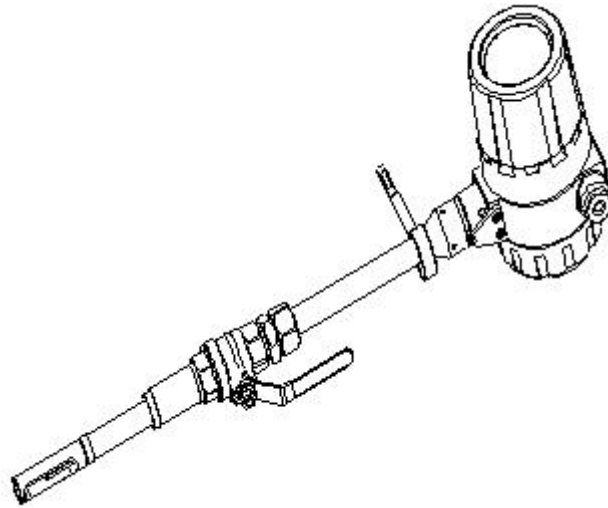


Thermal Gas Mass Flowmeter

Installation and Operation Guide



KAIFENG HUABANG INSTRUMENT CO.,LTD

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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:

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

Where: ρ_g is specific gravity of medium

V is velocity

K is balance coefficient

Q is heater power

ΔT is differential temperature

The medium temperature range of meter is $-40^{\circ}\text{C} \sim 220^{\circ}\text{C}$.

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

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

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°C (kg/m^3)

P is the pressure in working condition (kPa)

T is the temperature in working condition ($^{\circ}\text{C}$)

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°C 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°C~+220°C Transmitter: -20°C~+45°C |
| 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

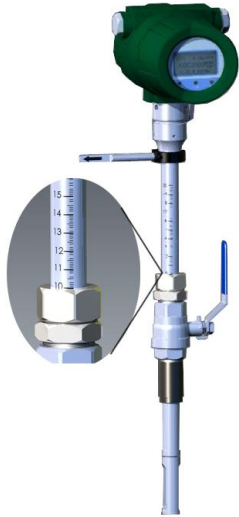


Fig. 1 Standard Insertion Flow Meter
(Pipe size DN100-DN500)



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

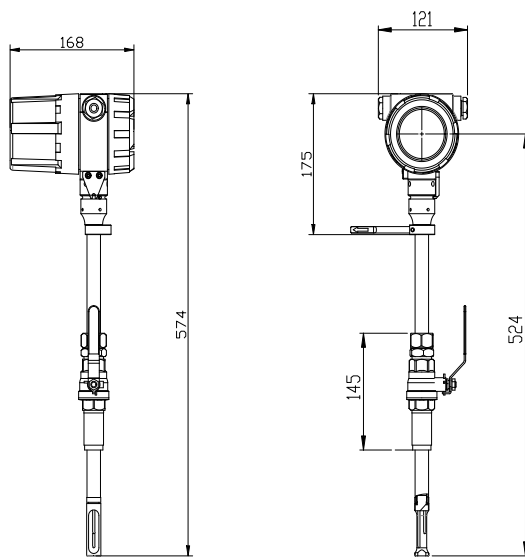


Fig. 3 Hot-tapped Insertion Flow Meter
(Pipe size DN100-DN4000. Special requirements please contact us)

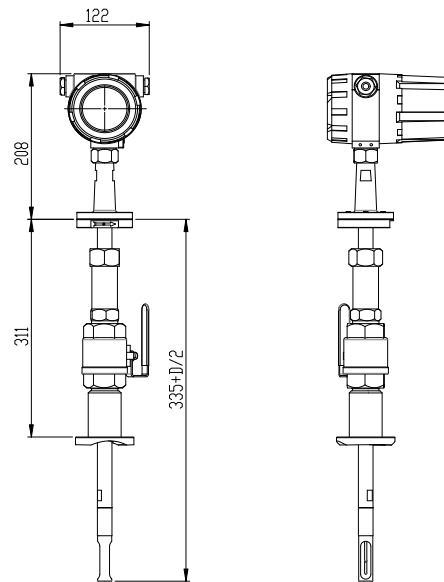
The insertion sensor of compact insertion flow meter should be inserted to axis of pipe, and the length of the insertion sensor is decided by pipe size, please confirm the pipe size when ordering. If the insertion sensor can't be inserted to axis of pipe, the manufacturer will provide a calibration factor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

