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# AFM2000 SERIES METAL TUBE ROTAMETER



\* Read this manual before using the product

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# Profile

Founded in 1993, HollySys is a leading supplier of intelligence solutions with more than 4,700 employees and operates in both China and abroad. HollySys is headquartered in Beijing with R&D, production, and service bases in Beijing, Hangzhou, Xi'an, Singapore, and local branches in major cities in China, as well as offices in India, Malaysia and Indonesia, establishing a comprehensive service network across the world.

HollySys business consists of industrial intelligence, transportation intelligence, and food and pharmaceutical intelligence, covering the main industries for the national economy and the people's livelihood. With years of technological accumulation in various fields and continuous capacity building, we can provide customers with customized integrated solutions, stable and reliable products, and full lifecycle services, helping them improve market competitiveness. Over the past three decades, we have served more than 35,000 clients, successfully completed more than 45,000 projects, and gained more than 1,000 new clients each year, making HollySys a world-renowned brand in automation and intelligence filed.

The HOLLiAS industrial control platform of HollySys features a series of advanced, practical and reliable industrial automation systems and HollySys automation instrumentations products. The system products include MACS-K, MACS-S industrial control system DCS, professional control systems such as DEH, ETS and SIS, and whole-process information-based software for manufacturing enterprises. Instrumentation products include isolated safety barriers, signal isolators, surge protectors, power transmitters, pressure transmitters, electromagnetic flowmeters, metal tube float meters, magnetic level gauges, radar level gauges, throttling elements, thermal elements, and pressure gauges.

The company's products have been successfully applied to major projects and key equipment, including 1000MW ultra-supercritical thermal power units, 1.2 million tons of urea and 5 million tons of oil refining main units, earning a good reputation in the industry.

Specializing in HollySys Instrumentation and control system engineering and integration, the company can provide both new and brown field projects of enterprises with HollySys proprietary products, as well as comprehensive engineering services such as customized design and construction & commissioning.

HollySys has always pursued continuous innovation and R&D while sticking to its vision "create the most valuable intelligent company through stable and sustainable development" to provide more reliable, secure, and intelligent technology and products for our customers.

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# 1. Terms and Conditions

## 1.1 Notice for use

Metal tube rotameter is also known as variable-area rotameter (hereinafter referred to as instrument). It can be used to measure steam, continuous clean gases and liquids, especially to measure and control small flow with low velocity in harsh medium conditions. It is not suitable for measuring media containing solid particles or of high viscosity. Please contact us when ordering the instrument to confirm whether the instrument meets its requirements if the medium conditions are quite bad.

The rotameter is particularly suitable for measuring the following media, such as water, hydrocarbons, anti-corrosion protectants and lubricants, chemistry products and additives, solutions, superheated steam, air, industrial gases, etc.

Use it only under medium conditions (temperature, pressure, medium, environment, etc.) specified by instrument data.

### Notice!

The user assumes sole responsibility for the suitability of the rotameter and the corrosion resistance of the measured material.

Our company does not assume any responsibility for the accuracy reduction or broken instrument caused by any malicious damage to the instrument, extended use or misusing according to the instrument data conditions.

## 1.2 Safety of use

Please read the related instructions carefully when using this product to avoid injury to users, damage to equipment or other accidents due to improper use. For the instrument used in explosion-proof occasions, it is necessary to carefully check whether the nameplate of the instrument has explosion-proof requirements and explosion-proof labels before being put into operation. It should be installed and used correctly according to the explosion-proof requirements to avoid safety risks and ensure safe production.

## 1.3 Copyright

The copyright of this article belongs to the company, and the company has the right to interpret, change and improve it. No more noticing if it changes.

## 1.4 Technical support

When choosing products, please read this manual carefully and select the instrument suitable for the function according to your conditions.

If there is any technical problem in your reading or selection, something not clearly explained in the manual or any help you need, please contact us in time to get satisfying technical support and help to solve problems.

# 2. Product description

## 2.1 Introduction

AFM 2000 series metal tube rotameter is a variable-area flow instrument by locating the rotor. It is made by metal with design of modular. AFM 2000 has characteristics of small volume, small pressure loss, large range ratio, easy installation and maintenance, so it is widely used in complex, harsh environment in various industries to measure and control small flow with low flow rate and all kinds of harsh medium conditions.

The international advanced contactless magnetic sensor is adopted in AFM2000 series metal tube rotameter with single chip microprocessor system. It has functions of liquid crystal display, accumulation, far transmission and upper and lower limit alarm output. With high accuracy and reliability, better performance, multi-parameter calibration, power down protection and other features, the instrument can completely replace the imported instrument of the same type.

According to different user's needs and different occasions, there are a variety of measurement forms of AFM2000 series metal tube rotameter for users to choose. According to the output form, there are local indication type, remote transmission type, control alarm type. According to the classification of explosion-proof requirements, it can be divided into ordinary type, intrinsically safe type, isolation explosion-proof type. According to user's field process flow requirements, there are different way of installation including vertical mounting type (AFM2000-0), upward downward mounting type (AFM2000-1), side in side out mounting type (AFM2000-2), bottom in side out mounting type (AFM2000-3), threaded connection type (AFM2000-4) and horizontal mounting type (AFM2000-6R/L).

## 2.2 Features

- 1) Modular design, easy to maintain, maintenance free for normal use.
- 2) Simple and practical, low installation cost, and on-site measurement without the need for auxiliary power supply.
- 3) General concept of explosion-proof: integration of isolation explosion-proof and Intrinsic safety explosion-proof.
- 4) Flexible measurement methods: flow direction horizontal, bottom-up, bottom-up, left and right, bottom side.
- 5) All metal structure, earthquake resistant, pressure resistant, temperature resistant, and corrosion resistant.
- 6) Multiple lining materials: 304, 316, 316L, Hastelloy, PTFE lining, etc.
- 7) Flexible connection methods: flanges, threads, quick clamps, etc.
- 8) Measurement amplitude width: 10:1; 20:1 in special circumstances.
- 9) Various power sources (220V AC, 24V DC, battery powered).
- 10) Multi variable output (current 4 20mA, can communicate with HART, Modbus 485 communication).

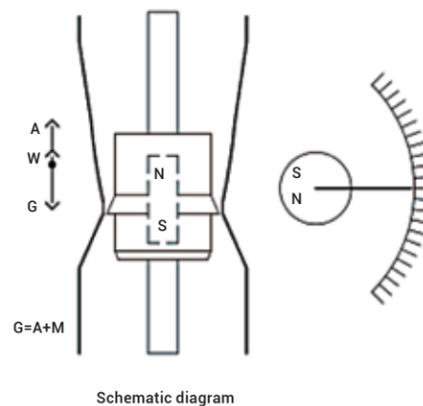
## 2.3 Structure and principle

AFM2000 series metal tube rotameter is composed of two parts:

Measuring tube - magnetic coupling, sensor;

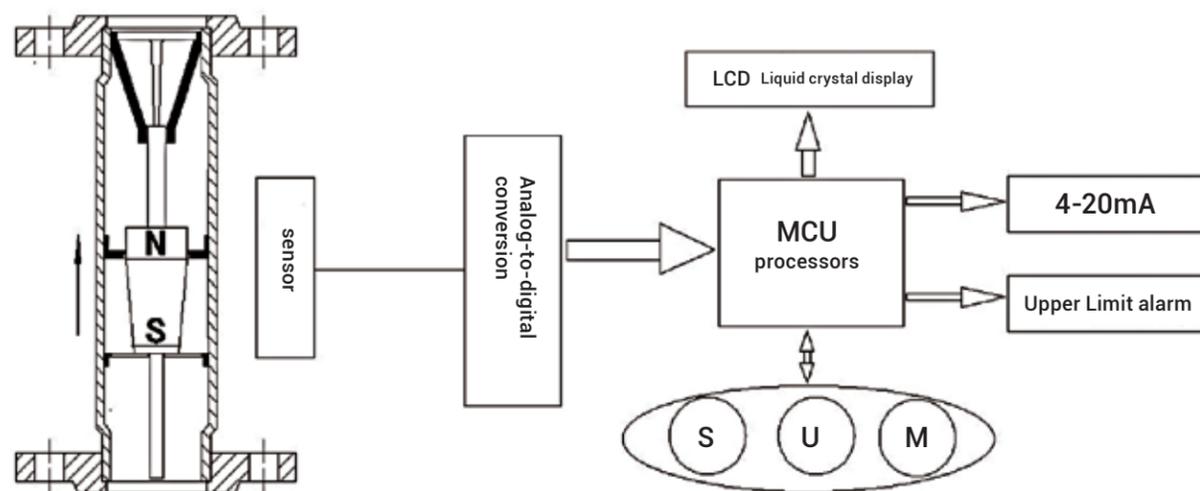
Indicator - signal converting, conditioning, scale indication or number display.

There are four types of wetted materials of the measuring tube: stainless steel, Hastelloy, titanium, stainless steel lining PTFE; Users can choose different wetted materials according to different process pressure and corrosion requirements of media, to meet the needs of pressure resistance and media anticorrosion. According to different measurement requirements, users can choose different combinations of indicators in the selection to achieve different measurement requirements. See the specific indicator type and corresponding function in the indicator section.



### Measuring principle:

When a medium flows through the sensor under relatively fixed conditions and the flow reaches a certain flow within the designed flow range, the rotor rises to a certain position of the cone and becomes relatively static. At this time, the cross-section area of the flow changes, and the three forces received by the rotor reach balance (gravity = thrust + buoyancy). The flow will be indicated at this position while the pointer and shafting components are driven by the tight magnetic coupling drive system. At the same time, it can be converted through the modularized design of the converter into the corresponding flow of 4 ~ 20mA out, Modbus communication and Hart communication. The change of rotor position reflects the change of medium flow.



