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1. Overview

Metal tube rotameter flowmeter (metal tube rotor flow meter) is a variable area flow measurement. meter commonly used in industrial automation process control. It is featured by small size, large detection range and easy operation, it can be used to measure the flow of liquids, gases and steam, and particularly suitable for the measurement of low flow speed and small flow rate.

Over the years, metal tube rotameter flowmeter have been widely used in industries such as petroch e-micals, iron and steel,electric power, metallurgy, light industry, food, pharmaceuticals and water treat -ment for their excellent performance and reliability, as well as good performance-to-price ratio.

This manual is prepared for professional technicians. It is suitable for the design and selection of metal tube floater meters and can also be used as reference by end users when using them.

This manual respectively introduced the working principle, functions, features, technical parameters, meter type and dimensions, flow calculation, wiring method, installation and maintenance of the metal tube rotameter flowmeter.

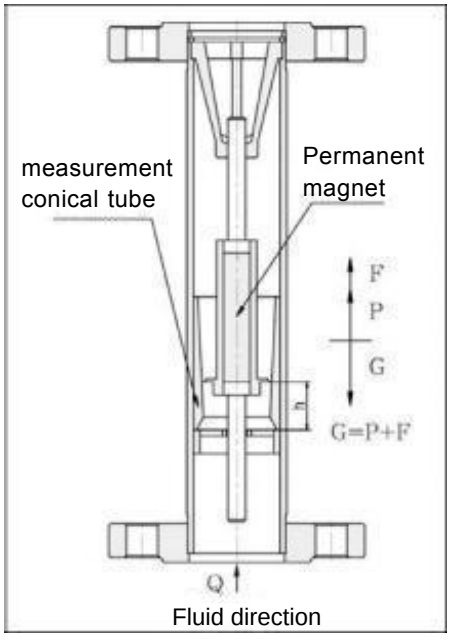
This manual is only prepared for the design, selection and use of the metal tube floater meters, meanwhile, the manufacturer reserves the right to improve certain technical parameters without prior notice.

2. Measurement Principle

Metal tube rotameter flowmeter is mainly composed of two parts: sensor and indicator. The sensor is mainly composed of connection flange, measurement conical tube, floater and upper and lower guiders; the indicator is mainly composed of enclosure, magnetic drive system, dial and electric remote transmission system.

In the vertical conical measurement tube, there is a measuring part-floater (Fig. 1) that can move up and down, when the fluid passes through the conical tube from bottom to top, the floater is moved upward along the conical tube by the force of the fluid. When the flow rate of the fluid increases, the displacement of the floater increases; conversely, when the flow rate of the fluid decreases, the displacement of the floater decreases. That is to say, the fluid flow rate determines the position of the floater in the measurement tube, thus determines the size of the annular area between the floater and conical tube.

When the flow rate of the fluid is maintained at a constant flow rate Q, the floater is also in a state of dynamic equilibrium and staying at a position h in the conical tube, at which point the annular area between



the floater and the conical tube remains constant. The floater is affected by three forces: the gravity G of the floater, the buoyancy F of the floater, and the force P applied to the floater by the fluid, these three forces achieve balance (Fig. 1). According to the Bernolli equation, the principle of force balance and the law of fluid continuity in the hydrodynamic, the instantaneous fluid flow rate passing through the annular area at the time can be calculated, therefore, the metal tube rotameter flowmeter uses the principle of measuring the flow rate using variable areas.

Inside the floater, a high-performance permanent magnet is embedded, when the floater is in the equilibrium position, a uniform and stable magnetic field is formed around the floater. A magnetic sensor is installed outside the conical tube, so that the linear displacement of the floater in the measurement tube can be transmitted to the indicator through a non-contact way, after detection and processing, it is finally displayed on the indicator dial or output corresponding standard 4-20mA current signal.

3. Functions and Features

◆Suitable for small-diameter and low-flow medium flow measurement

◆Low requirement for straight pipe section

◆Dual-line LCD display, local instantaneous/accumulated flow display

◆Full metal structure, suitable for high temperature,high pressure and strong corrosive media

◆Can be used in flammable and explosive dangerous occasions

◆recovery, data backup and power-down protection functions

◆Reliable operation, low maintenance and long service life

◆Wide range ratio 10:1

◆Keyboard on indicator to facilitate setting

◆Non-contact magnetic coupling

◆drive Optional DC power supply or battery power

◆supply with data Multi-parameter calibration function

4. Technical Parameters

▲ Flow meter diameter: DN15,DN20, DN25, DN32,DN40,DN50, DN65,DN80, DN100, DN125,DN150,DN200 (Please consult with the manufacturer for other diameters)

▲ Flow Range Liquid : 1.0～250000l/h Gas: 0.05～3000m3/h
(For the flow rate range, please refer to page 11)

▲ Range ratio: 10:1, 20:1 (special)

▲ Accuracy Grade: 1.5, 1.0 (Special)

▲ Pressure rating: DN15, DN25, DN50: 4.0MPa (maximum 20MPa) DN80, DN100, DN150: 1.6MPa (Maximum: DN80: 10MPa; DN100: 6.4MPa; DN150: 4.0MPa)

▲ Medium temperature standard:: -30℃~+120℃, high temperature: 120℃~350℃

▲ Power Supply: 24VDC ,220VAC,3.6V Lihium battery

▲ Output signal: 4 ~ 20mADC (two-wire system), HART protocol, RS485communication, Pulse

- ▲ Output load: 500Ω(at 24V power supply)
- ▲ Ambient temperature: Local type: -40℃~120℃ Remote type: -30℃~60℃
- ▲ Storage conditions: Temperature: -40℃~85℃ Humidity: ≤ 85%
- ▲ Connection method: Flange, Tri-Clamp, Threaded
  flange standard: HG/T20592-2009,
  (other connection forms can be negotiated with the manufacturer)
- ▲ Cable Interface: M20×1.5, 1/2''NPT
- ▲ Enclosure Protection : IP65
- ▲ Explosion Proof Marking :Intrinsically Safe: Ex ia IICT6, Flameproof : Ex d IICT6
- ▲ Pressure loss: See flow chart for details
- ▲ Medium viscosity: DN15: η<5mPa.s DN25: η <250mPa.s DN50～DN150: η<300mPa.s
- ▲ Wetted material: R1: 304, 06Cr19Ni10; R0: 316, 06Cr17Ni12Mo2; HC:Hastelloy C;
  RL: 316L, 022Cr17Ni12Mo2; Ti: Titanium; RP: Teflon lining

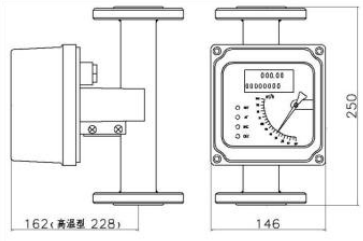
5.Flow meter Types and Dimensions

The flow meter consists of measurement tube (sensor) and indicator (electronic converter), different types of measurement tubes and indicators can be selected and assembled into various forms of complete meter to meet the needs of site. Various flow meters types and dimensions, connection flange standards and magnetic filter's installation dimensions are described below.

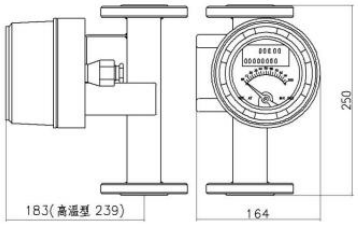
5.1 Product Classification

Metal tube rotameter flowmeter products can be divided into five types based on the direction of the fluid inlet and outlet, and each type can be further divided into standard, high-temperature, jacket type and so on, which are separately described below.

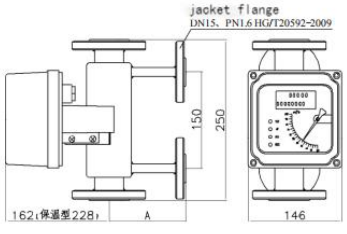
5.1.1 Vertical type



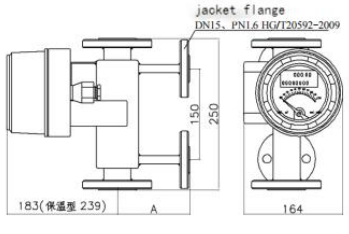
Standard type M1 indicator



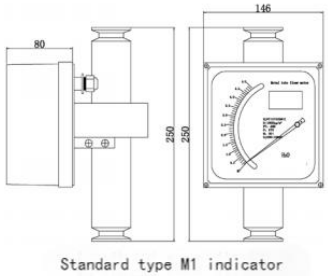
Standard type M2 indicator



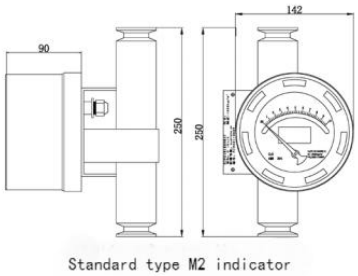
Cooling jacket type M1 indicator



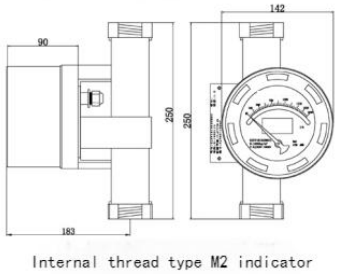
Cooling jacket type M2 indicator



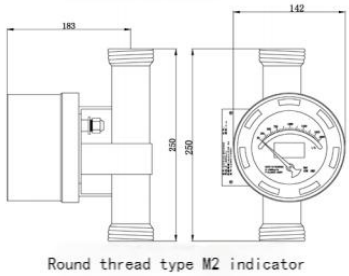
Standard type M1 indicator



Standard type M2 indicator



Internal thread type M2 indicator

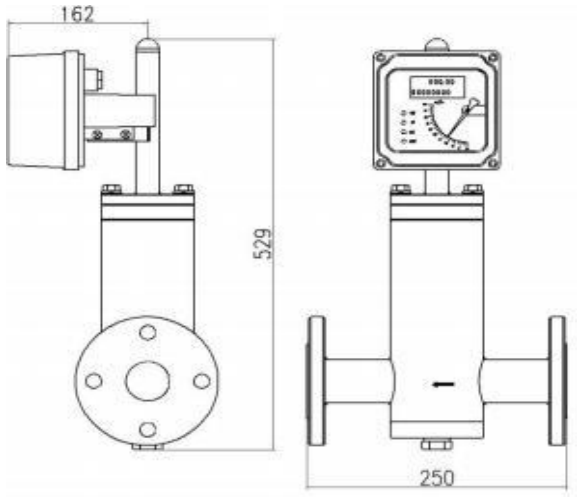


Round thread type M2 indicator

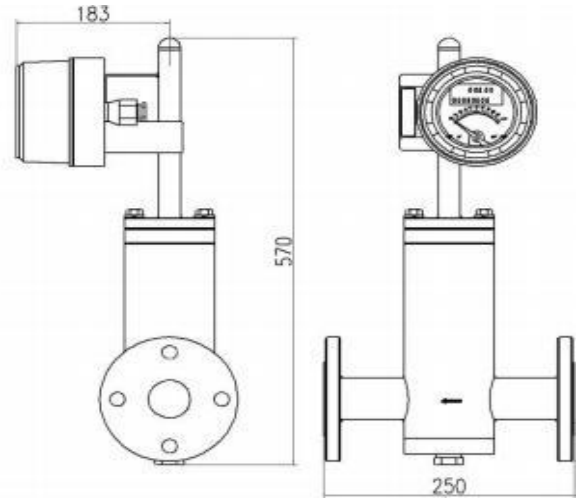
Diameter	DN15	DN25	DN50	DN80	DN100	DN150	DN200
A	100	120	135	150	160	180	200
Standard type weight kg	5.0	6.5	10	16	17	35	50
Jacket type weight kg	7.5	9.5	13	19	20	40	55

