FXGUF Gas Ultrasonic Flow Meter

- Made with German Advanced Technology
- Multiplex Dual Channel and Six Channel Measurement
- Eddy Current and Asymmetric Flow Detection
- Laminated shielding of electric and magnetic fields, high noise immunity
- Zero drift automatic correction, accuracy is not affected by the environment
- Measurement accuracy grade: 1.0
- Comply with Chinese Standard GB/T 32201-2015
- Ultra-wide range ratio
- Ultra-low "zero" starting flow rate
- The metering range can cover Roots meter and turbine meter.
- Double backup lithium battery power supply
- High precision temperature and pressure compensation, volume correction
- Intelligent switching of various gas working conditions and standard temperature and pressure
- Mass storage, can save data for one year
- Intelligent fault detection, fault alarm
- Maintenance-free, cleaning-free, long service life
- The meter can be rotated 180 degrees to facilitate reading.

Contents

1. Production Introduction 2

2. Main Features.....2

3. Working Principle.....2

4. Technical Performance Indices.....5

5. Overall Dimensions and Installation.....8

6. Use and Setting of Flow meter 10

7. Cleaning and Maintenance.....18

8.Packaging, Transportation and Storage.....19

9.Ordering instructions.....19

1. Product Introduction

FXGUF Series Gas Ultrasonic Flow Meter is produced by advanced German technology. All its key components are imported from original equipment, featuring high reliability and long service life. It is a new type of precision measuring instrument with high precision and high reliability. It can be widely applied to gas flow measurement in urban gas, petroleum, chemical industry, electric power, metallurgy and other industries.

FXGUF Series Gas Ultrasonic Flow Meters are designed with unique multiplexed dual channels (DN25-DN80) and multiplexed six channels (DN100-DN200), which can eliminate the influence of eddy current and asymmetric flow, add redundant backup channels to multiplexed channels, and improve the reliability of the system. Comply with China standard GB/T 32201-2015.

2.Main Features

Made with German Advanced Technology
Multiplex Dual Channel and Six Channel Measurement
Eddy Current and Asymmetric Flow Detection
Laminated shielding of electric and magnetic fields, high noise immunity
Zero drift automatic correction, accuracy is not affected by the environment
Measurement accuracy grade: 1.0
Comply with Chinese Standard GB/T 32201-2015
Ultra-wide range ratio
Ultra-low "zero" starting flow rate
The metering range can cover Roots meter and turbine meter.
Double backup lithium battery power supply
High precision temperature and pressure compensation, volume correction
Intelligent switching of various gas working conditions and standard temperature and pressure
Mass storage, can save data for one year
Intelligent fault detection, fault alarm
Maintenance-free, cleaning-free, long service life
The meter can be rotated 180 degrees to facilitate reading.

3. Working Principle

3.1 Basic Working Principle of Ultrasonic Flow Meter

Ultrasonic flow meter is based on the principle of measuring the relationship between the time of sound wave propagation in flowing medium and the flow rate. It is generally believed that the actual propagation speed of acoustic wave in fluid is determined by the propagation speed (C_f) of acoustic wave in the static state of the medium and the axial average velocity (V_m) of fluid
Component composition in the direction of sound wave propagation. As shown in fig. 1, the relationship

between downstream and upstream propagation time and each quantity is:

$$t_{down} = t_{AB} = \frac{L}{(C_f + V_m \cos \emptyset)} \qquad t_{up} = t_{BA} = \frac{L}{(C_f - V_m \cos \emptyset)} \qquad (1)$$

In the formula:

t_{up} ———the time when the sound wave propagates countercurrently in the fluid;

t_{down} ——-the time when the sound wave propagates in the fluid along the current;

C_f ———the speed at which sound waves travel in fluids;

V_m———axial average velocity of fluid;

Ø ———channel angle;

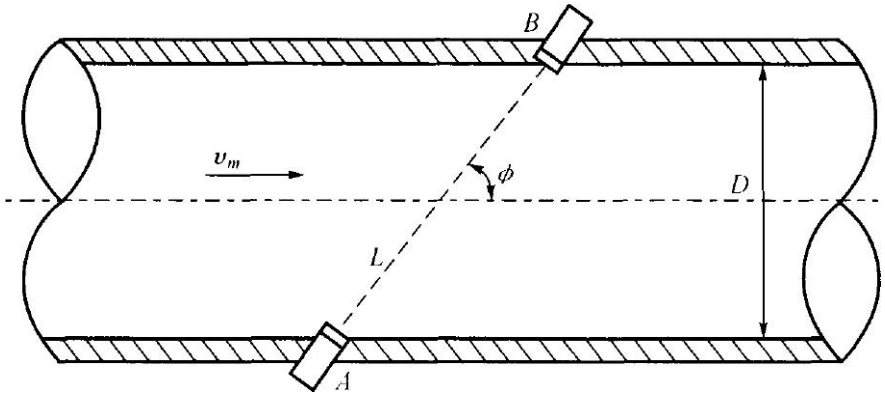


Fig. 1 general schematic diagram

Using equation (1), the expression of fluid flow rate can be obtained:

$$V_m = \frac{L}{2\cos\phi}\left(\frac{1}{t_{down}} - \frac{1}{t_{up}}\right) \qquad (2)$$

The measured fluid flow rates **Vi (i=1,2,....k)** of a plurality of channels; The estimated value of the average flow rate **V** of the pipeline can be obtained by combining the mathematical functional relations, and the volume flow rate $\mathbf{q_v}$ can be obtained by multiplying the estimated value by the flow area A, as shown in Equation (3):

$$q_v = A\ \bar{V} \qquad (3)$$

$$\bar{V} = (\ _1, \cdots, \ ) \qquad (4)$$

Type: k ———Number of channels

3.2 Accurate Time of Flight Measurement Based on Echo Response

The key technology of ultrasonic flow meter is to accurately measure the flight time of acoustic wave in fluid, and the flight time consists of inherent delay **ε** (uncertainty) of sensor and flight time t_0 in fluid, as shown in

fig. 2.

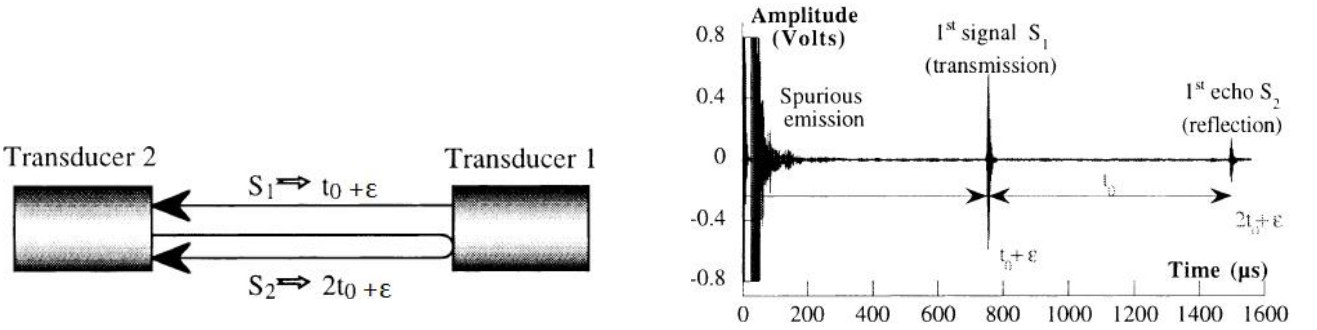


Fig. 2 schematic diagram based on echo response

That is , $t1=t0 + \varepsilon$ $t2=2\ t0 + \varepsilon$ (5)

$t0=t2 - t1$ (6)

Therefore, the uncertain inherent delay **ε** of the sensor and the processing circuit is eliminated, and the flight time t_0 of the acoustic wave in the fluid is accurately measured.

