FXTF Series Turbine Flow Meter

(For liquids)

Content

1.Overview

Turbine flow meter (hereinafter referred to as FXTF) are the main varieties of impeller-type flow (velocity) meters, and impeller-type flow meters include anemometers, water meters, etc. FXTF is composed of a sensor and a conversion display. The sensor uses a multi-blade rotor to sense the average flow rate of the fluid, thereby deriving the flow rate or total amount. The rotation speed (or number of revolutions) of the rotor can be detected by mechanical, magnetic induction, and photoelectric methods, and displayed and recorded by the readout device. It is said that the United States issued the first FXTF patent as early as 1886, and the patent in 1914 believes that the flow of FXTF is related to frequency. The first FXTF in the United States was developed in 1938. It was used to measure the flow of fuel on airplanes. It was only after World War II that a high-precision and fast-response flow meter was urgently needed for jet engines and liquid jet fuel. Industrial applications. Today, it has been widely used in various departments of petroleum, chemical industry, scientific research, national defense, and measurement.

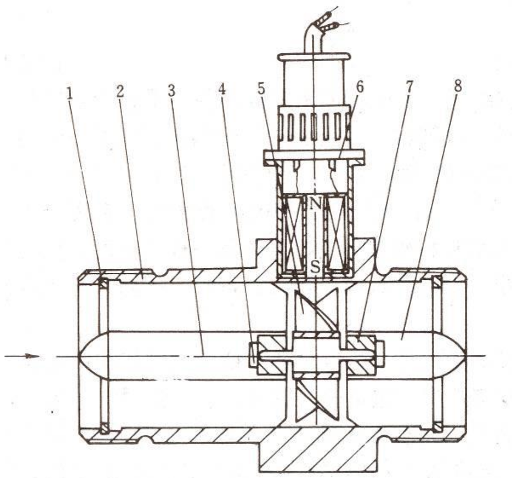
Among the flow meters, FXTF, positive displacement flow meters and Coriolis mass flow meters are the three types of products with the best repeatability and accuracy. FXTF has its own characteristics, such as simple structure, few processing parts, light weight, and convenient maintenance. , Large flow capacity and adaptability to high parameters, etc., are difficult to achieve with the other two types of flow meters.

The FXTF series turbine flow meter is a new generation of turbine flow meter with the advantages of simple structure, light weight, high precision, good reproducibility, sensitive response, convenient installation, maintenance and use. It is widely used. It is not corrosive to stainless steel 1Cr18Ni9Ti, 2Cr13, corundum Al2O3, cemented carbide in the measurement of closed pipelines, and no impurities such as fibers, particles, and liquids with a kinematic viscosity less than 5×10-6m2/s at working temperature. For liquids with a kinematic viscosity greater than The liquid of 5×10-6m2/s can be used after the flow meter is calibrated in real liquid. If matched with a display instrument with special functions, it can also carry out quantitative control, over-quantity alarm, etc. It is an ideal instrument for flow measurement and energy saving.

2.Working Principle

Figure 1 shows a schematic diagram of the turbine flow sensor structure. It can be seen from the figure that when the measured fluid flows through the sensor, the impeller rotates under the action of the fluid, and its speed is proportional to the average flow velocity of the pipeline, and the rotation of the impeller changes periodically The magnetic resistance value of the magnetoelectric converter. The magnetic flux in the detection coil changes periodically to produce a periodic induced electric potential, that is, an electric pulse signal, which is amplified by an amplifier and sent to the display instrument for display.

Figure 1



The flow equation of turbine flow meter can be divided into two types: practical flow equation and theoretical flow equation.

(1) Practical flow equation

$$q_v=f/K$$

$$q_m=q_v\rho$$

qv, qm ……respectively volume flow, m3/s, mass flow, kg/s;

f ……The frequency of the output signal of the flow meter, Hz;

K ……The meter coefficient of the flow meter, P/m3.

The relationship curve between the coefficient of the flow meter and the flow rate (or the Reynolds number of the pipeline) is shown in Figure 2. It can be seen from the figure that the meter coefficient can be divided into two sections, namely the linear section and the non-linear section. The linear section is about two-thirds of its working section, and its characteristics are related to the sensor structure size and fluid viscosity. In the non-linear section, the characteristics are greatly affected by bearing friction and fluid viscous resistance. When the flow rate is lower than the lower limit of the sensor flow rate, the meter coefficient changes rapidly with the flow rate. The relationship between pressure loss and flow is approximately square. When the flow exceeds the upper limit of the flow, attention should be paid to prevent cavitation. The shape of the FXTF characteristic curve with similar structure is similar, and it differs only in the level of systematic error.

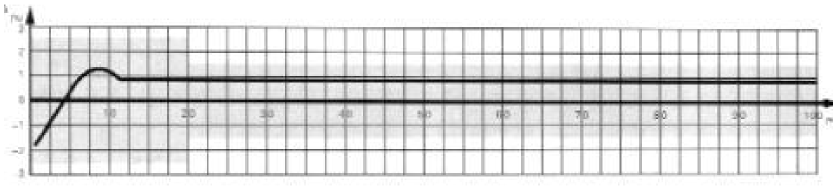


Figure 2

The meter coefficient of the sensor is verified by the flow calibration device. It does not ask the internal fluid mechanism of the sensor at all. It takes the sensor as a black box and determines its conversion coefficient according to the input (flow) and output (frequency pulse signal), which is convenient for practical applications. . However, it should be noted that this conversion coefficient (meter coefficient) is conditional, and its calibration condition is the reference condition. If it deviates from this condition, the coefficient will change during use. The change depends on the sensor type, pipeline installation conditions and fluid physical parameters. Circumstance.

