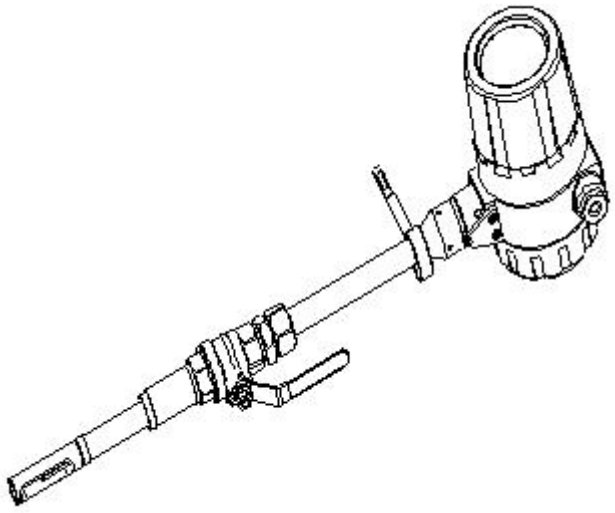
Thermal Gas Mass Flowmeter

Installation and Operation Guide



CONTENTS

Safety Information

Thank you for purchasing our quality Thermal Gas Mass Flowmeter with independent research and development.
We have written this guide to provide the persons responsible for the installation, operation and maintenance of your flow meter with the product specific information they will need.
In order to prevent damage to instrument and make the instrument in the best performance and stable operation, please read this manual thoroughly before installation.

Please have a safekeeping of this manual and together with the instrument after reading.

Please pass this manual to technical department of end user to keep.

This manual classifies important grade of safety attentions by Caution and Warning.

Caution

Error operation in case of ignoring the tips might cause the personal injury, or damage to the instrument and property.

Warning

Error operation in case of ignoring the tips might cause the personal injury or major accident.

This manual contents the following icons:

 Indicates safety attentions which are dangerous.

 Indicates safety attentions which are.needed to pay attention to.

 Indicates safety attentions which are.forbidden.

 **Select explosion-proof instrument for explosive environment application**

Confirm whether the nameplate of instrument has the identifiers of explosion-proof certification and temperature class, the instrument can't be used in explosive environment without those identifiers.

 **The explosion-proof temperature class of instrument must meet the explosion-proof and temperature of environmental requirements on site**

When the instrument is in used explosion-proof environment, make sure that the explosion-proof certification and temperature class of instrument meet to the requirements

on site.

No opening while working in explosive environment

Before wirings, please power instrument off.

The protection class of instrument must meet the working condition requirements on site

The requirement of protection class on site should be under, or the same as the protection class of instrument to ensure that the instrument is working fine.

Confirm the power type

Customers can select the power type: 220VAC or 24VDC (Please state it when ordering). Please confirm the power type before installation.

Confirm the working environment of instrument and medium temperature

The environment on site and the maximum medium temperature should be under the nominal value of instrument. (The details of nominal value are shown in Part 2 Specifications.)

No hot-tapped installation and maintenance while the medium temperature is too high

When temperature of measuring medium is higher than the temperature that human can bear, or higher than the temperature of possible danger, should shut down or do cooling process to reach a safety temperature, and then do hot-tapped operation. If there are no conditions to do hot-tapped operation, should shut down to avoid dangers.

Confirm the ambient pressure of instrument and medium pressure

The ambient pressure on site and the maximum medium pressure should be under the nominal value of instrument. (The details of nominal value are shown in Part 2 Specifications.)

No hot-tapped installation and maintenance while the medium pressure is too high

When absolute pressure of measuring medium is higher than 5 times standard atmospheric pressure, or higher than the pressure of possible danger, should shut down

or do reducing pressure to reach a safety pressure, and then do hot-tapped operation. If there are no conditions to do hot-tapped operation, should shut down to avoid dangers.

Extra requirements of special medium

The properties of some gas are special, it is needed to order special product, please check the manual of special product thoroughly to make sure whether it meets the requirements on site before installation.

No hot-tapped installation and maintenance while the medium is dangerous gas

When the medium may cause injury to humans, no hot-tapped installation and maintenance, should shut down or do security processing to reach a safety condition, and then do hot-tapped operation. If there are no conditions to do hot-tapped operation, should shut down to avoid dangers. The dangerous gases are such gas and chlorine, etc.

If doubting that the instrument in the event of failure, please do not operate it

If there are something wrong with the instrument or it had been damaged, please contact us.

Part 1 Introduction

Thermal gas mass flow meter is designed on the basis of thermal dispersion, and adopts method of constant differential temperature to measuring gas flow. It has advantages of small size, easy installation, high reliability and high accuracy, etc.

The meter contains two platinum resistance temperature sensors. The thermal principle operates by monitoring the cooling effect of a gas stream as it passes over a heated sensor. Gas flowing through the sensing section passes over two sensors one of which is used conventionally as a temperature sensor, whilst the other is used as a heater. The temperature sensor monitors the actual process values whilst the heater is maintained at a constant differential temperature above this by varying the power consumed by the sensor. The greater the gas velocity, the greater the cooling effect and power required to maintain the differential temperature. The measured heater power is therefore a measure of the gas mass flow rate.

The format of gas velocity and power is shown as below:

$$V = \frac{K[Q/\Delta T]^{1.87}}{\rho_g} \quad \text{.....(1)}$$

Where: ρ_g is specific gravity of medium

V is velocity

K is balance coefficient

Q is heater power

Δ T is differential temperature

The medium temperature range of meter is -40℃～220℃.