3.3 Multiplex Multi-channel Ultrasonic Flow Meter

The ultrasonic flow meter designed by multiplexing multi-channel has the characteristics of high noise resistance, capability of detecting eddy current and asymmetric flow, elimination of uncertain inherent delay of sensors and processing circuits, accurate measurement, etc. At the same time, the multiplexed channel can be used as redundant backup. Even if the individual sensors are damaged, the FXGUF ultrasonic flow meter can still work normally, greatly improving the reliability of detection.

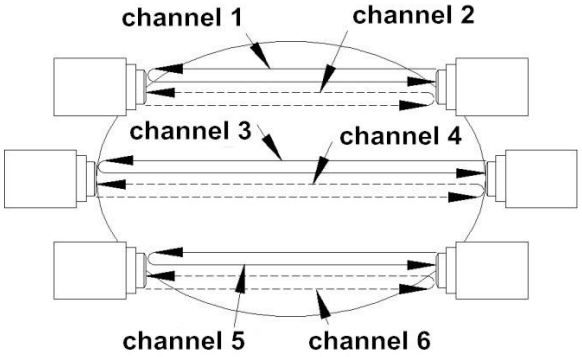


Fig. 3 schematic diagram of multiplex multi-channel

3.4 Working Principle of Volume Correction

Volume correction multi-channel signals sent by temperature, pressure and flow sensors are substituted into formula operation by microprocessor according to gaseous equation to realize real-time display and signal remote transmission.

Gaseous equation: $$V_0 = V * \frac{(P_a + P_g)T_0}{P_0 T} * \frac{Z_n}{Z_g} = V * \frac{P}{P_0} * \frac{T_0}{T} * F_z^2 \qquad (7)$$

In the formula: V_0 ——volume in standard state (m3)

V ——volume under working condition (m3)

$P=P_a+P_g$ ——absolute pressure (kPa) at pressure detection point of flow meter

P_a ——local atmospheric pressure (kPa)

P_g—— gauge pressure (kPa) at pressure detection point of flow meter

P_0 ——standard atmospheric pressure (101.325kPa)

T_0 —— absolute temperature in standard state (293.15K)

T ——absolute temperature (293.15+t)K of measured medium

t ——temperature of medium to be measured (°C)

$F_z=\sqrt{\frac{Zn}{Zg}}$ ——Gas compressibility factor

Z_n ——Gas Compression Coefficient in Standard State

Z_g ——Gas Compression Coefficient in Working State

4. Technical Performance Indicators

4.1 Adoption of Standards

FXGUF series gas ultrasonic flow meters conform to Chinese standard GB/T 32201-2015.

4.2 Measurement Accuracy Grade

The accuracy level of measurement within the range is 1.0
0.1Qmax~ Qmax maximum permissible error: ±1.0%, repeatability: ±0.2%

4.3 Electrical Performance Indicators

4.3.1 working power supply

- Internal power supply: 3.6V lithium battery (model ER34615), which displays the battery capacity in real time.
- External power supply: 5~24VDC, ripple ≤ 50mV, the system automatically switches external power supply, and the external power supply adopts DC-DC management mode. (Safety barrier shall be installed when using intrinsic safety function)

4.3.2 overall power consumption

- Internal power supply: average power consumption ≤1.5mW, two lithium batteries can be used continuously for more than 6 years.
- external power supply: average power consumption ≤1W

4.3.3 Input Signal

- Flow signal: 200 KHz±10%, Vpp≥ 10mV
- Temperature signal: analog signal output by temperature sensor
- Pressure signal: analog signal output by pressure sensor

4.3.4 Output Signal

- Working condition pulse signal output (3-wire system) FOUT: pulse signal output high level ≥(V external-2V), low level ≤0.5V, drive current ≥20mA, transmission distance ≤ 50m, powered by external power supply.
- Ic card pulse signal output (two-wire system) IC _ out: CMOS level, output in pulse signal string mode, normally low level. The pulse output format can be selected, and the volume flow represented by one pulse is set by the output pulse equivalent, namely 0.1m3、1m3、10m3； The level width is set by the output pulse width, which is 5ms, 50ms and 1000ms respectively, and is used together with the IC card controller. Transmission distance ≤ 5m, powered by internal power supply.
- Alarm signal output: the output mode is CMOS level output, which is low level in normal time and high level in alarm time.

1) battery under voltage alarm output: when the battery voltage is lower than 3.2V, BAT_AL2 port outputs an alarm signal; When the battery voltage is lower than 3.1V, BAT_AL1 port outputs an alarm signal.

2) Over-flow Range Alarm Output HL: When the flow range exceeds the upper limit, HL outputs an alarm signal.

- 4~20mA standard analog signal output: 4 ~ 20mA analog signal corresponds to standard volume flow, range is set by upper and lower limits of standard temperature and pressure flow, lower limit corresponds to 4mA, and upper limit corresponds to 20mA. Transmission distance ≤ 200m, connection mode is

two-wire system or three-wire system, and power supply voltage is 24VDC.

- Signal output of RS-485 interface: MODBUS protocol RTU mode, half duplex mode, baud rate 1200~9600 optional, see MODBUS communication protocol description for details. RS-485 communication can realize the following functions:

1) Directly connect with the upper computer, which can remotely transmit the temperature, pressure, standard volume flow and total volume of the measured medium, total volume of working conditions, relevant parameters of the instrument, fault codes, operation status and real-time data, etc.

2) It can be used together with a special signal acquisition instrument and can form a remote data acquisition and monitoring system through GPRS/CDMA, Internet and telephone network. Data transmission is carried out through the network, the historical data and fault status of any flow meter in the network are read, and relevant parameters of various flow meters can be remotely set.

3) SCADA system and DCS system can be formed together with PLC and RTU.

- Real-time database: flow meter has real-time data storage function, including:

1) the latest 2500 times of flow start-stop time and the corresponding standard cumulative flow value;

2) Cumulative flow value at a certain moment in the latest 100 months;

3) For the latest 5000 times of state data (including: time, temperature, pressure, instantaneous flow rate, working condition cumulative flow rate, standard cumulative flow rate, etc.), the recording time interval can be set, ranging from (1 min to 9999 min).