3.2 Dimensions

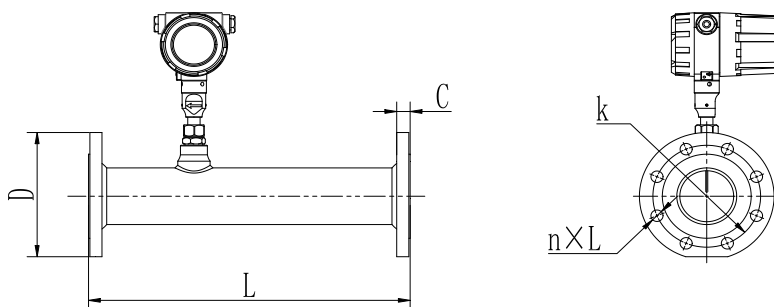
Dimensions of standard insertion sensor



Dimensions of hot-tapped insertion sensor



The dimensions of flanged sensor




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


| Nominal Diameter | Flange Outer diameter | Center Hole | Screw Hole | Screw Thread | Sealing Face | | Flange Thickness | Pipeline Length |
|------------------|-----------------------|-------------|------------|--------------|--------------|---|------------------|-----------------|
| | | | | | d | f | | |
| DN | D | k | n×L | | | | 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 |

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

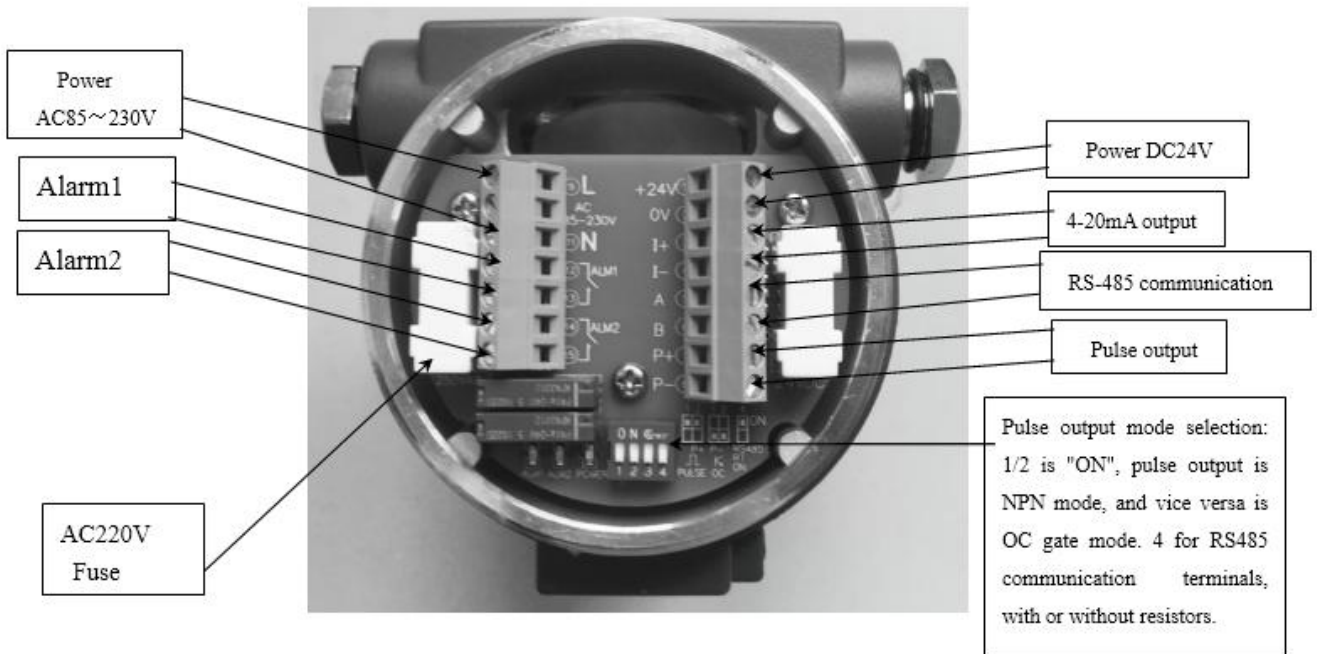
4.1 Instruction of Sensor Wirings

| 1 | 2 | 3 | 4 | 5 | 6 |
|---------|---------|---------|-------|-------|-------|
| RT1 | RT2 | RT2 | RH1 | RH2 | RH2 |
| PT1000A | PT1000B | PT1000B | PT20A | PT20B | PT20B |

Temperature sensor (Pt1000)

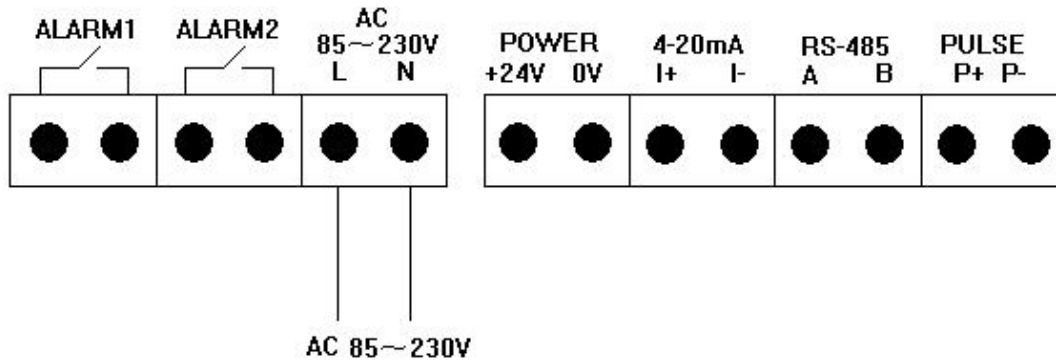
Heater (Pt20)