(2) Theoretical flow equation

According to the theorem of moment of momentum, the equation of motion of the impeller can be listed.

$$J\frac{dw}{dt} = M_1 - M_2 - M_3 - M_4$$

J: Moment of inertia of the impeller;

dw/dt: Rotational acceleration of impeller;

M_1: The driving force of the fluid is rejected;

M_2: Viscous resistance moment;

M_3: Bearing friction resistance moment;

M_4: Magnetic drag torque。

When the impeller rotates at a constant speed, $J\frac{dw}{dt} = 0$, so $M_1 = M_2 + M_3 + M_4$. It can be obtained by theoretical analysis and experimental verification

$$n = Aqv + B - \frac{C}{qv}$$

n: Impeller speed;

qv: Volume flow;

A : Coefficients related to fluid physical properties (density, viscosity, etc.), impeller structure parameters (blade angle, impeller diameter, flow channel cross-sectional area, etc.);

B: Coefficient related to blade head clearance and fluid velocity distribution;

C: Coefficient related to friction torque.

Scholars at home and abroad have proposed many theoretical flow equations, which are suitable for various sensor structures and fluid working conditions. So far, the hydrodynamic characteristics of turbine instrument characteristics are still not very clear, and it has a complicated relationship with fluid physical properties and flow characteristics. For example, when the flow field has vortices and asymmetric velocity distribution, the hydrodynamic characteristics are very complicated. The instrument coefficient cannot be derived theoretically, and the instrument coefficient still needs to be determined by the actual flow calibration. However, the theoretical flow equation has great practical significance. It can be used to guide the design of sensor structure parameters and the prediction and estimation of the change law of the instrument coefficient when the field conditions change.

3.Product Features

1. 1. High accuracy, generally up to ±1%R, ±0.5%R, high-precision type up to ±0.2%R;
2. 2. Good repeatability, short-term repeatability can reach 0.05%~0.2%. Because of its good repeatability, such as frequent calibration or online calibration can obtain extremely high accuracy, it is the preferred flowmeter in trade settlement. ；
3. 3. Output pulse frequency signal, suitable for total measurement and connection with computer, no zero drift, strong anti-interference ability;
4. 4. High frequency signals (3~4kHz) can be obtained, and the signal resolution is strong;
5. 5. Wide range, medium and large diameters can reach 1:20, and small diameters are 1:10;
6. 6. Compact and lightweight structure, convenient installation and maintenance, and large circulation capacity;
7. 7. It is suitable for high-pressure measurement, and there is no need to open holes on the meter body, and it is easy to make a high-pressure meter;
8. 8. There are many types of special sensors, which can be designed as various special sensors according to the special needs of users, such as low temperature type, two-way type, downhole type, special type for sand mixing, etc.;
9. Can be made into a plug-in type, suitable for large-caliber measurement, low pressure loss, low price, can be taken out continuously, easy to install and maintain.

4.Parameters

1.Technical performance

Table 1

Diameter & Connection	4、6、10、15、20、25、32、40 - Thread 15、20、25、32、40）50、65、80、100、125、150、200 - Flange
Accuracy	±1%R、±0.5%R、±0.2%R
Diameter-Flow Ratio	1:10；1:15；1:20
Body Material	SS304, SS316, etc
Medium Temperature	-20～＋120℃
Ambient Environment	T: －10～+55℃，H: 5％～90％，P: 86～106Kpa
Output Signal	Sensor：Pulse，low level≤0.8V high level≥8V Converter：2 wire 4 ~ 20mA DC current signal
Power Supply	Sensor：+12VDC 、+24VDC） Converter：+24VDC Local Display can choose 3.2V Li Battery
Signal Cable	STVPV3×0.3 (3 wire), 2×0.3 (2 wire)
Signal Transport	≤1000m

Distance	
Signal Cable Connection	Standard：Hausmann.　　Explosion：M20×1.5 Female Thread
Explosion Class	Standard：None.　　Explosion：ExdIIBT6
Enclosure	IP65

2.Measuring Range & Working Pressure

Table 2

Diameter（mm）	Flow Range（m^3/h）	Extend Flow Range（m^3/h）	Working Pressure（MPa）	High Pressure Type（MPa）（Flange）
DN 4	0.04～0.25	0.04～0.4	6.3	12、16、25
DN 6	0.1～0.6	0.06～0.6	6.3	12、16、25
DN 10	0.2～1.2	0.15～1.5	6.3	12、16、25
DN 15	0.6～6	0.4～8	6.3、2.5（flange）	4.0、6.3、12、16、25
DN 20	0.8～8	0.45～9	6.3、2.5（flange）	4.0、6.3、12、16、25
DN 25	1～10	0.5～10	6.3、2.5（flange）	4.0、6.3、12、16、25
DN 32	1.5～15	0.8～15	6.3、2.5（flange）	4.0、6.3、12、16、25
DN 40	2～20	1～20	6.3、2.5（flange）	4.0、6.3、12、16、25
DN 50	4～40	2～40	2.5	4.0、6.3、12、16、25
DN 65	7～70	4～70	2.5	4.0、6.3、12、16、25
DN 80	10～100	5～100	2.5	4.0、6.3、12、16、25
DN 100	20～200	10～200	2.5	4.0、6.3、12、16、25
DN 125	25～250	13～250	1.6	2.5、4.0、6.3、12、16
DN 150	30～300	15～300	1.6	2.5、4.0、6.3、12、16
DN 200	80～800	40～800	1.6	2.5、4.0、6.3、12、16

5.Flow Meter Classification

1．According to the classification of instrument function, FXTF series turbine flowmeter can be divided into two categories：

- Turbine flow sensor / transmitter
- Turbine flow meter

2．Function

- Turbine flow sensor / transmitter

This type of turbine flow product itself does not have the on-site display function, and only transmits the flow signal remotely. The flow signal can be divided into pulse signal or current signal (4-20mA); the meter is low in price, high in integration, small in size, especially suitable for use with secondary display, PLC, DCS and other computer control systems.

According to different output signals, this kind of products can be divided into FXTF-N type and

FXTF-A type.

FXTF-N type sensor: 12～24VDC power supply, three-wire pulse output, high level ≥ 8V, low level ≤ 0.8V; signal transmission distance ≤ 1000 meters;

FXTF-A transmitter: 24VDC power supply, two-wire 4-20mA output, signal transmission distance ≤1000.