- Additional mechanical counter: irreversible mechanical counter, cumulative flow never lost, counting range: 0~99999999 m3

4.4 Technical Performance Indicators

4.4.1 See the following table for the model specifications and basic parameters of flowmeter:

FXGUF Ultrasonic Flow Meter (Wide Range) **table 2**

Diameter DN（mm）	Item	Initial flow (m3/h)	Flow range (m3/h)	Accuracy （m3/h）
25	FXGUF-25	0.02	1~40	1%
32	FXGUF-32	0.03	5-50	
40	FXGUF-40	0.05	6~100	
50	FXGUF-50	0.07	4~160	
80	FXGUF-80	0.10	8-400	
100	FXGUF-100	0.20	16~700	
150	FXGUF-150	0.40	20~1400	
200	FXGUF-200	0.50	36~2000	

4.4.2 Typical Characteristic Curve

Typical characteristic curve of flow meter is shown in fig. 4, y coordinate represents the basic error of the meter, and x coordinate represents the percentage of maximum flow.

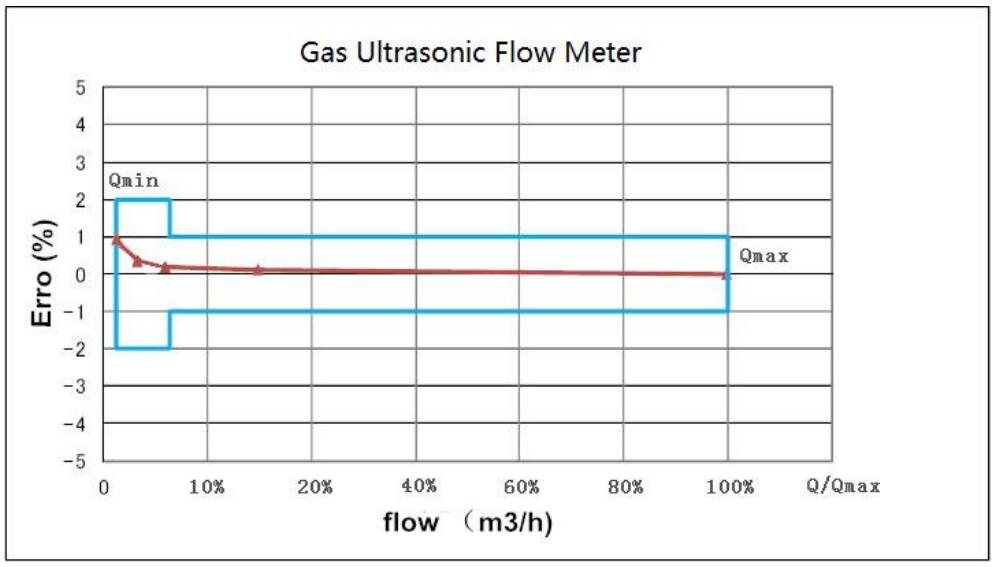


Fig. 4 typical characteristic curve

5. Overall dimensions and installation

5.1 overall dimensions

The external dimensions of the ultrasonic flow meter are shown in fig. 5, the dimensions not noted in the figure are listed in table 3. the flow meter is connected by flange. the flange dimensions shall comply with GB/t 9112 ~ 9113 2000 "steel pipe flange".

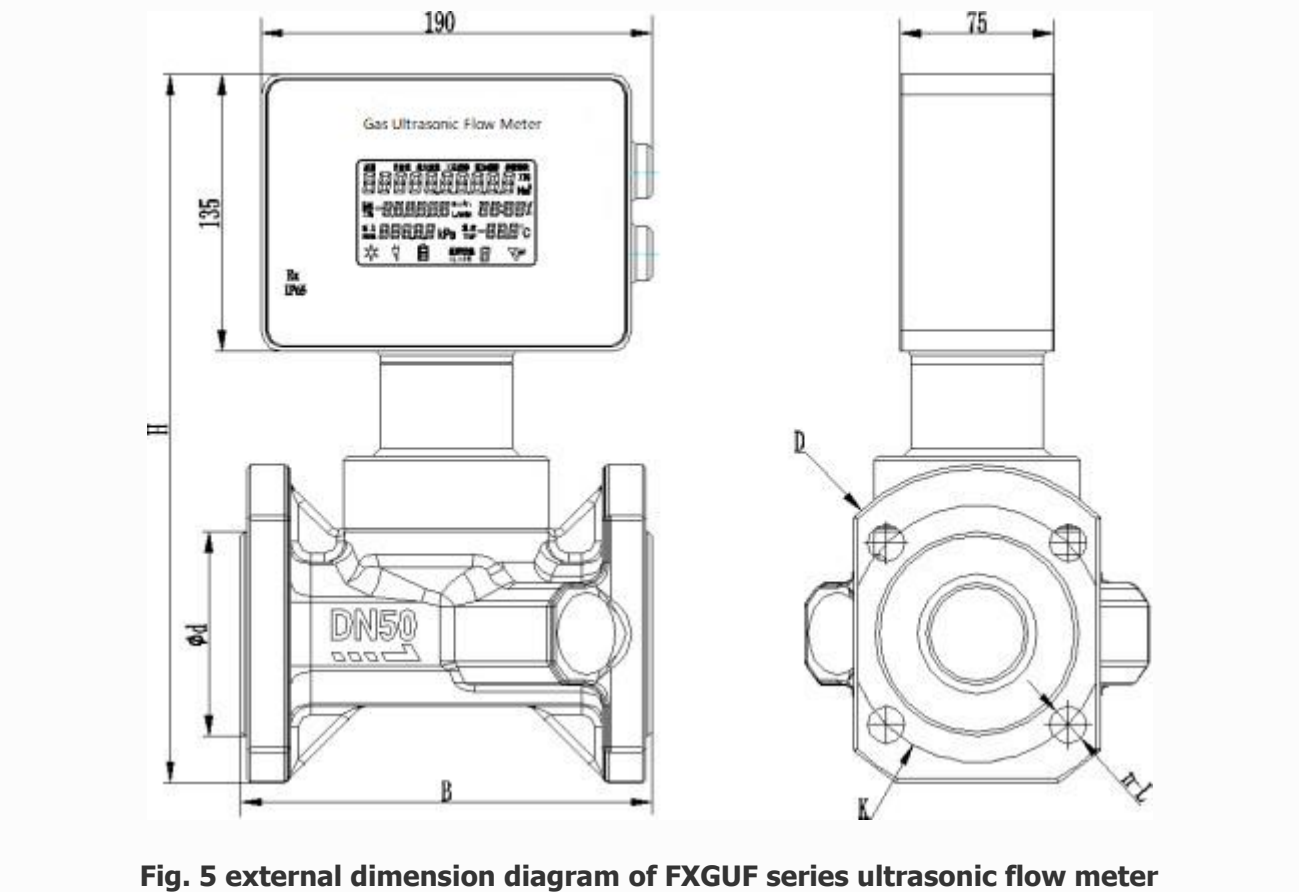


Fig. 5 external dimension diagram of FXGUF series ultrasonic flow meter

Overall dimensions of flow meter table 3

Item	Diameter DN(mm)	B	1.6MPa					2.5MPa				
			H	D	d	K	n-L	H	D	d	K	n-L
FXGUF-25	25（1”）	200	307	115	65	85	4-⌀	307	115	65	85	4-⌀
FXGUF-40	40（1 ”）	200	345	150	84	110	4-⌀	345	150	84	110	4-⌀
FXGUF-50	50（2”）	200	345	165	99	125	4-⌀	345	165	99	125	4-⌀
FXGUF-80	80（3”）	240	393	200	132	160	8-⌀	393	200	132	160	8-⌀
FXGUF-100	100（4”）	300	403	220	156	180	8-⌀	411	235	156	190	8-⌀
FXGUF-150	150（6”）	450	428	285	211	240	8-⌀	435	300	211	250	8-⌀
FXGUF-200	200（8”）	600	453	340	266	295	12-⌀	463	360	274	310	12-⌀