## 2.4 Product function

<b>LCD:</b>	Support customizing the display of instantaneous value, the accumulated value, current output value and percent of range.
<b>Output signal:</b>	4 ~ 20MA two-wire output.
<b>HART Communication:</b>	Support universal HART protocol; Modbus protocol.
<b>Configuration functions:</b>	Configure engineering units, media state, medium density, operating pressure, operating temperature, the density of the rotor, measuring range, variables display, alarm and so on; reset accumulated flow and adjust zero.
<b>Protection function:</b>	Set limit superior and limit inferior protection values; 3.8mA or 22mA will be the output when it is below the limit inferior or above the limit superior.
<b>Monitoring functions:</b>	On-line monitoring of instantaneous value, its percentage, output current and accumulated value etc.
<b>Calibration function:</b>	Calibrate analog output current.
<b>Demarcation function:</b>	Demarcate 5 to 16 points.
<b>Reset master variable:</b>	Zero adjustment function.
<b>Power-down protection:</b>	Data will not be lost in case of power down.
<b>LCD backlight:</b>	LCD with backlight can make it easier to observe instruments at night or in dark light.
<b>Storage of accumulated value:</b>	Store accumulated values and change storage cycles.
<b>In-place configuration function:</b>	Configure engineering units, media state, medium density, operating pressure, operating temperature, the density of the rotor, measuring range, displayed variables and alarm and protection value. Reset accumulated values, adjust zero and recover data.
<b>Current output adjustment:</b>	Adjust current of 4mA and 20mA.
<b>Data backup and recovery:</b>	After the instrument configuration and calibration, the manufacturer will make factory backup of the original information. If the on-site personnel cannot work normally due to abnormal adjustment of the instrument, the password "5942" can be entered into the data recovery function of data operation, and the manufacturer's factory information can be selected to override the user's illegal error information, so as to reach the normal working state.
<b>Achievable parameter setting:</b>	Multi-parameter calibration, automatic ambient temperature compensation function.
<b>Users revision:</b>	Users can amend 5-points on the scene (to adjust curves of the instrument).

## 2.5 Technical parameters

Technical Parameters	Product Model AFM2000-0	AFM2000-1 / 2 / 3
Instrument diameter	DN15~DN150	
Measuring range	Water (20°C ) 16~150000L/h; Air (20°C 0.1013MPa) 0.5~5000m³/h	
Range ratio	Standard: 10:1; Particular: 20:1	
Accuracy	1.0 level; 1.5 level	
Height	Standard: 250mm (Please consult the manufacturer about the particular one)	
Wetted materials	R0 (316) R1 (304) RL (316L) RP (PTFE lining) RC (Hastelloy C) RT (Ti titanium lining)	R0 (316); R1 (304); RL (316L);
Pressure level	Standard: DN15~DN50 4.0MPa; DN80~DN150 1.6MPa; Particular: DN15~DN50 5~42MPa; DN80~DN150 2.5~16MPa; Jacketed pressure rating: 1.6MPa;	Standard: DN15~DN50 4.0MPa; DN80~DN150 1.6MPa; Particular: DN15~DN50 5~42MPa; DN80~DN100 2.5~25MPa; DN150 2.5~16MPa
Connection	Flange Standard: HG/T20592-2009; Or any other standards specified by users	
Ambient temperature	-40°C ~120°C , Flameproof: -20°C ~+40°C , Intrinsically Safe: -20°C ~+40°C	
Medium temperature	Standard -40°C ~+120°C ; Particular -80°C ~+350°C ; PTFE lining ≤ 80°C	
Signal output	Two-wire 4~20mA output; Hart communication; Two-wire prefabricated switch sensor, 8V DC power supply;	
Power supply	Standard: 24VDC (10.8V DC~28V DC) AC type: 220V AC (85~265V AC) Battery type: 3.6V-9Ah lithium battery	
Explosion-proof levels	Intrinsically Safe: Exia II CT6 Ga Flameproof: Exd II CT6 Gb	
Protection class	IP65	
Medium viscosity	DN15: ≤ 5mpa.s (H15.1~15.3) ≤ 30mpa.s (H15.4~15.9) DN25: ≤ 250mpa.s DN50~DN150: ≤ 300mpa.s	
Way of display	On-site pointer display; LCD	
Electrical connections	1/2" NPT; M20×1.5	

Technical Parameters	Product Model AFM2000-4	AFM2000-5
Meter diameter	DN15~DN100	DN15~DN100
Measuring range	Water (20°C ) 16~100000L/h Air (20°C 0.1013MPa) 0.5~3000m³/h	Water (20°C ) 16~100000L/h Air (20°C 0.1013MPa) 0.5~3000m³/h
Range ratio	Standard: 10:1; Particular: 20:1	
Accuracy	1.0 level; 1.5 level	
Height	Standard: 250mm (Please consult the manufacturer about the particular one)	
Wetted materials	R0: 316; R1: 304; RL: 316L;	R0 (316); R1 (304); RL (316L);
Pressure level	Standard: DN15~DN50 4.0MPa please consult the manufacturer about the particular one	Standard: DN15~DN100 1.6MPa please consult the manufacturer about the particular one
Connection	Pipe thread; SMS Thread	Jacket (quick connector)
Ambient temperature	-40°C ~120°C , Flameproof: -20°C ~+40°C , Intrinsically Safe: -20°C ~+40°C	
Medium temperature	Standard -40°C ~+120°C ; Particular -80°C ~+350°C	
Signal output	Two-wire 4~20mA output; Hart communication; Two-wire prefabricated switch sensor, 8V DC power supply;	
Power supply	Standard: 24VDC (10.8VDC~28VDC) AC type: 220VAC (85~265VAC) Battery type: 3.6V-9Ah lithium battery	
Explosion-proof level	Intrinsically Safe: Exia II CT6 Ga Flameproof: Exd II CT6 Gb	
Protection level	IP65	
Medium viscosity	DN15: ≤ 5mpa.s (H15.1~15.3) ≤ 30mpa.s (H15.4~15.9) DN25: ≤ 250mpa.s DN50~DN100: ≤ 300mpa.s	
Display method	On-site pointer display; LCD	
Electrical connection	1/2" NPT; M20×1.5;	

Technical Parameters	Product Model AFM2000-6 R/L	
Meter diameter	DN15~DN50	DN80~DN150
Measuring range	Water (20°C ) 16~25000L/h Air (20°C 0.1013MPa) 0.5~1000m³/h	Water (20°C ) 16~150000L/h Air (20°C 0.1013MPa) 1000~4000m³/h
Range ratio	Standard: 10:1; Particular: 20:1	
Accuracy	1.0 level; 1.5 level	
Height	250mm	250mm or 350-400mm
Wetted materials	R0: 316; R1:304; RL: 316L;	R0 (316); R1 (304); RL (316L);
Pressure level	Standard: DN15~DN50 4.0MPa Particular: DN15~DN50 6.3MPa	Standard: DN80~DN150 1.6MPa Particular: DN80~DN50 6.3MPa
Connection	Flange Standard: HG/T20592-2009; Or any other standards specified by users	
Ambient temperature	-40°C ~120°C , Flameproof: -20°C ~+40°C , Intrinsically Safe: -20°C ~+40°C	
Medium temperature	Standard -40°C ~+120°C ; Particular -80°C ~+350°C	
Signal output	Two-wire 4 ~ 20mA output; Hart communication; Two-wire prefabricated switch sensor, 8V DC power supply;	
Power supply	Standard: 24VDC (10.8VDC~28VDC) AC type: 220VAC (85~265VAC) Battery type: 3.6V-9Ah lithium battery	
Explosion levels	Intrinsically Safe: Exia II CT6 Ga Flameproof: Exd II CT6 Gb	
Protection class	IP65	
Medium viscosity	DN15: ≤ 5mpa.s (H15.1~15.3) ≤ 30mpa.s (H15.4~15.9) DN25: ≤ 250mpa.s DN50~DN150: ≤ 300mpa.s	
Way of display	On-site pointer display; LCD	
Electrical connections	1/2" NPT; M20×1.5;	

## 2.6 Type demonstration

Type Demonstration of Metal Tube Rotameter

AFM2000	① / ② / ③ / ④ / ⑤ / ⑥					
① Installation form	0	Vertical installation, bottom in and up out				Select the corresponding installation according to the on-site media flow direction
	1	Vertical installation, up in and bottom out				
	2	Side - side installation, bottom side in and up side out				
	3	Bottom installation, bottom in and up out				
	4	Thread installation, bottom in and up out (only DN15 ~ DN100)				
	5	Jacket Installation, bottom in and up out (only DN15 ~ DN100)				
	6R	Horizontal Installation, right in and left out				
	6L	Horizontal Installation, left in and right out				
② Wetted materials	R0	316, 0Cr18Ni12Mo2Ti				Select the corresponding material according to the medium corrosion condition.
	R1	304, 1Cr18Ni9Ti				
	RL	316L, 00Cr17Ni14Mo2				
	RP	304 PTFE lining, 306 PTFE lining				
	RC	Hastelloy C-276				
	RT	Titanium alloy (Ti, TA10)				
③ Instrument caliber	DN15	Select the corresponding caliber according to the flow range of the instrument. In order to ensure the measurement accuracy and stability of the instrument, avoid selecting large caliber with small flow or small caliber with large flow.				
	DN25					
	DN50					
	DN80					
	DN100					
	DN150					
④ Additional structure	W	Sanitary (only AFM2000-4, AFM2000-5)				
	Z	Damping (Gas medium)				
	T	Jacket type (Heat preservation or cooling required)				
	G	High temperature (liquid temperature>120°C ambient temperature>60°C ) (no intrinsic safety)				
	Y	High pressure (higher than standard pressure)				
	M	485 communication Three-wire DC24V/4~20mA				
	H	Hart communication				
⑤ Indicator M4	P	Pulse output				
	M41	On-site Indication (pointer)				
	M42	On-site Indication (pointer and 24VDC/4, two-wire 4-20hA)				
	M43	Pointer and LCD, 3.6VDC Battery (no intrinsic safety)				
	M44	Pointer and LCD (24VDC/ two-wire 4-20MA)				
	M45	Pointer and LCD (220VAC/ 4-20MA output) (no intrinsic safety)				
	MK1	1 limit switches, 8VDC, no intrinsic safety				
⑥ Explosion-proof	MK2	1 limit switches, 8VDC, no intrinsic safety				
	Ex	Intrinsically safe explosion-proof				
	Ed	Isolation explosion-proof				
AFM2000	① / ② / ③ / ④ / ⑤ / ⑥					