In the format (1), the specific gravity of medium is related to the density:

$$\rho = \rho_n \times \frac{101.325 + P}{101.325} \times \frac{273.15 + 20}{273.15 + T} \quad \text{.....(2)}$$

Where: ρ_g is the medium density in working condition（kg/m^3）

ρ_n is the medium density in standard condition, 101.325kPa and 20℃ （kg/m^3）

P is the pressure in working condition（kPa）

T is the temperature in working condition （℃）

In the formats (1) and (2), there is a certain functional relationship between the velocity and pressure in working condition, medium density, the temperature in working condition.

Due to the sensor temperature is always 30℃ higher than the medium temperature (environment temperature), and the meter adopts method of constant differential temperature, therefore the meter do not need to do temperature and pressure compensation in principle.

Part 2 Specifications

Features

- Measuring the mass flow or volume flow of gas
- Do not need to do temperature and pressure compensation in principle with accurate measurement and easy operation.
- Wide range: 0.5Nm/s～100Nm/s for gas. The meter also can be used for gas leak detection
- Good vibration resistance and long service life. No moving parts and pressure sensor in transducer, no vibration influence on the measurement accuracy.
- Easy installation and maintenance. If the conditions on site are permissible, the meter can achieve a hot-tapped installation and maintenance. (Special order of custom-made)
- Digital design, high accuracy and stability
- Configuring with RS485 or HART interface to realize factory automation and integration

Description	Specifications
Measuring Medium	Various gases (Except the acetylene)
Pipe Size	DN10～DN4000mm
Velocity	0.1～100 Nm/s
Accuracy	±1～2.5%
Working Temperature	Sensor: -40℃～+220℃ Transmitter: -20℃～+45℃
Working Pressure	Insertion Sensor: medium pressure≤ 1.6MPa Flanged Sensor: medium pressure≤ 1.6MPa Special pressure please contact us
Power Supply	Compact type: 24VDC or 220VAC, Power consumption ≤18W Remote type: 220VAC, Power consumption ≤19W
Response Time	1s
Output	4-20mA (optoelectronic isolation, maximum load 500Ω), Pulse, RS485 (optoelectronic isolation) and HART
Alarm Output	1-2 line Relay, Normally Open state, 10A/220V/AC or 5A/30V/DC
Sensor Type	Standard Insertion, Hot-tapped Insertion and Flanged
Construction	Compact and Remote

Pipe Material	Carbon steel, stainless steel, plastic, etc
Display	4 lines LCD Mass flow, Volume flow in standard condition, Flow totalizer, Date and Time, Working time, and Velocity, etc.
Protection Class	IP65
Sensor Housing Material	Stainless steel (316)

Part 3 Mechanical Construction

3.1 Appearance

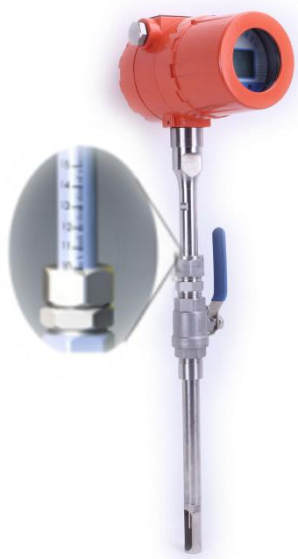


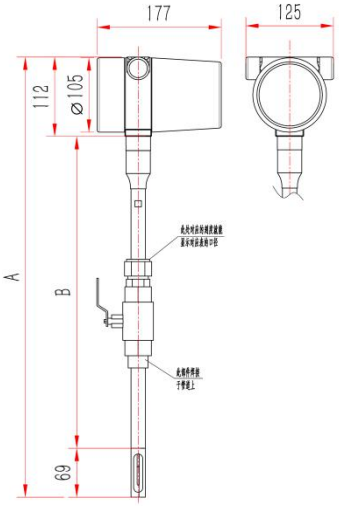
Fig. 1 Standard Insertion Flow Meter
(Pipe size DN50-DN1000)

Fig. 2 Flanged Flow Meter
(Pipe size DN10-DN80)

The insertion sensor of compact insertion flow meter should be inserted to axis of pipe, and the length of the insertion sensor is decided by pipe size, please confirm the pipe size when ordering. If the insertion sensor can't be inserted to axis of pipe, the manufacturer will provide a calibration factor to achieve an accurate measurement.

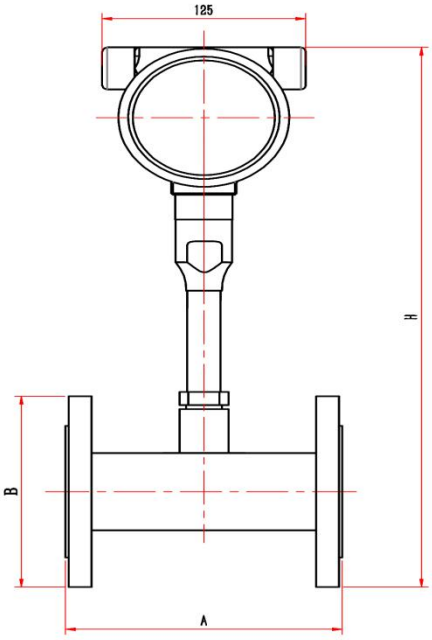
3.2 Dimensions

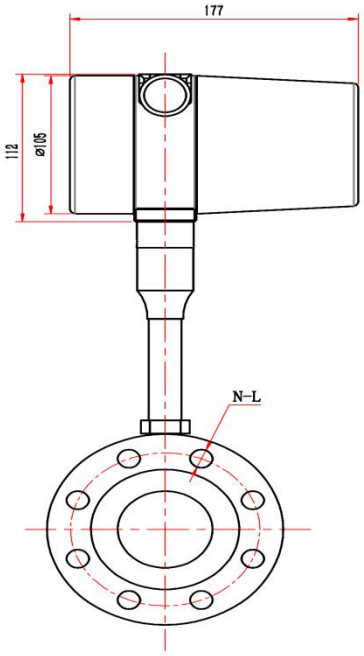
Dimensions of standard insertion sensor



Nominal diameter	A	B
DN65-DN200	431	250
DN250-DN500	551	370
DN550-DN1000	811	630

The dimensions of flanged sensor





PN1.6Mpa Plane and surface plate flat welding steel pipe flanges (Unit: mm)

