



FvLuoky GAS Thermal Mass Flowmeter

FHF20 Series

User Manual

FY/JC 80 A / O 15/08 V 1.5



FuYi Intelligent Instrument (Shanghai) Co., Ltd.

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※Safe Use Instrument※

Thank you for purchasing the hot gas mass flowmeter developed and produced by our company.

The user manual of the thermal gas mass flowmeter records how to use this product correctly and safely. This product is a precise electronic instrument for gas flow measurement. Please read this manual carefully before installing and debugging in order to prevent the instrument from being damaged and to perform the best performance and stable operation.

- ◇ After reading this manual, please keep it in good condition and move along with this instrument.
- ◇ Please hand in this manual to the technical department of the end user.
- ◇ The important level of safety matters in this manual is classified by dangerous attention.



Notice

If the warning is ignored and the wrong operation is carried out, it may cause personal injury or damage to the instrument and



Dangerous

If the warning is ignored and erroneous operation is carried out, it may result in personal casualties or major safety accidents.

The following identities may appear in the user manuals used.



The left picture shows possible danger;



The left picture says something that must be noticed;



The left picture indicates prohibited matters.



Selection of explosion-proof instruments in the application of explosive atmospheres. Make sure whether there is an explosion-proof certification mark and temperature group mark on the instrument nameplate. Instruments without this mark can not be used in explosion environment.



The instrument explosion-proof temperature group must meet the environmental requirements of site explosion protection and temperature. When applied in the occasion with explosion-proof requirements, the explosion-proof temperature group of the instrument should be confirmed to meet the requirements of explosion-proof and temperature on site.





No live opening operation in explosive environment When go with wiring operation, the power supply should be disconnected before operation.





The protection level of meters must meet the requirements of field conditions Instrument protection level is checked and classified according to the relevant requirements of


GB4208-93 (equivalent to IEC529). The level of protection required on site shall be lower than or equal to the level of protection of the instrument to ensure that the working environment of the instrument is good.


 **Confirm the type of power supply** Users can choose two power supply modes for the instrument, AC 220V and DC + 24V (goods should be specified). Confirm whether the power supply type matches the meter before installation.


 **Confirm instrument working environment and medium temperature** The maximum design temperature of the site environment and medium shall be lower than the nominal value of the instrument (see Technical Parameters and Functions in this specification for details).


 When the medium temperature is too high, it is forbidden to install and maintain on line. When the measured medium temperature is higher than the human body to withstand the temperature or higher temperature danger occurs, should be discontinued or cooling treatment, then the operation is safe temperature, no on-line operation, should be discontinued operations, in order to avoid danger.

 **Confirm instrument working environment air pressure and medium pressure.** The environmental pressure and the maximum design pressure of the medium at the site shall be lower than the nominal value of the instrument (the nominal value is detailed in the Technical Parameters and Functions in this specification).

 **When the medium pressure is too high, it is forbidden to install and maintain on line.** When the absolute pressure of measuring medium is higher than 5 standard atmospheric pressure, or higher than the potential dangerous pressure, shutdown or depressurization should be carried out, and then operation should be carried out when the safety pressure is reached, and production should be stopped without conditions.

 **Additional requirements for special medium measurements** Some gas media have special characteristics, which require users to specify special types of products according to the actual situation of the site. Before installation, users should carefully check whether the types of products meet the requirements of the site.

 **When the medium is dangerous gas, it is forbidden to install and maintain on line.** When measuring the type of gas which may cause harm to human body, it is forbidden to install and maintain on-line. Relevant safety treatment should be carried out so that the site conditions can be safely installed before operation. No conditions for on-line operation should be stopped, so as to avoid any danger. Such gases as gas, chlorine and so on.

 **Do not operate if this instrument is defective.** If the instrument is defective or damaged, please contact our technicians or qualified maintenance personnel for inspection.

1.Summary

Thermal gas mass flowmeter is designed based on the principle of thermal diffusion. The instrument uses constant temperature difference method to measure gas accurately. It has the advantages of small volume, high degree of digitalization, convenient installation and accurate measurement.