5.2 Installation Requirements

5.2.1 One-way operation of instrument: (fluid flows in one direction)

- Without rectifier, along the direction of fluid, the length of front straight pipe shall be ≥ 10DN, and the length of rear straight pipe shall be ≥ 3DN
- With rectifier, along the direction of fluid, the length of front straight pipe shall be ≥ 5DN, and the length of rear straight pipe shall be ≥ 3DN

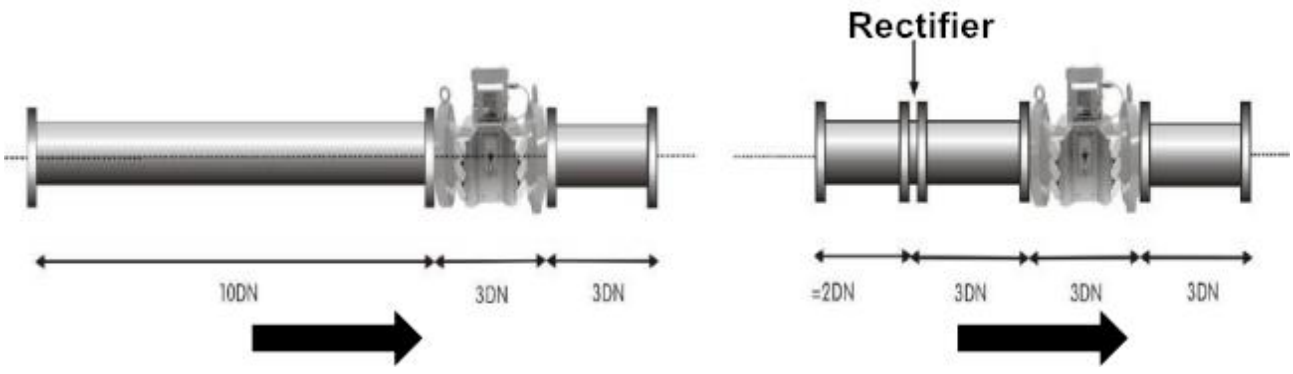


Fig. 7 schematic diagram of unidirectional operation and installation

5.2.2 Two-way operation of instrument: (fluid flows in both directions)

- Without rectifier, the length of front straight pipe shall be ≥ 10DN, and the length of rear straight pipe shall be ≥ 10DN.
- With rectifier, the length of front straight pipe shall be ≥ 5DN, and the length of rear straight pipe shall be ≥ 5DN.

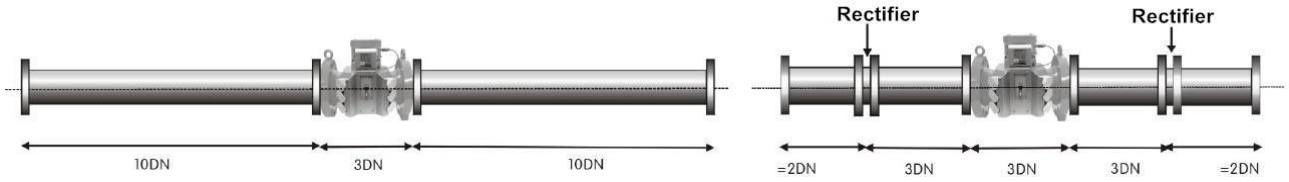


Fig. 8 schematic diagram of bidirectional operation and installation

6.Use and Setting of Flow Meter

6.1 Use Environment

- Ambient temperature: -20℃~60℃
- Relative humidity: 5%~95%
- Atmospheric pressure: 70kPa~106kPa

6.2 Medium Conditions

- The medium to be tested shall be single-phase gas without vortex and shall be free of impurities such as oil stain.
- The flow rate and pressure range of the medium to be measured shall be within the range specified by the flow meter.
- Temperature range of measured medium: -30℃~80℃

6.3 Display Mode and Parameter Setting

6.3.1 Display Mode

- Cumulative flow display: standard temperature and pressure displays 0~9999999999× 10 Nm3
  the working condition shows 0 ~ 9999999999× 10 m3
- Instantaneous flow display: standard temperature and pressure displays 0 ~ ±999999 Nm3 or (L/min)

the working condition shows 0 ~ ±999999 m3 or (L/min)

- Medium pressure display: 0~99999KPa
- Medium temperature shows: -99.9 ~+99.9℃
- Flow ratio display: 0~100%
- Time display: xx: xx 24: 00
- Battery power display:
- External power supply access display:
- Measurement status display:
- Fault status display:

  Main board system failure: 故障状态 ALARM

  flow measurement failure: flow Er-X

  pressure measurement failure: pressure Er-X

  temperature measurement failure: temperature Er-X

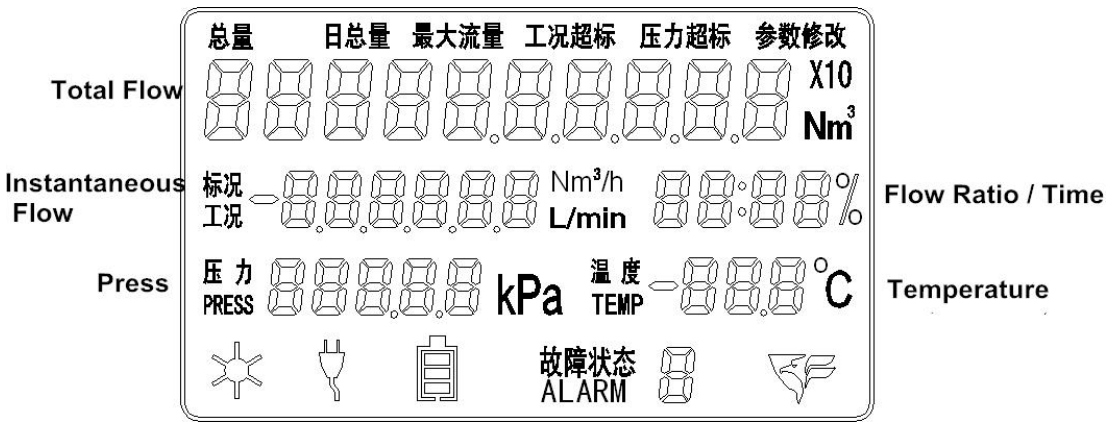


Fig. 9 schematic view of LCD panel

6.3.2 operation keys

The meter is provided with page turning key (SW1), bit selection key (SW2), cycle adding key (SW3) and confirmation/exit key (SW4). The functions of each key are as follows:

- Page Turn Key (SW1): Turn to the next setting.
- Bit Selection Key (SW2): Move the cursor bit by bit from left to right.
- Cycle Add Key (SW3): The value at the cursor cycle increases.
- Confirm/Exit key (SW4): set parameters confirm and exit.