4.2 Instruction of Transmitter Wirings

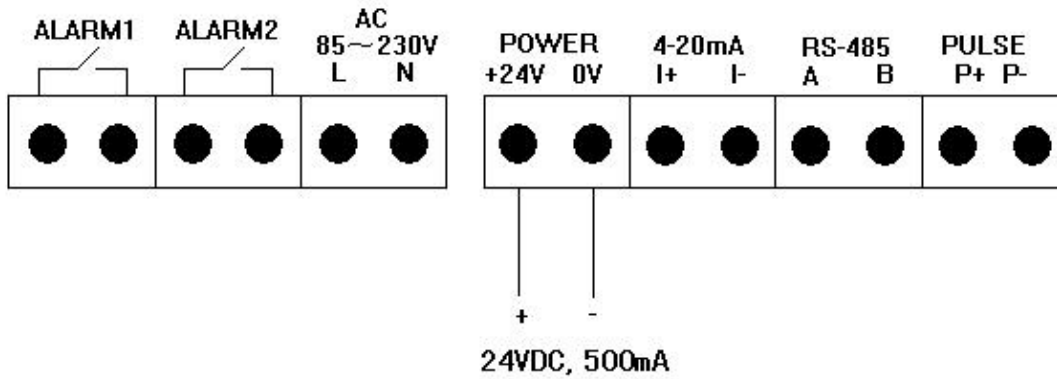


4.3 The Wirings of Power Supply

1. AC power supply

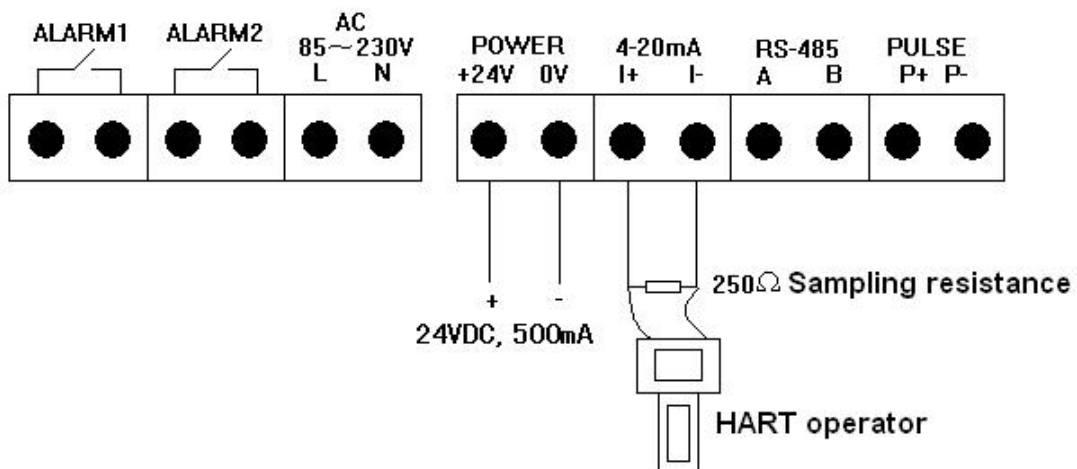


2. DC power supply

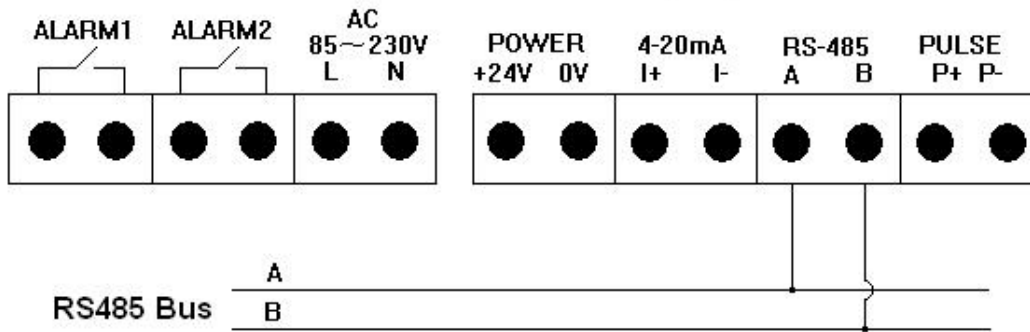


4.4 The Wirings of Outputs

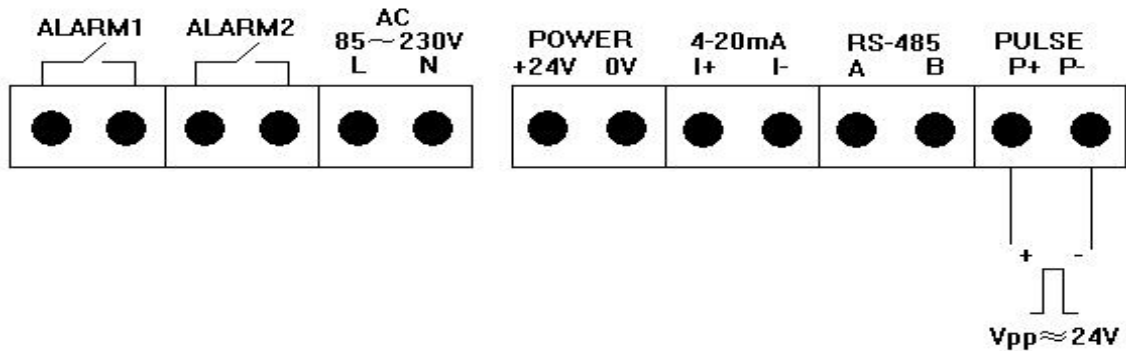