The sensor part consists of two reference platinum resistance temperature sensors. When the instrument works, one sensor continuously measures the medium temperature T_1 ; the other sensor is used to sense the fluid velocity from heating to higher than the medium temperature T_2 , which is called the velocity sensor. The temperature $\Delta T = T_2 - T_1$, $T_2 > T_1$. When there is fluid flowing through, because gas molecules collide with sensors and take away the heat of T_2 , if the temperature of T_2 is lowered and the T_1 is kept unchanged, the power supply current of T_2 must be increased. The gas flow rate is faster and the heat taken away is more. There is a fixed functional relationship between the gas flow rate and the heat added. This is the principle of constant temperature difference.

$$V = \frac{K[Q/\Delta T]^{1.87}}{\rho_g}$$

ρ_g — Fluid gravity (Density dependent)

V — Current Speed

K — Equilibrium coefficient

Q — Heating amount (Related to specific heat and structure)

ΔT — Temperature difference

Since the temperature of the sensor is always about 30 degrees higher than that of the medium (environment), the thermal gas flowmeter does not need temperature compensation in principle.

The thermal gas mass flowmeter is suitable for medium temperature range. -40-220°C.

(1) Correlation between specific gravity and density in fluid $\rho = \rho_n \times \frac{101.325+P}{101.325} \times \frac{273.15+20}{273.15+T}$

ρ_g — Medium density under working conditions (kg/m³)

ρ_n — Density of media under standard conditions (101.325 Kpa, 20°C) (kg/m³)

P — Working condition pressure (kPa)

T — Working condition temperature (°C)

It can be seen from formula (1) (2) that the relationship between flow velocity and working pressure, gas density and working temperature has been determined.

Thermal gas mass flowmeter is not only unaffected by temperature, but also unaffected by pressure. Thermal gas mass flowmeter is a real direct mass flowmeter. Users need not revise the pressure and temperature.

2 . Technical Parameter

The thermal gas mass flow meter has the following technical advantages. :

- Real mass flowmeter can measure gas flow without temperature and pressure compensation, which is convenient and accurate. The mass flow rate or standard volume of gas can be obtained.
- Wide range ratio, which can measure gas up to 100Nm/s to 0.1Nm/s, can be used for gas leak detection.
- Its seismic performance is good and its service life is long. The sensor has no moving parts and pressure sensing parts, and is not affected by vibration.
- Easy installation and maintenance. The installation and maintenance of non stop production can be realized under the conditions of the site. (Special customization is required.)
- Digital design. Integral digital circuit measurement, accurate measurement and convenient maintenance.
- With RS-485 communication or HART communication, factory automation and integration can be realized.

法兰管径	15,20,25,32,40,50,65,80,100mm	现场指示	4排液晶显示器
插入管径	100 - 3000mm	电流输出	4 - 20 mA (2线式)带HART信号
测量介质	各种气体 (乙炔气除外)	通讯协议	HART(兼容)or RS485(MODBUS Protocol)
材质	304 / 316	外壳材质	铝合金
精确度	+/-1.0% 读取值	电源供应	85 - 230 VDC
重复性	+/-0.2%读取值	电气接口	M20*1.5, 1/2NPT
接续方式	法兰式 / 插入式	按键	4个内置按键可操作及显示控制
法兰规格	JIS 10K / JIS 20K / JIS 40K	环境温度	-30 - +60℃
	ANSI 150# / ANSI 300# / ANSI 600#	相对湿度	5 - 45%
	DIN PIN 10 / PN 16 / PN25 / PN 40	压力	0.6 - 10Mp
介质温度	-10 - +80℃	防爆等级	Exd IIC T6
	-10 - +200℃	防护等级	IP65、IP67
	-10 - +350℃	结构形式	一体式, 分体式

3. Structure Diagram

3.1 Installation and connection of integral instruments Appearance structure diagram



Fig. 1 is suitable for pipe diameter of DN2100 or less than DN500. Fig. 2 is suitable for pipe diameter of DN10 or less than DN100.

Simplified hot gas mass flow meter Full tube type thermal gas mass flow meter

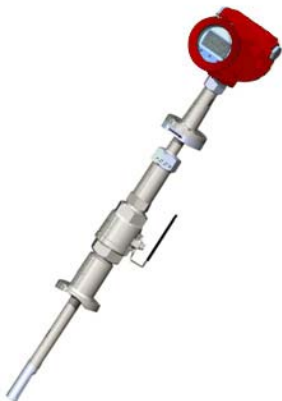


Fig. 3 is suitable for pipe diameter of DN100 or less than DN4000.



Figure 4: outline size: long 248* width 160* deep 76m


Online installation of thermal gas mass flowmeter

The insert should be inserted into the axis of the measured pipeline, so the length of the measuring rod depends on the size of the pipe diameter. Instructions should be made when ordering. If it can not be inserted into the axis of the pipeline, a calibration coefficient will be provided by the manufacturer to complete the accurate measurement.