5.1.2 Horizontal type

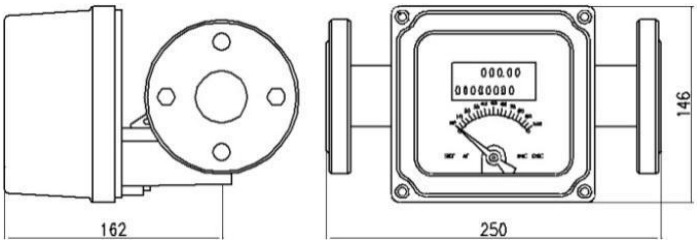
For horizontal installation type flow meters, T-shaped structure is adopted when the diameter is less than DN50 (including DN50); and spring structure is adopted when ＞ DN50.



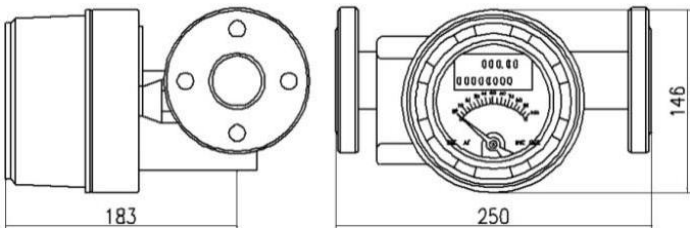
T-shaped structure M1 indicator



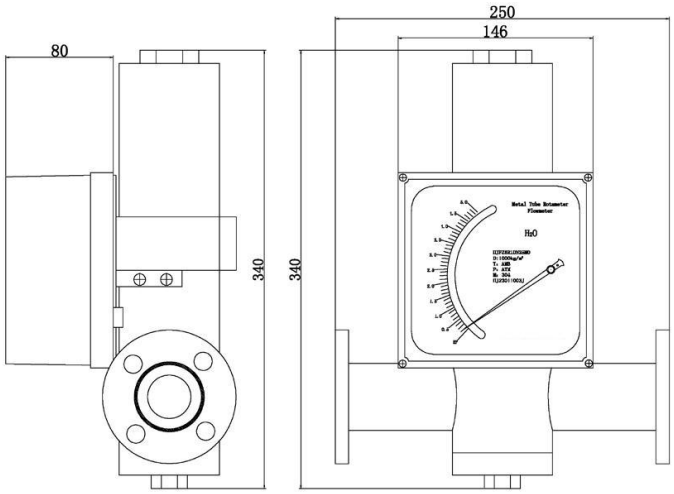
T-shaped structure M2 indicator



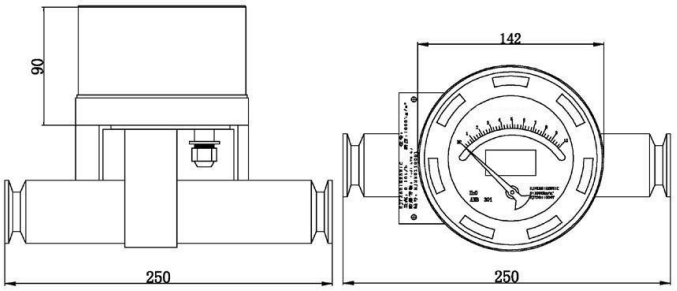
Spring structure M1 indicator



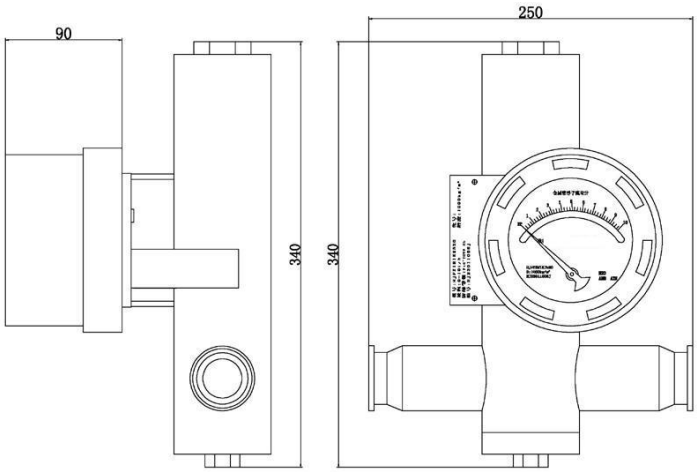
Spring structure M2 indicator



T-shaped structure M1 indicator



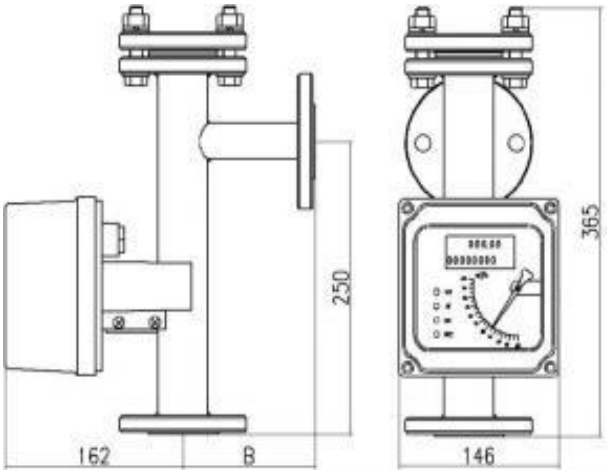
Spring structure M2 indicator



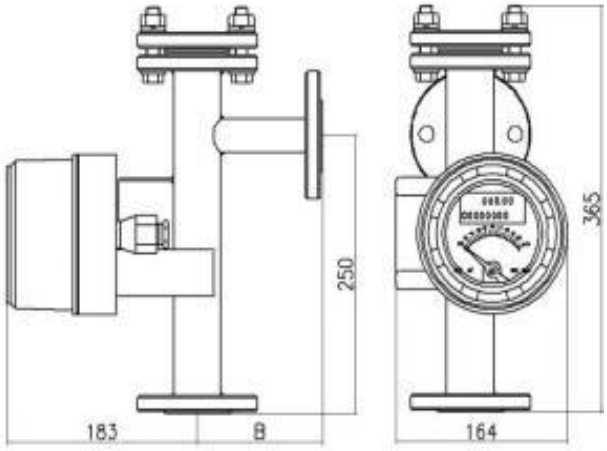
T-shaped structure M2 indicator

Diameter	DN15	DN25	DN50	DN80	DN100	DN150	DN200
T-shaped structure weight kg	6	10	20				
Spring structure weight kg				16	17	35	50

5.1.3 Bottom-in and side-out type



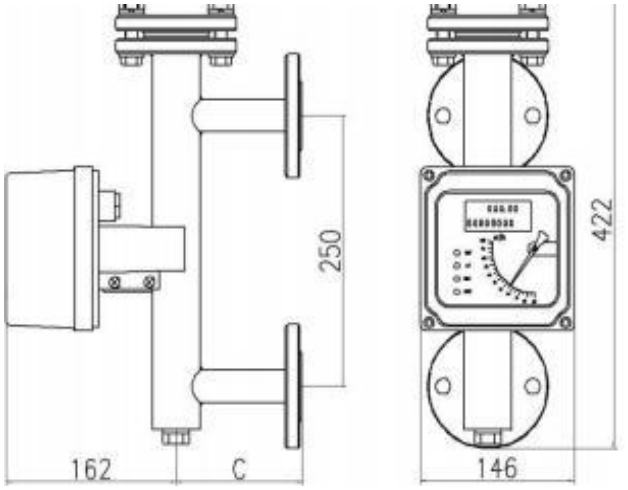
Standard M1 indicator



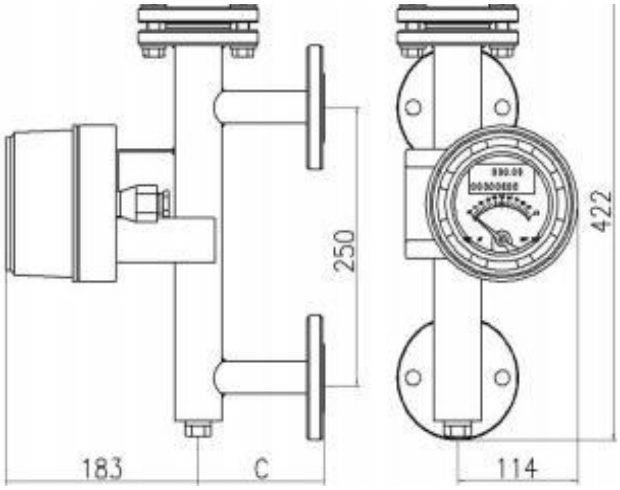
Standard M2 indicator

Diameter	DN15	DN25	DN50	DN80	DN100	DN150	DN200
B	100	120	135	150	160	180	200
Weight kg	5.5	6.5	13	22	26	50	57