This kind of turbine flow products are divided into two types: basic type and explosion-proof type (ExdIIBT6). The appearance is shown in the figure.

Figure 3

Turbine flow sensor / transmitter

Figure 4

Explosion type

- Turbine flow meter

A new type of intelligent instrument that integrates turbine flow sensor and display integration developed with advanced ultra-low power single-chip microcomputer technology, adopts double-row LCD on-site display, has compact structure, intuitive and clear reading, high reliability, and is not affected by external power Obvious advantages such as interference, lightning resistance, and low cost. The instrument has a three-point correction of the instrument coefficient, intelligent compensation of the nonlinearity of the instrument coefficient, and can be corrected on-site. The high-definition liquid crystal display simultaneously displays the instantaneous flow (4 significant digits) and cumulative flow (8 significant digits, with a clear function). All valid data will not be lost for 10 years after power failure. This type of turbine flow meter are all explosion-proof products, with an explosion-proof grade: ExdIIBT6.

This type of turbine flow meter can be divided into FXTF-B type and FXTF-C type according to the power supply mode and whether it has remote signal output.

FXTF-B type: Power supply adopts 3.2V10AH lithium battery (can run continuously for more than 4 years); no signal output function.

FXTF-C type: The power supply adopts 24VDC external power supply, and outputs 4-20mA standard two-wire current signal. According to different site needs, RS485 or HART communication can be added.

Figure 5

Turbine flow meter

6.Code Table

Table 3

Code								**Description**
FXTF–	□	/□	/□	/□	/□	/□	/□	
Diameter	4							4mm，flow range 0.04～0.25m³/h，wide range 0.04～0.4m³/h
	6							6mm，flow range 0.1～0.6m³/h，wide range 0.06～0.6m³/h
	10							10mm，flow range 0.2～1.2m³/h，wide range 0.15～1.5m³/h
	15							15mm，flow range 0.6～6m³/h, wide range 为 0.4～8m³/h
	20							20mm，flow range 0.8～8m³/h，wide range 0.4～8m³/h
	25							25mm，flow range 1～10m³/h，wide range 0.5～10m³/h
	32							32mm，flow range 1.5～15m³/h，wide range 0.8～15m³/h
	40							40mm，flow range 2～20m³/h，wide range 1～20m³/h
	50							50mm，flow range 4～40m³/h，wide range 2～40m³/h
	65							65mm，flow range 7～70m³/h，wide range 4～70m³/h
	80							80mm，flow range 10～100m³/h，wide range 5～100m³/h
	100							100mm，flow range 20～200m³/h，wide range 10～200m³/h
	125							125mm，flow range 25～250m³/h，wide range 13～250m³/h
	150							150mm，flow range 30～300m³/h，wide range 15～300m³/h
	200							200mm，flow range 80～800m³/h，wide range 40～800m³/h
Converter		N						No display, +12V power, pulse
		A						Remote display, 2 wire 4～20mA
		B						Local display, battery powered
		C						Local display,2 wire 4～20mA
		C1						Local display, RS485

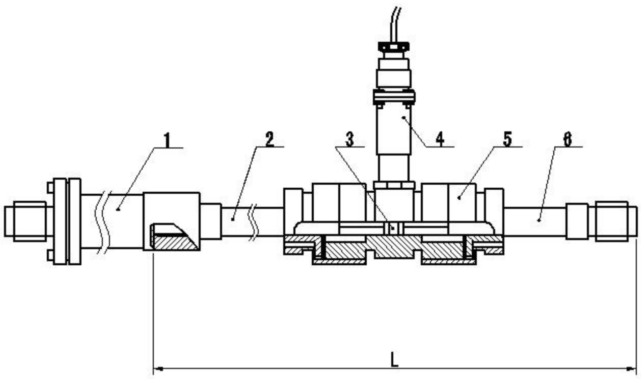
	C2	Local display, HAR
Accuracy	05	Accuracy 0.5%
	10	Accuracy 1.0%
Flow Range	W	Wide Range
	S	Standard Range
Material	S	SS304
	L	SS316(L)
Explosion Proof	N	No Explosion Proof
	E	Explosion Proof Type （ExmIICT6 or ExdIIBT6）
Pressure Grade	N	Normal （See table 2）
	H(*x*)	High Pressure （See table 2）

DN15～DN40 is thread connection, if use flange connection please add (FL) behind Diameter.

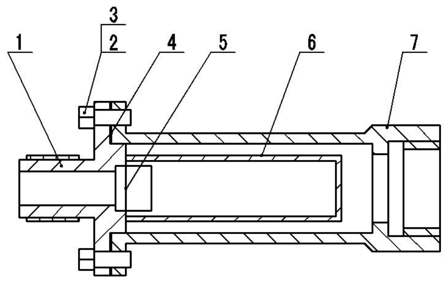
For example: FXTF-40(FL)/C/05/S/S/E/H16

7.Dimension

The installation method of the sensor is based on different specifications, using thread or flange connection, the installation method is shown in Figure 6, Figure 7, Figure 8, and the installation dimensions are shown in Table 4.