1. The wirings of Four-Wire 4-20mA output and HART operator



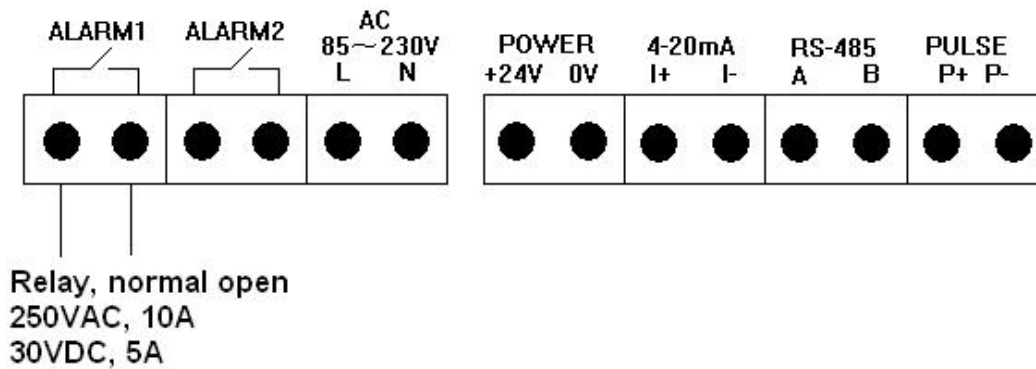
2. The wirings of RS485 output



3. The wirings of pulse output



4. The wirings of alarm output



Part 5 Installation

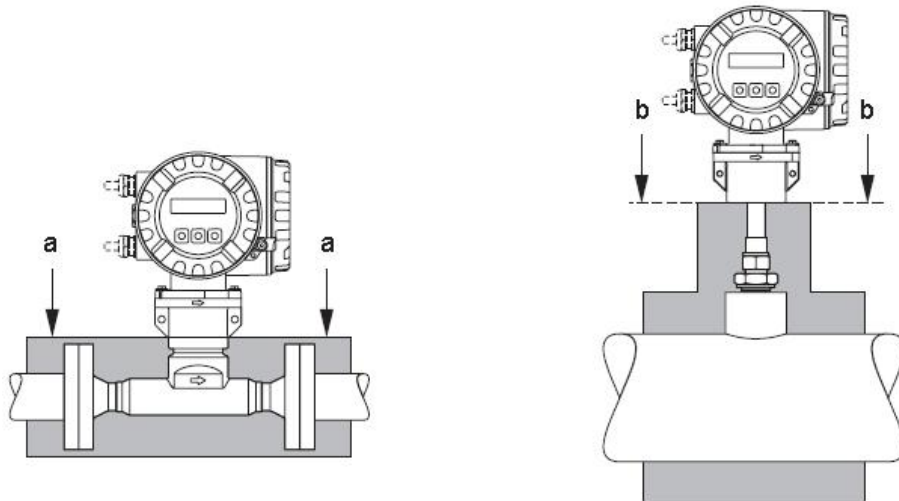
5.1 Installation Position

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.