5.1.4 Side-in and side-out type



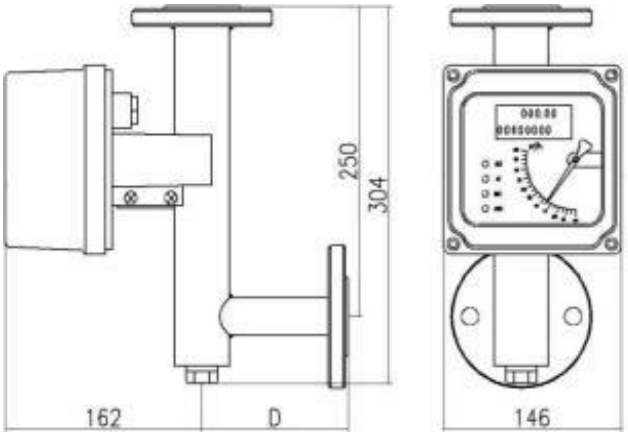
Standard M1 indicator



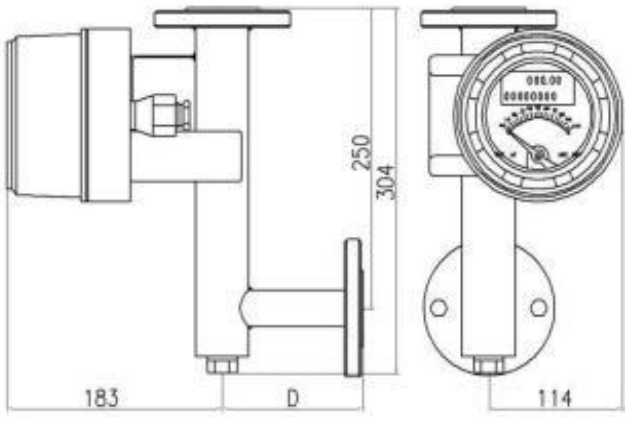
Standard M2 indicator

Diameter	DN15	DN25	DN50	DN80	DN100	DN150	DN200
C	100	120	135	150	160	180	200
Weight kg	6	7	14	24	28	52	60

5.1.5 Side-in and top-out type



Standard M1 indicator



Standard M2 indicator

Diameter	DN15	DN25	DN50	DN80	DN100	DN150	DN200
D	100	120	135	150	160	180	200
Weight kg	5.5	6.5	10.5	16	17	36	52

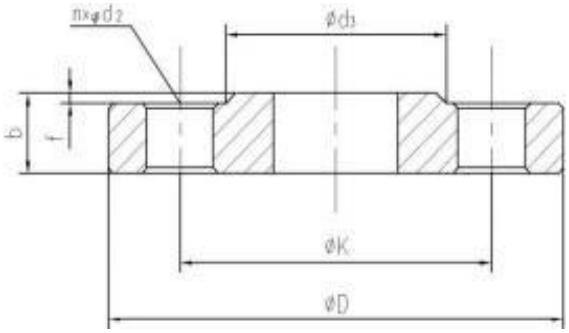
5.2 Flange size

The standard type metal tube rotameter flowmeter adopts the flange standard of HG/T20592-2009, the specific dimensions are shown in Table 6; other flange standards can be produced according to the requirements of users.

Ministry of Chemical Industry Standard Flange

(HG/T20592-2009)

DN/PN	D	K	d3	b	f	N	d2
15/4.0	95	65	46	14	2	4	14
25/4.0	115	85	65	16	2	4	14
50/4.0	165	125	99	20	2	4	18
80/1.6	200	160	132	20	2	8	18
100/1.6	220	180	156	22	2	8	18
125/1.6	250	210	184	22	2	8	18
150/1.6	285	240	211	24	2	8	22



Flange Dimensions

American National Standard Flange

(ANSI B 16.5 150lb)

DN	D	K	d3	b	f	N	d2
1/2”	88.9	60.5	35.1	11.2	1.6	4	15.7
1”	108.0	79.2	50.8	14.2	1.6	4	15.7
2”	152.4	120.7	91.9	19.1	1.6	4	19.1
3”	190.5	152.4	127.0	23.9	1.6	4	19.1
4”	228.6	190.5	157.2	23.9	1.6	8	19.1
5”	254.0	215.9	185.7	23.9	1.6	8	22.4
6”	279.4	241.3	215.9	25.4	1.6	8	22.4

German National Standard Flange

(DIN2501)

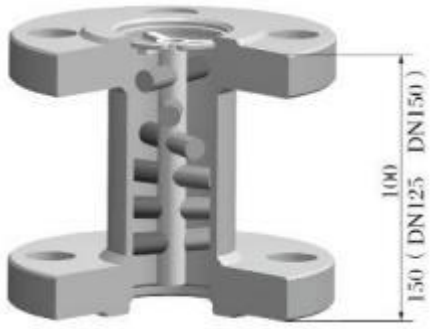
DN/PN	D	K	d3	b	f	N	d2
15/4.0	95	65	46	16	2	4	14
25/4.0	115	85	68	18	2	4	14
50/4.0	165	125	102	20	3	4	18
80/1.6	200	160	138	20	3	8	18
100/1.6	220	180	162	20	3	8	18
125/1.6	250	210	188	22	3	8	18
150/1.6	285	240	218	22	3	8	22

The DIN2501 flange standard is basically equivalent to the following standards and can be used together

Standard	Standard Name	Pressure Rating PN MPa					Standard	Standard Name	Pressure Rating PN MPa
HG20527-1992	Steel pipe flange	0.6	1.0	1.6	2.5	4.0	DIN2527-1992	Flange	0.25～10.0
HG20592-1992	Steel pipe flange	0.6	1.0	1.6	2.5	4.0	DIN2566-1975	Threaded flange	1.0～1.6
HG20592-1997	Steel pipe flange	0.6	1.0	1.6	2.5	4.0	DIN2573-1975	Flat welded flange	0.6～1.0
HGJ44～76-1991	Steel pipe flange	0.6	1.0	1.6	2.5	4.0	DIN2655-1975	Flat welding ring plate loose flange	0.25～4.0
GB112～9123-2000	Steel pipe flange	0.6	1.0	1.6	2.5	4.0	DIN2673-1962	Butt welding ring plate loose flange	1.0

5.3 Magnetic filter

If the media contains ferromagnetic particles, a magnetic filter should be installed at the upstream of the flowmeter inlet. For DN100 (included) or smaller, the height is 100mm; for more than DN100, the height is 150mm.



6. Indicator and Limit Alarm Device

The indicator of the metal tube rotameter flowmeter is the displaying and conversion part of the flow meter; the limit alarm device can realize the flow rate over-limit alarm and is used as the flow switch.

6.1. Selection of Indicator

User can choose the local display type, electric remote type, intrinsically safe explosion proof type, flameproof type or HART protocol type according to the actual needs of the site, the detailed functions of various indicators are shown in the following table.

Indicator Type	Function Description of Indicator
Model M0	Local indicator,pointer indication of instantaneous flow rate, no power supply, no 4-20mA remote transmission, optional flow rate alarm device,optional instantaneous flow rate value or percentage value dial.

Model M1	Square enclosure, both local and electric remote transmissions are available. For local type, the pointer indication of instantaneous flow rate, no power supply and no 4-20 mA remote transmission. For remote transmission, 24VDC power supply, local pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2-wire 4-20mA output, and panel has 4 keys for viewing and modifying internal parameters.
Model M2	Round enclosure, both local and electric remote transmissions are available. For local type, the pointer indication of instantaneous flow rate, no power supply and no 4-20 mA remote transmission. For remote transmission, flameproof design and optional HART protocol functions. 24VDC power supply, on-site pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2-wire 4-20mA output, and panel has 4 keys for viewing and modifying internal parameters.
Model M3	Square enclosure （ M9 ） , 24VDC power supply, local pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2 -wire 4-20mA output, and panel has 4 keys for viewing and modifying internal parameters.
Model M4	Round enclosure（M40）, both local and electric remote transmissions are available. For local type, the pointer indication of instantaneous flow rate, no power supply and no 4-20 mA remote transmission. For remote transmission, flameproof design and optional HART protocol functions. 24VDC power supply, on-site pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2 -wire 4-20mA output, and panel has 4 keys for viewing and modifying internal parameters.
Model M5	Large stainless steel enclosure, pointer indication of instantaneous flow rate or LCD indication of instantaneous and accumulated flow rate
Model M6	Small round stainless steel enclosure, instantaneous indication of flow rate, or LCD indication of instantaneous and accumulated flow rate
Model M7	Stamped small stainless steel enclosure,instantaneous indication of flow rate
Model M8	Stamped large stainless steel enclosure,instantaneous indication of flow rate or LCD indication of instantaneous and accumulated flow rate
Model M9	Round enclosure(blue), both local and electric remote transmissions are available. For local type, the pointer indication of instantaneous flow rate, no power supply and no 4-20 mA remote transmission. For remote transmission, flameproof design and optional HART protocol functions. 24VDC power supply, on-site pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2 -wire 4-20mA output, and panel has 4 keys for viewing and modifying internal parameters.
Model M10	Stamped stainless steel enclosure (diameter 146mm),instantaneous indication of flow rate

Model M11	Round enclosure(M30), both local and electric remote transmissions are available. For local type, the pointer indication of instantaneous flow rate, no power supply and no 4-20 mA remote transmission.. 24VDC power supply, on-site pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2-wire 4-20mA output.
Model M12	Round enclosure（Double electrical interface）, both local and electric remote transmissions are available. For local type, the pointer indication of instantaneous flow rate, no power supply and no 4-20 mA remote transmission. For remote transmission, flameproof design and optional HART protocol functions. 24VDC power supply, on-site pointer indication of instantaneous flow rate, LCD indication of instantaneous and accumulated flow rate, 2-wire 4-20mA output, and panel has 4 keys for viewing and modifying internal parameters.

6.2. Selection of Alarm Device

The K1 and K2 limit alarm devices are installed in the M1 local indicator, K1 is the lower limit and K2 is the upper limit, the alarm point can be freely set. K1, K2 alarm switch consists of two parts, one part is in the indicator and referred to as TG22. The TG22 is composed of a SJ3.5N sensor and the cutting blade on a rotating shaft. The alarm point can be freely set throughout the entire flow range and indicated on the dial by the positioning pointer. The other part is the external WE77/Ex transistor relay.

The SJ3.5 type sensor is used in conjunction with the transistor relays WE77/Ex-1 and WE77/Ex-2 to achieve the remote transmission of upper and lower limit alarm signals, and has intrinsically safe explosion-proof performance, the explosion-proof mark is Ex ia IICT6; of which WE77/Ex-1 can be provided with a SJ3.5 sensor to achieve the single alarm point control; WE77/Ex-2 can be provided with two SJ3.5 sensors to achieve the control of upper and lower alarm points.