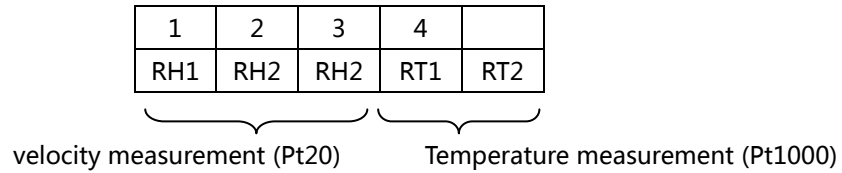
Flange type meets national standard GB/T9119-2000.

4. Installation method of cable

 No live operation is prohibited.

 Confirm power supply type

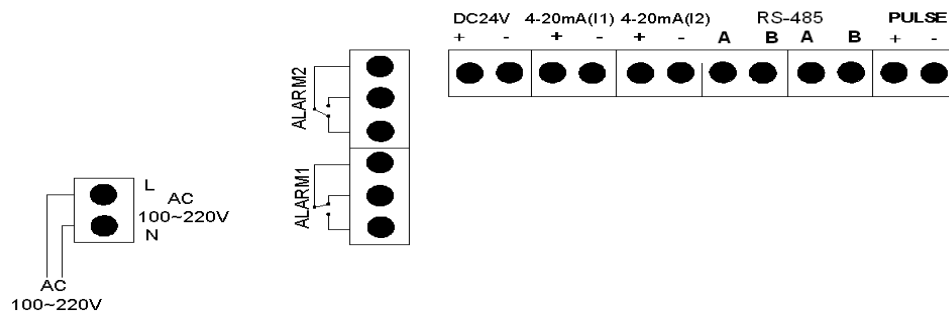
4.1 Description of sensor terminal :



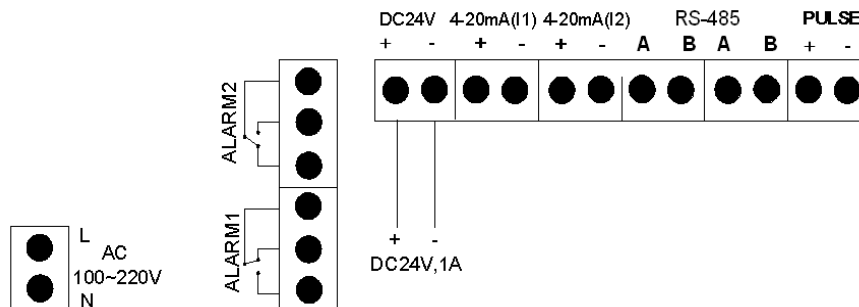
4.2 Terminal description and wiring method :

4.2.1 Connection of power source :

a. AC power supply connection

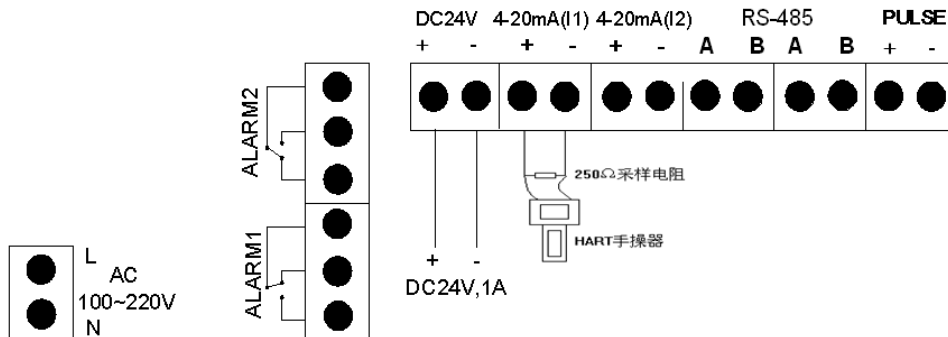


b. DC 24V power supply connection:

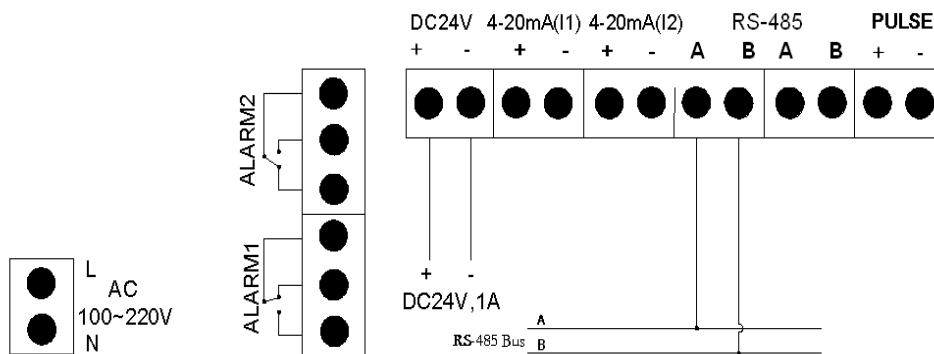


4.2.2 Instrument output wiring :

1. Four wire 4-20mA current output and HART handheld connection:

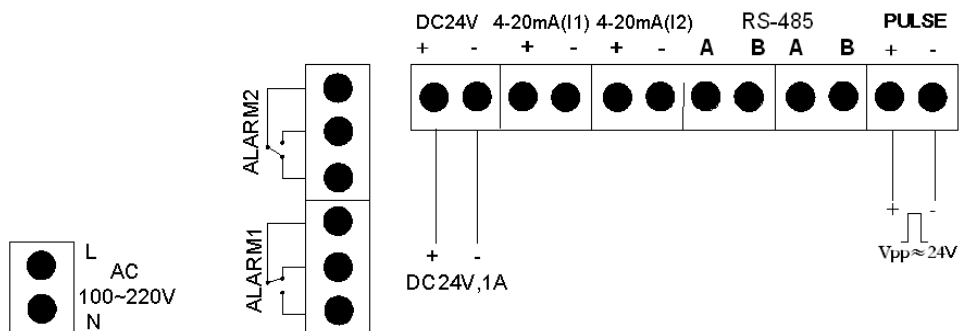


2. RS-485 Communication connection



4.2.3 Alarm output connection:

3. Pulse output connection



5. Installation of field instruments

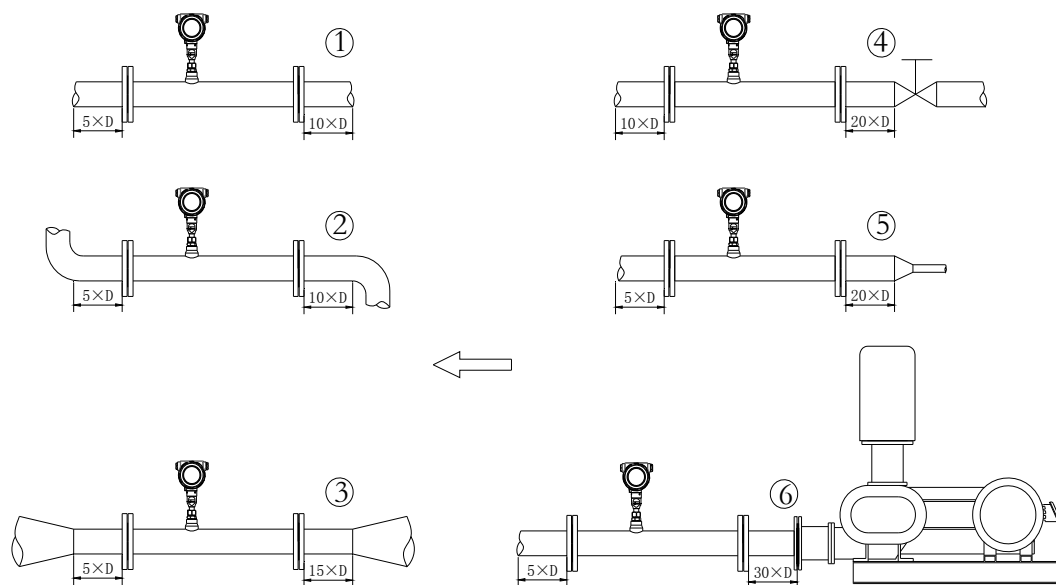
⚠ If the meter is installed outside, the instrument shading cover should be added to avoid the sun and rain..

- ⊘** It is forbidden to install in strong vibration.
- ⊘** It is forbidden to expose to environments containing large amounts of corrosive gases.
- ⊘** Do not share power with equipment of polluting power source such as frequency converter

and welding machine. If necessary, install purifying power source for converter.