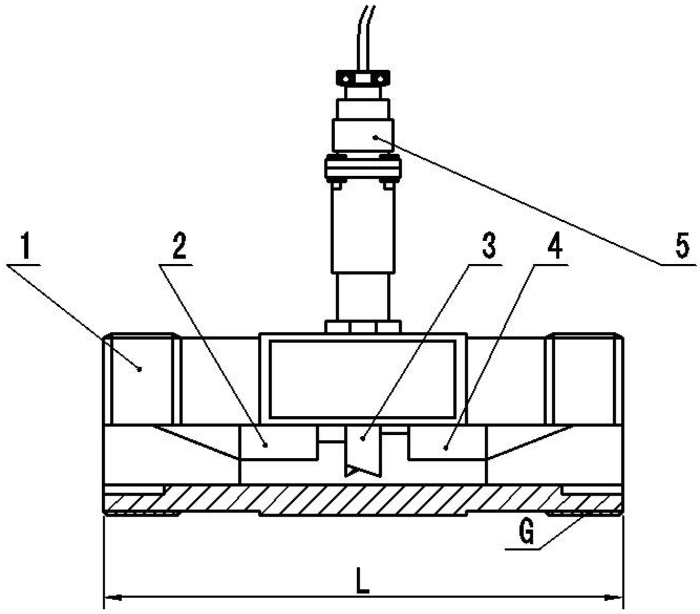
Sensor Dimension



Strainer Dimension

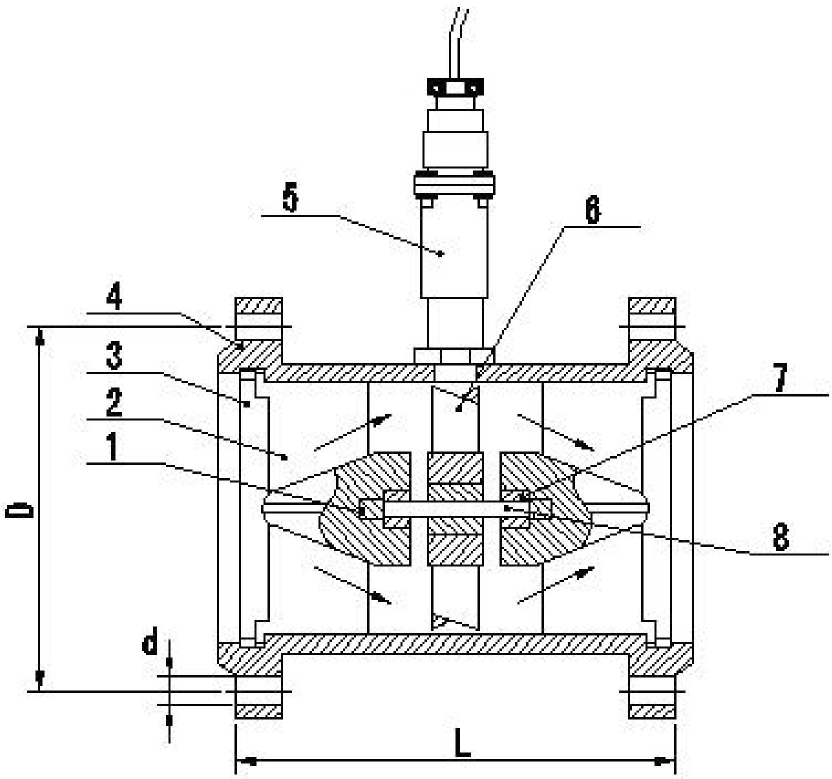
1.Strainer 2.Pipe 3.Impeller 4.Amplifier 5.Housing 6.Pipe

Figure 6 FXTF-4～10 Sensor Dimension



1. Housing 2. Guide Element 3. Impeller 4. Guide Element 5. Amplifier

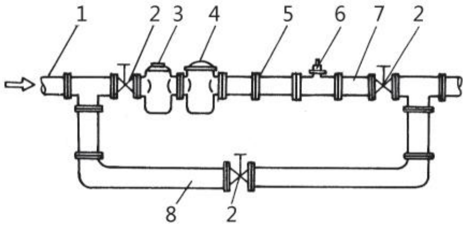
FIgure 7 FXTF-15～40 Sensor Dimension



1. Ball Bearing 2. Guide Element 3. Rising Ring 4. Housing
5. Amplifier 6. Impeller 7. Bearing 8. Axis

Figure 8 FXTF-50～200 Sensor Dimension

Figure 9



1-Entry 2-Valve 3-Strainer 4-Getter
5-Straight Pipe 6-Sensor 7-Straight Pipe 8-Bypass Pipe

Table 4

Diameter（mm）	L(mm)	G	D(mm)	d(mm)	Holes
4	295	G1/2			
6	330	G1/2			
10	450	G1/2			
15	75	G1	Φ65	Φ14	4
20	80	G1	Φ75	Φ14	4
25	100	G5/4	Φ85	Φ14	4
32	140	G2	Φ100	Φ14	4
40	140	G2	Φ110	Φ18	4
50	150		Φ125	Φ18	4
65	170		Φ145	Φ18	4
80	200		Φ160	Φ18	8
100	220		Φ180	Φ18	8
125	250		Φ210	Φ25	8
150	300		Φ250	Φ25	8
200	360		Φ295	Φ23	12

8.Installation Notice

（1）Installation place

The sensor shall be installed in a place convenient for maintenance, and the pipeline shall be free of vibration, strong electromagnetic interference and thermal radiation. A typical installation piping system for a turbine flow meter is shown in Figure 9. The configuration of each part of the figure can be determined by the situation of the object under test, and not all of them are required. Turbine flow meter is sensitive to the distortion of flow velocity distribution and rotating flow in the pipeline. The flow into the sensor shall be fully developed. Therefore, necessary straight pipe section or flow regulator shall be provided according to the type of choke on the upstream side of the sensor, as shown in Table 5. If the upstream side flow blocking parts are not clear, it is generally recommended that the length of the upstream straight pipe section is not less than 20d and the length of the downstream straight pipe section is not less than 5D. If the installation space cannot meet the above requirements, a flow regulator can be installed between the choke and the sensor. When the sensor is installed outdoors, measures shall be taken to avoid direct sunlight and rain。

表 5

Item	Single 90 ° Elbow	Two 90° elbows in same plane	Two 90° elbows in different plane	Concentric reducer	Fully open the valve	Half open valve	Downstream
l/DN	20	25	40	15	20	50	5

（2）Installation requirements for connecting pipes

Sensors installed horizontally require that the pipeline should not have a visually perceptible inclination (usually within 5°), and the vertical deviation of the pipeline of the sensor installed vertically should also be less than 5°.

Where continuous operation is required and the flow cannot be stopped, a bypass pipe and a reliable shut-off valve should be installed (see Figure 9), and no leakage of the bypass pipe should be ensured during measurement.