Nominal Diameter （DN）	High（H）	Installation length（A）	Flange outer diameter（B）	The number of bolts （N）	Diameter of bolt hole
10	329	170	90	4	M12
15	332	170	95	4	M12
20	337	170	105	4	M12
25	342	170	115	4	M12
32	354	170	140	4	M16
40	359	170	150	4	M16
50	370	170	165	4	M16
65	388	190	185	8	M16
80	527	190	200	8	M16
100	537	200	220	8	M16
125	552	200	250	8	M16
150	577	200	285	8	M20
200	607	200	340	12	M20
250	760	240	405	12	M24
300	790	240	460	12	M24

For DN15-DN80, the meter can be made with threading to connect.

The above table is used for rated pressure of 1.6MPa. If the rated pressure is more than 1.6MPa, please contact us for special order.

Part 4 Wirings

No operation when the meter is working

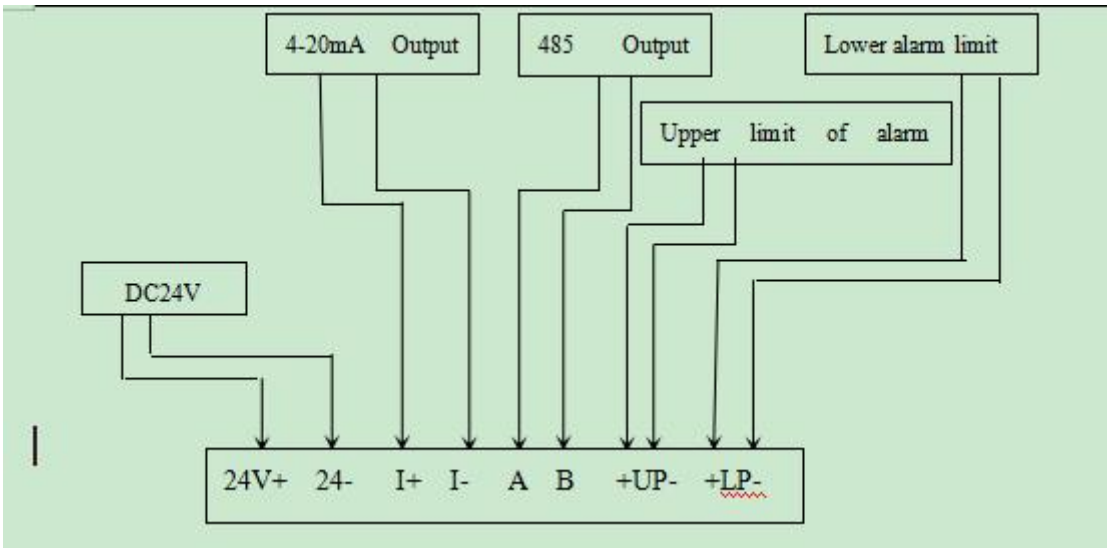
Confirm the power supply type

4.1 Instruction of Sensor Wirings

1	2	3	4
RT1	RT2	RH1	RH2

Temperature sensor (Pt1000) Heater (Pt20)

4.2 Instruction of Transmitter Wirings



Part 5 Installation

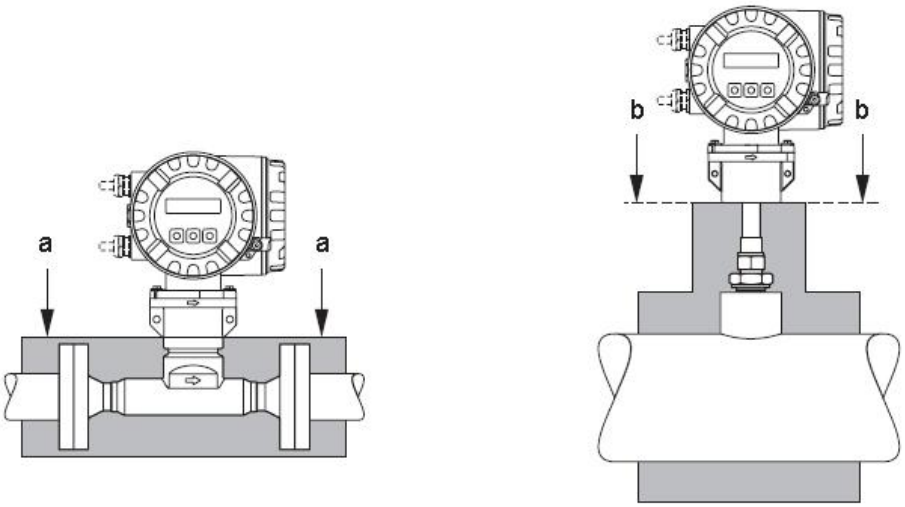
5.1 Installation Position

Thermal meters require a fully developed flow profile as a prerequisite for correct flow measurement. For this reason, please note the following points when installing the device.