6.21 WE77 transistor relay and SJ3.5 sensor's technical parameters are shown in the table below

Model	WE77/E-1	WE77/E-2	Model	SJ3.5-N	SJ3.5-SN
Power Supply	220VAC,24VDC		Power Supply	8VDC	8VDC
Power Consumption	About 3.5VA		Effective area, open	≥ 3mADC	
Working Temperature	-25℃～ +60℃		Effective area, closed	≤ 1mADC	≤ 1mADC
Open circuit voltage	8(13.5)V	8(13.5)V	Self inductance	250μH	100μH
Short Circuit Current	8(31)mA	8(62)mA	Self capacitance	50nF	60nF
Permissible inductance	3(31)mH	1(7.6)mH	Working temperature	-25℃～ +70℃	-40℃～ +100℃
Permissible capacitance	230(609)nF	160(539)nF			

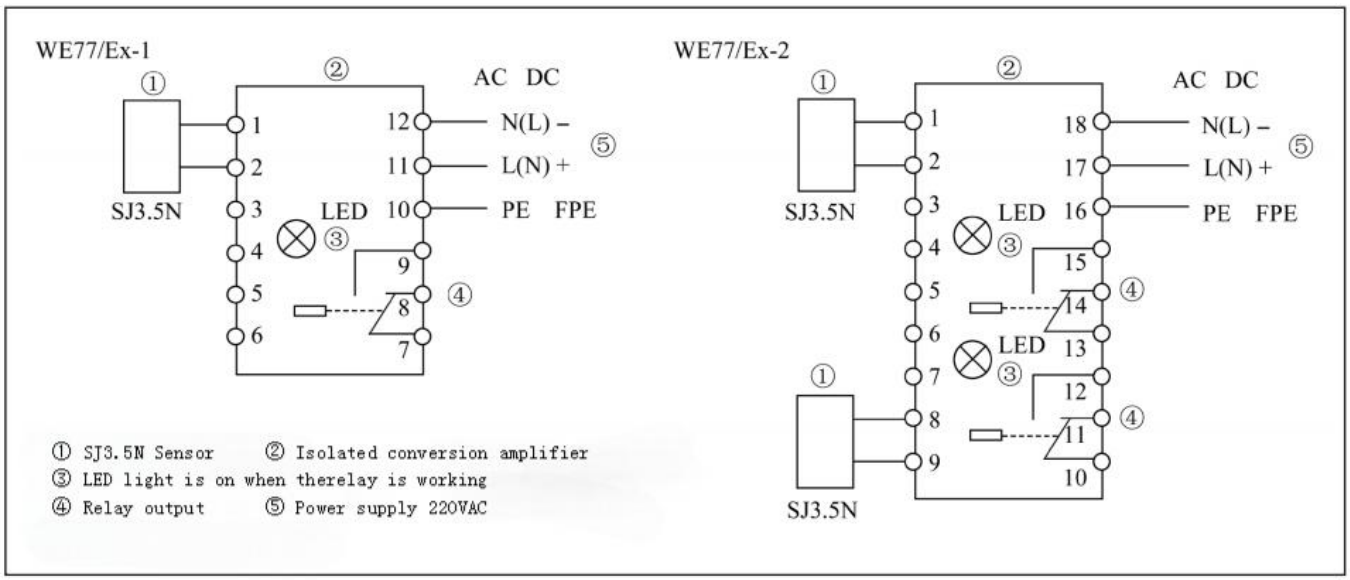
6.2.2 Adjustment and Electrical Connection of WE77 Transistor Relay and SJ3.5 Sensor:

Transistor relays include power supply, transistor rectification amplifiers and output intermediate relays. The WE77/EX-1 and WE77/EX-2 are usually connected to a normally open operating mode, which can be changed to a normally closed working mode or a normally closed working mode with open circuit monitoring by changing the wiring.

Replace the jumper according to the figure below to obtain various working conditions. An LED tube is used to indicate "relay closed".

Model	WE77/E-1	WE77/E-2	Model	SJ3.5-N	SJ3.5-SN
Power supply	220VAC、24VDC		Power supply	8VDC	8VDC
Contact capacity	3A		Effective area,open	≥ 3mADC	
Power Consumption	About 3.5VA		Effective area, closed	≤ 1mADC	≤ 1mADC
Working temperature	-25℃~ +60℃		Self inductance	250μH	100μH
Open circuit voltage	8(13.5)V	8(13.5)V	Self capacitance	50nF	60nF
Short circuit current	8(31)mA	8(62)mA	Working temperature	-25℃~ +70℃	-40℃~ +100℃
Permissible inductance	3(31)mH	1(7.6)mH			
Permissible capacitance	230(609)nF	160(539)nF			

6.2.3 Installation and Dimensions of WE77/Ex Transistor Relay (See the figure below)



7. Diameter Calculation and Flow Rate Table

The flow rate tables listed in this manual are calculated using water and air as the standard medium, therefore, the flow rate of the measured medium on the site must first be converted into the volumetric flow of water or air, and then check the corresponding diameter in the flow rate table. This section is used for the selection of flow meter diameter during the design.

7.1. Calculation of Liquid Flow Rate

7.1.1 Measured liquid's volume flow rate Qt

According to the density and maximum flow rate of liquid, put them into equation (1) to calculate the flow rate of water, then find the corresponding diameter and floater code in the flow rate table, and put the flow rate value of the water corresponding to the floater code into equation (1) again to calculate the flow rate of the measured liquid, then the flow rate is rounded to get measured liquid's scale range.

$$Q_S = \sqrt{\frac{(\rho_f - \rho_s)\rho_t}{(\rho_f - \rho_t)\rho_s}} \times Q_t \quad \text{.....(1)}$$

7.1.2 Measured liquid's mass flow Q_m

The calculation method is the same as above and the formula is based on equation (2)

$$Q_S = \sqrt{\frac{\rho_f - \rho_s}{(\rho_f - \rho_t)\rho_t\rho_s}} \times Q_m \text{.....(2)}$$

In which:

Q_t: Maximum volumetric flow rate of the measured liquid

Q_m: Maximum mass flow rate of the measured liquid

Q_s: Flow rate of calibration medium water

ρ_t: Density of floater

ρ_t: Density of the measured liquid

ρ_s: Density of calibration medium water

7.1.3 Calculation Example

For a kind of liquid, the operating density is 720 kg/m3, the maximum flow rate is 1800 l/h, calculate the diameter, floater code, and scale range.

Solution: Take the density of the floater as 7850 kg/m3 and the density of water as 1000kg/m3, put 720 (kg/m3) and 1800 (l/h) into formula (1),

Calculate to get $Q_S = \sqrt{\frac{(7850-1000)\times 720}{(7850-720)\times 1000}} \times 1800 = 1497.06$

Check the flow rate table to get: Diameter DN25, floater code: F25.2, Qs= 1600, re-put Qs to equation (1), calculate to get Qt= 1923.77, after rounding, determine the scale range of the measured liquid: 190~1900 l/h.

7.2. Calculation of Gas Flow Rate

Because the gas is greatly affected by temperature and pressure, its calculation is different from the calculation of liquid. In the flow rate conversion, not only the influence of density but also the influence of temperature and pressure should be taken into account, therefore, when calculating the gas flow rate, it is absolutely necessary to accurately provide the temperature and pressure of the measured gas under working conditions.

7.2.1 If the user gives the gas volume flow rate in the standard state, then calculate according to formula (3):

$$Q_S = \sqrt{\frac{\rho_{st}}{\rho_s} \times \frac{P_s}{P_t} \times \frac{T_t}{T_S}} \times Q_N \quad \text{……(3)}$$

7.2.2 If the user gives the gas volume flow in the operating state, then calculate according to formula (4):

$$Q_S = \sqrt{\frac{\rho_{st}}{\rho_s} \times \frac{P_t}{P_s} \times \frac{T_s}{T_t}} \times Q_t \quad \text{……(4)}$$

7.2.3 If the user gives gas' mass flow rate, then calculate according to equation (5):

$$Q_S = \sqrt{\frac{1}{\rho_t \times \rho_s}} \times Q_m \quad \text{……(5)}$$

Q_N: Maximum volumetric flow rate of the gas in the standard state (Nm^3/h)

Q_t: Maximum volumetric flow rate of the gas in the operating state (m^3/h)

Q_m: Maximum mass flow rate of gas (kg/h)

Q_s: Volumetric flow rate of air in the calibration state(m^3/h)

ρ_{st}: Density of gas in the calibration state (kg/m^3)

ρ_s: Density of air in the calibrated state (kg/m^3)

ρ_t: Density of gas in operating condition (kg/m^3)

Ps: Absolute pressure of the air in calibration state (0.1MPa)

P_t: Absolute pressure of the gas in operating condition (MPa)

T_s: Absolute temperature of the air in the calibration state (K)

T_t: Absolute temperature of the gas in the operating condition (K)

7.2.4 Calculation Example

A kind of gas, carbon dioxide, average molecular weight 44, process pressure 0.2 MPa, process temperature 25 ℃, maximum flow rate 48Nm^3/h, please calculate diameter, floater code and scale range.

Solution:

ρ_{st}= 1.803kg/m^3 P_t =0.2+0.1=0.3MPa

ρ_s= 1.2041kg/m^3 T_t =273.15+25=298.15K

Ps=0.1MPa Ts =293.15K Q_N =48Nm^3/h

Put the above known conditions into equation (3)

Get $$Q_S = \sqrt{\frac{1.803}{1.204}\times\frac{0.1}{0.3}\times\frac{298.15}{293.15}} \times 48 = 34.2$$

Check the flow rate table to get: Diameter DN25, floater code F25.1, Q_S=35 after rounding. Re-put QS into equation (3) to get Q_N=49.123Nm^3/h,

The scale range of the measured medium after rounding is: 4.9 to 49 Nm^3/h.

7.3. Floater Density Tables of Various Materials

Material	CrNi Stainless Steel	PTFE	C4 Hastelloy	Ti Titanium Alloy
Density (t/m^3)	7.85	3.4	8.3	2 .1

Note: Standard state: 0℃ (273.15K), 0.1MPa

Calibration state: 20℃ (293.15K), 0.1MPa

7.4. Flow Meter

◆ Vertically installed flow meter (see the following table)

Diameter	Floater code	Water L/h (0.1013MPa abs, 20℃)		Air m3/h (0.1013MPa abs, 20℃)	Pressure loss kPa (Negotiate with the manufacturer if low pressure loss is required)	
	Floater Material	Stainless Steel	PTFE、Ti	Stainless Steel	Stainless Steel	PTFE、Ti
DN15	F15.0	10	-	-	1.5	-
	F15.1	16	-	0.5	1.5	-
	F15.2	25	-	0.7	1.5	-
	F15.3	40	25	1.2	1.5	1.5
	F15.4	60	40	1.8	1.5	1.5
	F15.5	100	60	2.8	1.5	1.5
	F15.6	160	100	4.5	1.5	1.5
	F15.7	250	160	7.5	3.0	1.5
	F15.8	400	250	12	3.0	3.0
	F15.9	600	400	18	3.5	3.0
DN25	F25.0	1000	600	30	1.5	1.5
	F25.1	1200	800	35	1.5	1.5
	F25.2	1600	1000	45	3.0	1.5
	F25.3	2000	1200	60	3.0	1.5
	F25.4	2500	1600	75	3.5	3.0
	F25.5	3000	2000	90	3.5	3.0
	F25.6	4000	2500	120	8.0	3.5
	F25.7	5000	3000	150	8.0	3.5
	F25.8	6000	-	180	16.0	-
DN50	F50.0	6000	4000	180	3.0	3.0
	F50.1	8000	5000	240	3.0	3.0
	F50.2	10000	6000	300	4.0	3.0
	F50.3	12000	8000	360	4.0	3.0
	F50.4	16000	10000	480	8.0	4.0
	F50.5	20000	12000	600	8.0	4.0
DN80	F80.0	25000	16000	750	14.0	8.0
	F80.1	30000	20000	900	14.0	9.0
	F80.2	40000	25000	1200	20.0	12.0
	F80.3	50000	30000	1500	20.0	15.0
DN100	F100.0	60000	40000	1800	28.0	25.0
	F100.1	80000	50000	2400	28.0	27.0
	F100.2	100000	60000	3000	40.0	38.0
DN125	F125.1	100000	80000	3000	45.0	35.0
	F125.2	125000	100000	-	48.0	40.0
DN150	F150.1	125000	100000	-	48.0	40.0
	F150.2	150000	125000	-	50.0	42.5
DN200	F200.1	150000	Consult the manufacturer for special requirements			
	F200.2	200000				