Insert a short pipe to replace the sensor at the position where the sensor is installed in the newly laid pipeline, and then formally connect the sensor after the "line sweeping" work is completed to confirm that the pipeline is cleaned. Due to neglect of this work, it is not uncommon for sensors to be damaged by wire sweeping.

If the fluid contains impurities, a filter should be installed on the upstream side of the sensor. For those that cannot stop the flow, two sets of filters should be installed in parallel to remove impurities in turn, or an automatic cleaning filter should be used. If the measured liquid contains gas, a getter should be installed on the upstream side of the sensor. The drain outlet and air outlet of the filter and getter should lead to a safe place.

If the sensor installation position is at the low point of the pipeline, in order to prevent impurities in the fluid from depositing and stagnating, a discharge valve should be installed in the subsequent pipeline to regularly discharge the precipitated impurities.

If the measured fluid is a liquid that is easy to vaporize, in order to prevent the occurrence of cavitation, which affects the measurement accuracy and service life, the pressure at the outlet of the sensor should be higher than the minimum pressure pmin calculated by formula 5 $p_{min}=2\triangle p+1.25p_v$ **Pa**

p_{min}——Min Pressure Pa；

$\triangle p$——The pressure loss at the maximum flow rate of the sensor, Pa；

p_v——Saturated vapor pressure of tested liquid at the highest use temperature, Pa.

The flow regulating valve should be installed downstream of the sensor, and the shut-off valve on the upstream side should be fully opened during measurement, and none of these valves should vibrate or leak outward. For processes that may produce reverse flow, check valves should be added to prevent reverse flow of fluid.

The sensor should be concentric with the pipeline, and the sealing gasket should not protrude into the pipeline. The liquid sensor should not be installed at the highest point of the horizontal pipeline, so as to prevent the gas accumulated in the pipeline (such as air mixed in when the flow is stopped) staying at the sensor, and it is not easy to discharge and image measurement.

The pipes before and after the sensor should be firmly supported without vibration. For fluids that are easy to condense, heat preservation measures should be taken for the sensor and its front and rear pipeline.

9.Wiring

- Turbine flow sensor/transmitter (FXTF-N type, FXTF-A type)
  1. Standard

First loosen the screws on the upper part of the Hausmann connector and unplug the connector part. The structure of the connector part is shown in Figure 10a. Pry the terminal block from the gap. The terminal block is shown in Figure 10b.

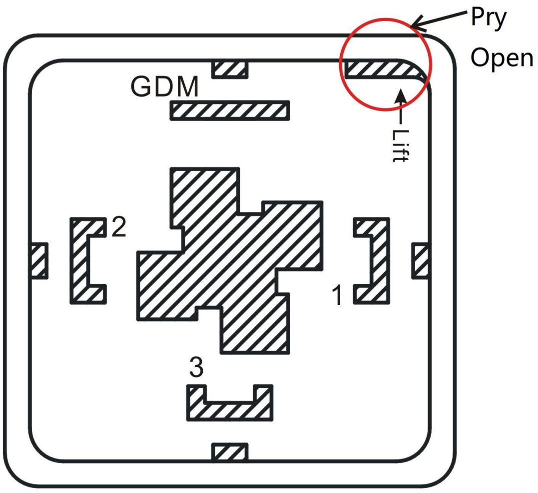


Figure 10a

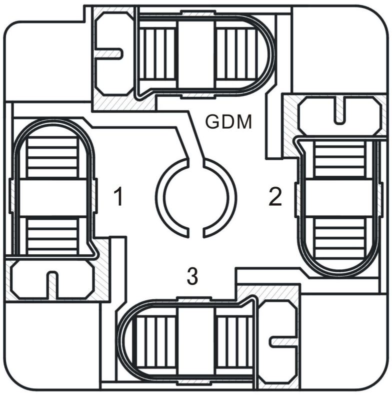


Figure 10b

FXTF-N type turbine flow sensor wiring method：

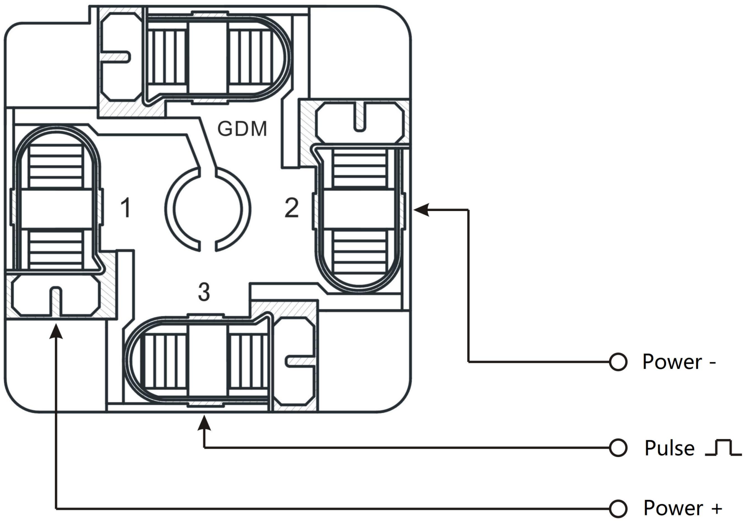


Figure11

Before leaving the factory, all the instruments have been wired and equipped with 5m lead wires, which can be used directly by customers. Please refer to the wiring prompt label at the end of the shielded wire of the actual product for the wiring method of the lead.