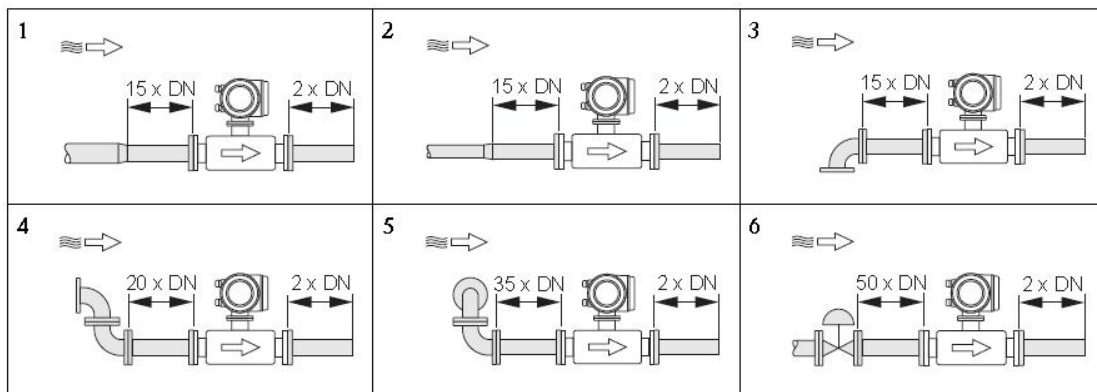
- a Maximum insulation height for the flanged sensor
- b Maximum insulation height for the insertion sensor

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, $50 \times \text{DN}$ 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.

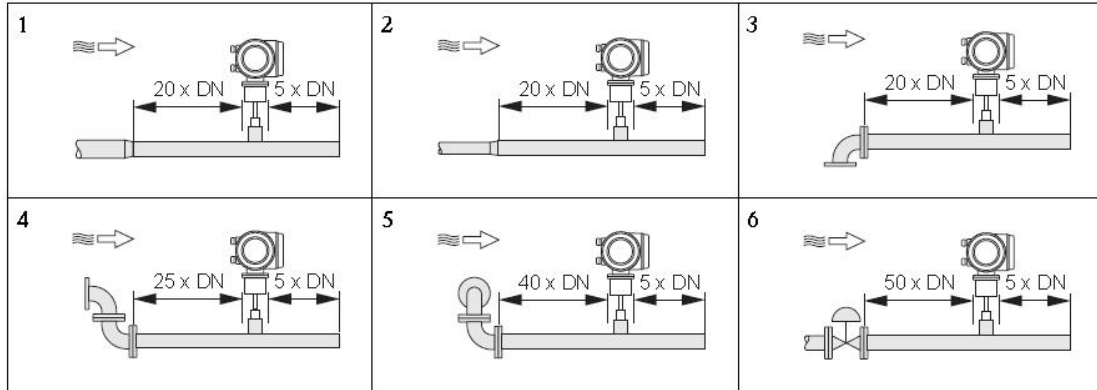
The minimum recommendations for inlet and outlet runs (without flow conditioner) are:

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

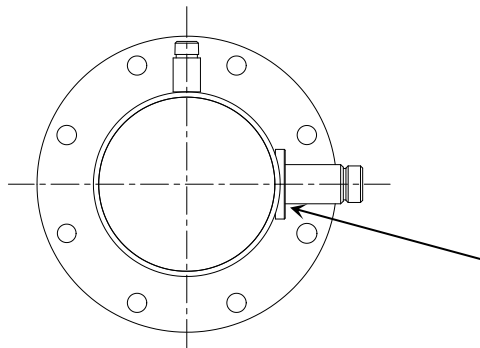


The base of Hot-tapped insertion type The base of standard insertion type

 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.

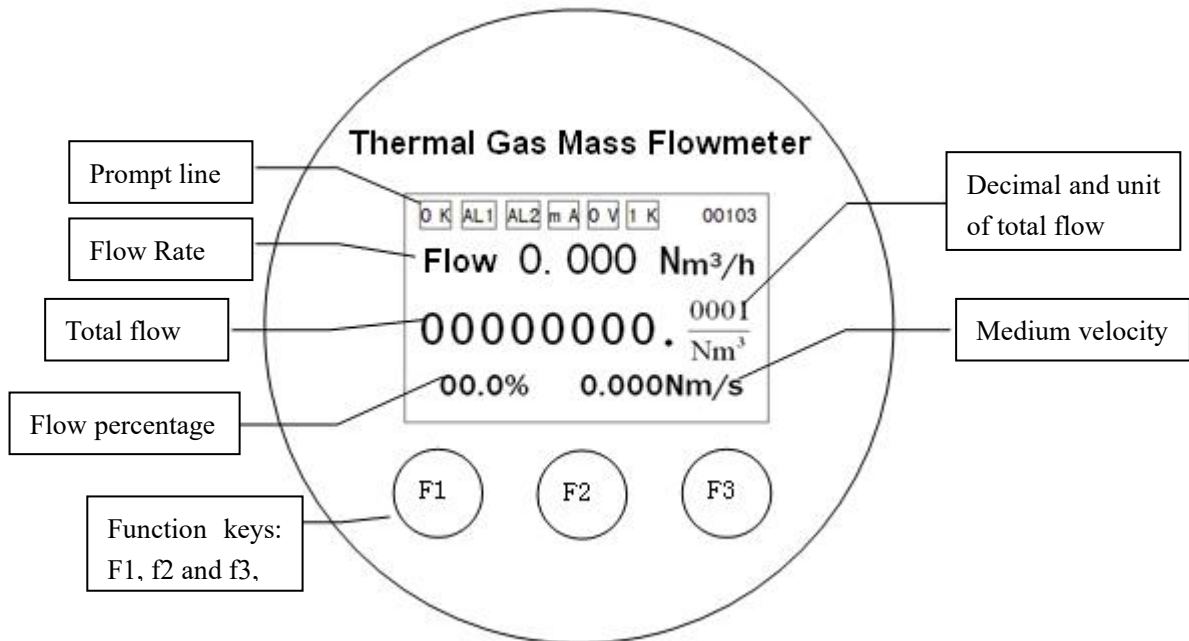
The installation of hot-tapped insertion type

