertion depth,

E=H-Y

6.5 Cable laying and wiring

There are two types of cable laying: clear number and dark number. Which number setting to use depends on the specific situation of the site.

Figure 4 shows the electrical wiring diagram

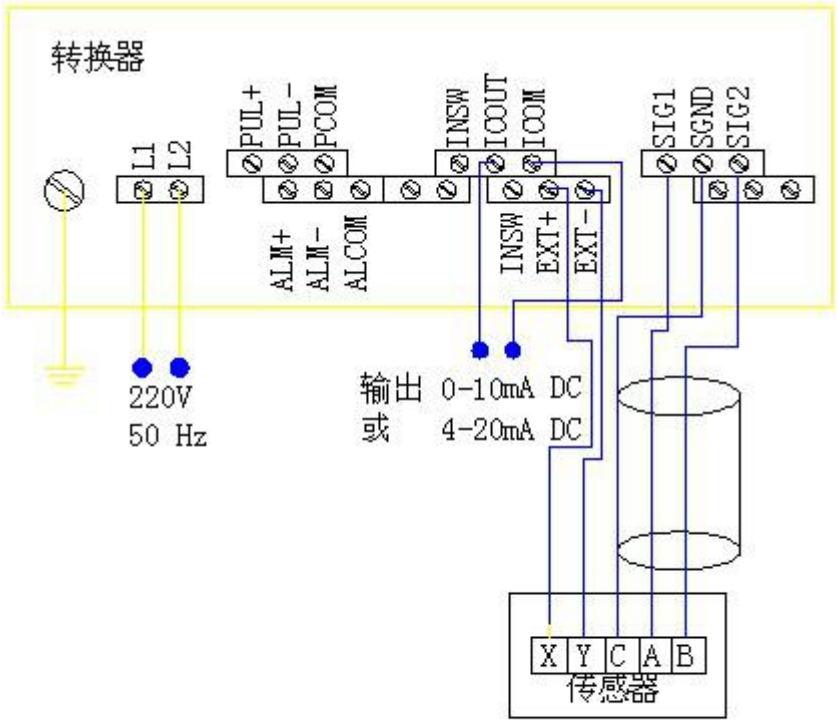


图4 接线图

between the sensor and the converter. As can be seen from the figure, there are two cables between the sensor and the converter. One is the excitation line that the converter provides excitation current to the sensor, and the other is the signal line that the sensor outputs electromotive force to the converter.
The following points must be paid attention to when laying and wiring cables:

① Signal cables should not be laid in parallel with external high-current power cables at close distances. Signal cables should generally be electrically shielded from external cables through threaded steel pipes. The threaded steel pipe should be connected to the earth wire.

② When laying in the open, there should be a distance of more than 1 meter between the signal cable and the power cable. The signal cable and the excitation cable should also keep a certain distance. When laying through steel pipes, the excitation cables should also be placed through the pipes.

③The distance between the sensor and the converter is generally 50 meters. If you need to extend the cable under special circumstances, you should contact our factory. The model of signal cable and excitation cable provided by our factory is RWP double-core polyvinyl insulated shielded sheathed cable, the specification is 2 ×32/0.2 outer diameter Φ8mm, and the length is 15 meters. For special requirements, please indicate to our factory when ordering.

④The factory is not responsible for the converter's power supply line and output current and frequency cables. Since the load current required by these two cables is only tens to hundreds of milliamps, and the transmission distance is related to the distance from the field to the control room, users can prepare the power supply and output signal cables according to actual needs.

⑤Connect the wires in a one-to-one correspondence with the converter and sensor terminal identifiers shown in Figure 4.

6.6 Grounding

The flow signal generated by the sensor is very weak, usually in the microvolt or millivolt level. Therefore, preventing the influence of external electrical interference is an important factor in the good use of flow meters. Grounding is a very effective measure to solve the influence of electrical interference.
The grounding requirement of the sensor is mainly the grounding of the measured medium. The grounding end of the sensor and the converter (terminal "C" is connected to the metal shielding net of the flow signal cable, and is connected to the measured medium through the inserting rod. When the measured pipeline is a non-metallic pipeline, in order to ensure a good grounding, you can Add a ground wire to the ground terminal of the sensor directly to the ground. The grounding resistance should be less than 10Ω

6.7 Preparation before use

①After installing the wiring, check whether the installation and wiring are correct before formal use.
②Open the upstream flow control valve of the sensor, and then open the downstream flow adjustment valve to discharge the fluid for a few minutes, and then discharge

the gas contained in the fluid. Close the downstream flow control valve and the upstream flow control valve, so that the pipe is filled with fluid but does not flow.
③Check the following technical indicators of the sensor with a multimeter:
A. The resistance between the excitation terminals "X" and "Y" and the ground terminal "C" is infinite.
The resistance between the B ground terminal "C" and the insertion rod is zero.
The C multimeter is set at the x1KΩ file. Use a black test pen to point to terminal "C" and a red pen to point to terminals "A" and "B" respectively. The resistance values are both 10~30KΩ, and there is charging and discharging.

