

Selection Manual of PCL-M Thermal Gas Mass Flowmeter

Features

- Direct measurement of mass flow rate without temperature and pressure compensation
- There are no flow-stopping or flow-blocking components in the measuring pipe, which will not cause pressure loss or blockage
- Simple structure, easy to install, no high requirement for straight pipe sections
- No mechanical transmission parts, strong and vibration-resistant
- Wide range ratio 100:1; Large bore, low flow rate, negligible pressure loss
- High-performance intelligent microprocessors and analog-to-digital, digital-to-analog conversion chips
- Suitable for flow measurement of all kinds of single or mixed gases

Uses and Industries

- Oil and gas, chemical, metallurgy, pulp and paper, food and medicine, environmental protection and other industries
- Measurement of biogas, gas, natural gas, liquefied gas, boiler preheating air

Note:

- 1 Do not misuse the document.
- 2 The information in this selection is for reference only and should not be used as a product installation guide.
- 3 Complete installation, operation and maintenance information is provided in the product manual



Product Overview

The PCL-M series thermal gas mass flowmeter is designed based on the principle of thermal diffusion. This instrument uses the constant temperature difference method for accurate gas measurement. It has the advantages of small size, high degree of digitalization, easy installation and accurate measurement.

Principle of Measurement

Thermal flowmeters are flowmeters designed based on the principle of thermal diffusion. That is, when a fluid flows over a heat-generating object, the amount of heat dissipated by the heat-generating object is proportional to the flow rate of the fluid. The thermal flowmeter has two standard platinum resistance temperature sensors, one used as the heat source and the other for measuring the temperature of the fluid. When the fluid flows, the temperature difference between the two is linearly related to the flow rate. Then, through microelectronic control technology, this relationship is converted into a linear output signal for measuring the flow rate. The gas mass flow rate is: q_m

$$q_m = \left[\frac{1}{C} \left(\frac{I_H^2 R_H}{T_0 - T_1} - \frac{B}{C} \right) \right]^2$$

The physical quantities represented by each parameter in the formula are respectively:

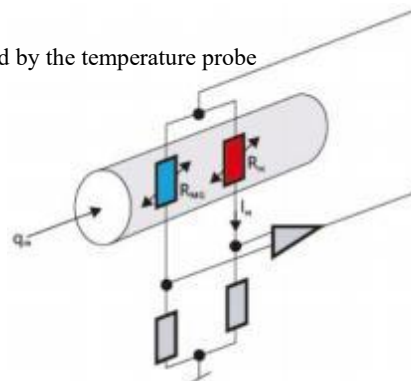
I_H : The current flowing through the heating resistor in the heating probe

R_H : Heating resistor resistance value

T_0 : The temperature obtained by inverting the voltage and current across the heating resistor