- Observe the recommended inlet and outlet requirements.
- Good engineering practice is necessary for the associated pipe work and installation.
- Ensure correct alignment and orientation of the sensor.
- Take measures to reduce or avoid condensation (e.g. install a condensation trap, thermal insulation, etc.).
- The maximum permitted ambient temperatures and the medium temperature range must be observed.
- Install the transmitter in a shaded location or use a protective sun shield.
- For mechanical reasons, and in order to protect the pipe, it is advisable to support heavy sensors.
- No installation in where large vibration exists
- No exposure in the environment containing a lot of corrosive gas
- No sharing power supply with frequency converter, electric welding machine and other machines which can make power-line interference. If necessary, please add power conditioner for transmitter power supply.

Thermal insulation

When the gas is very humid or saturated with water (e. g. Bio Gas), the piping and flowmeter body should be insulated to prevent water droplets condensing on the measuring sensor.



a Maximum insulation height for the flanged sensor

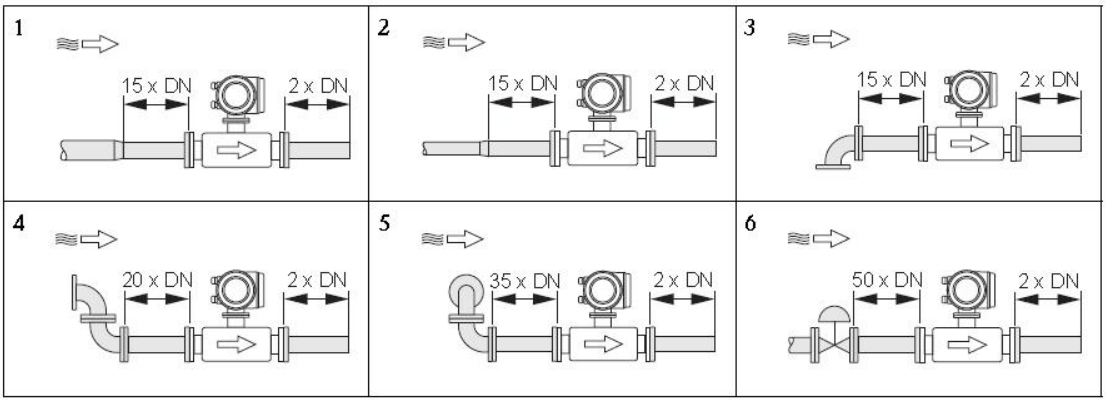
b Maximum insulation height for the insertion sensor

The thermal dispersion principle is sensitive to disturbed flow conditions.

- As a general rule, the thermal flowmeter should always be installed as far away as possible from any flow disturbances. For further information please refer to ISO 14511.
- Where two or more flow disturbances are located upstream of the meter, the recommended inlet length for the flow disturbance causing strongest disturbance must be used. E.g. where a valve is mounted before a bend, upstream of the flowmeter, 50 × DN of pipe work is required from the valve to the flowmeter.
- For very light gases such as Helium and Hydrogen all upstream distances should be doubled.

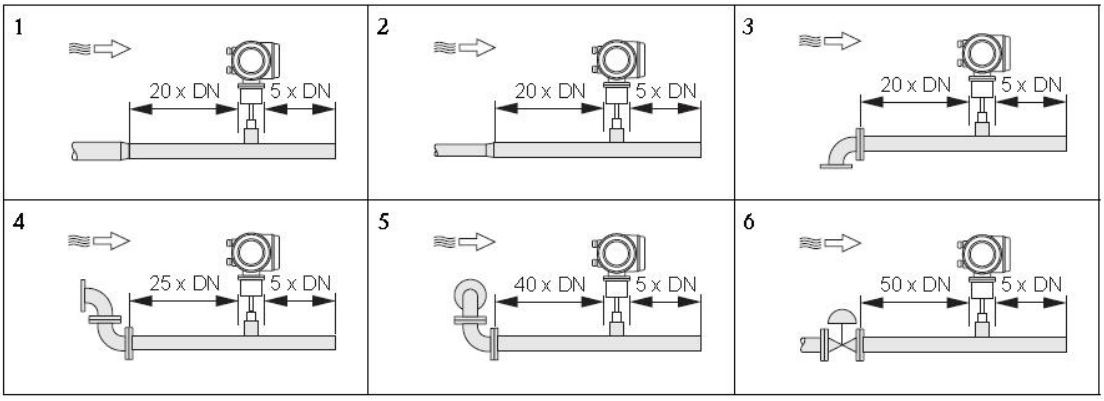
The minimum recommendations for inlet and outlet runs (without flow conditioner) are:

Flanged sensor



1 = Reduction, 2 = Expansion, 3 = 90° elbow or T-piece, 4 = 2 × 90° elbow, 5 = 2 × 90° elbow (3-dimensional), 6 = Control valve.

Insertion sensor



1 = Reduction, 2 = Expansion, 3 = 90° elbow or T-piece, 4 = 2 × 90° elbow, 5 = 2 × 90° elbow (3-dimensional), 6 = Control valve or pressure regulator.

A specially designed perforated plate flow conditioner can be installed if it is not possible to observe the inlet runs required.

5.2 Pipework requirements

- Good engineering practice should be followed at all times:
- Correct preparation, welding and finishing techniques
- Correctly sized gaskets
- Correctly aligned flanges and gaskets
- Connecting pipe work should match the internal diameter of the flowmeter.
- Maximum pipe diameter mismatch should not exceed:
  -1 mm (0.04 inch) for diameters < DN 200 (8")
  -3 mm (0.12 inch) for diameters ≥ DN 200 (8")
- New installations should be free of metallic and abrasive particles to prevent damage to the sensing elements on start-up

For further information please refer to ISO 14511.