FXTF-A type turbine flow transmitter wiring method:

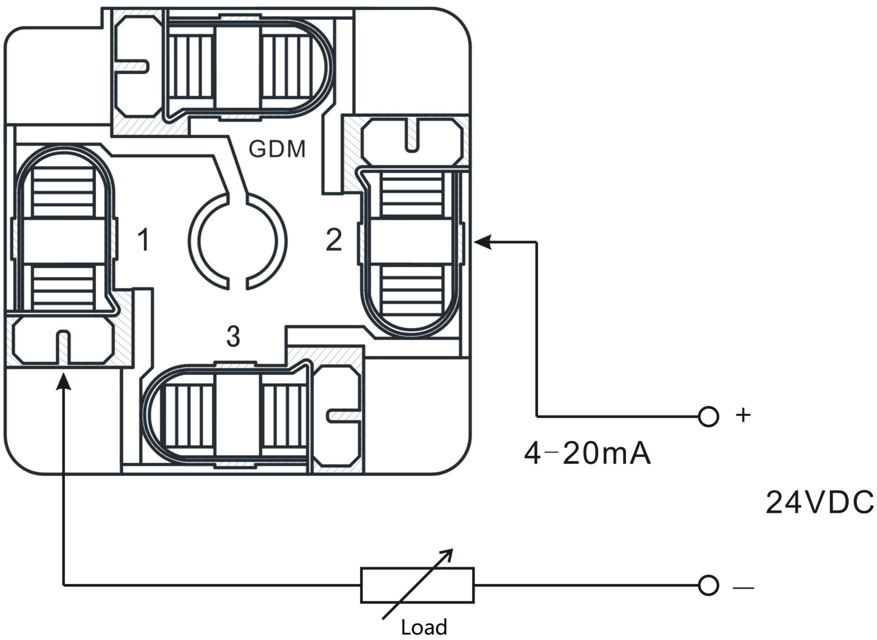


Figure 12

2.Explosion Type

FXTF-N type turbine flow sensor wiring method:

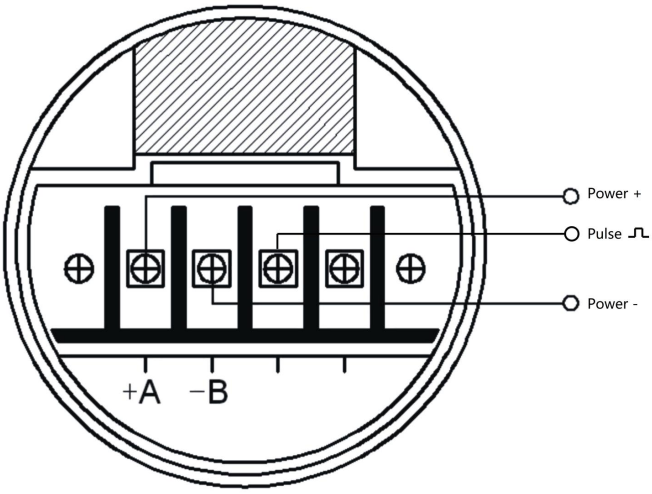


Figure 13

FXTF-A type turbine flow transmitter wiring method：

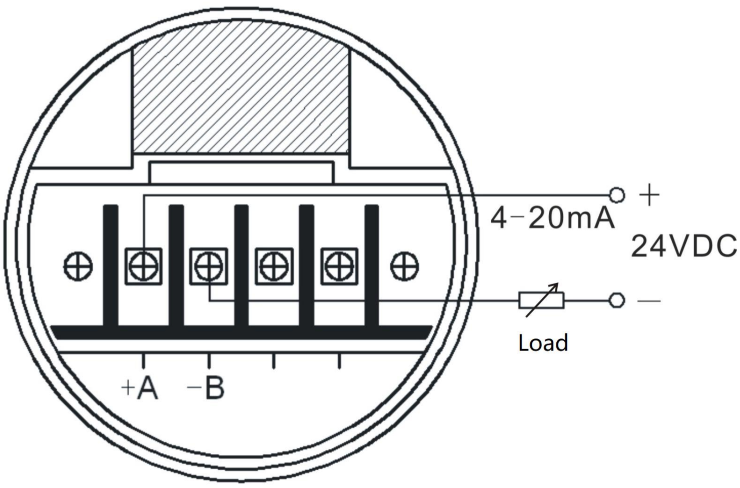


Figure 14

- Intelligent integrated turbine flowmeter（FXTF-C 型）

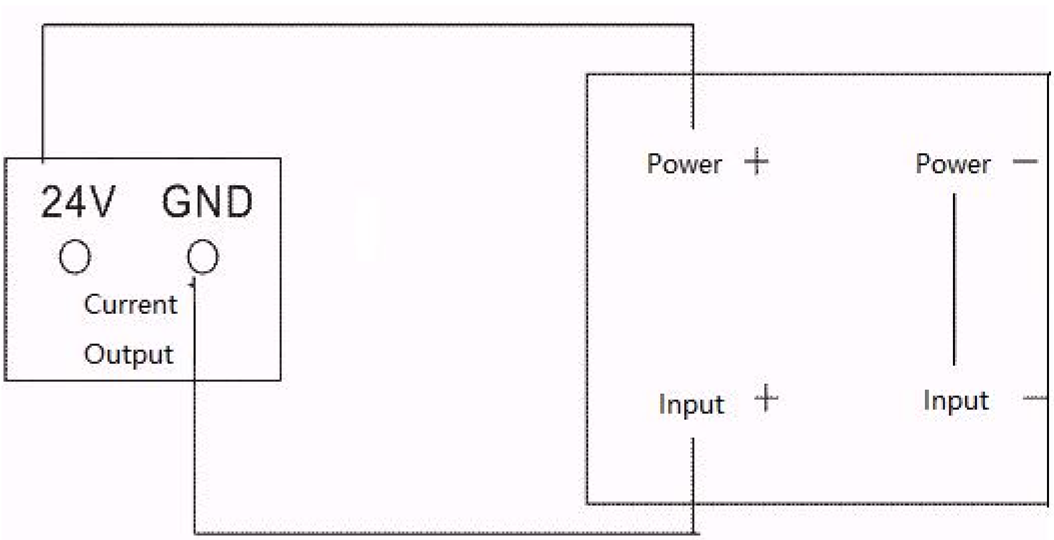


Figure 15

10.Testing & Using

FXTF-N Basic Turbine Flow Sensor

Standard turbine flow sensor has been calibrated and adjusted before leaving factory, no need to debug.