T_1 : The temperature of the gas measured by the temperature probe

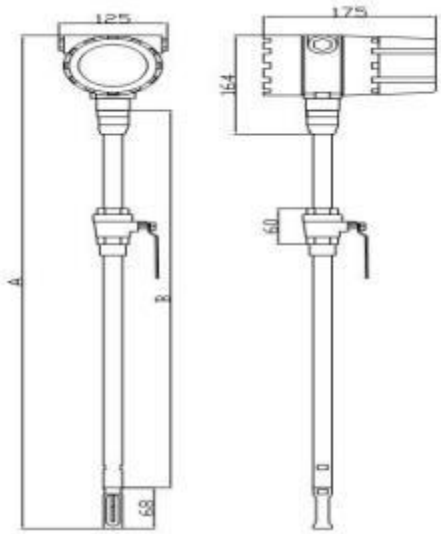
B And: Empirical coefficient



Performance parameters

Structural form	Insertable	Pipe type
Measuring medium	Common steady-state gases (unstable media such as acetylene, boron trichloride cannot be measured)	
Pipe diameter range	DN50 to 4000mm	DN6 to 2000mm
Flow velocity range	0.1 to 120Nm/s	
Accuracy	$\pm(1.5\% \text{ reading} + 0.3\% \text{ full scale})$	
Operating temperature	Sensor: -40 to +450 ° C Converter: -20 to +70 ° C	
Working pressure	Medium pressure $\leq 2.5 \text{ MPa}$	Medium pressure $\leq 1.6 \text{ MPa}$
Power supply	(DC 24V or AC 220V) $\leq 18 \text{ W}$	
Response speed	1s	
Output signal	4-20mA(optically isolated, maximum load 500 ohms), RS-485(optically isolated, custom required)	
Alarm	1-2 normally open contacts, 24V/0.5A	
Supply type	Integrated structure	
Pipe material	Carbon steel, stainless steel, plastic, etc	
Live display	Four lines of Chinese character LCD display	
Display content	Mass flow, standard volume flow, cumulative flow, standard flow velocity, etc	
Protection level	IP65	
Sensor material	Stainless steel	Stainless steel, carbon steel

External dimensions

Structural form	Dimension drawing Unit: mm
PCL-M series insertable thermal mass flowmeters	

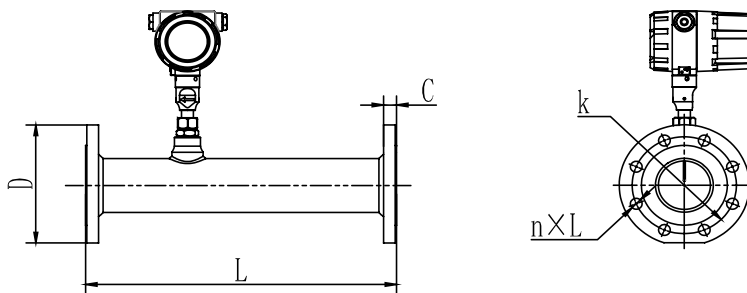
The external dimensions of the PCL-M series insertable thermal mass flowmeters are shown in Table 1 below.

Table 1 Dimensions table of insertable thermal mass flowmeters

Nominal diameter	A	B
DN65-DN350(inclusive)	560	340
DN350-DN500(inclusive)	640	425
DN500-DN1000(inclusive)	820	600

Note: The PCL-M series insertable thermal mass flowmeter should be inserted into the axis of the pipe being measured, so the length of the measuring rod depends on the diameter of the pipe being measured. Please specify when placing the order. If it cannot be inserted into the pipe axis, the manufacturer will provide calibration coefficients for accurate measurement.

Dimensions

Structural form	Dimension drawing Unit: mm
PCL-M series pipe section type thermal mass flowmeter	

The external dimensions of the PCL-M series pipe section thermal mass flowmeter are shown in Table 2 below.

Table 2 External dimensions of pipe section thermal mass flowmeter

GB/T9119-2000 PN1.6Mpa(16bar) flat, raised plate flat welded steel pipe flange

Nominal diameter	Flange outer diameter	Center hole diameter	Screw holes	Thread specifications	Sealing surface		Flange thickness	Instrument mounting length
					d	f		
DN	D	K	N×L		d	f	C	L
15	95	65	4 x 14	M12	45	2	12	170
20	105	75	4 x 14	M12	55	2	14	170
25	115	85	4 x 14	M12	65	2	14	170
32	140	100	4 x 18	M16	78	2	16	170
40	150	110	4 x 18	M16	85	3	18	170
50	165	125	4 x 18	M16	100	3	18	170
65	185	145	4 x 18	M16	120	3	20	190
80	200	160	8 x 18	M16	135	3	20	190
100	220	180	8 x 18	M16	155	3	22	200

Notes:

1. The flanges are in accordance with the national standard GB/T9119-2000. And manufactured in accordance with GB/T9119-2000 standard.

2. Pipe thread connection may be used for DN15 to DN80, but it can only be carried out after reaching a technical agreement with the instrument provider.
3. Only the maximum rated pressure data of 1.6Mpa is provided in the table. For pressures higher than the rated pressure, customization is possible, but it must be carried out after reaching a technical consensus with the instrument provider.
4. Installation dimensions of pipe sections with diameters above DN100 can only be produced after reaching an agreement with the instrument supplier.