5.3 Installation Steps

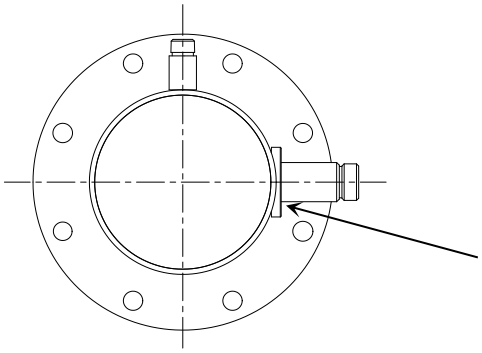
The base of thermal flowmeter

The base of Hot-tapped insertion type The base of standard insertion type

No welding in explosive environment

Carry out the welding operation in accordance with the requirements of special environment.

When installing, place the base on the top of pipe, and make the through-hole of base be perpendicular to axis of pipe. The good welding location of base and welding process is as below.



Before Welding, the base should be processed as the same as the circular arc of pipe to ensure sealing

Good welding location of base

The installation of standard insertion type

Identify an appropriate location for the flow meter.

Confirm the inner diameter and wall thickness of pipe

- Place the other part of meter into ball valve, and calculate the insertion depth according to the inner diameter and wall thickness of pipe. This step doesn't need to screw the nut by hand.
- Turn the connecting rod of sensor to make the mark direction of sensor as the same flow direction.
- According the calculated data on site, ensure the insertion depth by corresponding

calibration on the connecting rod, and then screw the nut tightly.

- If the meter is horizontal installation, the display of the meter can be installed in the direction of 90°, 180° or 270° to meet various requirements.

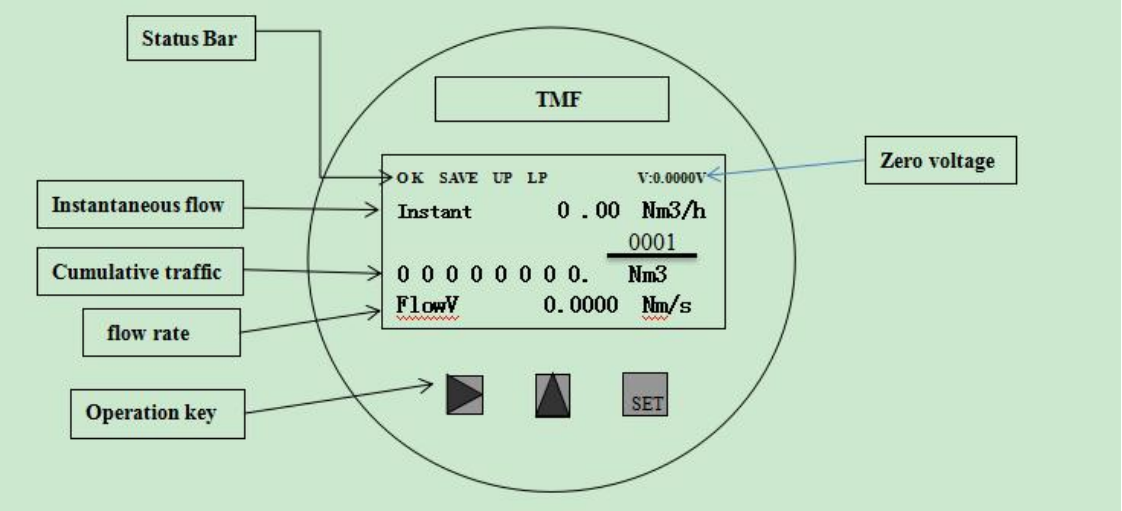
The installation of hot-tapped insertion type

- Before installation, please conform the connection type and install fittings.
- Before installation, the site must be shut down, and strictly follow the rules of factory.
- Identify an appropriate location for the flow meter.
- According to length requirement of meter, cut the pipe, and install the flanges and bolts on the pipe.
- Ensure the mark direction of meter is as the same flow direction, the display is perpendicular to horizontal plane, the axis of pipeline is paralleled to horizontal plane, the error can’t be more than ±2.5, and then fix the meter by bolts.

Part 6 Operation and Programming

6.1 Display

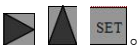
The display of meter in working status is shown as below.



The prompt line:

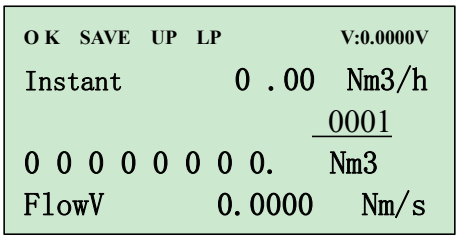
（1）When the meter is working normally and power is on, it will perform self-test. When the self-test is normal, it will prompt OK, SAVE;

（2）Instrument alarm channel prompt, UP indicates the upper limit alarm, LP indicates the lower limit alarm。

（3）The instrument performs parameter setting by pressing the button. Generally, some parameters are set manually by using the button during installation.。The meter has three buttons, from left to right is  。Usually  is shift key,  is add key,  is confirm save and change button, confirm and shift button under password menu, Under the password menu  is the confirmation and shift button。