- 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:

`OK`: The meter can do self-checking. If the system is normal after self-checking, it will display `OK`, else it will display `ERR`. The error information can be checked in "Self-Test" set-up menu.

`AL1`: Alarm information. `AL1` means path 1 alarming, and `AL2` means path 2 alarming.

`mA`: If the current output is more than 20mA, it display `mA`, else it will be blank.

`OV`: If the operation parameters overflow, it display `OV`, else it will be blank.

`1K`: For convenience of display and read, when the total flow is more than 10 000 000, it display `1K`, and the is the display total flow multiplied by 1000.

`00103`: Information of communication status. The first three digits indicate meter address; the fourth digit indicates parity check (0: none; 1: odd; 2: even); and the fifth digit indicate baud rate (0: 1200; 1: 2400; 2: 4800; 3: 9600). If the meter address is 1, no parity check, and the baud rate is 9600, it will display "00103".

After powering on, the meter will do self-checking. If the system is normal after self-checking, it will display `OK`, else it will display `ERR`. The error information can be

checked in "Self-Test" set-up menu.

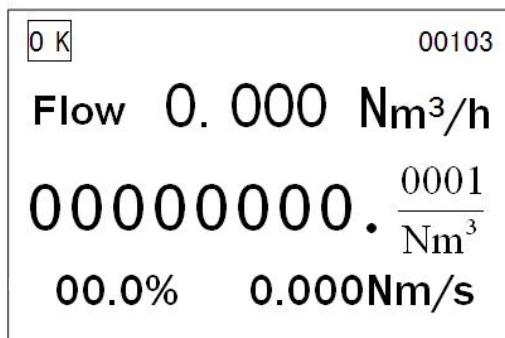
When the meter works fine or after powering on, the meter will do self-checking.

If the system is abnormal after self-checking, the meter will display the submenu of error self-checking (Details in self-Checking menu). 1~2 seconds later, the meter will enter the main menu automatically. Else the meter will enter the main menu directly.

The meter has three function keys: F1, F2 and F3. F1 is Shift Key, F2 is Enter/Next Key, and F3 is Modify Key. (If there are some special functions of keys, please follow the instruction below the LCD)

6.2 Parameters Setup

6.2.1 Main Menu



In main menu, press F2 to enter setup menu.

In setup menu, press F1 and F2 at the same time to enter main menu.

6.2.2 Setup Menu

- Setup menu--**
1. Unit Display
 2. Self-Checking
 3. Total Reset
 4. Parameter Setup
 5. Calibration
 6. Password
 7. Query

In main menu, press F2 to enter setup menu.

In setup menu, press F1 to select submenu, and press F2 to enter submenu.

6.2.3 Unit Display

| |
|--------------------------|
| Flow: Nm ³ /h |
| Total: Nm ³ |
| Shift Enter Mod |

In setup menu, press F1 to select "Unit Display", and press F2 to enter.
Press F1 to select the unit of flow or total, and press F3 to modify the unit.

Flow: The unit of flow rate. The unit can be selected Nm³/h, Nm³/min, NI/h, NI/min, t/h, t/min, kg/h and kg/min.

Total: The unit of total flow. The unit can be selected Nm³, NI, t and kg.

Select the needed unit, and then press F2 Enter key, the main menu will display with the selected unit.

6.2.4 Self-Checking

| | | | |
|---------------|---|--------|---|
| Self-Checking | | | |
| Clock | √ | Memory | √ |
| Power | √ | AD Con | √ |
| Param | √ | Sensor | √ |

In setup menu, press F1 to select "Self-Checking", and press F2 to enter.

If the meter display **ERR** in main menu, press keys to enter this submenu to check the details of running status, √ is ok, and × means this option is abnormal.

After powering on, the meter will do self-checking. If there are one or some abnormal options, the meter will display the self-test menu. When the meter is running, it also can enter this menu to check the running status of meter.