◆ Horizontally installed flow meter (see the following table)

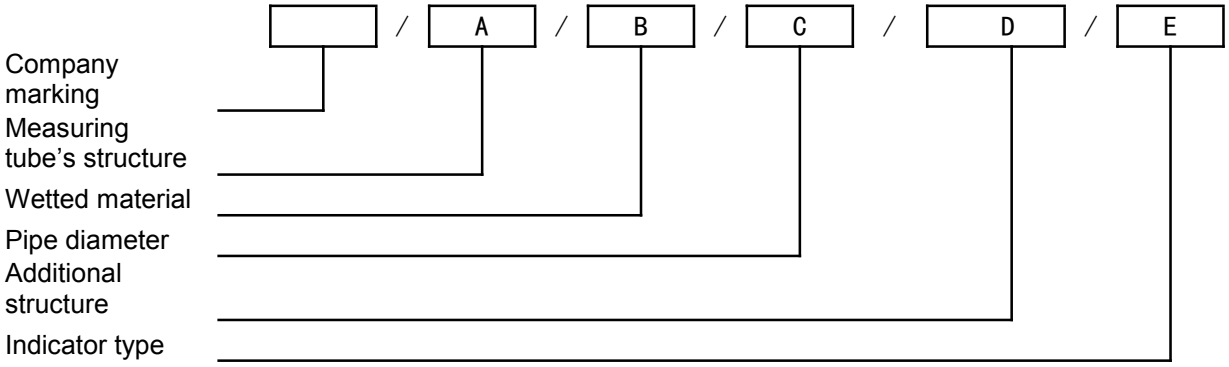
Diameter	Floater code	Water L/h (0.1013MPa, 20℃)		Air m3/h (0.1013MPa, 20℃)	Pressure loss kPa (Negotiate with the manufacturer if low pressure loss is required)	
	Floater Material	Stainless Steel	Ti	Stainless Steel	Stainless Steel	Ti
DN15	F15.5	160	100	4.5	1.5	1.5
	F15.6	200	120	6.0	1.5	1.5
	F15.7	250	160	7.5	2.0	2.0
	F15.8	400	250	12	2.0	2.0
	F15.9	600	400	18	3.5	3.5
DN25	F25.0	1000	600	30	1.5	1.5
	F25.1	1600	1000	45	1.5	3.0
	F25.2	2000	1200	60	3.0	3.0
	F25.3	2500	1600	75	3.0	3.5
	F25.4	3000	2000	90	3.5	3.5
	F25.5	4000	2500	120	8.0	8.0
DN50	F50.0	6000	4000	180	3.0	3.0
	F50.1	8000	5000	240	3.0	3.0
	F50.2	10000	6000	300	4.0	4.0
	F50.3	12000	8000	360	4.0	4.0
	F50.4	16000	10000	480	8.0	8.0
DN80	F80.1	25000	16000	750	14.0	14.0
	F80.2	30000	20000	900	14.0	14.0
	F80.3	40000	25000	1200	20.0	22.0
DN100	F100.0	60000	40000	1800	30.0	30.0
	F100.1	80000	50000	2400	30.0	30.0
	F100.2	100000	60000	3000	45.0	45.0
DN125	F125.1	100000	80000	3000	45.0	45.5
	F125.2	125000	100000	-	46.0	48.0
DN150	F150.1	125000	100000	-	48.0	46.0
	F150.2	150000	125000	-	50.0	50.0
DN200	F200.1	150000	Consult the manufacturer for special requirements			
	F200.2	200000				

Note: The data in the flow meter is the standard parameters of the meter, if the user has special flow range requirements, please consult with the supplier.

Reference table (clamp type) for sanitary flow meter is generally subject to the American standard

DN	Pipe Standard	OD of Pipe	Clamp Size
15	1/2”	φ19	φ50.5
20	3/4”	φ22	φ50.5
25	1”	φ25.4	φ50.5
32	1.1/4”	φ32	φ50.5
40	1.1/2”	φ38	φ50.5
50	2”	φ51	φ64.0
65	2.1/2”	φ63	φ77.5
80	3”	φ76	φ91.0
100	4”	φ101.6	φ119

8. Guide on Flange Selection



Measuring tube's structure A		Wetted material B		Pipe diameter C				Additional structure D	
1-	Bottom-in and top-out	R0-	06Cr17Ni12Mo2	Flange type		Sanitary type		No	
2-	Top-in and bottom-out	R1-	06Cr19Ni10/304	DN15	DN65			T-	Jacket type
3-	Bottom-in and top side-out	RP-	PTFE	DN20	DN80	K19	K38	Z-	Dampinɡ type
4-	Bottom side-in and top side-out	Ti-	Titanium alloy	DN25	DN100	K22	K51	G-	High temperature type
5-	Right-in and left-out	RL-	022Cr17Ni12 Mo2/316L	DN32	DN125	K25	K63	Y-	High pressure type
6-	Left-in and right-out			DN40	DN150	K32	K76		
				DN50	DN200		K101		

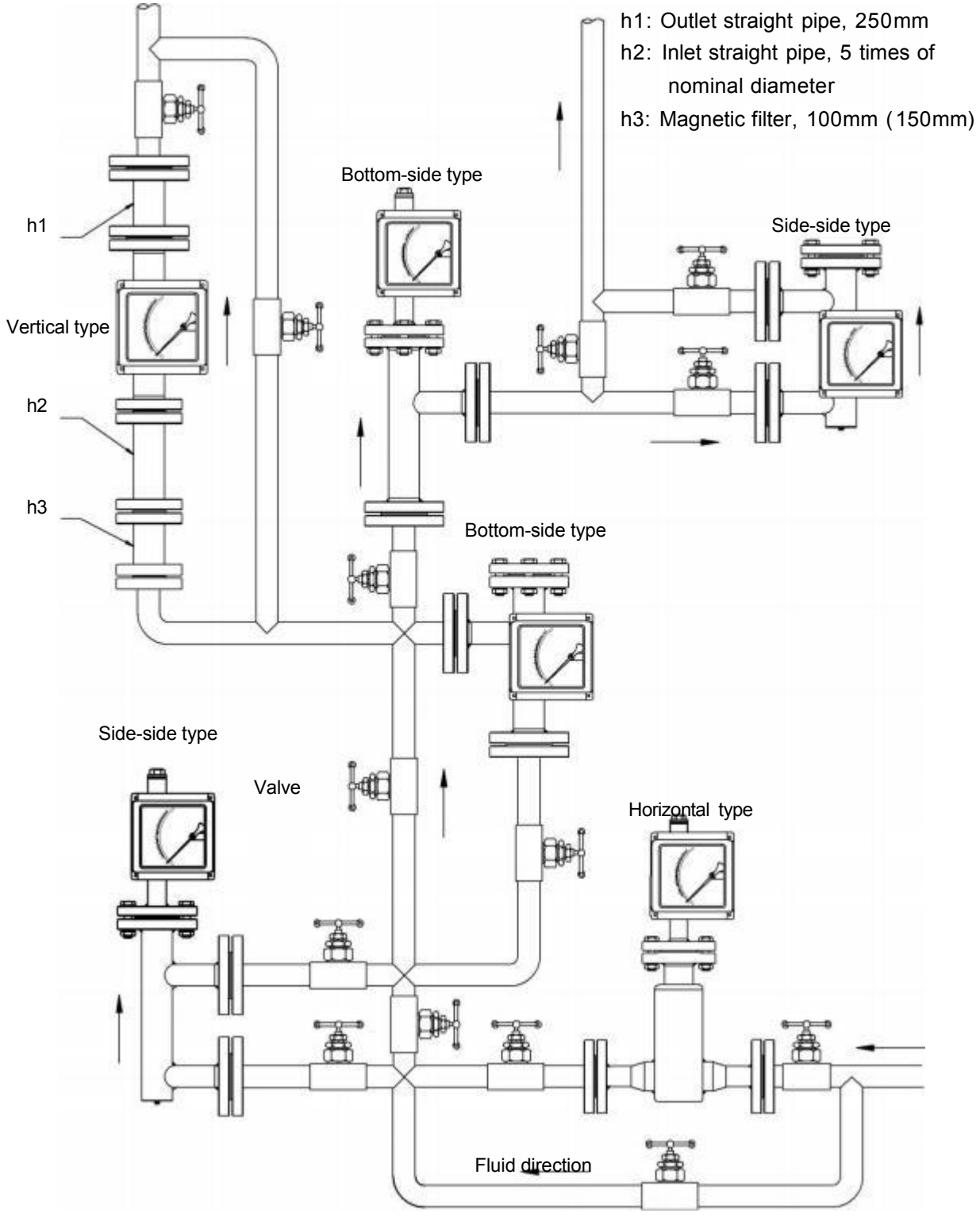
E Code combination of indicator form	
M0	Local indicator, mechanical pointer indication of instantaneous flow.
M1	Square enclosure, mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow
M2	Round enclosure(white), mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow is also available
M3	Square enclosure（M9）, mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow is also available
M4	Round enclosure（M40）, mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow is also available
M5	Large stainless steel round enclosure, mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow is also available

M6	Small stainless steel round enclosure, mechanical pointer indication of instantaneous flow rate.LCD indication of instantaneous/accumulated flow is also available	
M7	Stamped small stainless steel enclosure,instantaneous indication of flow rate	
M8	Stamped large stainless steel enclosure,instantaneous indication of flow rate or LCD indication of instantaneous and accumulated flow rate	
M9	Round enclosure(blue), mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow is also available	
M10	Stamped stainless steel enclosure(diameter 146mm), instantaneous indication of flow rate	
M11	Round enclosure(M30), mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow	
M12	Round enclosure(Double electrical interface), mechanical pointer indication of instantaneous flow rate, LCD indication of instantaneous/accumulated flow is also available	
	Power supply	
	None	M0 indicator only
	A	220VAC 50Hz power supply, 4-20mA signal output, backlight is available
	B	Battery-powered, no signal output
	C	24VDC two-wire power supply, 4-20mA signal output, backlight is available
	D	24VDC three and four-wire power supply, 4-20mA signal output, backlight is available
	Explosion-proof marking	
	None	Ordinary non-explosion-proof
	i	Intrinsically safe Ex ia IICT6
	d	Flameproof Ex d IICT6
	Alarm or pulse output	
	None	Without alarm or pulse output
	K1	Upper limit alarm or one pulse output
	K2	Lower limit alarm or one pulse output
	K3	Upper and lower limit alarm or dual pulse output
* For M0 indicator,if alarm function is selected, the alarming is started by initiator and the corresponding transistor relay.		