6.2 Parameters Setup

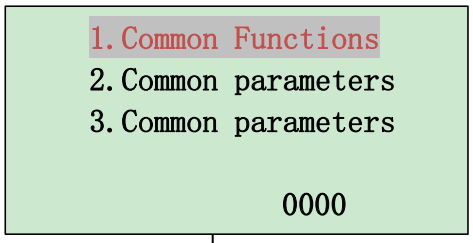
6.2.1 Main Menu



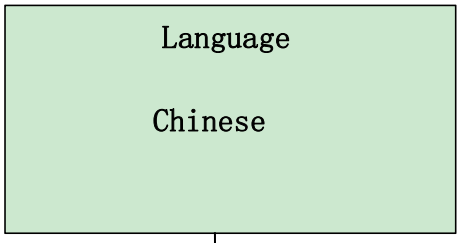
Under this interface , press ▶ （Shift） button to enter the setup menu;

6.2.2 Parameter setting main interface

Press ▶(Shift Select Menu)key

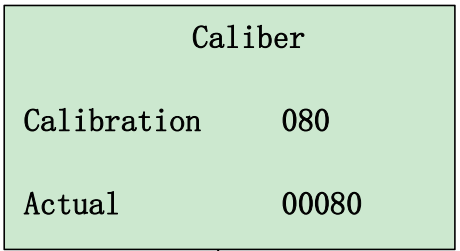


In the main interface, press ▶ to enter the main menu interface. You can use the ▶ shift keys to select the corresponding menu item and press SET to enter.

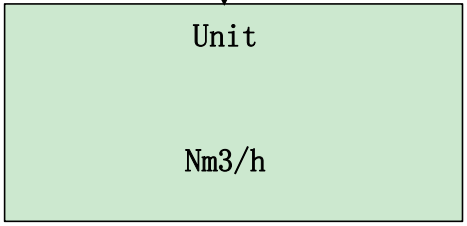


In the main menu of the main interface, press SET to enter the common menu interface. Press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters.

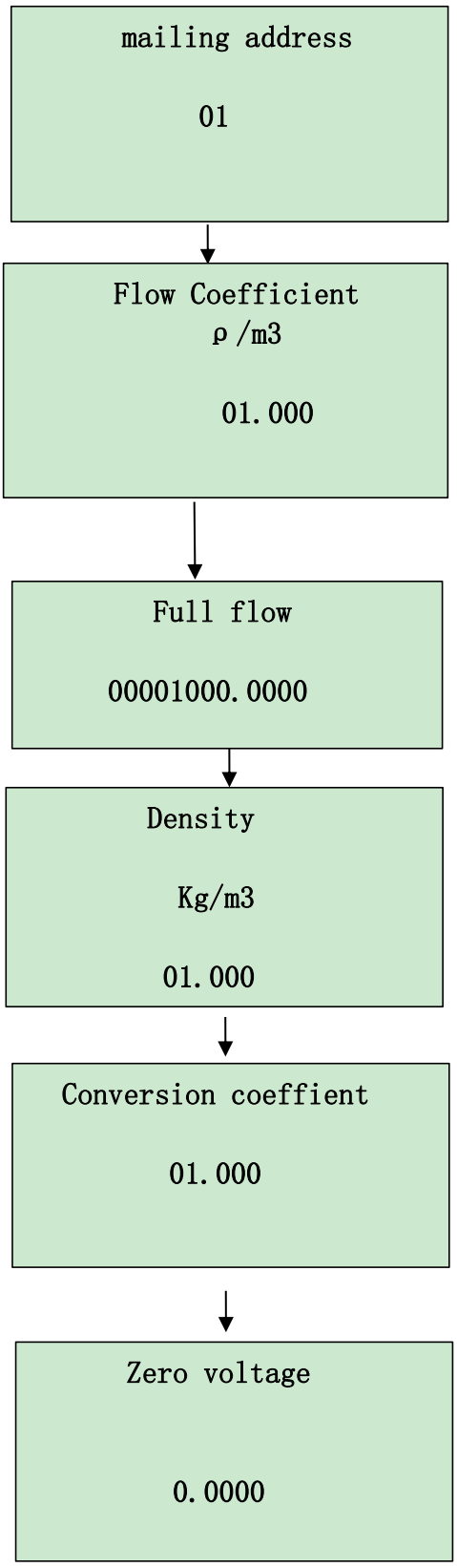
The default is Chinese display, you can switch English display.



Under the language menu, press SET to save and enter the caliber menu. Press SET to save and go to the next menu, press ▶ to move the cursor position, and ▲ to modify the parameters.



Under the caliber menu, press SET to save and enter the unit menu. Press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters.



Under the unit menu, press SET to save and enter the communication address menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters.

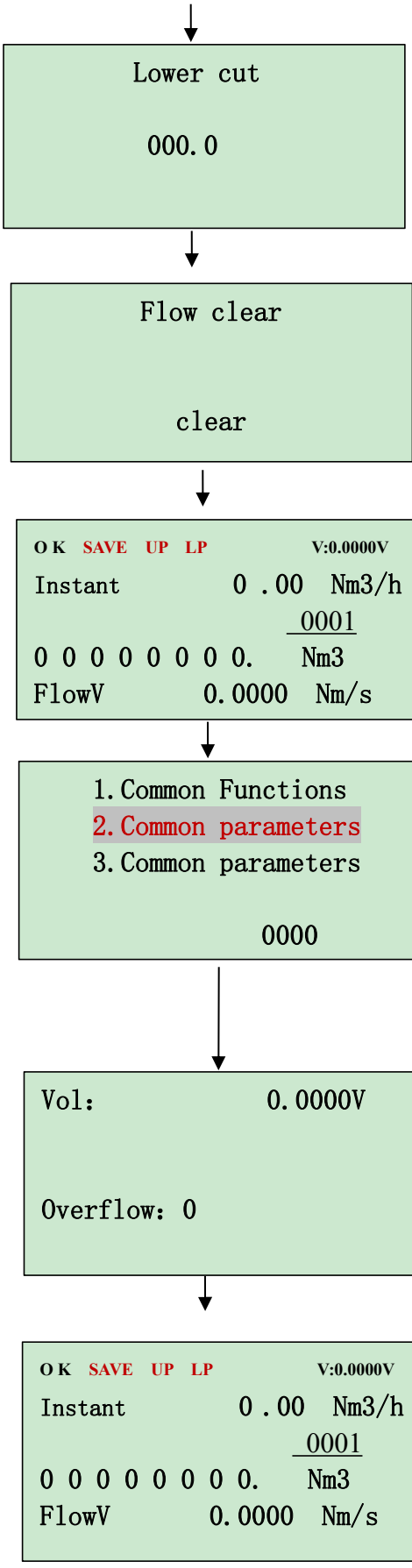
In the Communication Address menu, press SET to save and enter the flow coefficient menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters. The coefficient is proportional to the flow rate, which is the total coefficient.