## 2.7 Flowmeter

Rotor material: 1 □ R0, R1, RC

2 □ PTFE, RT

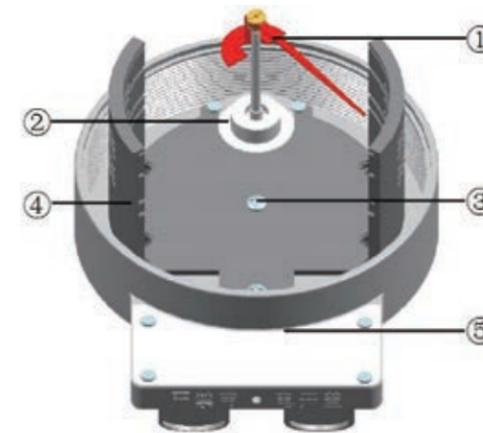
Caliber	Rotor size	Water (20°C)		Air	Standard AFM2000-0	
		L/h		0.1013MPa (abs) 20°C	The maximum pressure loss	
DN		1 □	2 □	1 □	water	air
				m <sup>3</sup> /h	kPa	
15	H15.1	16	-	0.5	2.0	7.0
	H15.2	25	16	0.7	2.3	7.2
	H15.3	40	25	1.1	2.5	7.3
	H15.4	63	40	1.8	2.5	7.5
	H15.5	100	63	2.8	2.5	7.8
	H15.6	160	100	4.8	2.6	8.0
	H15.7	250	160	7.0	2.7	10.0
	H15.8	400	250	10.0	2.9	10.8
	H15.9	630	400	16.0	3.4	14
25	H25.1	630	400	16	4.0	7.0
	H25.2	1000	630	30	4.1	8.0
	H25.3	1600	1000	45	4.4	12.0
	H25.4	2500	1600	70	5.2	19.0
	H25.5	4000	2500	110	7.0	25.0
	H25.6	6300	4000	180	12.5	33.0
50	H55.1	6300	4000	180	4.7	8.0
	H55.2	10000	6300	250	5.1	15.0
	H55.3	16000	10000	400	6.2	22.0
	H55.4	25000	16000	1000	8.0	35.0
80	H85.1	25000	16000	1000	5.3	15.0
	H85.2	63000	25000	1200	7.8	22.0
100	H105.1	63000	40000	1800	11.4	35.0
	H105.2	100000	63000	3000	16.7	
150	H155.1	150000	100000	4000	17.0	

## 2.8 Indicator

With different modules, M4 indicator has different functions.

Displayed variables of indicators with LCD can be set. Please see the commissioning instruction for further information.

### 2.8.1 M41 Indicator (Basic type)

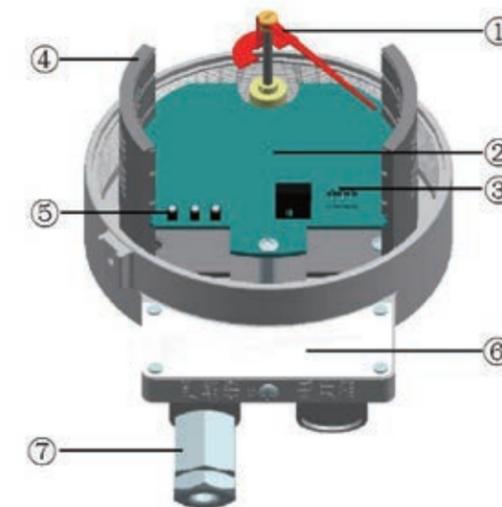


- ①—Pointer
- ②—Shafting subassembly
- ③—Rail bracket fastening screws
- ④—Rail bracket
- ⑤—Nameplate

#### The key function:

The indicator and sensor cooperate to realize on-site indication without external power supply.

### 2.8.2 M42 Indicator

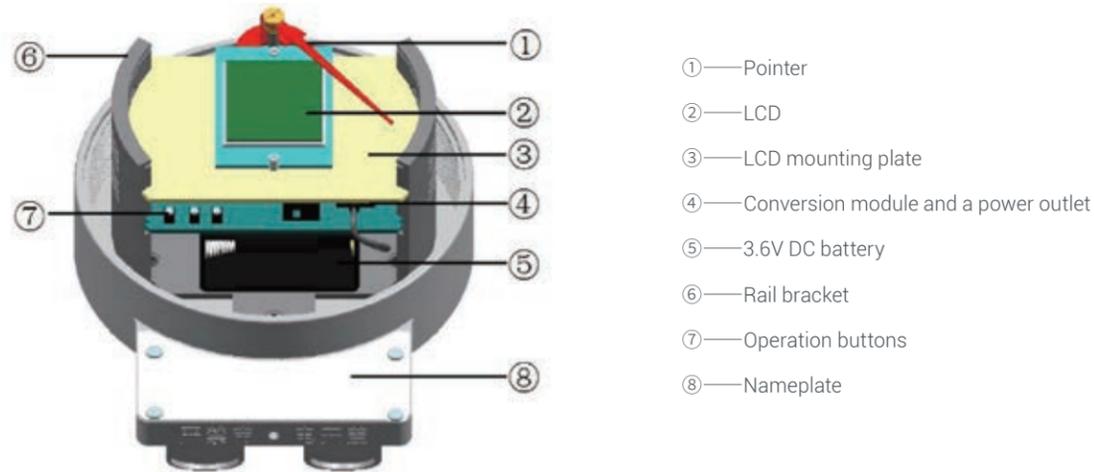


- ①—Pointer
- ②—Signal transmission module
- ③—Terminals
- ④—Rail bracket
- ⑤—Operation buttons
- ⑥—Nameplate
- ⑦—Outlet connector

#### The key function:

It can realize on-site indication with sensors, 24VDC power supply and two-wire 4-20mA output.

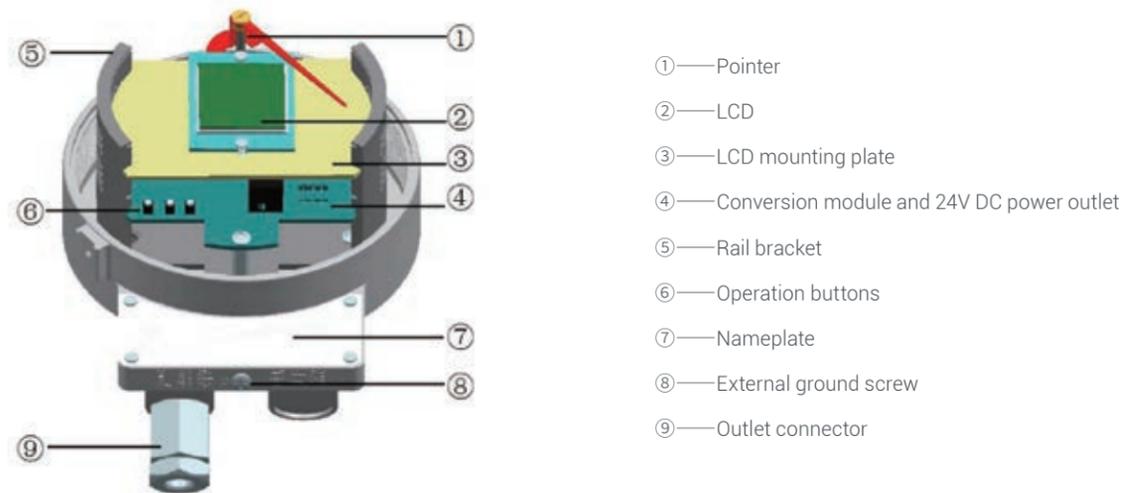
### 2.8.3 M43 Indicator



**The key function:**

It can realize LCD and indication with sensors, 3.6V DC power supply and no output.

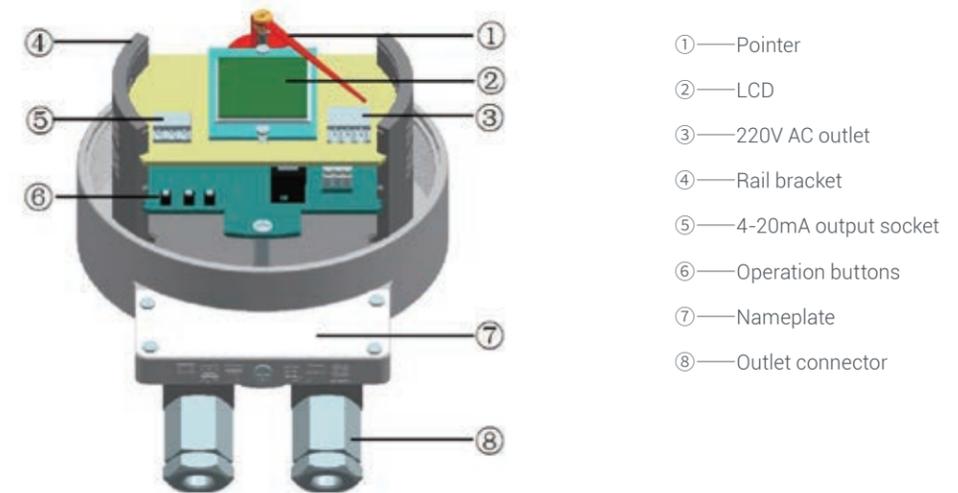
### 2.8.4 M44 Indicator



**The key function:**

It can realize LCD and indication with two-wire 4-20mA output (Hart communication or Modbus communication), sensors and 24VDC power supply.

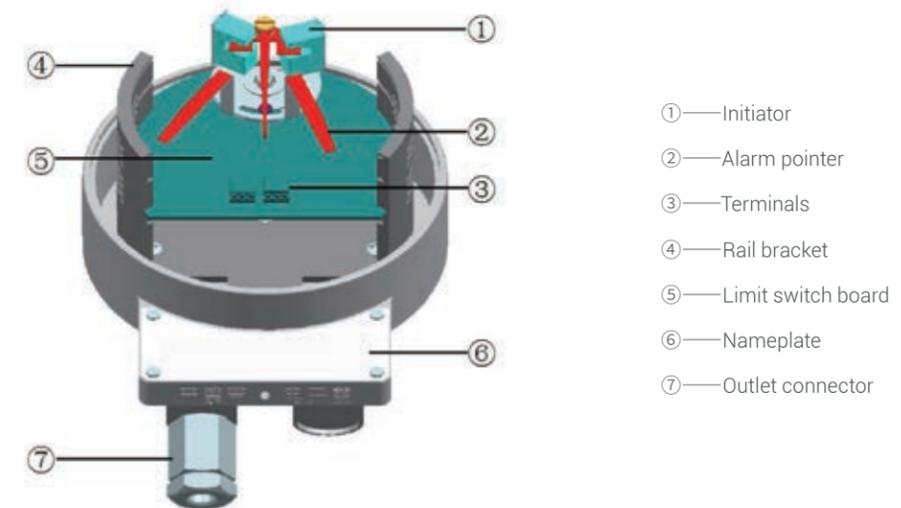
### 2.8.5 M45 Indicator



**The key function:**

It can realize LCD and indication with sensors, 220VAC power supply and 4-20mA output (Hart communication or Modbus communication).