6.3.3 jumper cap setting

The instrument is provided with four jumper caps, JP1, JP2, JP3 and JP4. The functions of each jumper cap are as follows:

- JP1: Cancels Battery Voltage Detection
- JP2: Standby
- JP3: Standby

- JP4: Standby

6.3.4 parameter setting

Page No.	Definition	Symbol	Numerical	Remarks
1	user password	PA	XXXX	user password
	Vendor password	PP	XXXX	Vendor password
	Software version	vb	X.X	software version (read only)
2	4-20mA set	FH	XXXXXX	20mA corresponding flow rate
		C	X.XXX	Output trim factor
3	flow alarm output	EH	XXXXXX	Alarm maximum flow
		H	XXX	Maximum percentage
		L	XX	Percentage of lower limit
4	Data save interval	dt	XX-XX	XX State data saving interval
	Communication settings	Ad	XX	communication address
		TA	X	communication baud rate
5	meter No.	FP	XXXXXXXX	meter No.
	Relative density of natural gas	gr	X.XXX	The relative density of gas is less than 0.1, and the compression factor is not calculated.
6	N2 Molar number	N2	X.XXXX	<0.1500
7	Co2 Molar number	Co2	X.XXXX	<0.1500
8	Time	Y-M-D H:M	XXXX-XX-XX XX:XX	Year-month-day Hours: minutes
9	IC card signal output setting	F0	XX-XX	0X：1 Cubic/pulse 1X：0.1 Cubic/pulse 2X：1 Cubic/pulse 3X：10 Cubic/pulse X0: Pulse width 50ms X1：Pulse width 500ms
		cA	X.XXX	Standby
10			X-X-X-X.XNP	Standby
			XXXXXX	Standby
	Set correction pressure		XXXX.X	Set correction pressure
11	Pressure module setup	FULL	XX.XX	Pressure range (read only)
		P0	XXX.X	Set atmospheric pressure
		P/E	XXX.X	Pressure compensation
	Set temp.		XXX	Setting correction temperature
12	set user password	PA	XXXX	user password
	Set the manufacturer password	PP	XXXX	manufacturer password
	Temperature compensation		XX.X	Temperature compensation
13	standard temp. and		XXXXXXXXX	Integer part of total

	pressure Total		XXX	Decimal part of total
14-21	discharge coefficient	1H—8H	XXXXXX.X	Segmented flow coefficient
			XXXX.XX	Segmented flow point
22	Zero flow setting	0F	XXX.X	Zero flow setting 1
		1F	XXX.X	Zero flow setting 2
			XXXX	Automatic correction of time difference (read only)
		F	XXX.X	Zero flow setting 3
	Diameter		XXX	Meter diameter
23	transmission time	T-X	XXX.XXX	Forward Transmission Time (Read Only)
			XXX.XXX	Reverse Transmission Time (Read Only)
			XX	Automatic Gain Control Factor 1(AGC) (Read Only)
			XXX.XX	Transmission Time Difference (Read Only)
			XX	Automatic Gain Control Factor 2(AGC) (Read Only)
24	Instrument coefficient	0H	XXXXXX.X	Instrument coefficient
			XXXXXX	Target Instrument Factor (Read Only)

Setting method of instrument coefficient:

1) Read out from flow meter: Kold= (0H) meter coefficient, Kobj= target meter coefficient

2) Set the instrument coefficient in the sonic nozzle calibration device to: Kobj

3) Calibrate a new instrument coefficient through a sonic nozzle calibration device: Knew

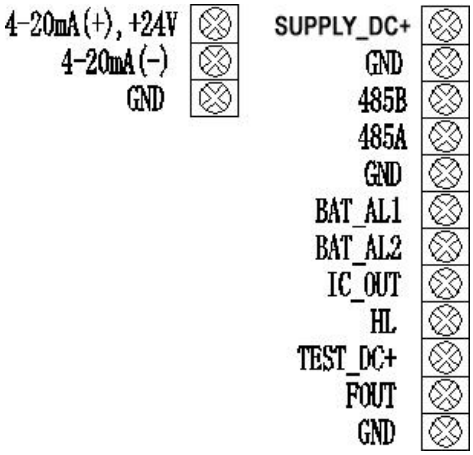
4) Replace (0H) meter coefficient in flow meter with: (0H) meter coefficient =(Knew/ Kobj)* Kold

6.3.5 Wiring Methods

6.3.5.1 External power supply and output terminal

As shown in fig. 10, the definitions and functions of each terminal are as follows:

- Supply _ DC+:external power supply, 5~24VDC
- GND: Internal ground wire, or external power supply negative pole
- 485B: RS-485 communication terminal B
- 485A: RS-485 communication terminal A
- GND: Internal ground wire, or external power supply negative pole
- BAT_AL1: Battery under voltage alarm 1, battery less than 3.1V
- BAT_AL2: Battery under voltage alarm 2, battery below 3.2V
- IC _ out: IC card pulse output for IC card controller
- HL: When the flow range exceeds the upper limit, an alarm signal is output
- Test _ DC+:calibration power supply, 5~24VDC



- FOUT: calibration pulse output
- GND: Internal ground wire, or external power supply negative pole

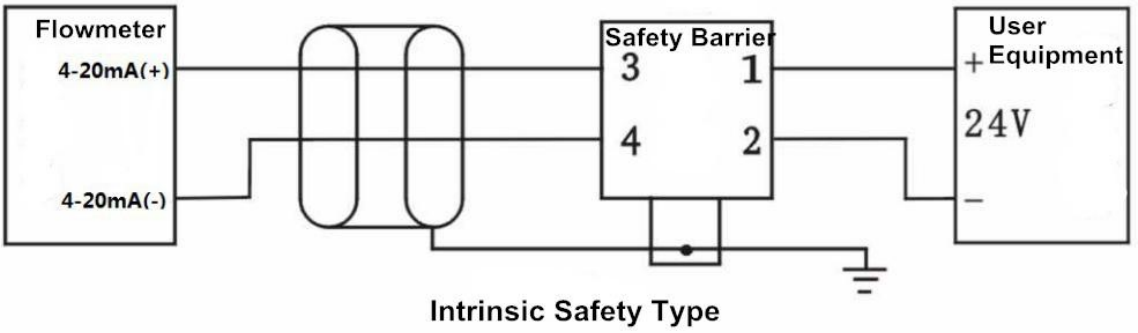
Fig. 10 schematic diagram of wiring terminals