In the Flow Factor menu, press SET to save and enter the full flow menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters

Under the Full Flow menu, press SET to save and enter the Density menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters

Under the density setting menu, press SET to save and enter the conversion factor menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters. Enter the corresponding conversion coefficient value for different media.

Under the Conversion Factor menu, press SET to save and enter the zero voltage menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters
This menu is set to 0 point voltage.



Under the zero voltage menu, press SET to save and enter the lower cut menu. press SET to save and go to the next menu, press ▶ to move the cursor position, and, ▲ to modify the parameters

This menu cuts off the value of the instantaneous flow.

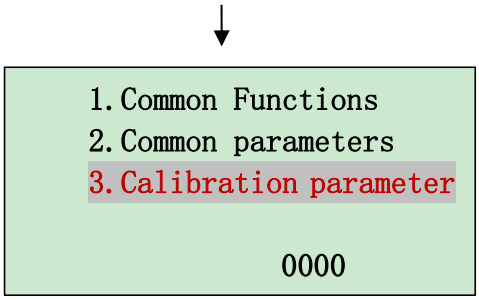
Under the lower cut menu, press SET to save and enter the clear menu. Press ▲ to clear the accumulated flow.

In this interface, double-click to select the common parameter query.

In this interface, press SET to enter the common parameter query menu.

Under the Query menu, press SET to save and re-enter the main page display. Press ▲ to calibrate the zero point. Zero calibration is to calibrate the piping in a closed, non-ventilated condition. The overflow flag is 1 when the flow rate exceeds 100000000. When this bit is greater than 10, it is automatically cleared. When the accumulated flow is cleared, this bit is also cleared. Press SET under this menu to return to the main page.

In this interface, press three times to select the calibration parameter settings.



In this interface, press SET to enter the calibration parameter password input.

Appendix 1 Troubleshooting and Repair

Fault	Cause	Solution
No display	1. No power supply	Get power supply
	2.SMPS is damaged	Get power supply, if the power indicator light is out, it means that the SMPS is damaged, Please contact supplier.
	3.The wirings of DC24V are reversed	Check the wirings, make the wirings right
	4.The position of LCD is wrong	Reinstall the LCD
	5.The LCD is damaged	Check the power indicator light. If the light is on, it means that the LCD is damaged. Please contact supplier
Low velocity	1.The wirings of sensor are reversed	Rewiring or reinstall the sensor
	2.The sensor is dirty	Clean sensor
	3.The sensor is damaged	Return to supplier
	4.Some parameters of flow setting are wrong	Check the parameters setting
Abnormal	1. Some parameters of velocity	Check the parameters setting

velocity and large fluctuation	setting are wrong	
	2. Fluid properties is pulsating in turn	Adjust the system filter
	3. The sensor is dirty	Clean sensor
	4. The sensor is damaged	Return to supplier
Abnormal 4-20mA output	1. The setting of 20mA range is wrong	Right settings
	2.The Transmitter has fault	Return to supplier
	3.The connection is not a loop circuit	Check the connection
Abnormal frequency output	1. Some parameters of frequency setting are wrong	Right settings
	2. The Transmitter has fault	Return to supplier
	3.The connection cable is damaged	Check the connection
Abnormal alarm	1. Some parameters of setting are wrong	Right settings
	2.The meter has no alarm function	Contact supplier
	3.The relay is damaged	Return to supplier
Abnormal RS485 output	1. The settings of baud rate and address are wrong	Right settings
	2. The wirings are reversed	rewiring
	3. The connection cable is damaged	Check the connection

Appendix 2 The Density and Conversion Coefficient of Common Gas

According to different gas on site, the calibration in lab translates the flow rate of actual gas on site into flow rate of air, and then begins to calibrate the flow rate at present. Therefore, when using the meter on site, the meter displays mass flow or volume flow of actual gas.

When translating the flow rate of gas into flow rate of air, there is a conversion coefficient table of different gas.