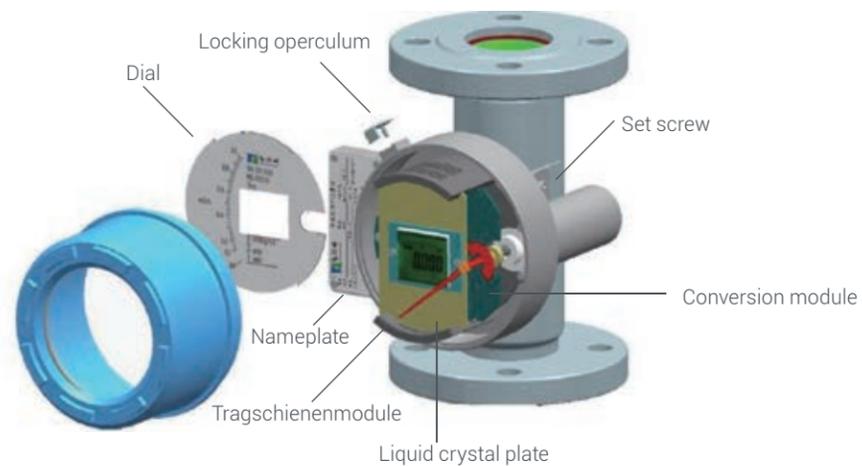
### 2.8.6 MK1/MK2 Indicator



**The key function:**

It can realize 1 or 2 points alarm with sensors, 1 or 2 limit switches and transistor amplifiers. See the following introduction for further information.

## 2.9 Indicator structure and its disassembly



- 1) An indicator consists of a cover, a dial, a conversion module, a guide frame of plug and play module, pointers, shafting subassembly, a chassis and other components.
- 2) Loosen the anti-loose screw of the cover and unscrew the cover (the cover must be tightened to prevent corrosive gas and water vapor from entering the cover and corroding the components).
- 3) Dial: Installed in the most front grooves (no other grooves can be used). Be careful not to deform or bend the dial when disassembling and installing.
- 4) Liquid crystal plate: Installed in the second notch below the dial; can be removed from the upper side along the plug and play groove after pulling out the line. Plug and play.
- 5) Switch board: Installed in the third layer groove; can alarm with the pointers fan-shaped plate. Plug and play.
- 6) Conversion module: Installed in the groove of the fourth layer. After removing the power plug, use a Phillips screwdriver to remove the fastening screw on the positioning column on the left side of the conversion module, and then remove it.
- 7) Shafting subassembly: Remove the third fixing screw on the guide frame and remove the guide frame and shafting subassembly.
- 8) Remove the screw of connection and location between the indicator and the sensor (measuring tube) to separate the sensor and the indicator.

## 2.10 Damping device

Metal tube rotameters with damping devices is to slow down or overcome table indicator instability, pointer swing, output fluctuation, being not available, etc.

### Damping devices should be added in the following cases:

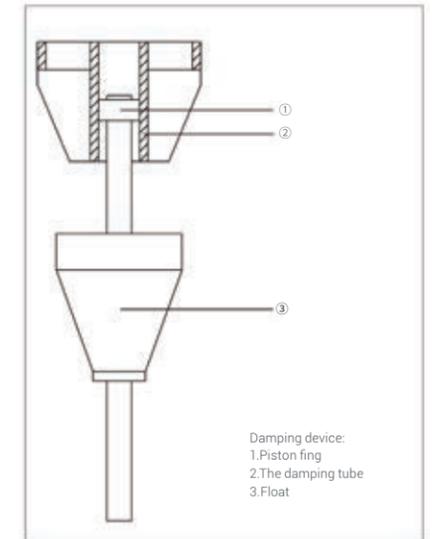
- 1) Low operating pressure.
- 2) The pressure of the installation position is unstable.
- 3) The inner diameter of the pipe before and after the instrument changes too much.
- 4) The front and rear straight pipe sections do not meet the requirements of use seriously.
- 5) The measuring medium is gas.

Under these circumstances, the medium flows in the measuring tube of the rotameter extremely unstably, and the rotor jumps up and down because the three forces on it cannot reach the equilibrium state. The moving rotor is transmitted through the magnetic coupling system to make the pointer's shafting change, which finally causes continuous and non-stop swing of the pointer and large output range. The user cannot read the current instantaneous scale value at all, and the transmission output signal cannot be adopted by the system.

Therefore, customers are advised to choose additional structure with damping device meters to avoid the above situation. Even so, it still cannot guarantee the stable operation of the instrument, pointer wobble and output fluctuation. Therefore, it is recommended that the user should work on the fundamental process design, installation position of the instrument, pipeline configuration, pressure regulation and pressurization to completely avoid the situation that may lead to the unstable operation of the instrument.

### Note:

In order to create the working conditions in which instruments can be run stably, the working pressure should be stable and not less than 2 times of the instrument pressure loss in the selection design, and the working pressure of gas medium should not less than 5 times of the instrument pressure loss.

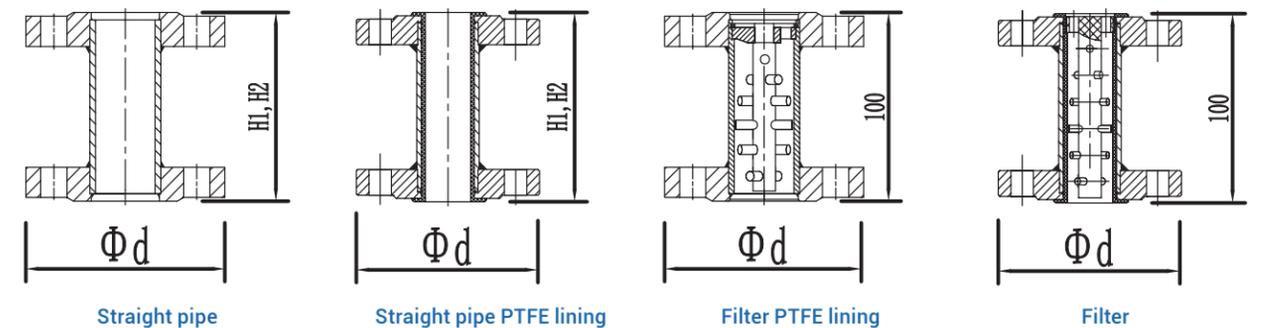


## 2.11 Mounting accessories - magnetic filter and the straight pipe

Installation accessories of metal tube rotameter: Users can choose to order or not order magnetic filter and straight pipe section. If there are small ferromagnetic particles in fluid or the welding slag in the pipeline is not cleaned, a magnetic filter should be installed in front of the instrument to prevent the ferromagnetic particles from adsorbed on the rotor when flowing through it, which may cause the rotor to get stuck, unable to return or cannot move freely. The magnetic filter should be cleaned regularly to prevent full absorption and guarantee the effect of filtering due.

There should be a straight pipe section of at least 5 times the diameter at the inlet of the rotameter and a straight pipe section of at least 250mm at the outlet. The user can choose to order the straight pipe section according to the requirements of the installation position, so as to meet the conditions of stable operation of the instrument.

### Sizes are as follows:



Caliber	DN15	DN25	DN50	DN80	DN100	DN150
The front part of straight pipe H1 ≥ (mm)	75	125	50	400	500	750
The latter part of straight pipe H2 ≥ (mm)	250	250	250	250	250	250
Φd (mm)	95	115	165	200	220	285

**Note:** The straight pipe and magnetic filters are according to HG / T20592-2009 flanges standard. Special criteria can be specified by users.

### 3. Electrical connections

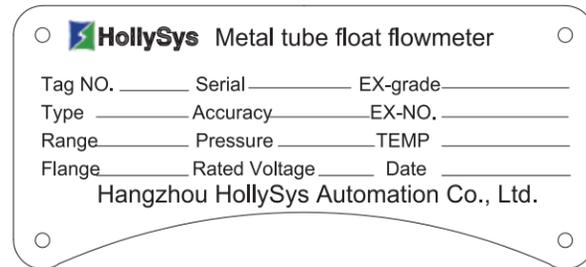
#### 3.1 Announcements

1) Electrical connections should only be conducted when the power is off. Instruments used in dangerous areas should be operated by professional personnel in accordance with explosion-proof documents and safety regulations. Please check the nameplate when installing the connection, confirm that the received instrument is consistent with the order, and confirm the voltage parameter on the nameplate.

2) The recommended cable diameter is 8 to 13mm. Bend the cable into a U-shape at the entrance of the cable connector to provide drip points; The connected cable joint should not be products made of ferromagnetic materials, which negatively affect the measurement.

3) After opening the front cover of the indicator, connect the cable to the terminal through the outlet connector, and then tighten the lock of the outlet connector to tighten the front cover of the indicator to ensure airtight in the cover.

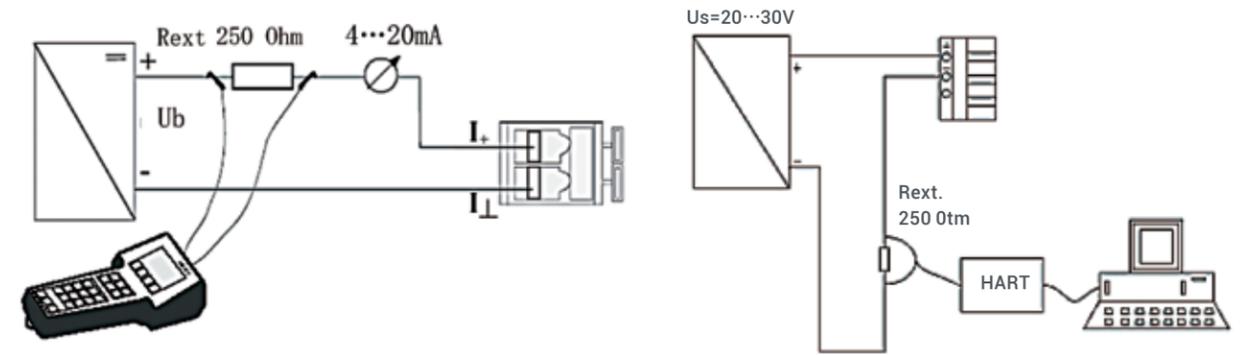
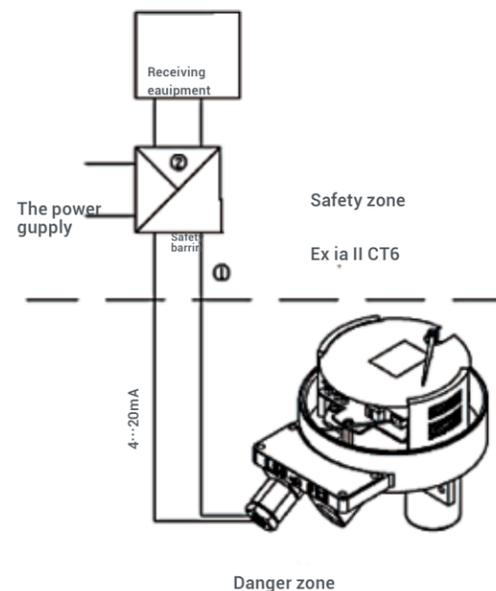
4) Announcements for explosion-proof products: In hazardous places, please firstly check the explosion-proof nameplate mark



on the meter indicator. If it is the intrinsic safety explosion-proof type EXiaII CT6Ga, the cable should be selected according to the maximum allowable distributed capacitance and inductance parameters of the connecting cable, and the rotameter should be powered by the safety gate placed in a safe place. If it is flame-proof EXdIICT6Gb, it should be noted that the cable should be directly led to a safe place without core wiring in the middle, and the cable lead and wiring terminal should be firmly and reliably connected without flying wire.