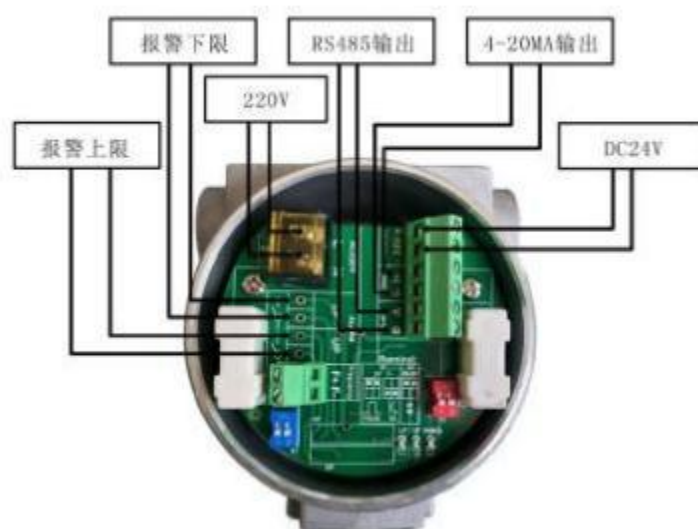
Electrical connections

1. Instructions for sensor terminal blocks

1	2	3	4
RT1	RT2	RH1	RH2

Temperature measurement (Pt1000)
Speed measurement (Pt20)

2. Terminal block instructions and wiring method



When wiring, select the corresponding power terminal according to the product specification and connect to the power line, then connect to the signal line according to the required output signal.

Notes:

1.  Do not operate with power on.
2. Con  m the type of power supply.

Installation

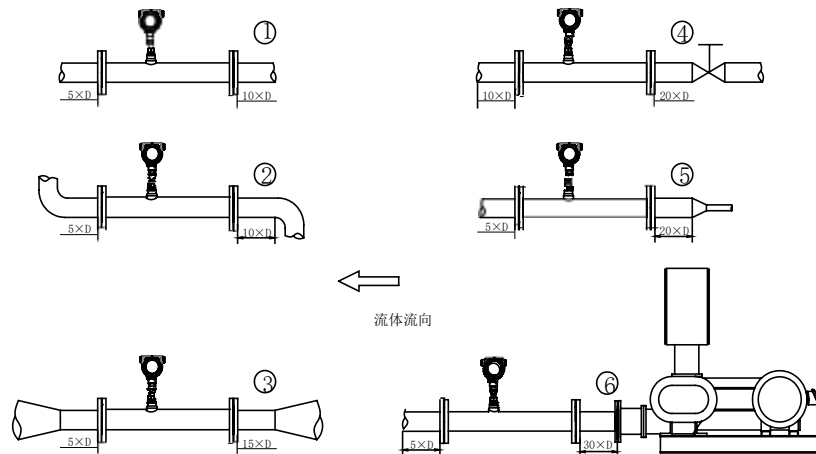
1. Installation notes

- (1) If the instrument is installed outdoors, a sunshade should be added to protect it from sun exposure and rain.
- (2) Do not install in a place with strong vibration.

- (3) Do not expose to environments containing large amounts of corrosive gases.
- (4) Do not share power with equipment that contaminates the power source, such as frequency converters, welding machines, etc. If necessary, install a purification power supply for the converter.

2. Installation location and requirements for pipelines

When installing the instrument, keep away from elbows, obstacles, reducers and valves to ensure a stable flow field. One side requires a longer upper limit straight pipe, with the front straight pipe length greater than $10D$ (D is the inner diameter of the pipe) and the rear straight pipe section longer than $5D$. The following figure shows the length of the straight pipe section required for several situations that are frequently encountered on site:



Installation requirements for front and rear straight pipe sections

The corresponding requirements for the front and back straight pipe sections are shown in Table 3.