Table 1 The Density and Conversion Coefficient of Common Gas

	Gas	Specific heat (Kal/g*℃)	Density (g/l, 0℃)	Conversion Coefficient
0	Air	0.24	1.2048	1.0000
1	Argon (Ar)	0.125	1.6605	1.4066
2	Arsine (AsH^3)	0.1168	3.478	0.6690
3	Boron Tribromide (BBr^3)	0.0647	11.18	0.3758
4	Boron Trichloride (BCl^3)	0.1217	5.227	0.4274
5	Boron Trifluoride (BF^3)	0.1779	3.025	0.5050
6	Borane (B^2H^6)	0.502	1.235	0.4384
7	Carbon Tetrachloride (CCl^4)	0.1297	6.86	0.3052
8	Carbon Tetrafluoride (CF^4)	0.1659	3.9636	0.4255
9	Methane (CH^4)	0.5318	0.715	0.7147
10	Ethylene (C^2H^4)	0.3658	1.251	0.5944
11	Ethane (C^2H^6)	0.4241	1.342	0.4781
12	Allylene (C^3H^4)	0.3633	1.787	0.4185
13	Propylene (C^3H^6)	0.3659	1.877	0.3956
14	Propane (C^3H^8)	0.399	1.967	0.3459
15	Butyne (C^4H^6)	0.3515	2.413	0.3201
16	Butene (C^4H^8)	0.3723	2.503	0.2923
17	Butane (C^4H^{10})	0.413	2.593	0.2535
18	Pentane (C^5H^{12})	0.3916	3.219	0.2157
19	Carbinol (CH^3OH)	0.3277	1.43	0.5805
20	Ethanol (C^2H^6O)	0.3398	2.055	0.3897

21	Trichloroethane ($C^3H^3Cl^3$)	0.1654	5.95	0.2763
22	Carbon Monoxide (CO)	0.2488	1.25	0.9940
23	Carbon Dioxide (CO^2)	0.2017	1.964	0.7326
24	Cyanide (C^2N^2)	0.2608	2.322	0.4493
25	Chlorine (Cl^2)	0.1145	3.163.	0.8529
26	Deuterium (D^2)	1.7325	0.1798	0.9921
27	Fluoride (F^2)	0.197	1.695	0.9255
28	Germanium Tetrachloride ($GeCl^4$)	0.1072	9.565	0.2654
29	Germane (GeH_4)	0.1405	3.418	0.5656
30	Hydrogen (H_2)	3.4224	0.0899	1.0040
31	Hydrogen Bromide (HBr)	0.0861	3.61	0.9940
32	Hydrogen Chloride (HCl)	0.1911	1.627	0.9940
33	Hydrogen Fluoride (HF)	0.3482	0.893	0.9940
34	Hydrogen Iodide (HI)	0.0545	5.707	0.9930
35	Hydrogen Sulfide (H_2S)	0.2278	1.52	0.8390
36	Helium (He)	1.2418	0.1786	1.4066
37	Krypton (Kr)	0..0593	3.739	1.4066
38	nitrogen (N_2)	0.2486	1.25	0.9940
39	Neon (Ne)	0.2464	0.9	1.4066
40	Ammonia (NH_3)	0.5005	0.76	0.7147
41	Nitric Oxide (NO)	0.2378	1.339	0.9702
42	Nitrogen Dioxide (NO_2)	0.1923	2.052	0.7366
43	Nitrous Oxide (N_2O)	0.2098	1.964	0.7048
44	Oxygen (O_2)	0.2196	1.427	0.9861
45	Phosphorus Trichloride (PCl_3)	0.1247	6.127	0.3559
46	Phosphorane (PH_3)	0.261	1.517	0.6869
47	Phosphorus Pentafluoride (PF_5)	0.1611	5.62	0.3002
48	Phosphorus Oxychloride ($POCl_3$)	0.1324	6.845	0.3002
49	Silicon Tetrachloride ($SiCl_4$)	0.127	7.5847	0.2823
50	Silicon Fluoride (SiF_4)	0.1692	4.643	0.3817

51	Silane (SiH_4)	0.3189	1.433	0.5954
52	Dichlorosilane (SiH_2Cl_2)	0.1472	4.506	0.4095
53	Trichlorosilane ($SiHCl_3$)	0.1332	6.043	0.3380
54	Sulfur Hexafluoride (SF_6)	0.1588	6.516	0.2624
55	Sulfur Dioxide (SO_2)	0.1489	2.858	0.6829
56	Titanium Tetrachloride ($TiCl_4$)	0.1572	8.465	0.2048
57	Tungsten Hexafluoride (WF_6)	0.0956	13.29	0.2137
58	Xenon (Xe)	0.0379	5.858	1.4066

Appendix 3 Upper Range Value of Common Gas

(Unit: Nm^3/h. The follow table can be extended)

Nominal Diameter (mm)	**Air**	**Nitrogen（N_2）**	**Oxygen（O_2）**	**Hydrogen(H_2)**
15	65	65	32	10
25	175	175	89	28
32	290	290	144	45
40	450	450	226	70
50	700	700	352	110
65	1200	1200	600	185
80	1800	1800	900	280
100	2800	2800	1420	470
125	4400	4400	2210	700
150	6300	6300	3200	940
200	10000	10000	5650	1880
250	17000	17000	8830	2820
300	25000	25000	12720	4060
400	45000	45000	22608	7200
500	70000	70000	35325	11280
600	100000	100000	50638	16300
700	135000	135000	69240	22100
800	180000	180000	90432	29000
900	220000	220000	114500	77807
1000	280000	280000	141300	81120
1200	400000	400000	203480	91972
1500	600000	600000	318000	101520
2000	700000	700000	565200	180480

The flow rate in standard condition: The flow rate is in the condition of 20℃ temperature and 101.325kPa pressure.

The unit of flow rate is optional: Nm3/h, Nm3/min, L/h, L/min, t/h, t/min, kg/h or kg/min.

The reduction formula of flow rate in working condition and flow rate in standard condition:

$$Qs = \frac{0.101325+p}{0.10325} * \frac{273.15+20}{273.15+t} * Qn$$

Qs: The flow rate in standard condition (Nm3/h).

Qn: The flow rate in working condition (m3/h).

t: The medium temperature in working condition (℃).

p: The medium pressure in working condition (Gauge pressure, MPa).