#### 3.2 Conversion module wiring

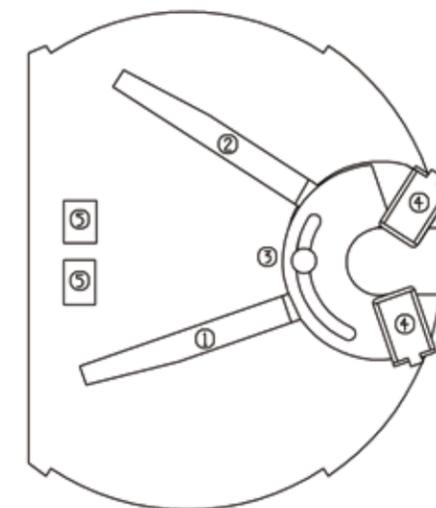
Only for M42, M44, M45 indicator. power lines and signal lines should enter from different outlet for M45 indicator with 220V AC power supply. Connection diagram is as follows:



#### 3.3 Limit switches and wiring

The M4 indicator can be fitted with a maximum of two limit switches, M4K1 and M4K2 indicator. The limit switch is a groove sensor activated by induction by a semicircular metal blade on the pointer. The switching point can be set by the limit pointer under the dial. The switch position is displayed on the dial. The part of the limit alarm switch installed in the indicator is called TG22, which is composed of SJ3, 5 type starter, aluminum sheet, etc. By changing the position of limit pointer, you can set the alarm value as you wish.

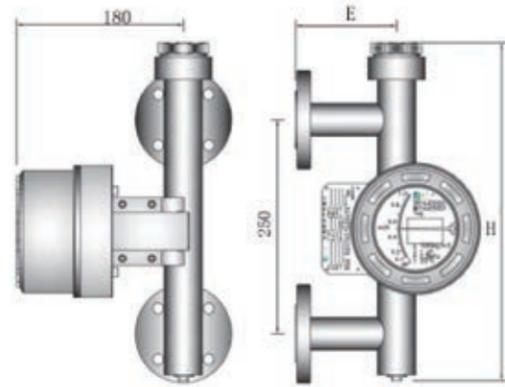
TG22 limit alarm switch with an external transistor relays used in conjunction with the implementation, lower limit alarm output signal, the transistor relay WE77 / EX-1 and WE77 / EX-2 includes a power pack, rectifier transistor amplifier and relay output. WE77 / EX-1 with a set of safety control circuit can be equipped with a limit switch, WE77 / EX-2 with two safety control circuit can be equipped with two limit switches. The intermediate relay is connected to the normally open working mode, and it is easy to change the jumper to the normally closed working mode according to the table below, or the normally closed working mode with the open-circuit fault LED monitoring.



- ① Offline alarm pointer
- ② On-line alarm pointer
- ③ Fastening screws
- ④ Limit switch
- ⑤ Connection terminals



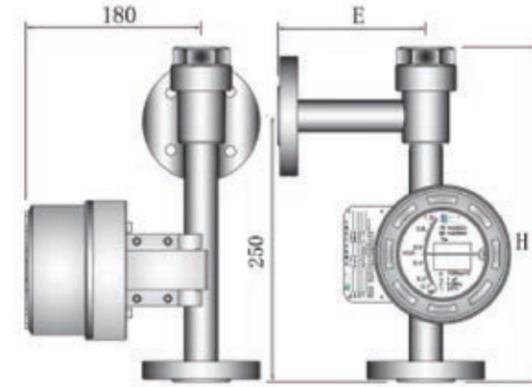
### 4.4 AFM2000-2



DN15~DN250

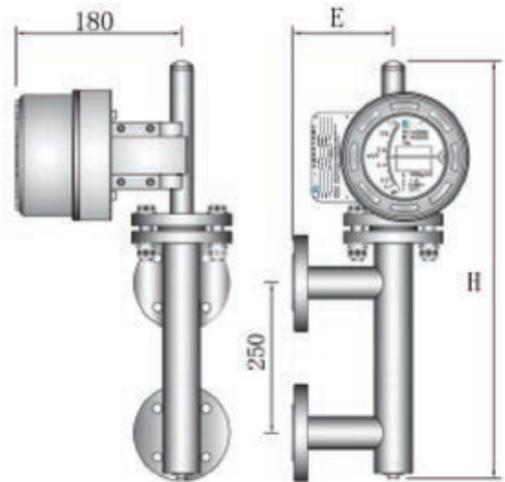
Caliber	E mm	H mm	Weight kg	Pressure LossKPa
DN15	120.0	400.0	6.0	21.0
DN25	120.0	400.0	7.2	30.0

### 4.5 AFM2000-3



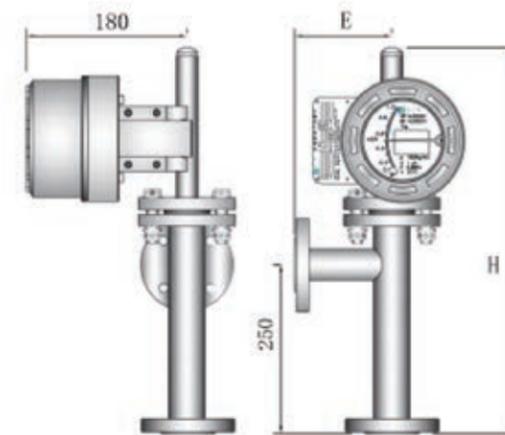
DN15~DN25

Caliber	E mm	H mm	Weight kg	Pressure LossKPa
DN15	120.0	300.0	6.0	18.0
DN25	120.0	310.0	7.0	28.0



DN50~DN150

Caliber	E mm	H mm	Weight kg	Pressure LossKPa
DN50	120.0	620.0	13.0	36.0
DN80	150.0	650.0	34.0	45.0
DN100	150.0	670.0	49.0	58.0
DN150	180.0	730.0	66.0	63.0



DN50~DN150

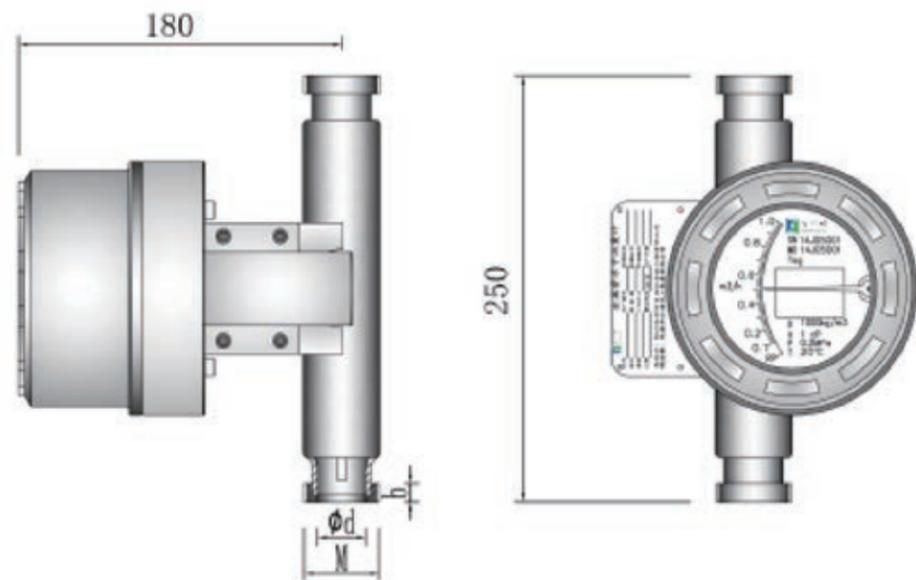
Caliber	E mm	H mm	Weight kg	Pressure LossKPa
DN50	120.0	540.0	12.0	28.0
DN80	150.0	550.0	33.0	35.0
DN100	150.0	560.0	48.0	45.0
DN150	180.0	600.0	65.0	58.0

### 4.6 AFM2000-4

AFM2000-4 refers to bottom-up meta-tube rotameter. Instruments produced by food-grade round thread DIN11851 and SMS can be used for food and pharmaceutical industries. Users can also customize products according to their specifications. Please contact the manufacturer at the time of ordering.