(1) Installation location and piping requirements

1、 Installation of instruments should be away from elbows, obstacles, diameters, valves to ensure a stable flow field, while requiring a longer upper limit straight pipeline, the front straight pipeline is longer than 10D, and the rear straight pipeline is longer than 5D. The following figure shows the length of straight pipeline required by several situations often encountered in the field. :



Straight pipe section before and after installation

Type	No	Front segment	Back segment
pipe	1	10D	5D
Bend	2	10D	5D
Expansion	3	15D	5D
Valve downstream	4	20D	5D
Condensation	5	20D	5D
Pumps downstream	6	30D	5D

2、 When the field can not meet the requirement of straight pipe, gas rectifier can be connected in series in order to reduce the requirement of straight pipe greatly. .

(2) Thermal gas mass flowmeter base



Fig. 5 on line mounting type welding base



Fig. 6 reduced welding



Welding operations in explosive environments are prohibited.



The environment with special requirements for welding shall be operated according to relevant requirements.

The base can be divided into standard type and simplified type according to different installation methods. The base should be located at the top of the section direction of the pipeline when installing, and the axis of the through hole of the base should be perpendicular to the axis of the pipeline. Ideal base welding position and welding technology. (See the picture as below)

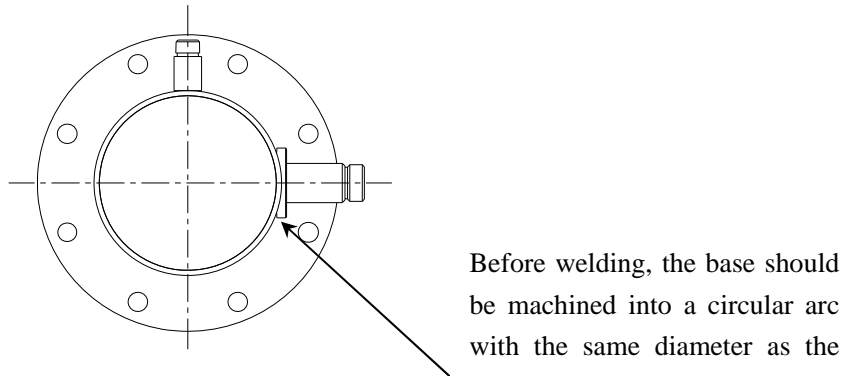



Fig. 7 welding position of ideal base


Installation of meters

(Simplified hot gas mass flow meter)

- 1) confirm the actual diameter and wall thickness of the pipeline before installing a simplified hot gas mass flow meter.
- 2) Put the rest of the hot gas mass flow meter into the special ball valve, and calculate the insertion depth according to the actual pipe diameter and wall thickness. This step allows you to insert roughly the size and tighten the nut with your hand.
- 3) Rotate the sensor connecting rod to make the marked arrow and the medium flow in the same direction.
- 4) According to the measured data, the corresponding calibration on the sensor connecting rod can be converted, and the locking nut can be used.
- 5) If you are horizontally installed, the display screen of this instrument can be flexibly installed at 90°180°270°to meet the actual needs of your site.

(Full tube type thermal gas mass flow meter)