6.2.5 Total Reset

| |
|-----------------------|
| Reset Password |
| 000000 |
| Shift Enter Mod |

In setup menu, press F1 to select "Total Reset", and press F2 to enter.
Press F1 to password, input reset password (default password is 000000), press F1 to shift digit, and press F3 to change the digit's number.
After inputting password, press F2 to enter total reset submenu.

Total Reset

0000000.0000

Reset Enter Reset

In order to prevent error operation, press F1 and F3 keys at the same time to do total reset. After finishing total reset, the display shows 0000000.0000.

In this submenu, press F2 key to enter running time reset.

Running Time Reset

00000000 min

Reset Enter Reset

The unit of running time is minute.

The largest time is with 8 digits, and the reset operation is as the same as total reset.

After resetting, press F2 key to return main menu.

6.2.6 Parameter Setup

Password Setup

000000

Shift Enter Mod

In setup menu, press F1 to select "Parameter Setup", and press F2 to enter.

Input reset password (default password is 000000), press F1 to shift digit, and press F3 to change the digit's number.

After inputting password, press F2 to finish password setup and enter language setup.

Equivalent ID

0100.000 mm

Shift Enter Mod

Equivalent ID is used to input the inner diameter of pipe. For rectangular tube, it needs to input a equivalent inner diameter. The unit is mm.

The range is 0000.000~9999.999.

Press F2 to enter filter coefficient.

Filter Coe 00

Shift Enter Mod

Filter coefficient. If the flow has a big fluctuation, increase this value to get a stable reading.

The range is 0~32, 0 means no filter.

Press F2 to enter low flow cutoff.

Low Flow Cutoff

000000.000

Shift Enter Mod

Low flow cutoff. Cut off the low flow according to the actual situation, and the unit is the same as flow rate.

The range is 0000.0000~9999.9999.

Press F2 to enter Density in Standard Condition.

Density SC

1.0000 Kg/m3

Shift Enter Mod

Density in Standard Condition.
(20°C, 101.325KPa).

That is used for flow rate display.

Medium: 00
Air
Conversion Coe: 01.0000

Shift Enter Mod

The conversion coefficient in meter is reference value, if necessary, modify this value.

The meter contain the conversion coefficient of 59 gases, if the medium is mixed gas, it needs to calculate the coefficient.

The density and conversion coefficient of common gas are shown in appendix 3.

Press F2 to enter Meter factor.

Meter factor:

1.0000

Shift Enter Mod

.The flow rate coefficients, the Meter factor = standard flow / instrument display flow;

Press F2 to enter Full Scale Flow

Full Scale Flow
Set scale:

0000000.000

Shift Enter Mod

The current output: the set of output variables, a transient flow and velocity of flow can be selected.
The instantaneous flow unit: Nm³/h, velocity of flow unit: Nm/s.

Set moves the cursor to the flow, according to the F3 to modify the velocity, move the cursor to the digital press F1 key, F3 key to change the numerical size.

The range of effective range: 0 ~ 9999999.999.
Velocity formula in Appendix 4

Address: 001
Baud: 9600
Parity: None

Shift Enter Mod

RS485 communication setup.

The meter's address range: 0~255. Baud rate can be selected 1200, 2400, 4800 and 9600. Parity check can be selected none, odd and even.

Press F2 to enter HART setup.

HART Address: 00
Protect: Close

Shift Enter Mod

HART communication setup.

The HART address range: 00~15. Protect is "Close", the HART operator can write data; Protect is "Open", the HART operator can't write data.

Press F2 to enter frequency output.

Output: Pulse
Freq: 0000-5000Hz
Range: 0000100.000

Shift Enter Mod

Frequency output: Pulse and Equivalent.

If Pulse (Flow rate) is selected, the first value of Freq is the frequency of pulse which is corresponding to flow 0, and the second value of Freq is the frequency of pulse which is corresponding to maximum flow.

Press F3 to enter equivalent output.

Output: Equivalent
Coe: 0000.0000

Shift Enter Mod

If Equivalent (Total Flow) is selected, set the equivalent coefficient. The largest coefficient is 1000.

Press F2 to enter path 1 alarm.

Alarm 1: upper flow
Alarm: +000000.000
Diff: 000.000

Shift Enter Mod

Path 1 alarm. Set the alarm of upper flow (Upper limit of flow rate), lower flow (Lower limit of flow rate), upper temp (Upper limit of temperature), lower temp (Lower limit of temperature) and none. Difference value is used to prevent alarm vibration around high alarm value. The difference value can make the alarm vibration in control area, but reduce the control precision at the same time. Set this value according application and experience.

Alarm 2: upper flow
Alarm: +000000.000
Diff: 000.000

Shift Enter Mod

Path 2 alarm. The setup is the same as path 1 alarm.

Date and Time:
2012-05-16
09:13:29

Shift Enter Mod

The date and time affect the data query and saving. Therefore, set the date and time before recording data.