Connection sizes of AFM2000-4 food-grade circular thread:

Caliber and pressure rating		Size (mm)					
		DIN11851 Food Threaded			SMS Food Threaded		
DN(mm)	PN Mpa	M	d	b	M	d	b
DN15	PN4.0	Rd34*1/8	16	12	Rd40*1/6	22.6	12
DN25	PN4.0	Rd52*1/6	26	14	Rd60*1/6	35	14
DN50	PN4.0	Rd78*1/6	50	14	Rd70*1/6	48.6	14
DN80	PN2.5	Rd110*1/4	81	20	Rd98*1/6	72.9	20
DN100	PN2.5	Rd130*1/4	100	20	Rd132*1/6	97.6	20

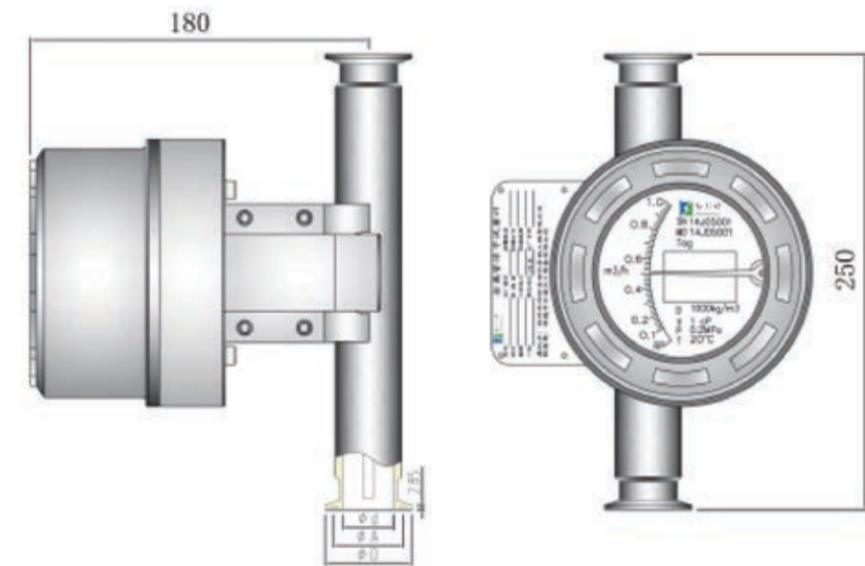


### 4.7 AFM2000-5

AFM2000-5 refers to quick-clamping bottom-up meta-tube rotameter. Instruments produced by sanitary quick-clamping connectors can be used for food industry or other flow-measuring circumstance requiring quick clamping to measure or control flow.

Detailed connection sizes are as follows:

Caliber and pressure grade		size (mm)		
DN(mm)	PN Mpa	D	A	d
DN15	PN4.0	50.5	43.5	15
DN25	PN4.0	50.5	43.5	25
DN40	PN4.0	50.5	43.5	37
DN50	PN4.0	64.0	56.5	50
DN80	PN2.5	106.0	97.0	80
DN100	PN2.5	119.0	110.0	100



## 4.8 AFM2000-6

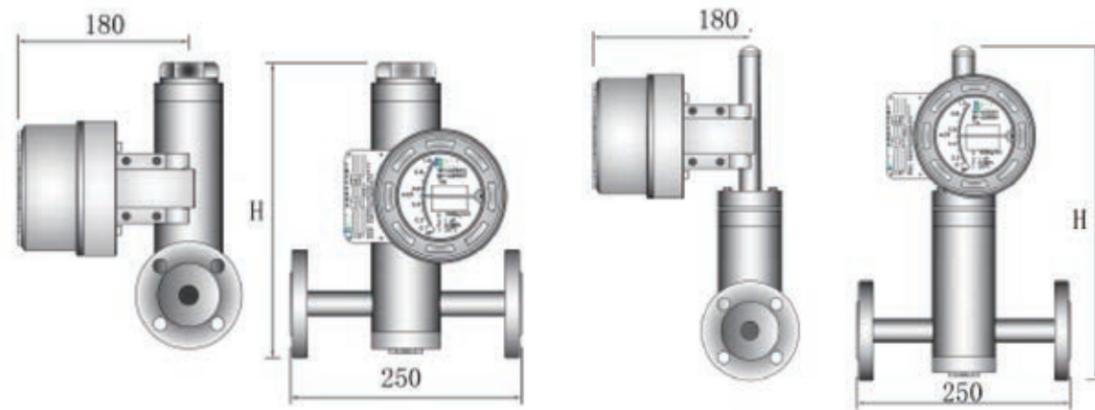


Diagram1 DN15~DN25 (H=380/400mm)

Diagram2 DN50 (H=480mm)

There are three structures of AFM2000-6. Flow direction of media should be noted in purchase order. For example, media flow direction of AFM2000-6R is from left to right. There are only two calibers, DN15 and DN25 in diagram 1; one caliber, DN50 in diagram 2; and free-adjusting caliber DN15~DN150 in diagram 3. Rotameters in diagram 3 can be adopted when DN15, DN25 or DN50 is used because of greater inside caliber, greater work pressure ( $PN \geq 4.0\text{MPa}$ ) and less sensitive to pressure. Rotameters in diagram 1 and 2 can be adopted when small inside caliber is used. Please contact suppliers at the time of ordering.

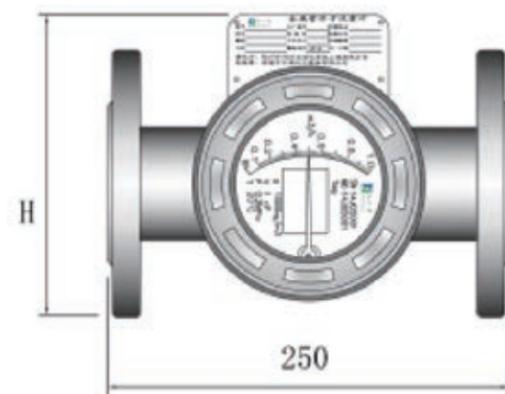


Diagram3 DN15 ~ DN150

## 5. Installation

### 5.1 Installation requirements

- 1) The new pipe must be cleaned or purged before the instrument is installed because the leftover ferromagnetic granular impurities such as welding slag in the pipe are tend to adsorb on the float, which could make float stuck and the instrument cannot work normally. If there is a by-pass of the instrument, the by-pass should be turned on for a while mode. Then, turn on the instrument pipeline after turn off the by-pass. If the fluid contains particles larger than  $50\mu\text{m}$  or magnetic particles, it is recommended to install a magnetic filter upstream of the meter.
- 2) Instrument should be installed as far as possible to make ferromagnetic materials away from the measuring tube, at least 100mm. The instrument should be installed far away from the motor, strong distribution box and other magnetic field, otherwise it may move the zero deviation of the rotameter, even make the meter not to work normally.
- 3) PTFE lining instrument should be installed to avoid that the hole of the upper and lower washers is less than the instrument diameter. Washer's diameter should be greater than the instrument diameter plus 8mm. Otherwise, the lining may be damaged due to washer extrusion, which results in inflexible rotor movement, liner leakage or damaged measuring tube.
- 4) Pay attention to protect the upper and lower mats of the meter when a PTFE lining meter is installed. If not, anti-corrosion ability of it will be lost. Do not tighten connection bolts at will, otherwise, it will deform PTFE. Please see the table below for the maximum torque:

Caliber	Maximum torque (Nm)	Bolts
DN15	9.3	4-M12
DN25	22	4-M12
DN50	55	4-M16
DN80	47	8-M16
DN100	39	8-M16
DN150	60	8-M16

- 5) Ensure that the meter is installed vertically or horizontally, that the inclination does not exceed  $5^\circ$ , and that the flow direction of the fluid is consistent with the flow direction indicated on the meter.
- 6) The upstream pipe holes and downstream pipe holes should share the same nominal size with the instrument. The upstream straight pipe section length should be more than 5 times the diameter of the meter. The downstream straight pipe section length should be more than 250mm. In order to prevent pipe expansion, the matching flange must be aligned with the pipe axially and parallel to each other.
- 7) Valves should be installed at the front and back of the rotameter to facilitate disassembly and maintenance of the instrument.
- 8) If the rotameter emits gases directly into the atmosphere, a throttle should be installed at the outlet of rotameters used to measure gaseous media to ensure proper measurement.
- 9) The outlet pipe and inlet pipe of the rotameter shall be equipped with support devices to minimize the external force applied to the flow meter, as shown in the installation diagram.
- 10) To facilitate the maintenance, replacement of flowmeters, and cleaning of pipes, it is recommended to install bypass pipes for meters.

- 11) Customer-supplied bolts and washers must be in accordance with the selected connection and pressure rating.
- 12) The valves at both ends of the flowmeter should be closed when a device is turned on. After the system pressure is stable, please slowly open the upstream valve, and then use the flow meter downstream regulating valve to adjust the flow. When the flow meter stops working, the upstream valve should be slowly closed, followed by the downstream adjusting valve to avoid the impact on the rotor caused by changed pressure and accidental damage to the flowmeter. avoid sudden changes of the measured flow when a flow meter is used.
- 13) Working pressure should be slowly increased to in the pipe as gas is measured. First, the flow rate should be changed by adjusting the opening of the valve to prevent the rotor from suddenly accelerating and bumping upward into the stopper (for example, in the case of using the solenoid valve) and damaging the measuring parts. Do not use solenoid valves. A manual flow regulator can be installed downstream of the meter for adjustment.

### 5.2 Protection class

Protection class: IP65

The following terms must be complied with:

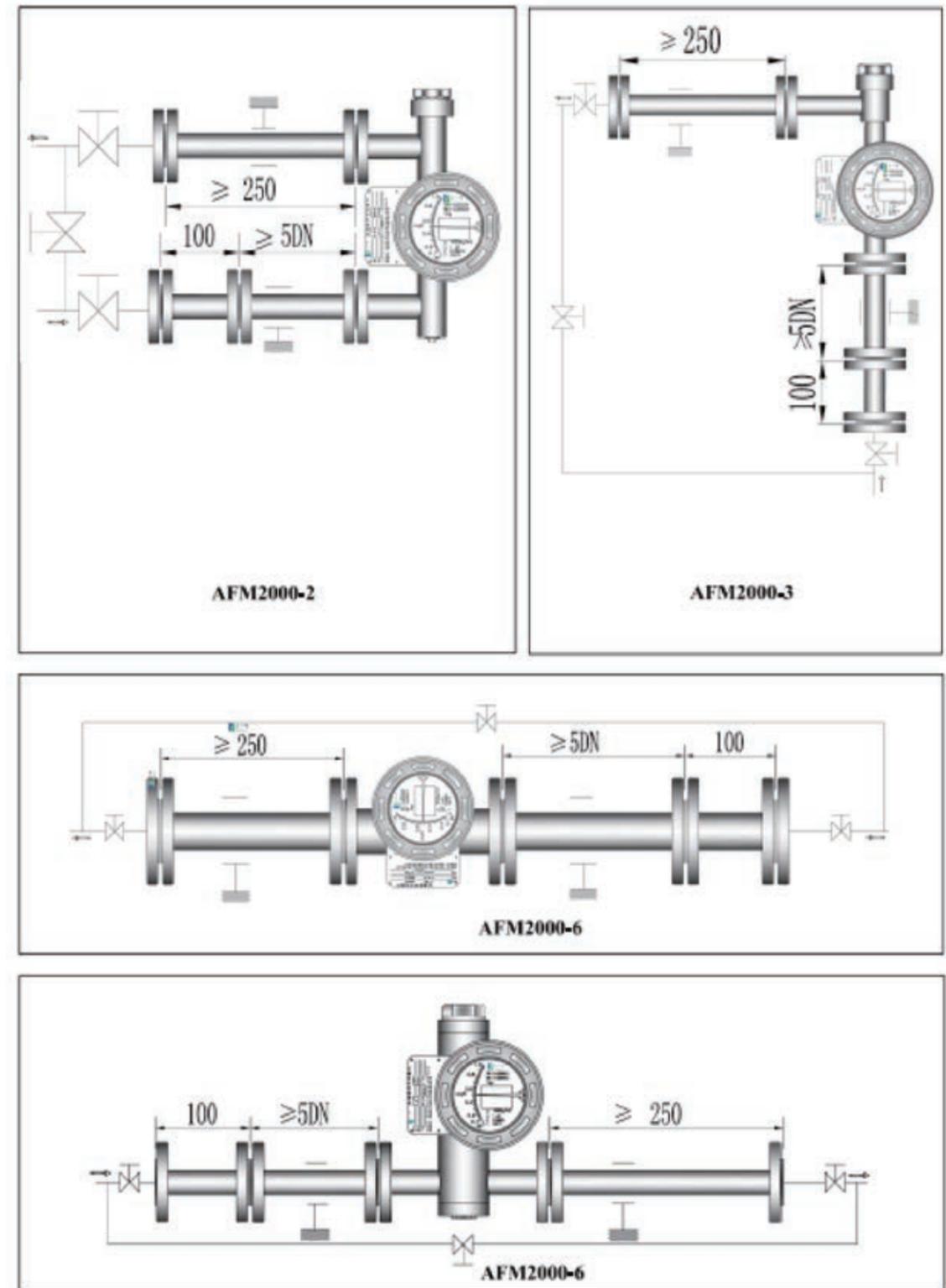
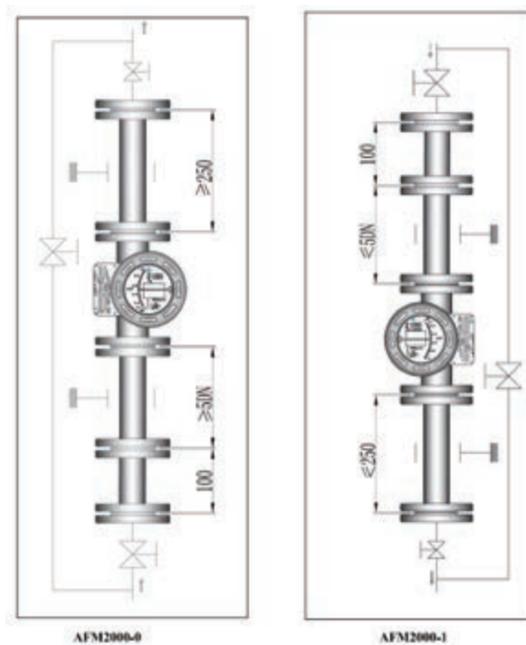
The original washers must be used and kept clean and in good condition. Defective washers must be replaced.

Drip bays must be set in cables to prevent water from entering covers.

Cable interface must be tightened. Please plug the cable interface if there is no cable in it.



### 5.3 Installation diagram



## 6. Maintenance

### 6.1 Indicator

1) Correct detection prerequisite of indicators: Ensure the rotor flexible and normal to operate. Check whether the positioning screws are loose. When removing the base or the indicator (do not remove it if not necessary), ensure that the position not to change. Otherwise, the indicator may be misaligned with the float.

2) There is a one-to-one correspondence between the indicator and the measuring tube. The indicator is consistent with the measuring pipe machine number. Even if the indicator is of the same caliber and parameter, it is not interchangeable.

3) Indicator detection steps and troubleshooting: Remove the meter as a whole, and check whether the rotor is of no corrosion or damage, whether the float is flexible, and whether the float can be placed at the bottom.

4) Pointer indicates inspection and treatment.

#### Pointer adjustment:

Place the meter vertically with the float at the bottom. Check whether the pointer correctly indicates RP point. If it does not indicate RP point, adjust the pointer to RP point. Move the pointer to the upper and lower limits, then twist it up or down from the axis of the pointer (like a normal pressure gauge pointer) until the pointer accurately indicates RP point. Or use a larger flat-head screwdriver to hold the pointer in a groove, and then turn the pointer to reach the exact RP point.

#### If the pointer is not flexible:

The limit ring of pointer bearing is badly loose, and the treatment method is shown in the relevant part of "Output current detection Steps and Troubleshooting" as below. If the bearing is not flexible in the case of long time use or harsh field environment, point a little high quality lubricating oil (such as watch oil) in the bearing part.

5) Output current detection steps and troubleshooting:

When the float is at the bottom, check whether the output current is 4mA. Push the float so that the pointer indicates each point in the middle (note that the pointer cannot only be moved to detect, otherwise the deviation is large), check whether the pointer is flexible, and whether the output current corresponds to the indication.

6) Steps for detecting deviation between output current and indication:

Make sure the pointer indicates correctly (if there is no standard flow in the field, the only detection method is that the float falls at the bottom, and the pointer should accurately indicate the RP point). Then the rotor can be pushed to detect the correspondence between the indication and the output.

#### Check whether the pointer and shaft limit ring are loose: detection and adjustment:

Phenomenon: zero output current is not 4mA or obviously indicates its inflexibility.

The detection method is: gently pull up the pointer, and check whether there is a large gap between the tube and the bearing caused by outward movement. This problem is generally caused by transportation vibration or flow instability for a long time. This problem is tend to cause the pointer to stick to the dial or coupling magnetic steel to touch the housing problem, and cause the indicating action is not flexible, and the output zero current deviation.

7) Handling method for loose limit ring of pointer bearing:

Remove the dial (do not touch the pointer hard), unplug the power supply, and use a small screwdriver to unscrew the converter from the left side to remove the converter. (Be sure to gently crack the guide rail to prevent damage), and then remove the cross screws on the guide rail. You can remove the whole shaft system on the right side after removing the frame.

8) Place the pointer of the coupling system upward in a flat and clean position (such as iron plate, etc.), and then loosen the top wire on the limit ring with the hex wrench to make the limit ring close to the bearing (but be careful to ensure that there is a little gap, that is, you feel a little displacement when gently pulling the pointer. If it is too tight, the action will be not flexible.

9) If it is too tight, you can pick up the coupling part and gently knock down the sensing component to make it flexible. Put it back as it was.

10) The screws on the guide rail should be tightened to check whether there is a phenomenon of sticking in the rotating state of the shaft.

11) Converter detection and adjustment:

- Power supply detection:

After connecting the converter to measure the power supply voltage, if the voltage is very low (such as less than 10.8VDC), or even continuous self-check phenomenon, the first is to confirm whether there is a problem with the power supply (or cable). It can be confirmed by a separate 24VDC power supply.

- Instrument anti-interference measures requirements:

because of the higher degree of intelligence (such as Hart communication), the corresponding anti-interference measures requirements of the instrument are improved accordingly.

- Environmental requirements for on-site instrument installation:

Avoid large motors and frequency conversion devices nearby.

- Power supply requirements:

the voltage is required to be stable and pure to avoid the occurrence of peak pulse interference in the state of large equipment start-stop, stop power supply and so on. In the case of power failure, power on the instrument after the device is powered on.

- Cable requirements:

Ensure that the onsite instrument cables are shielded cables and that the shielded cables are properly grounded to the instrument. (Note that it cannot be mixed with electrical ground, there should be independent grounding of the instrument).

- Cable laying requirements:

Instrument cables and power cables should not be mixed together (such as in the same bridge), and should be separated separately.

- Load requirements:

The load carried by the output current is generally required to range from 250 ohms to 750 ohms. Load greater than 750 ohms can make the output current smaller or jump. But the load is not recommended to be less than 250 ohms, otherwise the anti-interference ability decreases. It is suggested that if the site is directly to receive 4 ~ 20mA current secondary table or DCS, and the load is very small. There can be a 250-ohm resistance in the loop string for anti-interference.

12) Current output problem detection process:

Whether the indicator is removed or replaced. Positioning fastening screw. Check the pointer and axis. Check the flowmeter float. Whether the zero pointer indicates RP. Push the float to detect current. Current regulation.