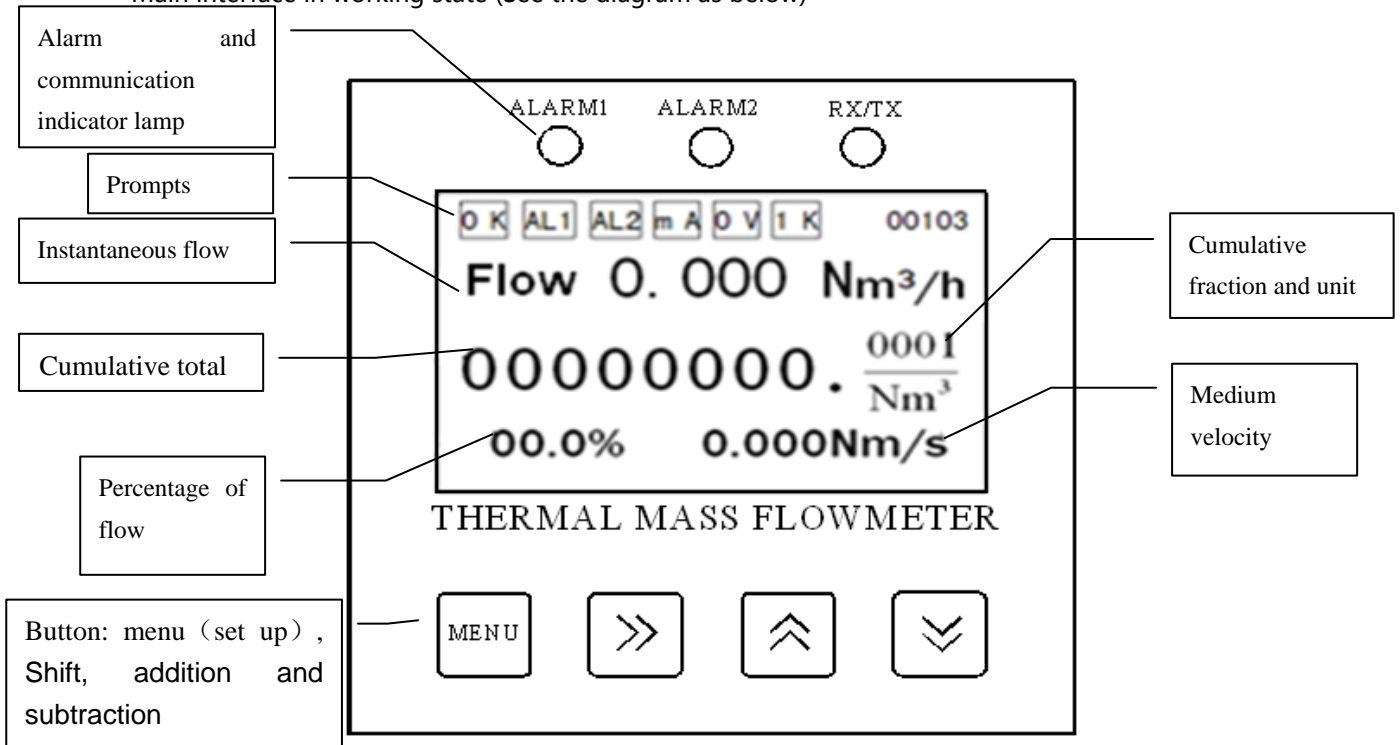
 Please reconfirm before installation. For connection of pipe sections, prepare flange connection related items such as gaskets and bolts.

 It is necessary to stop production before installation and strictly comply with the relevant regulations of the factory.

Full-tube meters have been installed on special pipes correctly in the factory. Users only need to assemble pipes on the spot, so it is simpler to install them than on-site plug-in ones. Firstly, select the appropriate installation point in the pipeline, then cut the pipeline according to the length of the necessary supporting section, install the corresponding flange and bolt. The fluid flow rate must be consistent with the flow label of the full tube hot gas mass flowmeter. And the display screen should be vertical and horizontal, and the axis of the pipeline should be parallel to the horizontal plane. The error should not exceed (+2.5 degrees). Finally, the instrument should be locked with bolts.

6. Commissioning and operation

Main interface in working state (See the diagram as below)



Prompts :

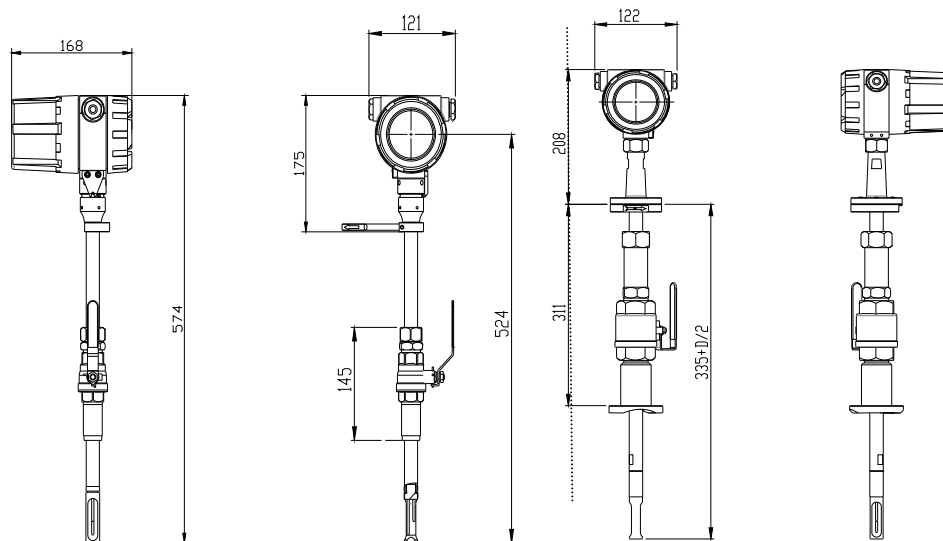
- 1、 When the instrument is working normally and powered on, it will be self-checked, OK will be prompted when self-checking is normal, ERR will be prompted when error occurs, and error will be checked in the self-checking menu;
- 2、 The instrument alarm channel prompts, AL1 indicates channel 1 alarm, AL2 indicates channel 2 alarm;
- 3、 When the output of flow current exceeds 20 m A, the prompt line shows m A, indicating overflow of current, if it is empty normally.
- 4、 Instrument operating parameters overflow, if the instrument running parameters overflow display O V, if normal will be displayed empty;
- 5、 In order to display and read conveniently, when the cumulative flow exceeds 10,000,000, the cumulative flow data of the instrument is divided by 1000, and the prompt line is 1K, need to be multiplied by 1000 when reading.
- 6、 Instrument communication status information shows that the first three are table numbers, the fourth is parity bit, 0:no check; 1:parity check; 2:even check; the fifth is baud rate, 0:1200; 1:2400; 2:4800; 3:9600. When the table number is 1, the check is no check, and the baud rate is 9600. The display interface prompt line displays "00103".