Pipe installation type	Serial Number	Front straight pipe section	Rear straight pipe section
Horizontal pipe	1	$10D$	$5D$
Bent tube	2	$10D$	$5D$
Expander tube	3	$15D$	$5D$
Valve downstream	4	$20D$	$5D$
Shrink tube	5	$20D$	$5D$
Pump downstream	6	$30D$	$5D$

Note: When the straight pipe section requirement cannot be met on site, gas rectifiers can be connected in series to significantly reduce the requirement for the straight pipe section.

3. Thermal gas mass flowmeter base



Figure 1 Online installation type welded base Figure 2 Simplified type

welded

Notes :

1.  Welding operations are prohibited in explosive environments.



2. Welding operations should be carried out in an environment with special requirements for welding.

The base is classified into standard type and simplified type based on different installation methods. During installation, the base should be placed at the very top of the pipe cross-section direction, and the axis of the base's through hole should be perpendicular to the pipe's axis. Ideal welding position and welding process for the base. (As shown below)

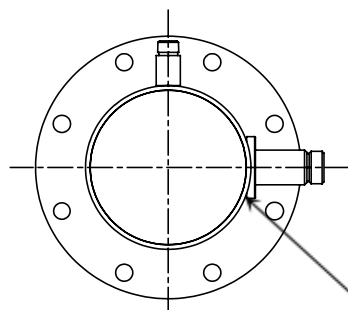


Figure 3 Ideal base welding position

Selection

PCL-M10-DA F3	P4	TA	M1	G0	S1	D15	EX0		
								Code	Explosion-proof
								EX0	No explosion-proof
								Code	Medium
								The codes and media are shown in Table 6	
								Code	Output signal
								S1	4-20mA, RS485, pulse, frequency
								S2	4-20mA, RS232, pulse, frequency
								Code	Power supply
								G0	24V DC
								Code	Sensor material
								M1	304 stainless steel
								M2	316L stainless steel
								Code	Medium temperature
								TA	- 40 ~ 200 °C
								Code	Rated pressure
								P1	PN10
								P2	PN16
								P3	PN25
								Code	Flange pipe type flange connection specification
								The codes and flange specifications are shown in Table 4	
								Code	Insertable product flange connection specifications
								Code and flange specifications are shown in Table 5	
								Code	Show type
								DA	One-piece
								Code	Show type
								DB	Split type
Code	Process installation method				Code	Process Installation Method			
PCL-M10	Flanged pipe type thermal gas mass flowmeter				PCL-M20	Insert-threaded connection thermal gas mass flowmeter			

Selection example: PCL-M10-DAF3P4TAM1G0S1D15EX0

Model description:

PCL-M10 flanged pipeline type thermal gas mass flowmeter, display type, flange connection specification DN50, rated pressure PN40, medium temperature -40~200 °C, sensor material 304 stainless steel, power supply



24VDC, output 4-20mA, RS485, pulse, frequency The medium is propane (C₃H₈), with no explosion-proof requirements.

Table 4 Flange connection specifications (applicable pipe type, insert type see Table 5)

Code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Specifications	DN25	DN40	DN50	DN65	DN80	DN100	DN125	DN150	DN200	Others

Table 5 Flange connection specifications (applicable insert type, pipe type see Table 4)

Code	F1	F2	F3	F4	F5	F6	F7	F8	F9
Specification	DN200	DN250	DN300	DN350	DN400	DN450	DN500	DN600	DN700
Code	F10	F11	F12	F13	F14	F15	F16	F17	F18
Specifications	DN800	DN900	DN1000	DN1400	DN1600	DN1800	DN2000	DN3000	Others

Selection Tips

According to the world's leading institutions, two-thirds of the faults of instruments in practical application are caused by incorrect selection and incorrect installation of the instruments. Therefore, the selection of flowmeters is a very important task in practical application. When making the selection, please note:

1 Collect process data

- The name of the fluid being tested, as well as the composition of the chemical substances it contains;
- The maximum flow rate, minimum flow rate and common flow rate of the fluid;
- The maximum working pressure of the fluid;
- The highest and lowest temperatures of the fluid.