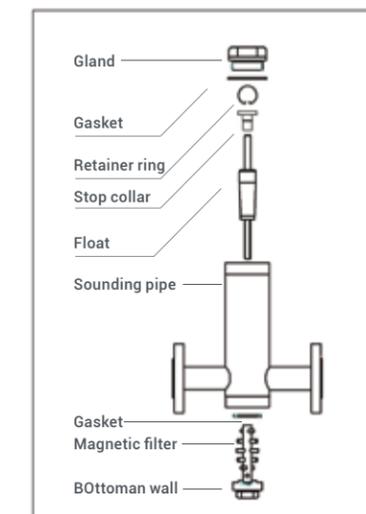
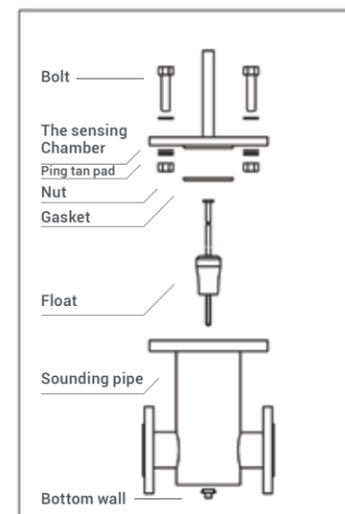
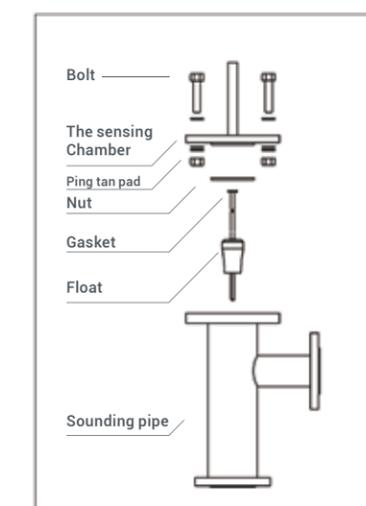
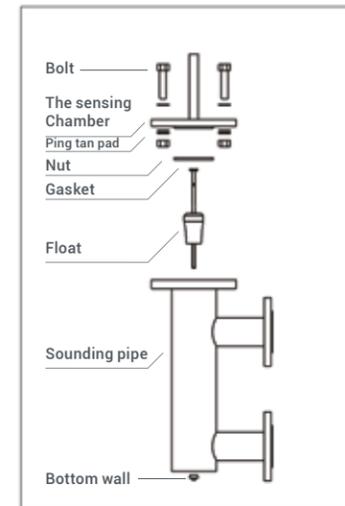
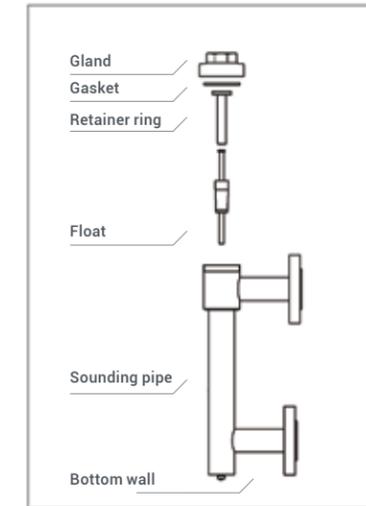
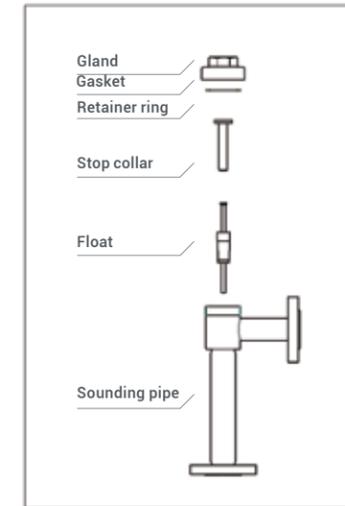
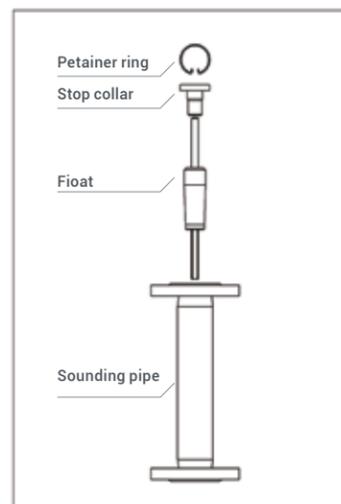
13) Switch plate indicator and alarm detection:

Indicator detection: If the indicator action is not flexible, it is necessary to detect the coordination between the pointer fan board and the switch plate starter. You can firstly draw the alarm board from the slot, and then test whether the pointer is flexible. If the action of removing the alarm board is flexible, observe whether there is a problem of sticking the starter wall when the pointer fan board is cut to the inside of the starter slot. You can adjust the pointer fan board to make the movement flexible. Others are as same as above.

## 6.2 Measuring tube

- 1) Metal tube float rotameter generally does not need maintenance, if the medium contains ferromagnetic particles or mud sand, may occur float stuck phenomenon (this phenomenon occurs in the new device driving stage, due to pipe cleaning is not clean, welding slag and other suction on the float caused by the float stuck) at this time regardless of the size of the flow in the pipeline, the pointer of the converter only stops on a scale (the visible instantaneous flow rate of the LCD display remains unchanged). In case of this phenomenon, the rotameter can only be removed from the pipeline to clear the blockage in order to resume normal operation.
  - 2) Note: If there is a stuck float problem, do not use hard objects to knock the measuring tube, otherwise it is easy to make the measuring tube deformed or damaged.
  - 3) To close the valve of the pipeline before removing the flow meter, (AFM2000-2, AFM2000-3, AFM2000-6) flow meter does not need to remove the flow meter from the pipeline, only need to close the valve, remove the upper and lower sealing fittings, see the following disassembly figure of measuring pipe) if used for corrosive media. Safety precautions should be taken to avoid the damage of residual liquid in the measuring tube. After the flow meter is removed (the seal is removed), remove the ring and float from the top, remove the ferromagnetic material and sediment, and reinstall the float and float after washing the measuring tube. Pay attention to ensure that the float can operate freely in the measuring tube.
- If the indicator of the flow meter is unstable in the process of system operation, it should be checked according to the composition conditions of the measuring system. There are roughly four reasons leading to this phenomenon: First, the flow rate in the pipeline is unstable. Second, the pressure difference at the inlet and outlet of the flow meter is too small (usually easy to occur when measuring gaseous medium) less than 5 times the pressure loss of the flow meter, if possible should try to open the inlet valve of the flow meter, appropriate to close the outlet valve. Third, the flow meter range selection is too large, the flow meter in the lower limit of the measuring range is not easy to establish a stable working state, should be returned to the manufacturer to reduce the measuring range. Fourth, there is two-phase flow in the measured body (liquid phase and gas phase exist at the same time). As long as measures are taken to eliminate the existence of two-phase flow, the instrument can operate stably.
- 4) The flow meter has been calibrated at the factory, generally do not need on-site calibration, if the flow in the pipeline is zero, and confirm that the float is not stuck by foreign matter, and the indication is not zero, this may be due to the influence of the ferromagnetic material around the flow meter, so that the zero offset, at this time should adjust the installation direction and position, so that the instantaneous flow indication is zero (or RP point). If the current is found to be incompatible with the pointer, zero should be recalibrated. See debugging instructions for the calibration method.
  - 5) Do not remove the indicator easily, otherwise there will be deviation.
  - 6) For the AFM2000-2 and AFM2000-3 flow meters, it is not necessary to remove the flow meter from the pipe during maintenance or cleaning, just take out the float from the upper part, see the dismantling diagram of the measuring pipe for details.

### Disassembly Diagram of Measuring Tube



## 7. Caliber

### Reminder:

There are no absolute correspondence among valve opening sizes, pump angles, flow rate or pressure, etc. None of them can represent the flow.

### 7.1 Determine correction factor Kx

1) Given the liquid volume flow Qv, Ka should be calculated by:

$$K_a = \sqrt{\frac{(\rho_s - \rho) \times \rho}{\rho_s - \rho}}$$

2) Given the liquid volume flow Qm, Kb should be calculated by:

$$K_b = \sqrt{\frac{\rho_s - 1}{(\rho_s - \rho) \times \rho}}$$

3) Given the gas volume flow Qv under standard conditions (0 °C, 0.1013MPa), Kc should be calculated by:

$$K_c = \sqrt{\frac{\rho \times P_n \times T}{\rho_n \times P \times T_n}}$$

4) Given the gas volume flow Qv in running state (0°C, 0.1013MPa), Kd should be calculated by:

$$K_d = 0.932 \times \sqrt{\frac{\rho \times P \times T_n}{\rho_n \times P_n \times T}}$$

5) Given the gas ass flow Qm, K should be calculated by:

$$K_e = \frac{1}{1.293} \times \sqrt{\frac{\rho_n \times P_n \times T}{\rho \times P \times T_n}}$$

### Among the above formulas:

ρ: The density of the measured medium

The density of liquid in the circumstance of 20 °C , 0.1013MPa (g/cm3)

The density of liquid in the circumstance of 20 °C , 0.1013MPa (g/cm3)

ρs: The density of the rotor

The density of stainless steel rotor is 7.8g/cm3

The density of PTFE rotor is 3.4g/cm3

The density of Nickel-based alloy rotor is 8.3g/cm3

ρn: Air density in calibration state (20 °C , 0.1013MPa) is 1.205kg/m3

T: Absolute temperature of the measured medium (K)

Tn: Absolute temperature of calibration medium (293.15K)

P: Absolute pressure of the measured medium (MPa)

Pn: Absolute pressure of calibration medium (0.1013MPa)

### 7.2 Determine rotor caliber and measurement range

1) According to the parameters provided by users in the selection specification, select the appropriate correction coefficient calculation formula to calculate the corresponding calibration medium flow Qs: Qs = Kx × Q

Qs --- The standard medium (air or water) Flow rate in the calibration status

Q --- The medium flow provided by the user

Kx --- The correction factor

2) Water and air flow rate B. Flow rate given in the table refers to 20°C , 0.1013MPa, which allows the range of + 10% of normal flow, ie, after the calculated water and air flow rate Qs, if the flow rate within a range shown in the table, it can rotor the corresponding number range and the corresponding measuring tube Caliber is selected.

3) According to the following formula to determine user flow rate measured medium scale limits Q:  $0.9 \times \frac{Q_i}{K_x} \leq Q \leq 1.1 \times \frac{Q_i}{K_x}$

### In the formula:

Qi refers to the volume flow in the flow meter rotor number corresponds to a water or air limits in the calculation does not take into viscosity correction is possible with computer calculations of a difference, then ask the user to assist.

## Appendices

### Hangzhou HollySys Automation System Engineering Co., Ltd.

#### Selection Specification

Contract No: \_\_\_\_\_ Delivery Time: \_\_\_\_\_

#### User Parameters

The Number of the Same Type: \_\_\_\_\_ Tag: \_\_\_\_\_

Product Model: \_\_\_\_\_ Accuracy: \_\_\_\_\_

Flanges Standard: \_\_\_\_\_ Pressure Level: \_\_\_\_\_

Media Name: \_\_\_\_\_ Medium Density under Standard Conditions (kg/Nm3): \_\_\_\_\_

Medium Viscosity (mPa.s): \_\_\_\_\_ Medium Density in Running State (kg/m3): \_\_\_\_\_

Operating Pressure (MPa): \_\_\_\_\_ Medium Temperature (°C): \_\_\_\_\_

#### Measuring Range

Minimal: \_\_\_\_\_  l/h  m3/h  Nm3/h Media State:

Normal: \_\_\_\_\_  l/h  m3/h  Nm3/h  air

Maximum: \_\_\_\_\_  l/h  m3/h  Nm3/h  liquid

Confirmed by the Factory:

Measuring Range: \_\_\_\_\_ Correction Factor: \_\_\_\_\_

DN: \_\_\_\_\_ PN: \_\_\_\_\_ Rotor Code: \_\_\_\_\_

#### Matching Accessories:

Bit No.	Name	Model Specifications	Quantity	Remarks

Table Maker: \_\_\_\_\_ Date: \_\_\_\_\_ Approver: \_\_\_\_\_ Date: \_\_\_\_\_