④Check that the supplied power voltage and frequency should meet the requirements of the converter installation and operation manual, and switch on the converter power.

⑤Use the multimeter's DC voltage of 2.5V or 10V to measure the voltage between the sensor terminals "X" and "Y". The pointer of the multimeter has low frequency oscillations several times per second. It shows that the sensor excitation system is working normally.

6.8 Adjustment and use

① If the flow rate of the pipeline to be measured is known, the flow range can be set according to the flow rate in the pipeline to be measured and the range setting method of the converter installation manual.

②After the preparation work is completed, first open the upstream flow control valve of the sensor, and then slowly open the downstream flow adjustment valve, and observe that the flow rate displayed by the converter should change from small to large. If the display shows a negative value, the power supply should be turned off and the signal wires "SIG1" and "SIG2" should be interchanged.

③According to the actual measured flow, set the flow range value and the coefficient of the converter according to the needs of the converter installation manual.

④If the sensor is installed in the open air or buried in the ground, after connecting the terminal wire of the riser, it can be sealed with the attached sealer.

⑤Open the upstream flow control valve of the sensor, and then open the downstream flow control valve to discharge the fluid for a few minutes, and then discharge the gas in the fluid. Close the downstream flow control valve and the upstream flow control valve, so that the pipeline is filled with fluid but does not flow, and the instrument is zeroed according to the method described in the installation and operation manual of the converter.
⑥Open the upstream flow control valve, and then slowly open the downstream flow control valve, and it can be put into operation after meeting the requirements. Flow calculation formula

$$Q = 2827.43D^2V(m^3/h)$$

In the formula: D——pipe inner diameter, m;
V——The average flow velocity of the pipeline, m/s.

7. Maintenance, repair and common troubleshooting

7.1 Maintenance

Sensors generally do not require regular maintenance. However, if the measured medium is easy to cause the electrode and the measuring head (measuring tube) surface or inner wall to adhere and scale, it must be cleaned regularly. The cleaning cycle depends on the adhesion and scaling speed. When cleaning the electrode and the measuring head (measuring tube), be careful not to damage the insulating material and the electrode.

7.2 Repair

If the sensor is faulty, it can be determined whether the measurement system of the sensor excitation system is normal according to the inspection methods described in Article 6.7 and Article 6.2.1 of this manual. If there is a fault, you should contact the factory, and general users are not allowed to repair it by themselves. Pay attention to closing the ball valve when disassembling the sensor.

7.3 See the table for common troubleshooting.

Failure phenomenon	cause	elimination method
Converter flow is negative	1. The sensor direction indicator rod is opposite to the fluid flow direction 2. X and Y or A and B in the sensor junction box are reversed	1. Rotate sensor direction 180° 2. Rewiring the converter
Converter output over range	1. The flowmeter range value is less than the actual measured value 2. Pipe is not filled with fluid 3. Excitation coil open	1. Expand flowmeter range 2. Close the small flow regulating valve 3. Rewire
The output signal fluctuates too much	1. There is gas at the sensor electrode, causing poor contact between the electrode and the medium 2. Deposits on the electrodes	1. Exhaust gas in the pipeline 2. Cleaning electrode
The output signal gradually drifts to zero	1. Sensor water 2. Electrodes are covered	1. Replace sensor 2. Cleaning electrode

8 Unpacking and product complete set

When unpacking the box, please check the model of the sensor according to the packing list, and check whether the sensor is defective or damaged. The complete set of the sensor includes:

1. HLDC plug-in electromagnetic flow sensor 1set
2. HLDC electromagnetic flowmeter converter 1set
3. Signal cable RVVP type double core PVC insulated shield 2× 15m
4. The ball valve Q41-16 ((PN1, 6 ma) 1 piece
5. The installed base 1 piece
6. Random file

HLDC type insert electromagnetic flow installation instructions	1piece
Product certificate	1piece
Product inspection sheet	1piece
Product packing list	1piece

9 Ordering instructions

9.1 When ordering, please specify the name of the measured medium, working pressure, medium temperature, flow (velocity) range, pipe diameter and the condition of the measured pipe network, etc.

9.2 If a longer cable is required at the installation site, please specify in the order.

10 Both the supply and demand parties shall be responsible during the warranty period

1. When storing in a warehouse, it should be placed in a dry, ventilated, non-corrosive place, with an ambient temperature in the range of 0-40℃ and a relative humidity of less than 85%.

2. The factory implements three guarantees for the products, and the warranty period is one year (calculated from the date of delivery). During the warranty period, under the condition that the user abides by the product use, storage and transportation regulations, if the product has quality problems, the factory is responsible for free repair or replacement.