When the instrument is powered on, the self-check error interface will be displayed if the self-check is abnormal (the self-check interface description refers to the self-check menu). After about 1 to 2 seconds, it will jump to the main interface. Otherwise, it will jump to the main interface directly. The instrument sets parameters through buttons. When installing, it is necessary to use buttons to manually set some parameters. The instrument has 4 keys, from left to right in order of MENU, shift, add and drop keys. Usually shift to shift key, MENU for confirm or change key, add or reduce to modify key.

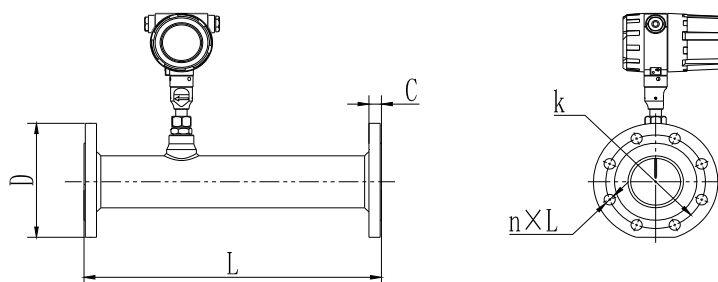
7. Structure size

Reduced size

Standard shape dimensions



Installation dimension of pipe section



GB/T9119-2000 PN1.6Mpa(16bar)flat surface、Inrush plate flat welded steel pipe flange
(Unit : mm)

DN	D	k	n×L		d	f	C	L
15	95	65	4×14	M12	46	2	14	280
20	105	75	4×14	M12	56	2	16	280
25	115	85	4×14	M12	65	2	16	280
32	140	100	4×18	M16	76	2	18	350
40	150	110	4×18	M16	84	2	18	350
50	165	125	4×18	M16	99	2	20	350
65	185	145	4×18	M16	118	2	20	400
80	200	160	8×18	M16	132	2	20	400
100	220	180	8×18	M16	156	2	22	500

1. The 1. flange adopts the national standard GB/T9119-2000 standard. And processing and production according to GB/T9119-2000 standard.
2. Pipe threaded connections can be used for DN15-DN80 meters,, but only after technical agreement with instrument suppliers is reached..
3. The table only gives the rated pressure data of up to 1.6 Mpa, which can be customized if it is higher than the rated pressure, but can be executed only after reaching technical agreement with the instrument supplier.

8. General gas density and relative air conversion tables

At present, the laboratory can't calibrate mass flow according to the actual gas used by users. Usually, the mass flow is calibrated after the actual gas flow is converted into air flow. When it is applied, the direct output shows the mass flow or volume flow of the actual gas used..