6.2.7 Calibration

The parameters in this submenu are very important. In order to prevent unauthorized operation or wrong operation, it needs to input password before entering this submenu.

Password

000000

Shift Enter Mod

In setup menu, press F1 to select "Calibration", and press F2 to enter.
Input the right password to enter calibration submenu.
Press F2 to enter zero voltage value.

Zero Volt: Measure
0.6500V
Please confirm the flow is 0

Shift Enter Mod

Zero voltage value is used to set the voltage value while the flow rate is 0.
Before calibration, confirm the flow in pipe is zero, and waiting for more than 30s to steady the flow. Press F1 and F3 keys at the same time until the meter displays success.
This value is can be input manually. Press F3 to select "Input", input this value manually, and then press F2 to enter R value.
Note: Don't input zero voltage value when the meter is running.

Zero Volt: Input
0.6500V
Please confirm the flow is 0

Shift Enter Mod

R Value (0°C):
1000.000 Ω

Shift Enter Mod

The resistance value is used to input the resistance value of temperature sensor.

Press F2 to enter velocity table.

Velocity table: 01
Volt: 00/0000 V
Vel: 000.000 Nm/s

Shift Enter Mod

Velocity table. Set the voltage and velocity in more than 40 sections.

After calibration, Input the voltage and velocity from small section to large section. (The velocity is zero in section 00).

Press F2 to enter flow correction.

Note: The meter calculates the flow by velocity table. Please don't modify the data in the table.

Flow correct: section 0
Flow: 0000000.000
Coe: 000000.0000

Shift Enter Mod

Flow correction. It can correct the flow in 5 sections.

Current: 4mA
Actual: 00.0000

Shift Enter Mod

Current calibration. If there is deviation in current output, use this submenu to calibrate current output.

Press F2 to enter zero and coefficient of current.

Zero: +0.0000
Coe: 1.0000

Shift Enter Mod

Current zero and coefficient calibration.

Note: Please don't modify these values when the meter is running.

6.2.8 Password

In this submenu, it can modify the password of total reset, setup and calibration.

Password
Total Reset Calibration
Shift Enter Mod

In setup menu, press F1 to select "password", and press F2 to enter.

In this menu, it can set the password of total reset, parameter reset and calibration.

Setup Password:
Old: 000000
New: 000001
Shift Enter Mod

After inputting old and new passwords, Press F2 to save setup, the LCD will display "Success", and then return to main menu.

Setup Password:
Old: 000000
New: 000001
Shift Enter Mod

6.2.9 Query

Day Record
Month Record
Year Record
Shift Enter Mod

In setup menu, press F1 to select "Query", and then press F2 to enter.

In query submenu, there are day, month and year records.

Day Record
2012-04-02
80.03 Nm3
Shift Enter Mod

In query submenu, press F1 to select Day Record, and then press F2 to enter.

In Day Record, press F1 to shift cursor position, and press F3 to modify the date.

For example, the "80.03 Nm3" is the totalizer on April 2th, 2012.

The method of querying Month and Year Records is the same as querying Day Record.

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 velocity and large fluctuation | 1. Some parameters of velocity setting are wrong | Check the parameters setting |
| | 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*°C) | Density (g/l, 0°C) | 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 ² H 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 ² H ⁴) | 0.3658 | 1.251 | 0.5944 |
| 11 | Ethane (C ² H ⁶) | 0.4241 | 1.342 | 0.4781 |
| 12 | Allylene (C ³ H ⁴) | 0.3633 | 1.787 | 0.4185 |
| 13 | Propylene (C ³ H ⁶) | 0.3659 | 1.877 | 0.3956 |
| 14 | Propane (C ³ H ⁸) | 0.399 | 1.967 | 0.3459 |
| 15 | Butyne (C ⁴ H ⁶) | 0.3515 | 2.413 | 0.3201 |
| 16 | Butene (C ⁴ H ⁸) | 0.3723 | 2.503 | 0.2923 |
| 17 | Butane (C ⁴ H ¹⁰) | 0.413 | 2.593 | 0.2535 |
| 18 | Pentane (C ⁵ H ¹²) | 0.3916 | 3.219 | 0.2157 |
| 19 | Carbinol (CH ³ OH) | 0.3277 | 1.43 | 0.5805 |
| 20 | Ethanol (C ² H ⁶ O) | 0.3398 | 2.055 | 0.3897 |

| | | | | |
|----|--|--------|--------|--------|
| 21 | Trichloroethane (C ³ H ³ Cl 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 ² N 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 ₂ S) | 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 ₂ O) | 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 ₂ Cl 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: Nm³/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°C 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:

$$Q_s = \frac{0.101325+p}{0.10325} \cdot \frac{273.15+20}{273.15+t} \cdot Q_n$$

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

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

t: The medium temperature in working condition (°C).

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