2. The maximum and minimum flow rates must conform to the values in the flow range table.

3. The actual maximum working pressure must be less than the rated working pressure of the flowmeter's guide tube.

4. The maximum and minimum working temperatures of the fluid must meet the temperature requirements specified by the flowmeter.

5 Determine whether there is negative pressure in the process line.

6. You can choose the appropriate flowmeter based on the actual situation. If the inner diameter of the selected flowmeter does not match the inner diameter of the on-site process pipeline, the pipe should be reduced or expanded.

If the pipeline is reduced, it should be considered whether the pressure loss caused by the reduction will affect the process flow.

b. For the sake of improving measurement accuracy and product price, smaller diameter flowmeters can be selected to reduce economic input.

Appendix:

1. Table of densities of general gases and conversion coefficients relative to air

At present, the laboratory cannot calibrate the mass flow rate according to the gas actually used by the user. Usually, the calibration is carried out after converting the flow rate of the gas actually used by the user into the flow rate of air. When users use it, what is directly displayed is the actual mass flow or volume flow of the gas used.

The conversion of different gases is done by conversion factor, and the conversion factor of a single component

gas can be found in a table. Here is the table below:

Table 6 Density of gases and conversion coefficient of air

Code	Gas	Specific heat (CAL/g °C)	Density (g/l 0 ° C)	Conversion coefficient
D00	Air	0.24	1.2048	1.0000
D01	Argon Ar	0.125	1.6605	1.4066
D02	Arsine AsH	0.1168	3.478	0.6690
D03	Boron tribromide BBr	0.0647	11.18	0.3758
D04	Boron trichloride BCl	0.1217	5.227	0.4274
D05	Boron trifluoride BF	0.1779	3.025	0.4384
D06	Borane BH ₂	0.502	1.235	0.5050
D07	Carbon tetrachloride CCl	0.1297	6.86	0.3052
D08	Carbon tetrafluoride CF	0.1659	3.9636	0.4255
D09	Methane CH	0.5318	0.715	0.7147
D10	Acetylene C ₂ H	0.4049	1.162	0.5775
D11	Ethylene CH ₂	0.3658	1.251	0.5944
D12	Ethane C ₂ H	0.4241	1.342	0.4781
D13	Propyne C ₃ H	0.3633	1.787	0.4185
D14	Propylene C ₃ H	0.3659	1.877	0.3956
D15	Propane CH ₃	0.399	1.967	0.3459
D16	Butyn C ₄ H	0.3515	2.413	0.3201
D17	Butene C ₄ H	0.3723	2.503	0.2923
D18	Butane C ₄ H	0.413	2.593	0.2535
D19	Pentane C ₅ H	0.3916	3.219	0.2157

Table 6(continued) Table of Gas Densities and Conversion Coefficients of air

Code	Gas	Specific heat (CAL/g °C)	Density (g/l 0 ° C)	Conversion coefficient
D20	Methanol CH ₃ OH	0.3277	1.43	0.5805
D21	Ethanol C ₂ H ₆ O	0.3398	2.055	0.3897
D22	Trichloroethane C ₃ H ₃ Cl	0.1654	5.95	0.2763
D23	Carbon monoxide CO	0.2488	1.25	0.9940
D24	Carbon dioxide CO	0.2017	1.964	0.7326
D25	Cyanide C ₂ N	0.2608	2.322	0.4493
D26	Chlorine Cl	0.1145	3.163	0.8529
D27	Deuterium D	1.7325	0.1798	0.9921
D28	Fluorine gas F	0.197	1.695	0.9255
D29	Germanium tetrachloride GeCl	0.1072	9.565	0.2654
D30	Germane GeH ₄	0.1405	3.418	0.5656
D31	Hydrogen H	3.4224	0.0899	1.0040
D32	Hydrogen bromide HBr	0.0861	3.61	0.9940



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