The sensor is connected with the secondary display instrument: first check whether the output characteristics of the sensor (frequency range, amplitude, pulse width, etc. of the output pulse) match the input characteristics of the display instrument. The parameter setting of the display instrument is set according to the instrument coefficient of the sensor. Check the sensor power supply and wiring system, and impedance matching. The preamplifier of the sensor should also be considered to prevent electromagnetic interference, such as rain and other measures should be taken outdoors.

The transmission cable usually uses a two-core or three-core communication cable with shielding and protective sleeve, and the effective cross-sectional area is 1.25~2mm2 multi-strand copper wire. The shielded wire can only be grounded at one end, preferably at the display meter end. Use a complete cable as much as possible (that is, no connection in the middle). It is best to put the cable in a metal tube to avoid mechanical damage. If the metal tube is installed in another cable at the same time, the maximum power of the cable cannot be greater than 10 times the minimum power of the flow signal cable of this meter.

The path of the transmission cable should not be parallel to the power supply line, nor should it be laid in the area where the power supply line is concentrated to avoid electromagnetic field interference.

FXTF-A Turbine Flow Transmitter

According to the customer's order requirements, the flow output zero point and full scale value of the A-type turbine flow transmitter have been debugged before leaving the factory.

After the flow meter is running, if the zero point output of the flow meter needs to be adjusted on site, proceed as follows:

Close the valve of the flow meter pipeline to confirm that there is no flow in the pipeline; turn on the power of the flow meter; connect the ammeter (the DC current file of the multimeter) in series to monitor the output current of the flow meter; fine-tune the W502 potentiometer on the converter circuit board to make the output The current returns to 4mA.

After the flow meter is running, the full-scale output value of the flow meter cannot be adjusted on site; if you need to adjust, please return the flow meter to the factory, and the manufacturer will complete it on the standard flow device according to your requirements.。

FXTF-B Intelligent Field Display Turbine Flow Meter

- Instrument built-in parameter setting: (only authorized engineer to operate)

01. Instrument panel key operation instructions

- Enter (exit) parameter setting menu: Press ▶ and **F** at the same time in working state
- Shift the cursor to the right：Press ▶ in parameter setting state
- Cursor position value plus 1：Press ▲ in parameter setting state
- Parameter menu switch：Press **F** in parameter setting state
- Accumulated flow is cleared：Press **F** and ▲ at working state

02. Parameter Description

The instrument program has three menus, which are displayed on three screens, all of which are three-point coefficient correction within the measuring range of the instrument. The upper row is the flow point frequency value, and the lower row is the flow point meter coefficient. The three menus can be cycled through the F key.

The display modes and functions of each menu are shown in Figure 16

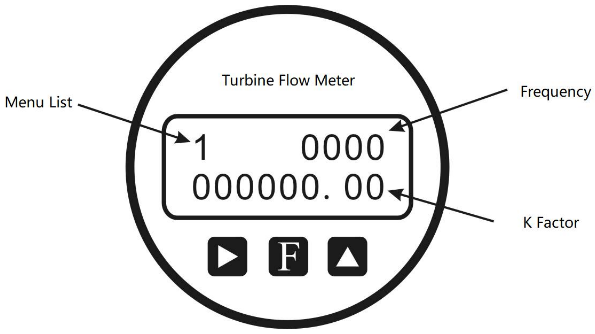


Figure 16

FXTF-C type intelligent field display turbine flow meter with 4-20mA output

01. Instrument panel key operation instructions

Same as battery-powered field display type turbine flow meter.

02. Parameter Description

The instrument program has four menus, which are displayed on four screens. The first three menus are for three-point coefficient correction within the measurement range of the instrument, which is exactly the same as the battery-powered field display turbine flow meter; the fourth menu is the 4-20mA output full-scale value. (That is, the flow point corresponding to 20mA). The four menus can be cycled through the **F** key.

The display methods and functions of menus 1 to 3 are the same as those of the battery-powered field display turbine flow meter. The display methods and functions of the fourth menu are shown in Figure 17

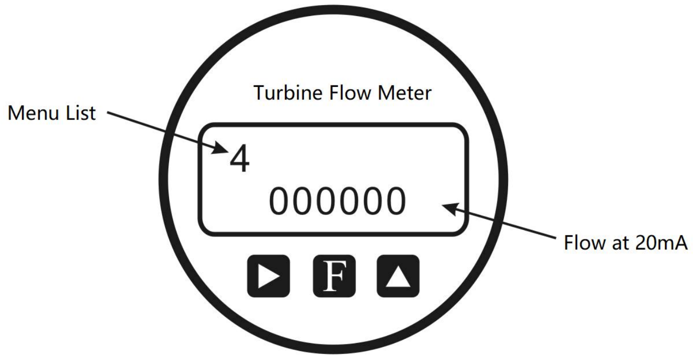


Figure 17

11.Precautions for use

（1）Opening and closing sequence of putting into operation

For flow sensors without a bypass pipe, first open the upstream valve of the flow sensor with a medium opening, and then slowly open the downstream valve. Run for a period of time (such as 10 minutes) at a small flow rate, and then fully open the upstream valve, and then open the downstream valve opening to adjust to the required normal flow.

For a flow sensor equipped with a bypass pipe, first fully open the bypass pipe valve, open the upstream valve with a medium opening, slowly open the downstream valve, and close the bypass valve opening to make the meter run at a small flow for a period of time. Then fully open the upstream valve, fully close the bypass valve (to ensure that there is no leakage), and finally adjust the downstream valve opening to the required flow rate.

（2）Activation of low temperature and high temperature fluids

The low-temperature fluid pipeline should be drained of water before the flow, and run at a small flow for 15 minutes when the flow is passed, and then gradually increase to the normal flow. When the flow is stopped, it should be carried out slowly, so that the pipe temperature and the ambient temperature gradually approach. High temperature fluid operation is similar to this.