6.3.5.2 Current Module Output Terminal

- 4-20mA (+),+24V: +24V External Power Supply Positive (3-wire or 2-wire)
- 4-20mA (−): Current Output (3-wire or 2-wire)
- GND: negative pole of 24V external power supply (3-wire system)

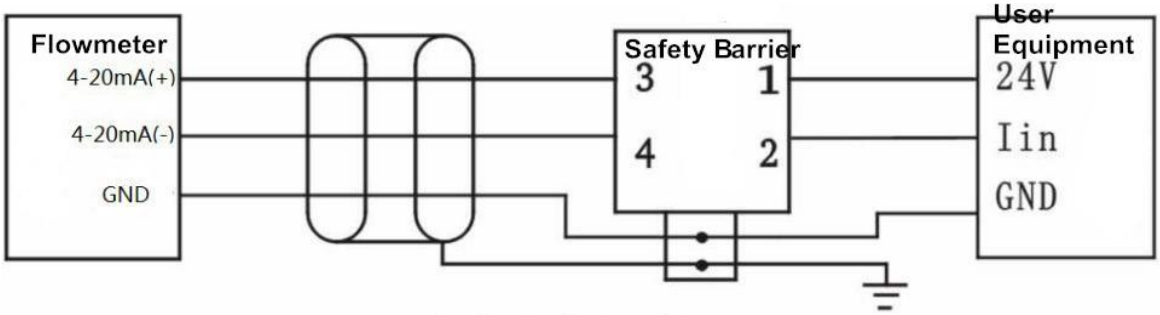
6.3.5.3 Wiring Mode of Flow Meter Output Terminal

1) Two-wire 4−20mA Output Connection



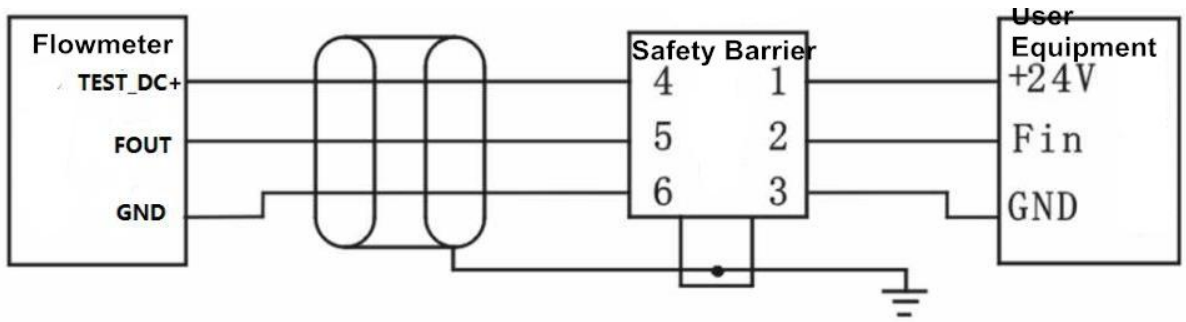
Intrinsic Safety Type

2) Three-wire 4−20mA Output Connection



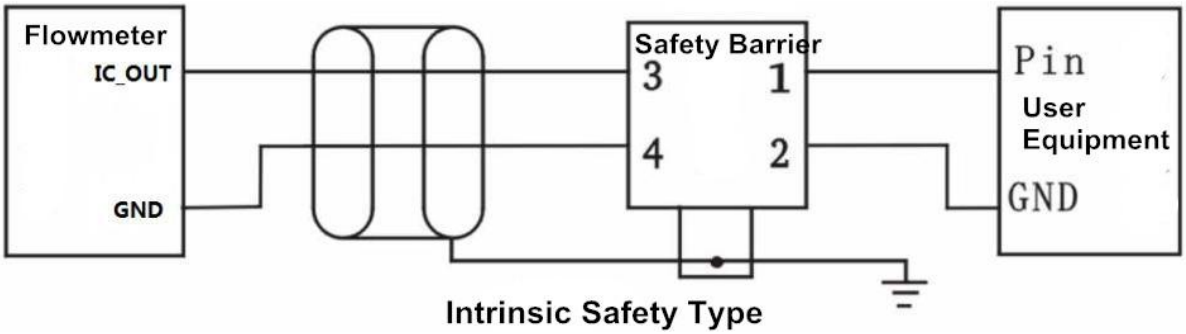
Intrinsic Safety Type

3) Pulse signal output connection mode (3-wire system)



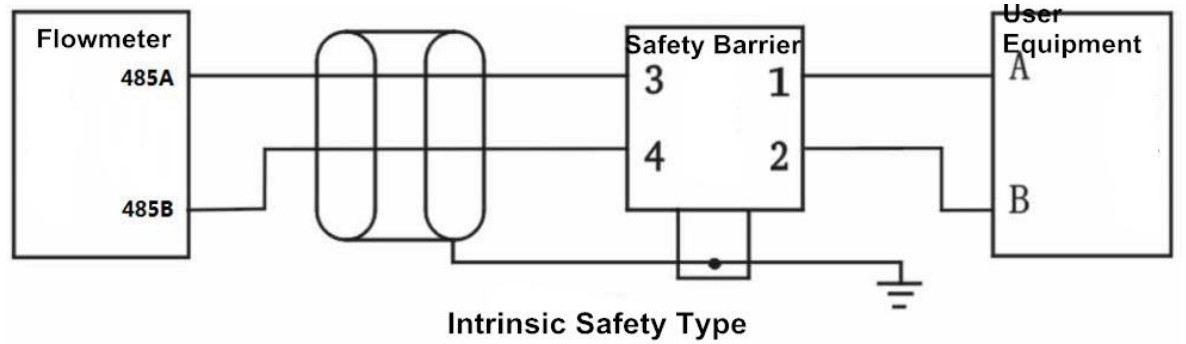
Intrinsic Safety Type

4) Standard Pulse Signal Output Connection Mode (Two-wire)