9.Installation Method and Considerations of Flow Meter

Flow meters of different specifications can be selected according to the layout of on-site process piping, of which the vertical installation type is standard type, and all other types are extended types. For example, if the conditions of site permit, the vertical type is preferred. The following schematic diagram can be referred for various installation methods of flow meter.

schematic diagram of flow meter installation



9.1 Considerations for flow meter Installation

9.1.1. When the meter arrives at the site, before being installed in the process line, it should be unpacked to carefully inspect the meter for any shipping damage.

9.1.2. Prior to installation, the process pipeline shall be purged and cleaned to prevent ferromagnetic impurities in the pipeline from attaching to the floater of the meter, which will affect the normal measurement of the instrument, even damage the meter. If it cannot be avoided, a magnetic filter at the meter inlet should be installed(Figure 17).

9.1.3. Because the instrument's measuring mechanism uses magnetic transfer and magnetoelectric signal processors, in order to ensure the normal use and performance of the instrument, ferromagnetic substances, strong magnetic fields or strong electromagnetic fields are not allowed to exist within at least 500mm of the installation position.

9.1.4. The meter installed in the pipeline shall not be affected by stress; the inlet and outlet of the meter shall have reasonable pipeline support so that the meter will be affected by the least stress from the process pipeline.

9.1.5. The installations of the meter are divided into horizontal installation and vertical installation; for vertically installed instruments, the verticality of the meter should be ensured and the tilt deviation should not exceed 3 degrees; for horizontally installed instruments, the horizontal straightness of the meter should be ensured and the tilt deviation should not be greater than 3 degrees.

9.1.6. When the meter is installed, the diameter of the upstream and downstream pipelines should be the same with the diameter of the instrument, and the connection flanges should be matched with each other; to ensure the measurement accuracy and stability of the instrument, the length of the straight pipe upstream of the meter is 5 times the nominal diameter of the instrument; the minimum length of the downstream straight section is 250mm.

9.1.7. Meters for gas measurement, if the meter discharges gas directly into the atmosphere, it will cause the distortion of meter data and even the damage of instrument. In such working condition, a throttle valve should be installed at the exit of the instrument.

9.1.8. Be careful when installing PTFE-lined instruments. Under low temperature conditions, PTFE will also be deformed under the influence of pressure, therefore, do not arbitrarily tighten the screws, the installation torques are shown in the table below.

mm Diameter mm	kgf.m Maximum torque Kgf.m	Stud bolt
DN15	0.9 ～ 0.95	4×M12
DN25	2.0 ～ 2.2	4×M12
DN50	5.2 ～ 5.6	4×M16
DN80	4.5 ～ 4.8	8×M16
DN100	4.6 ～ 5.0	8×M16
DN125	5.0 ～ 5.3	8×M18
DN150	6.5 ～ 6.8	8×M20

9.2 Meter Maintenance

9.2.1. The meter is a precision device, it must be handled with care in transportation, installation, storage and use; the savage transport, over-stressed installation and indiscriminate placement should be avoided. In all operations, the relative position of the sensor and the indicator must be ensured, and the position change will directly affect the measurement accuracy of the instrument.

9.2.2. In the course of long-term use, ferromagnetic impurities in the pipeline will be inevitably attached on the floater, which will jam the float or affect the measurement accuracy, the floater in the sensor must be cleaned from time to time; if a magnetic filter is installed , it also needs to be regularly cleaned.

9.2.3. The meter indicator is equipped with electronic components in it, after the meter is wired or the enclosure is removed, the screw must be tightened, the sealing performance of the enclosure must be ensured to prevent the entry of impurities, water or other substances, meanwhile, the reliable grounding of meter enclosure must also be ensured.

9.2.4. After the meter is installed, when it is used for the first time, please pay attention to:

When opening the valve, in order to avoid the floater crashing the limit device and causing damage to the meter by formed pressure shocks. Be sure to open the valve slowly!

Instruments for measuring gas are equipped with a gas damper to minimize the oscillation of the floater; to ensure the stability of the floater, a throttle valve can be installed at the outlet of the instrument.

9.2.5. For remote-type instruments, it is necessary to ensure that the instrument's wiring is properly connected before it is powered; for hazardous applications, explosion-proof type must be selected and installed in accordance with the explosion-proof requirements.

10. Electrical Connections

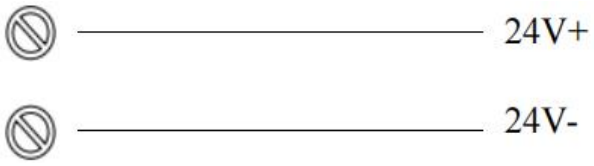
This chapter mainly introduces the power supply wiring of the flow meter, the connection with the safety barrier, and the technical parameters of the safety barrier.

10.1. Power wiring of flow meter

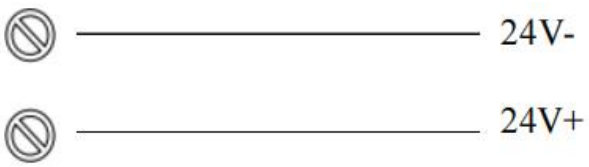
First, unscrew the front cover, you can see the terminals on the circuit board and connect the power cable according to the marking. The flame proof type should be grounded internally. The flow meter is a 2-wire 4-20mA output.