（3）Other matters needing attention

The opening and closing valve should be as smooth as possible. If automatic control opening and closing is adopted, it is best to use the "two-stage opening and two-stage closing" method to prevent the fluid from suddenly impacting the impeller or even water hammer damage to the impeller.

Check the pressure downstream of the flow sensor. When the pipeline pressure is not high, observe whether the downstream pressure of the sensor at the maximum flow rate is greater than the pmin calculated by formula 5 at the initial stage of operation, otherwise measures should be taken to prevent cavitation.

The meter coefficient of the flow sensor is verified by the standard device and is provided to the user to write on the verification sheet, so beware of loss. For long-term use of the sensor, due to bearing wear and other reasons, the meter coefficients will change, and offline or online calibration should be performed regularly. If the flow exceeds the allowable range, the sensor should be replaced.

Some measurement objects, such as when the oil product pipeline is changed or out of service, need to be cleaned regularly. The flow direction, flow rate, pressure and temperature of the fluid used for line sweeping and pigging should all meet the requirements of turbine flow meters, otherwise the accuracy will be reduced or even damaged.

In order to ensure the long-term normal operation of the flow meter, it is necessary to strengthen the operation inspection of the instrument, and take measures to eliminate the abnormality in time. Monitor the rotation of the impeller. If you hear an abnormal sound, use an oscilloscope to monitor the output waveform of the detection coil. If there is an abnormal waveform, you should remove the internal parts of the sensor in time. If any abnormality is suspected, it should be checked in time. Keep the filter unblocked. The filter can be judged from the pressure difference between the inlet and outlet pressure gauges to determine whether it is clogged. The gas escaping from the liquid in the getter should be discharged regularly, etc.

12.Debugging

Table 6

Description	Reason	Repairing
There is no display when the fluid is flowing normally, and the number of words in the total counter does not increase	1) Check the power cord, fuse, function selection switch and signal line for open circuit or poor contact 2) Check the internal printing plate and contact parts of the display for bad contact 3) Check the detection coil 4) Check the internal faults of the sensor. The above 1)~3) checks are confirmed to be normal or the fault has been eliminated, but there is still a fault phenomenon, indicating that the fault is inside the sensor flow channel. You can check whether the impeller touches the inner wall of the sensor and whether there are foreign objects stuck , Whether the shaft and bearing are stuck or broken	1) Use an ohmmeter to troubleshoot the point of failure 2) The printing board failure inspection can be used to replace the "spare version" method, replace the failed board and then perform a detailed inspection 3) Mark the position of the detection coil on the surface of the sensor, unscrew the detection head, and use an iron piece to move quickly under the detection head. If the number of counter words does not increase, check whether the coil is disconnected and solder joints are disconnected. 4) Remove foreign matter, and clean or replace damaged parts. After recovery, blow the impeller by hand or turn the impeller, there should be no friction, and re-calibrate after replacing the bearing and other parts to obtain a new meter coefficient.
No operation to reduce the flow rate, but the flow rate display is gradually decreasing	Check in the following order: 1) Whether the filter is clogged, if the pressure difference of the filter increases, it means that the sundries have been clogged 2) The valve core of the valve on the flow sensor pipe section is loose, and the valve opening is automatically reduced 3) The sensor impeller is hindered by debris or the bearing clearance enters the foreign matter, the resistance increases and the	1) Clear the filter 2) Judge whether the valve handwheel is adjusted effectively, and then repair or replace it after confirmation 3) Remove the sensor to clear it, and recalibrate if necessary

	deceleration slows down	
The fluid does not flow, the flow display is not zero, or the display value is unstable	1) The shielding of the transmission line is poorly grounded, and the external interference signal is mixed into the input terminal of the display instrument 2) The pipeline vibrates, and the impeller shakes with it, resulting in false signals 3) Leakage caused by improper closing of the shut-off valve, in fact the meter shows the leakage 4) Interference between the internal circuit boards of the display instrument or the deterioration and damage of electronic components	1) Check the shielding layer to show whether the terminal of the instrument is well grounded 2) Reinforce the pipeline, or install brackets before and after the sensor to prevent vibration 3) Repair or replace the valve 4) Adopt the "short circuit method" or check item by item to determine the source of interference and find out the point of failure
Significant difference between the displayed value and the empirical evaluation value	1) The internal failure of the sensor flow channel such as fluid corrosion, serious wear, impeller rotation abnormality due to debris obstruction, and instrument coefficient changes The blade is corroded or impacted, the tip is deformed, which affects the normal cutting of magnetic lines, the output signal of the detection coil is abnormal, and the meter coefficient changes; the fluid temperature is too high or too low, the shaft and the bearing expand or contract, and the gap changes too much to cause the impeller to rotate abnormally, and the meter coefficient Variety 2) The back pressure of the sensor is insufficient, cavitation occurs, which affects the rotation of the impeller 3) Causes of pipeline flow, such as reverse flow without check valve Bypass valve is not closed tightly, there is leakage Large flow velocity distribution distortion (caused by the upstream valve not being fully opened) or pulsation occurs upstream of the sensor The viscosity of the liquid changes greatly due to temperature, etc. 4) Display the internal failure of the instrument 5) The permanent magnetic material element in the detector loses its magnetism over time, and the magnetic weakening to a certain extent will also affect the measured value 6) The actual flow through the sensor has exceeded the flow range specified by the sensor	1)~4) Find out the cause of the failure, and look for countermeasures for the specific cause 5) Replace the loss-of-excitation element 6) Replace the appropriate sensor

13.Delivery & Storage

1. The sensor should be packed in a solid wooden box (small-caliber instruments can be used in a carton). It is not allowed to move freely in the box, and be handled with care during transportation, and brutal loading and unloading is not allowed.
2. The storage location should meet the following conditions:
3. 1. Rain and moisture proof.
4. 2. Not subject to mechanical vibration or impact.
5. 3. The temperature range is -20℃～+55℃.
6. 4. The relative humidity is not more than 80%.
7. There is no corrosive gas in the environment.

For more information, please view our web: felixmeter.com