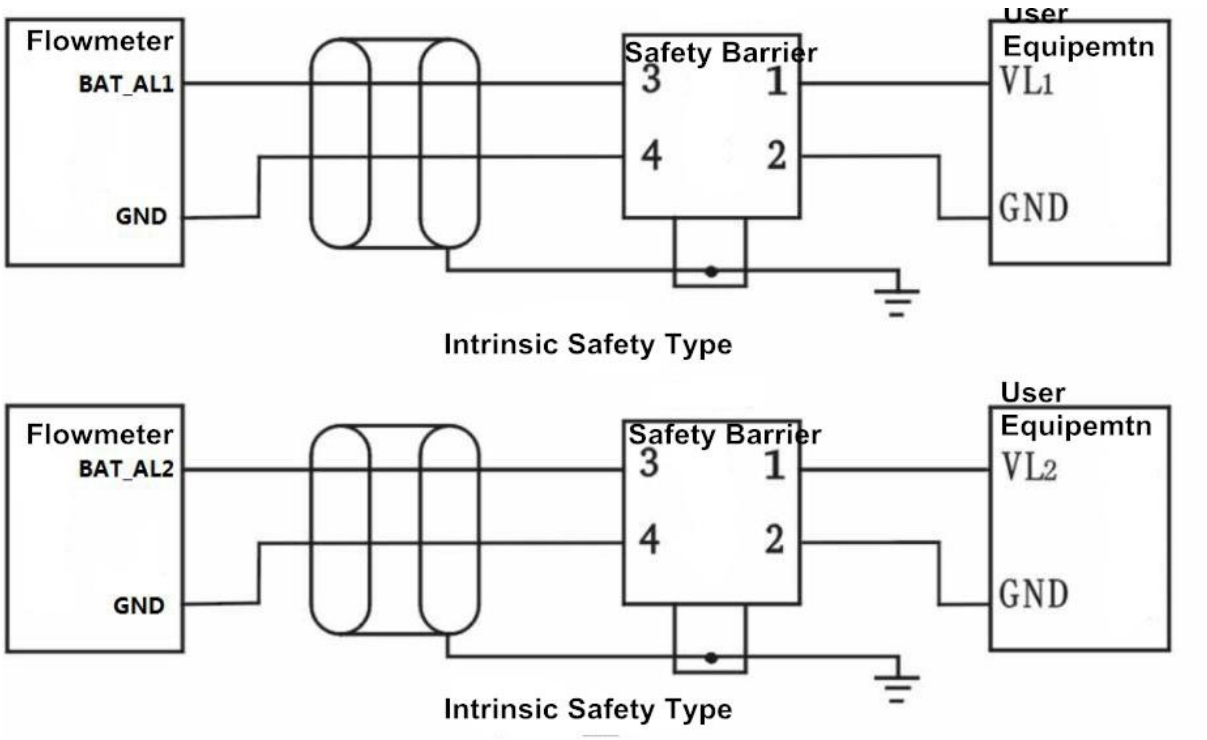
Intrinsic Safety Type

5) RS-485 communication output connection mode

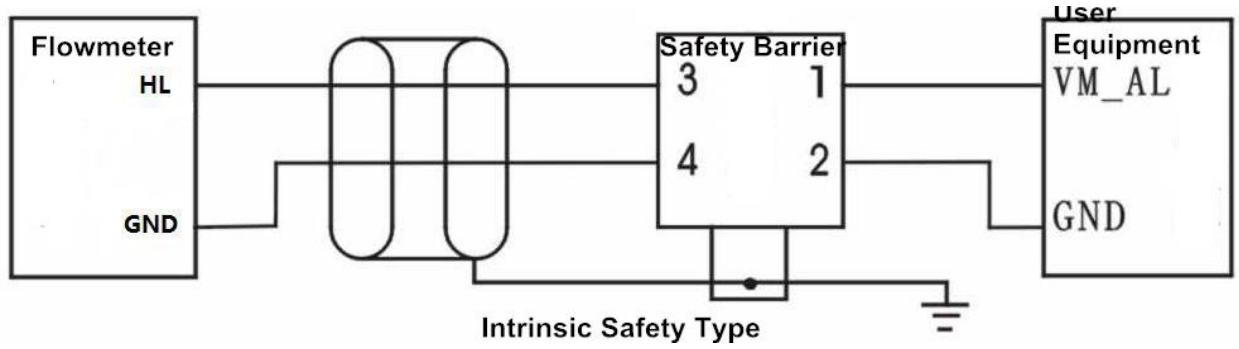


Intrinsic Safety Type

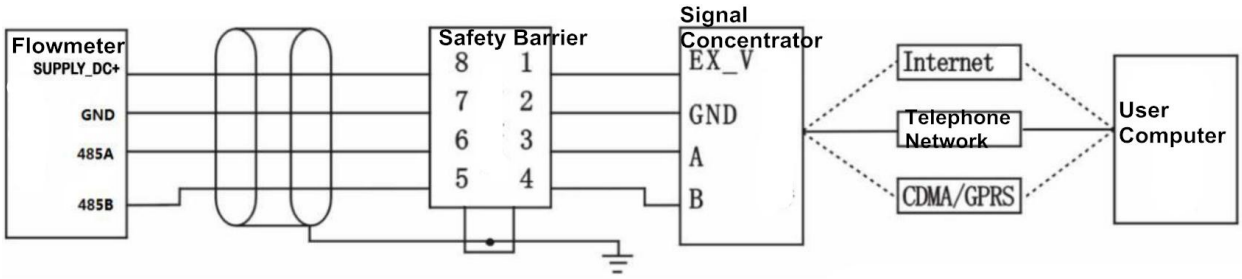
6) Battery undervoltage alarm output connection mode



7) Connection mode of alarm output for working condition flow exceeding range (Two-wire)



8) remote data acquisition connection mode



Intrinsic Safety Type

6.3.6 (4~20mA) Instructions for Using Standard Analog Signal Output

6.3.6.1 (4~20mA) two-wire system

(4~20mA) The relationship between the voltage of the current output circuit and the maximum resistance of the external load circuit is as follows:

R_L（max）=(V_S - 13)/20mA=(24-13)/20mA=550Ω

Then the matching load resistance should be R_L≤ 550Ω. The relationship between the power supply voltage and the load resistance of external load circuit is shown in fig. 11. The load resistance of the circuit shall be selected in the working area.

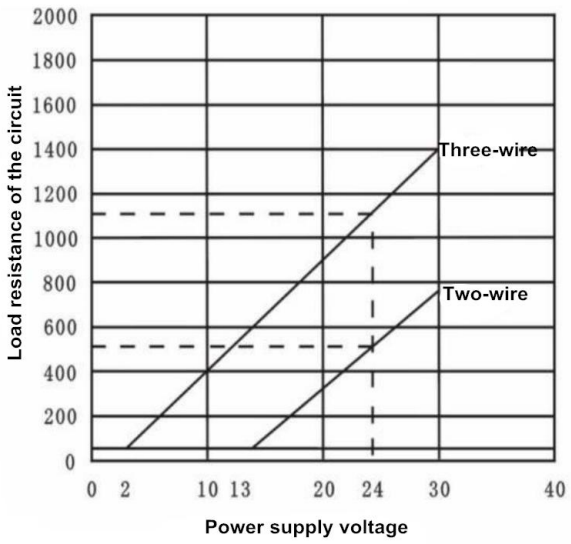


Fig. 11 Relationship diagram of power supply voltage and load resistance of the circuit

6.3.6.2 (4~20mA) three-wire system

(4~20mA) The relationship between the voltage of the current output circuit and the maximum resistance of the external load circuit is as follows:

R_L（max）=(V_S - 2)/20mA=(24-2)/20mA=1100Ω

Then the matching load resistance should be R_L≤ 1100Ω. The relationship between the power supply voltage and the load resistance of external load circuit is shown in fig. 11. The load resistance of the circuit shall be selected in the working area.

6.3.7 Use of Internal Battery Power Supply

When using in dangerous places, the flowmeter rear cover can only be opened after safety is confirmed. When replacing, the lead seal and rear cover can be opened, the old battery can be taken out, and the same type of battery (2 No.1 3.6V lithium batteries) can be replaced. Pay attention to the positive and negative polarity. After the battery replacement is completed, wait for 2 minutes, observe the battery power display symbol  on the liquid crystal panel, and close the rear cover only after the battery is full.