10.1.1 24VDC wiring diagram

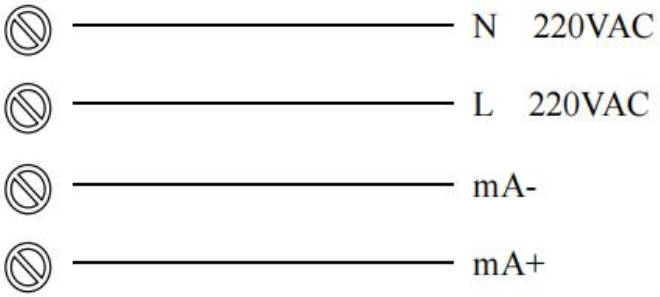
1. Square enclosure



2.Round enclosure

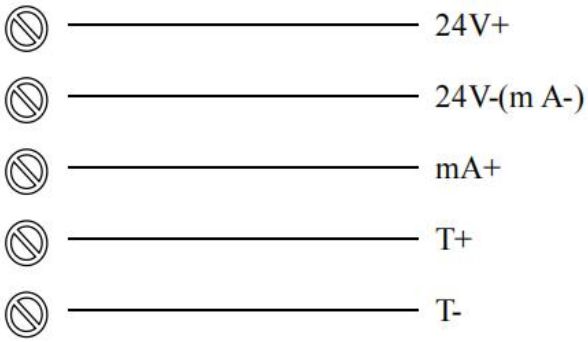


10.1.2 220VAC wiring diagram

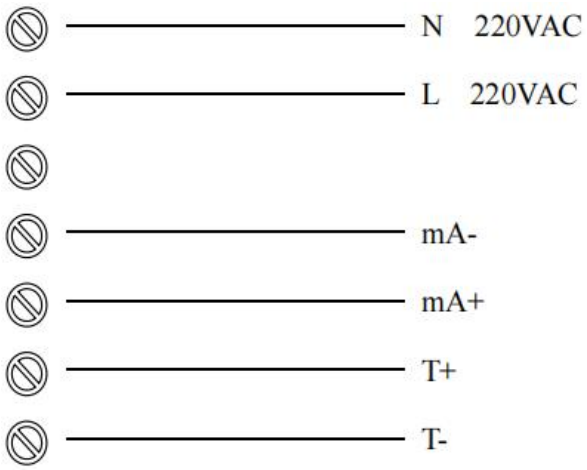


10.1.3 RS485 wiring diagram (T+ and T- are RS485 communication ports.
Do not connect to power supplies!!!)

24VDC wiring diagram

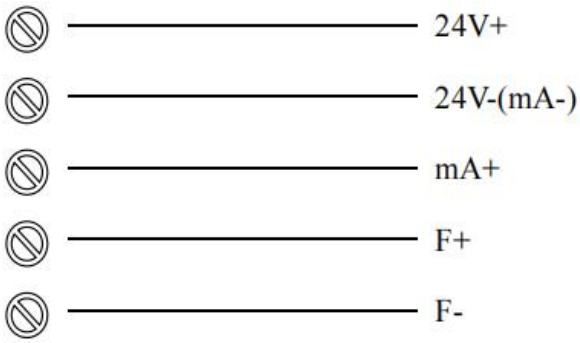


220VAC wiring diagram

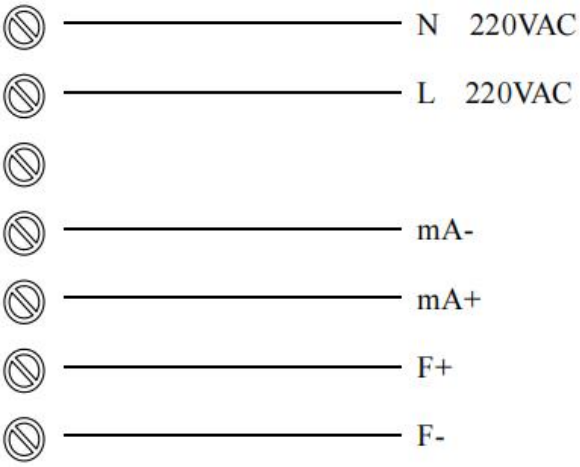


10.1.4 Cumulative pulse output wiring diagram

24VDC wiring diagram

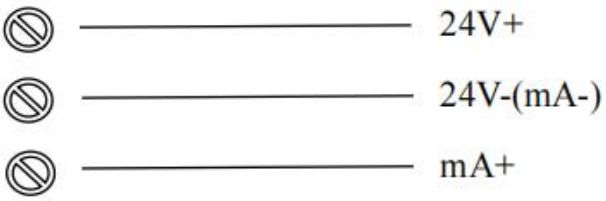


220VAC wiring diagram

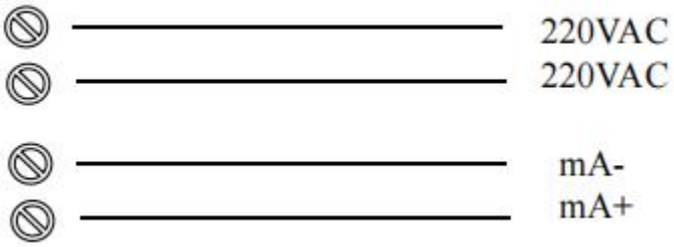


10.1.5 Double relay output wiring diagram

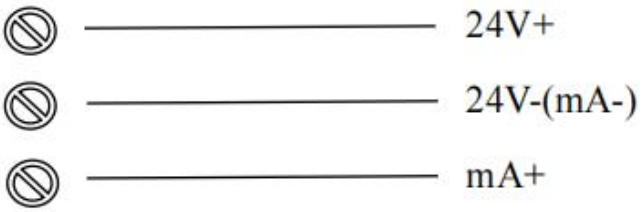
24VDC wiring diagram



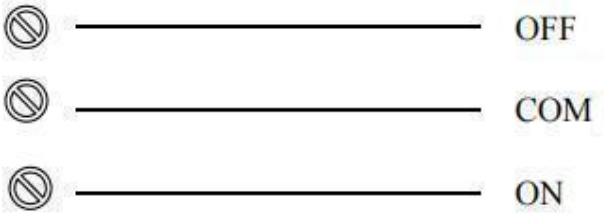
220VAC wiring diagram



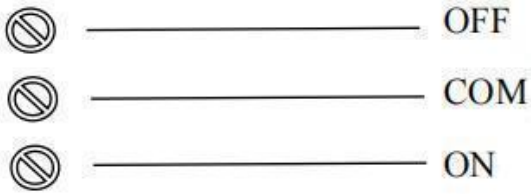
Upper alarm output terminal：



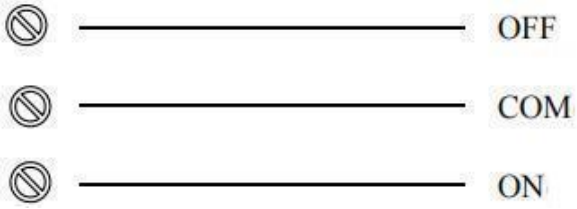
Upper alarm output terminal：



Lower limit alarm output terminal：

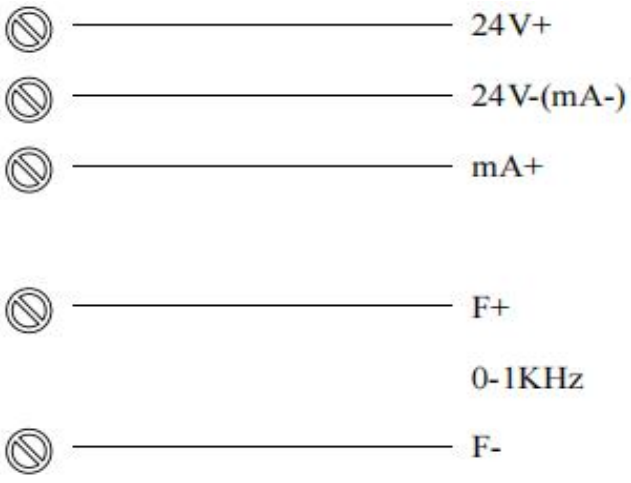


Lower limit alarm output terminal：



10.1.6 Instantaneous frequency output wiring diagram

24VDC wiring diagram



11. Operation Method of Indicators

The indicator directly displays the instantaneous flow and accumulated flow rate of the fluid through the LCD screen. The internal parameters of the meter can also be viewed using the 4 keys on the panel, and some of the parameters can be reset to realize the calibration function.

The basic parameters of this indicator are open to the user and can be accessed for viewing or modification by setting the corresponding password.

11.1 Key Definition

This product is designed with four buttons as follows:

SET	AT	INC	DEC

SET key: Main key function key, parameter confirmation;

AT key: Left shift key, moves the cursor to the left;

INC key: +1 key, and backward page key;

DEC key: -1 key, and page forward key.

11.2 Basic parameter annotations:

Password (CODE): 00001

parameters	Parameter Meaning	Setting range	Instructions
dPI	Decimal point set value	0～3	Corresponding operand
IEL	Cumulative traffic high 6 bits	The high value of accumulated traffic is automatically recorded	Read-only parameter
dFL	4mA calibration value	After entering this parameter, use a high-precision ammeter to measure the current value, and then input the current reading of the multimeter into this parameter to confirm, you can automatically calibrate the 4mA output.	
dFH	20mAcalibration value	Same method as above.	
Cod	Instrument slope correction	Default 1.0	
SPH	Full scale set value		

dLL	Small signal excision value	It is generally set at 10% of full scale	
LPd	The damping value can be set freely according to the field situation	0～10	It's usually set to 4
HFL	Sensor serial number	This value is not set when there is no HART requirement and no remote transmission upper and lower alarm type	HART parameter
HFd	Flow unit	Cyclic display: m3/h, L/h, Nm3/h, Nl/h, m3/min, L/min, Nm3/min, NL/min, kg/h, t/h, kg/min, t/min	0 to 11
HFP	Flowmeter installation form	"0" indicates down, "1" indicates up and down	Default is 0
HdL	Communication baud rate	0 indicates that the baud rate is 2400, and 1 indicates that the baud rate is 4800. 2 indicates that the baud rate is 9600, and 3 indicates that the baud rate is 19200	
HdC	The flow unit of the sensor caliber is only m^3/h or L/h	If HdC is set to 0, the indicator does not calculate the flow rate and displays instantaneous traffic If HdC is set to 1, the indicator calculates and displays the current flow rate by DN15 If HdC is set to 2, the indicator calculates and displays the current flow rate by DN20 If HdC is set to 3, the indicator calculates and displays the current flow rate by DN25 If HdC is set to 4, the indicator calculates and displays the current flow rate by DN32 If HdC is set to 5, the indicator calculates and displays the current flow rate by DN40 If HdC is set to 6, the indicator calculates and displays the current flow rate by DN50 If HdC is set to 7, the indicator calculates and displays the current flow rate by DN65 If HdC is set to 8, the indicator calculates and displays the current flow rate by DN80	0 to 12

HdC	The flow unit of the sensor caliber is only m^3/h or L/h	If HdC is set to 9, the indicator calculates and displays the current flow rate by DN100 If HdC is set to 10, the indicator calculates and displays the current flow rate by DN125 If HdC is set to 11,the indicator calculates and displays the current flow rate by DN150 If HdC is set to 12, the indicator calculates and displays the current flow rate by DN200	0 to 12
HdP	Equipment serial number	This value is not set if HART is not required	HART parameter
SOP	Parameter exit interface		

Note: When the indicator is a remote upper and lower limit alarm type, the functional meaning of the three parameters HFP, HFL, HFD has changed, and the functions of the three parameters are as follows:

Remote transmission upper and lower alarm type parameter description

argument	Parameter meaning	Set range	Instructions
HFP	Upper alarm value	0-Fullscale	User can modify, (When the instantaneous flow is higher than this value, the upper limit contact switch suction alarm)
HFL	Lower alarm value	0-Full scale	The user can modify, (when the instantaneous flow is lower than this value, the lower limit contact switch suction alarm)
HDC	Alarm point hysteresis setting	0 to 255	The Flow meter does not set decimal
		0 to 25.5	The flow meter is set to 1 decimal place
		0 to 2.55	The flow meter is set to 2 decimal places
		0 to 0.255	The flow meter is set to 3 decimal places
Note: When setting the alarm value, it should follow the principle that the upper alarm value is greater than the lower alarm value! Contact switching capacity: 24VDC 0.2A, passive switching output.			

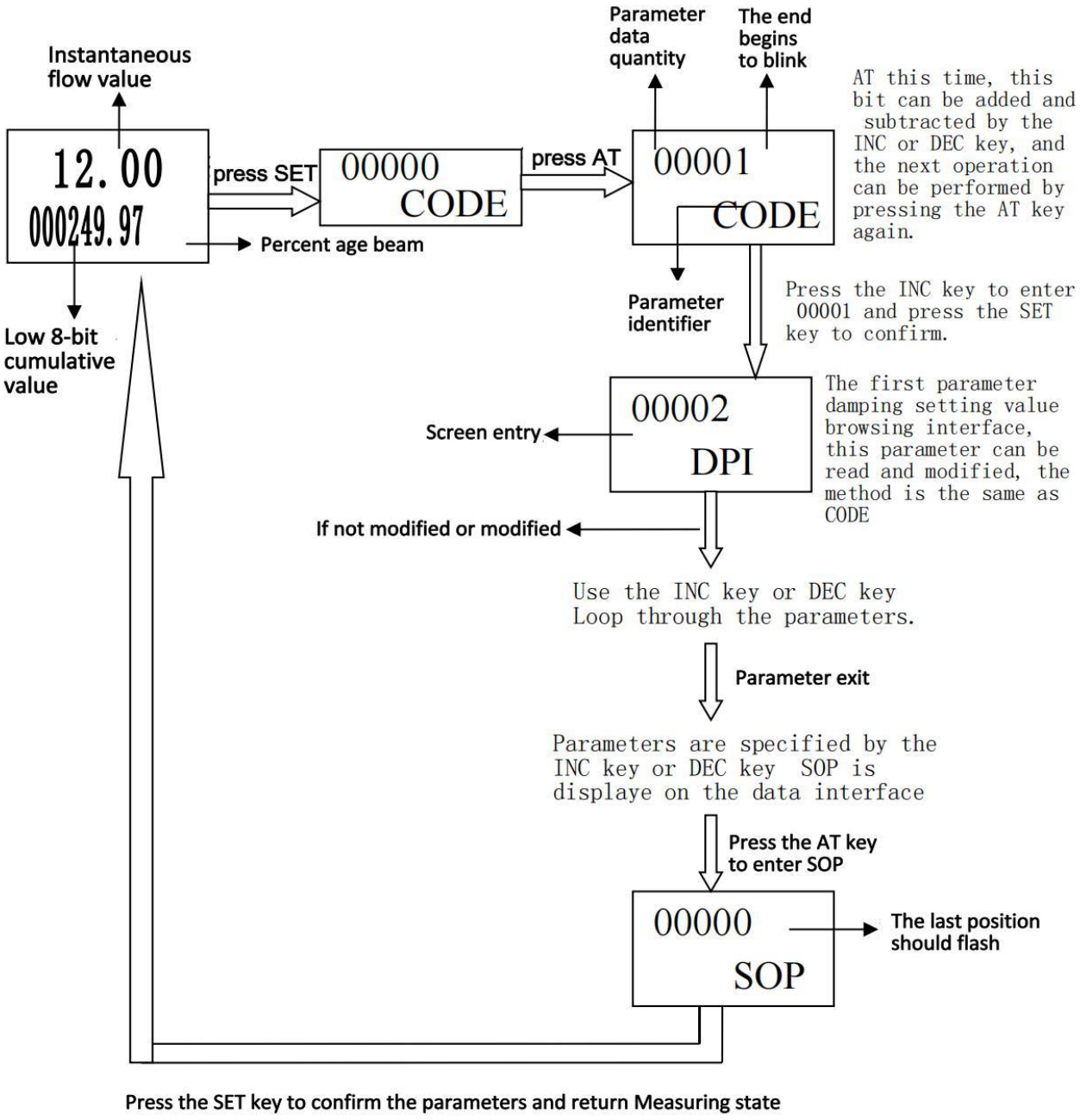
11.3 Enter the password Enter the password to access the function screen of each group:

In the measurement interface state, press SET key to release the "CODE" character, press "AT" key to select the cursor position, press "INC" or "DEC" key to enter the corresponding password value, and then press "SET" key to confirm, you can enter the functional interface of the group.