The conversion of different gases is carried out by conversion coefficient, and the conversion coefficient of single component gas can be checked. See the table as below:

No.	Gas	specific heat (cal/g°C)	density(g/L0°C)	Conversion coefficient
0	Air	0.24	1.2048	1.0000
1	Ar	0.125	1.6605	1.4066
2	AsH ³	0.1168	3.478	0.6690
3	BBr ₃	0.0647	11.18	0.3758
4	BCl ₃	0.1217	5.227	0.4274
5	B ₂ O ₃	0.1779	3.025	0.4384
6	B ² H ⁶	0.502	1.235	0.5050
7	CCl ⁴	0.1297	6.86	0.3052
8	CO ₄	0.1659	3.9636	0.4255
9	CH ⁴	0.5318	0.715	0.7147
10	C ² H ⁴	0.3658	1.251	0.5944
11	C ² H ⁶	0.4241	1.342	0.4781
12	C ³ H ⁴	0.3633	1.787	0.4185
13	C ³ H ⁶	0.3659	1.877	0.3956
14	C ³ H ⁸	0.399	1.967	0.3459
15	C ⁴ H ⁶	0.3515	2.413	0.3201
16	C ⁴ H ⁸	0.3723	2.503	0.2923
17	C ⁴ H ¹⁰	0.413	2.593	0.2535
18	C ⁵ H ¹²	0.3916	3.219	0.2157
19	CH ³ OH	0.3277	1.43	0.5805
20	C ² H ⁶ O	0.3398	2.055	0.3897
21	C ³ H ³ Cl ³	0.1654	5.95	0.2763
22	CO	0.2488	1.25	0.9940
23	CO ²	0.2017	1.964	0.7326
24	C ² N ²	0.2608	2.322	0.4493
25	Cl ²	0.1145	3.163.	0.8529
26	D ²	1.7325	0.1798	0.9921
27	MENU	0.197	1.695	0.9255
28	GeCl ⁴	0.1072	9.565	0.2654
29	GeH ₄	0.1405	3.418	0.5656
30	H ₂	3.4224	0.0899	1.0040
31	HBr	0.0861	3.61	0.9940

Table of conversion coefficients for single component gases (Continued) :

32	HCl	0.1911	1.627	0.9940
33	HF	0.3482	0.893	0.9940
34	HI	0.0545	5.707	0.9930
35	H ₂ S	0.2278	1.52	0.8390
36	He	1.2418	0.1786	1.4066
37	Kr	0.0593	3.739	1.4066
38	N ₂	0.2486	1.25	0.9940
39	Ne	0.2464	0.9	1.4066
40	NH ₃	0.5005	0.76	0.7147
41	NO	0.2378	1.339	0.9702
42	NO ₂	0.1923	2.052	0.7366
43	N ₂ O	0.2098	1.964	0.7048
44	O ₂	0.2196	1.427	0.9861
45	PCl ₃	0.1247	6.127	0.3559
46	PH ₃	0.261	1.517	0.6869
47	P ₂ O ₅	0.1611	5.62	0.3002
48	POCl ₃	0.1324	6.845	0.3002
49	SiCl ₄	0.127	7.5847	0.2823
50	SiH ₄	0.3189	1.433	0.5954
51	SiH ₂ Cl ₂	0.1472	4.506	0.4095
52	SiHCl ₃	0.1332	6.043	0.3380
53	SO ₂	0.1489	2.858	0.6829
54	TiCl ₄	0.1572	8.465	0.2048
55	Xe	0.0379	5.858	1.4066

9. Selection code

Sensor code									Transmitter code				Optiona	Description of the content
FHF20	-X	X	()	-X	X	X	X	X	-X	X	-X	X	-X	—Range(m3/h)
Type	-F													Flange type (≤DN100)
	-C													Insert type
Ex type	—													Standard
	Ex													CT6
Caliber		DN												Digital show
Floater material			-N											SUS 304
			-L											SUS 316
Temperature rgrade			1											-10~+80°C
			2											-10~+200°C
			3											-10~+350°C
Protection level			1											IP65
			2											IP67
Pressure class			1											4.0MPa
			2											1.6MPa
			3											1.0MPa
			4											Special consultation
Structure type				Y										one type
				F										Split type
Powder Supply				-1										220V AC
				-2										24V DC
Signal/Communication output				1										4~20MA+RS485
				2										4~20MA+HART
Electrical interface				-M										M20*1.5
				-N										1/2" NPT
Accuracy class				A										1.0
				B										1.5
												Accessory	flange , globe valve , signal line (__meter)	

Illustration

Model : FHF20-FEx (300) -N113Y-22-GA-5000m3/h (globe valve)

Thermal gas mass flow meter , insert type , size : DN300 , pipe material : SUS304 , temperature : -10~80°C , IP grade : IP65 , pressure grade : 1.0MPa , structure form : Integrated machine , powder supply : 24V DC , signal output : 4~20MA , Communication protocol : HART , Electrical interface : 1/2" NPT , LCD head , precision : 1.0 , explosion-proofCT6 , measuring range : 5000m3/h. Accessory : globe valve.



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