The replacement of batteries should be carried out with good ventilation and no gas leakage, and batteries of the same type should be used.

6.3.8 meter reading

Relevant metering parameters of the flowmeter are displayed on the liquid crystal screen of the flowmeter, which can realize direct reading.

7. Cleaning and Maintenance

7.1 Cleaning of Flow Meter

After the ultrasonic flow meter is used for a long time, dirt and dust will adhere to the inner wall and probe, affecting the measurement accuracy. Compressed air can be used to clean the inner wall of flowmeter and probe, or alcohol-containing cleaning soft cloth can be used to wipe. It is strictly prohibited to use detergents containing gasoline or corrosive substances!

7.2 Maintenance of Flow Meter

There are no mechanical parts inside the ultrasonic flow meter and no maintenance such as lubrication is required. All fault conditions will be displayed on the LCD panel, and users can repair according to the fault conditions. The electrical part adopts modular design, and the user can replace the corresponding module according to the fault state, or notify the manufacturer to carry out maintenance.

7.3 Anti-interference Capability

FXGUF series ultrasonic flow meters adopt high anti-noise design technology and pass the low-level interference and high-level interference tests specified in ISO9951. The front pipe section of flow meter shall be ≥10D, and the rear pipe section shall be ≥3D. As shown in Figure 12:

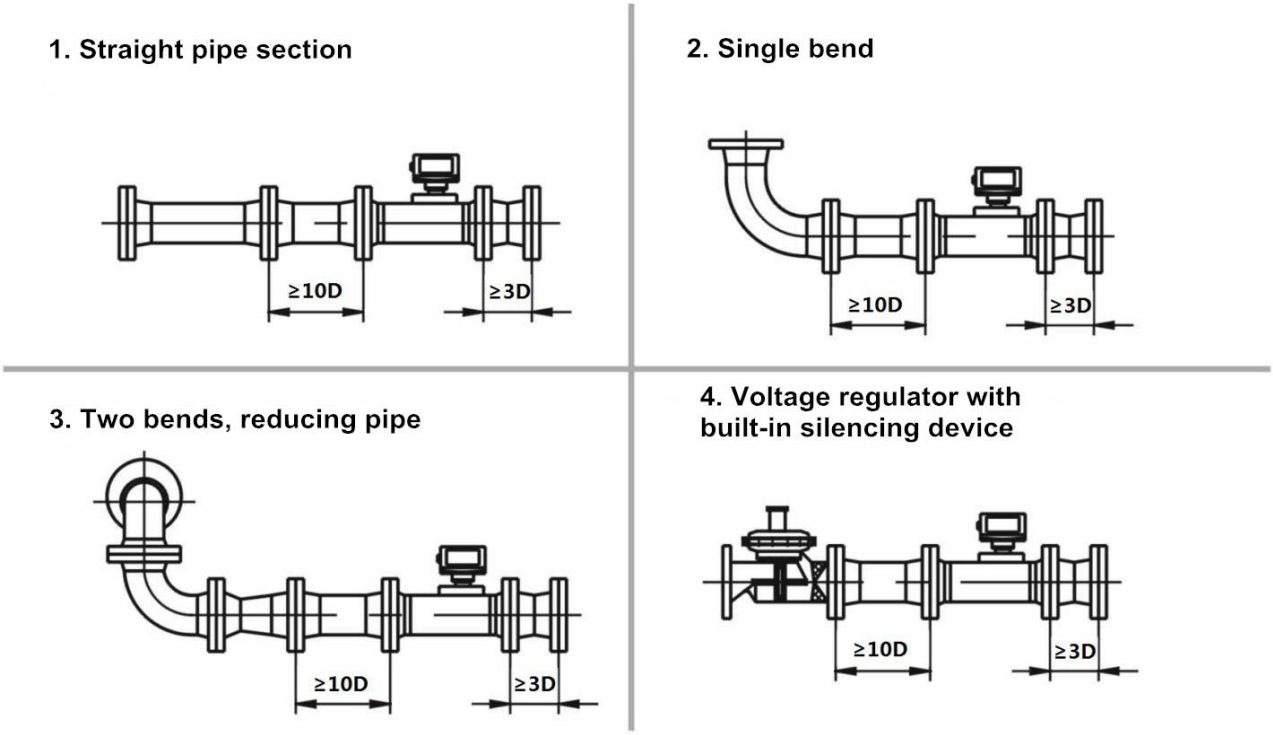


Fig. 12 Allowable installation mode of ultrasonic flowmeter

8. Packaging, transportation and storage

8.1 Flow meters shall be packed in solid wooden cases (medium and small caliber can be packed with foam and cartons), and shall not move freely in the boxes. They shall be handled with care, and rough handling is not allowed.

8.2 The storage of flow meter shall meet the following conditions:

- Rain-proof and moisture-proof;
- Not subject to mechanical vibration or impact;
- Temperature range: 10℃ ~+40℃;
- Relative humidity: not more than 95%;
- The environment does not contain corrosive gases.

9.Ordering instructions

9.1 When ordering this product, the user shall select the appropriate specifications according to the nominal pressure of the pipeline, the highest pressure of the medium, the medium temperature, the flow range and the environmental conditions.

9.2 Flow meters are generally of local display type, and other additional output functions are required. Please indicate when ordering.

9.3 Selection Examples

It is known that the actual working pressure of a certain gas supply pipeline is 1MPa~1.5MPa (gauge pressure), the medium temperature range is -10℃ ~+40℃, the gas supply volume is 40 ~ 950 Nm3, and the local atmospheric pressure is 101.3kPa, so it is required to determine the caliber of the flowmeter.

Analysis: Since the flow ranges given in Tables 1 and 2 above are the flow ranges under actual working conditions, the standard temperature and pressure flow should be converted into the working condition flow before selecting the appropriate caliber.

Calculation: when the medium pressure is the lowest and the temperature is the highest (the influence of gas compression factor may not be considered in the estimation and selection), when it is in the peak period of gas supply, it has the maximum volume flow rate, so there are:

$$\mathrm{Qmax} = \mathrm{Q0} * \frac{\mathrm{P0}}{\mathrm{P0} + \mathrm{P}} * \frac{T}{T0} = 950 * \frac{101.325}{101.3 + 1000} * \frac{273.15 + 40}{293.15} = 93.4 m3 / h$$

Similarly, when the medium pressure is the highest and the temperature is the lowest, when it is in the low period of gas supply, it has the minimum volume flow, so there are:

$$\mathrm{Qmin} = \mathrm{Q0} * \frac{P0}{P0 + P} * \frac{T}{T0} = 40 * \frac{101.325}{101.3 + 1500} * \frac{273.15 - 10}{293.15} = 2.3 m3 / h$$

That is, the flow rate of the medium in the working state ranges from 2.3 -93.4 m3/h.. According to tables 1 and 2, DN40 flow meter shall be selected.