11.4 Methods for modifying parameters of each instrument:

The user can modify the basic parameters, enter the password, use the page turning key to find the corresponding parameter, click the AT key to enter the parameter, use the cursor left key (AT) and the addition and subtraction key (INC, DEC) to modify the parameter, and then click the "SET" key to confirm the parameter modification.

In the measurement screen, go to browse parameter example:



11.5 Indicator Group password password and corresponding function

11.5.1 Basic Parameters, password (CODE) : 00001

After entering, you can view and modify basic parameters.

11.5.2 Manually Clear the Accumulator. Password: 00002

Enter the parameter confirmation to complete the cumulant zero, and then automatically return to the measure -ment state, while the cumulant will be accumulated from zero.

11.5.3 Restoring Factory Settings, password: 00009

Enter this set of parameters to restore the flow meter factory setting value.

11.5.4 Calibration password, CODE: 00188

Default 11 point calibration method.

This password is the manufacturer's password and does not need to be opened to on-site users.

11.5.5 Calibration password (CODE) : 00166

Arbitrary point calibration method, but at least the zero point and the range point need to be calibrated.

11.6 Indicator calibration procedures are described in detail

This indicator defaults to 11 point calibration mode.Specific operations are as follows:

11.6.1 Basic parameter setting

1.1 Confirm the decimal number according to the calibrated single range and input (corresponding parameter dPI).

This indicator specification：

Measuring range ≤60, optional 3 decimal places;

Measuring range ≤600, optional 2 decimal places;

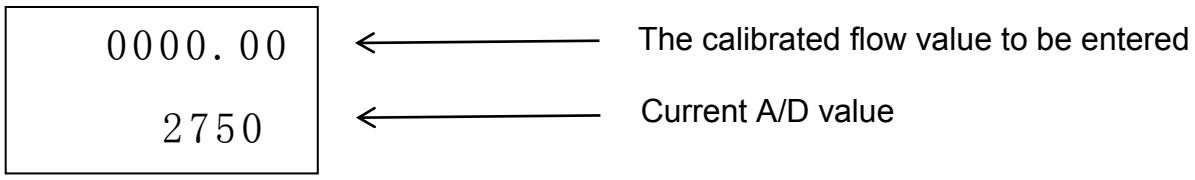
Measuring range ≤6000, optional 1 decimal place;

Measuring range > 6000 Select no decimal.

1.2 Input range (corresponding parameter SPH), calibrate zero 4mA current (corresponding parameter dFL), calibrate 20mA current (corresponding parameter dFH) and other parameters.

11.6.2 Entering the CODE screen, enter password 000188 to enter the calibration screen.

The interface is as follows：



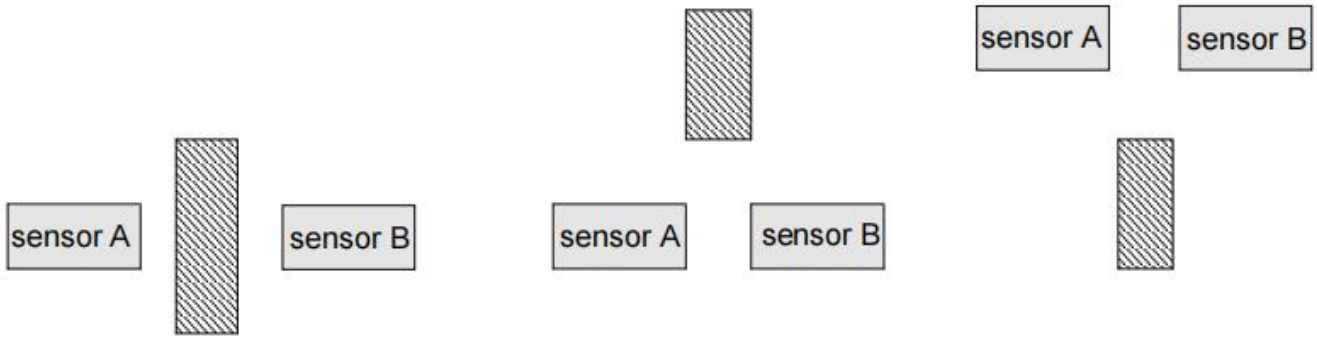
At this time, the interface displays the current required input calibration flow uplink, and displays the real -time measurement of the current A/D value downlink. Note that the magnetic steel on the pointer shafting must be fixed first at this time.

Take the vertical down and up rotameter as an example:

2.1 Magnetic steel position

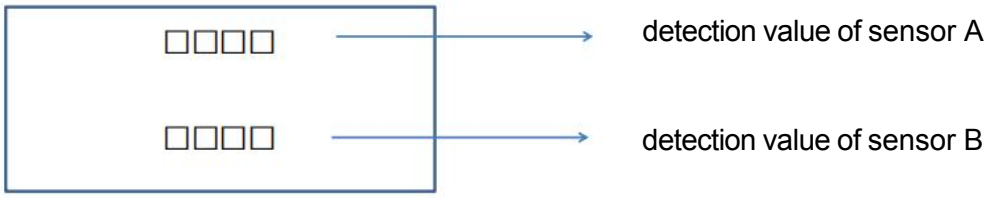
The converter uses dual Hall sensors to measure the rotation Angle of the magnetic steel, and the effective value is 120 degrees.The Hall sensor can detect the effective Angle value of the upper end face or the lower end surface of the magnetic steel, so pay attention to the relative position of the magnetic steel and the Hall the magnetic steel above or below the Hall sensor when using, and the magnetic steel should not be placed in the middle of the Hall sensor.

The magnetic steel should be placed above or below the Hall sensor.



2.2 Magnetic steel initial position adjustment method

2.2.1 Enter password



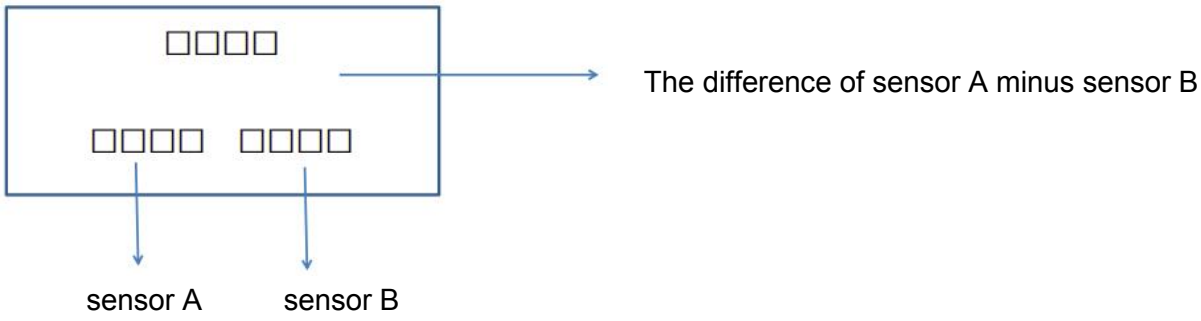
2.2.2 Fix the pointer in the middle position of the dial, rotate the induction magnetic steel, and observe the values of the sensors A and B, so that the two detection values are nearly equal.

The pointer moves from the bottom up (standard type), and it should be noted that the sensor A should change from large to small, and the zero point of the sensor A should be adjusted to about 2700.

The pointer moves from the top down (spring structure), and it should be noted that the sensor B should change from large to small, and the zero point of the sensor B should be adjusted to about 2700.

2.2.3 Converter signal matching (IEL: matching value), this step must be performed after completing step 2.2.

Press the INC key at this point :



Push the pointer slowly with the hand, so that the difference between the two sensors is zero or less than 10, then the converter will automatically match the converter zero value. After matching will automatically exit to return to the measurement interface, and the matching value into the "IEL" parameter.

2.2.4 After the match is successful, you can enter the "00001" password to see whether the IEL value is the sample value when the two signals are equal. Close to the value can be (the difference between the middle value is not more than 4), if the difference is large, you need to enter the 00036 password again, and then press the INC key to re-match.

Or two sensors A and B can be directly input into parameter IEL equivalent.

2.2.5 After the above steps are complete, the converter can be used normally.

2.3 Calibration：

Note that the calibration process must be scaled from small to large and zero must be calibrated. The indicator defaults to 11 point calibration mode (zero, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%).

① zero mark

In the calibration interface, confirm that the meter sensor is in the zero state and press the AT key, then the instrument enters the first standard point interface. The liquid crystal down A/D value is locked, no longer with the magnetic steel changes, the liquid crystal up starts to blink and display the current standard point flow value, then display zero, directly press SET to confirm, at this time the first point zero calibration is completed, the instrument returns to the initial calibration interface, the liquid crystal up no longer flashes and displays the next standard point flow value. LCD downlink A/D values are measured in real time to prepare for the next standard point.

② Calibration of other points

At this time, the next point should be marked according to the actual situation in order (10% flow point after the zero point is marked, 10% flow point is 20% point after the 10% flow point is marked...) For example, after the zero mark 10% point, the pointer action to the 10% flow point position is stable, after pressing the AT key, the liquid crystal down A/D value is locked, no longer changes with the magnetic steel, the liquid crystal up began to blink and display the current standard point flow value (at this time display 10% value), directly press SET to confirm, at this time the 10% point calibration is completed.

For the calibration of other points, press the AT key to repeat the above calibration process until the calibration is complete and the range point is confirmed, and the calibration is automatically returned to the measurement interface.

Push the float or pointer by hand to check whether the flow rate just calibrated is accurate.