FTI Company has the world's largest variety of high-quality vortex flowmeter series to meet the different needs of users, including conventional, compensated, and DSP series. Innovative DSP technology greatly improves the signal processing ability of the product and improves its reliability, offering accurate measurement of the flow of gas, liquid, and steam over a wide flow range.

Main features of the product:

- Able to accurately measure the flow rates of gas, liquid, and vapor over a wide range of flow rates, unaffected by the physical properties of the fluid;
- No moving parts, no wear, no need for mechanical maintenance;
- Simple mechanical installation and electrical connection;
- Diverse output signals, with the option to choose a two wire (4-20)mA output or three wire pulse output according to user’ s requirements;
- With excellent nonlinear correction function, greatly improving the linearity of the instrument;
- With independent password settings, different levels of password can be set for parameter, total reset, and calibration, convenient for user management;
- Self inspection function, with rich self inspection information, convenient for user maintenance and debugging;
- Equipped with software spectrum analysis function, improving the anti-interference and vibration resistance of the instrument;
- LCD dot matrix Chinese character display, intuitive and convenient, with simple and clear operation;
- Equipped with a fully functional HART protocol, including special commands;
- Configurable RS485 communication protocol;
- Able to be equipped with temperature and pressure sensors for compensation;
- Wide range of measurement media, capable of measuring steam, liquid, general gas, natural gas, etc. With exceeding compressibility factor for correction while measuring natural gas;
- With two language versions available for users to choose from, Chinese and English;
- Optional battery power supply, one battery can maintain full performance operation for at least 2 years.

1.Working principle

FB400 series vortex flowmeter is mainly composed of body, probe, and circuit board (signal converter). The basic working principle is Carmen vortex street principle. When the medium flows through a vortex generator (triangular cylinder) at a certain speed, two regular rows of vortices alternately generates on both sides of the cylinder. The vortices are arranged asymmetrically downstream of the cylinder, and the separation frequency of the vortices can be measured by a probe (piezoelectric sensor) placed at the rear end of the cylinder (Figure 1).

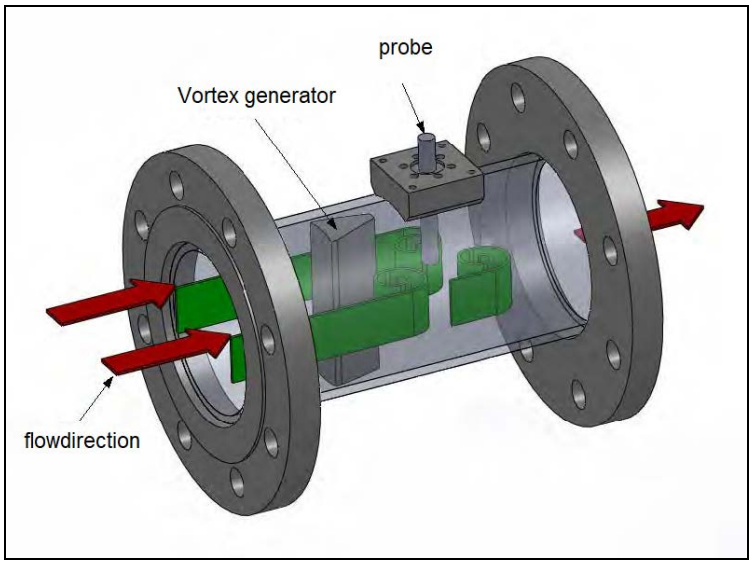


Figure 1 Working Principle

The vortex separation frequency f is proportional to the flow velocity v and inversely proportional to the width d of the vortex generator body:

$$f = St \times \frac{\mathrm{v}}{d}$$

St is the Strouhal number, which is dimensionless. When the geometry and size of the vortex generator are designed properly, St is a constant in a wide range of Reynolds number (Figure 2).

$$\mathrm{Re} = \mathrm{v} \times \frac{D}{\nu}$$

V: Kinematic viscosity of fluids
D: Caliber of flow meter

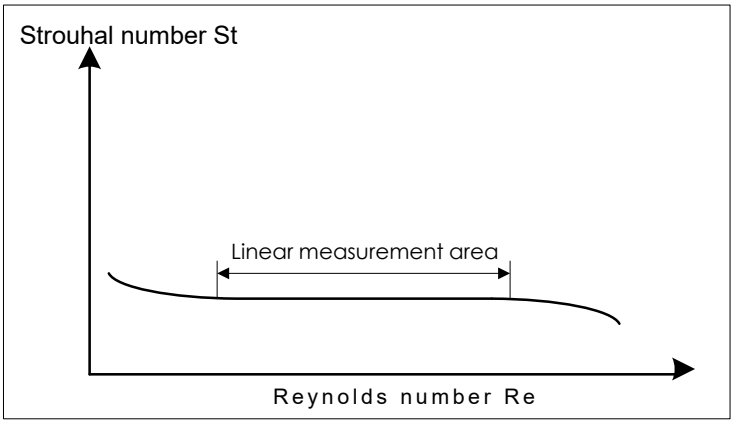
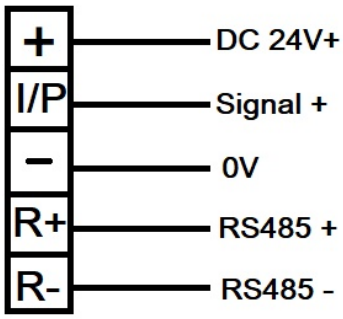


Fig. 2 Variation Relationship between Strouhal number St and Reynolds number Re

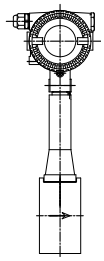
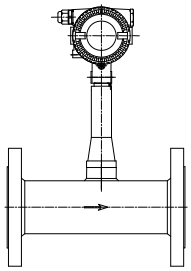
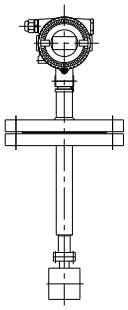
The measured vortex separation frequency varies with flow velocity and is unaffected by fluid density and viscosity. The local pressure pulsation generated by vortex separation is detected by the probe and converted into a pulse signal corresponding to the vortex frequency in the detection circuit. The circuit board (signal converter) converts this pulse signal into flow and outputs it.

2.Technical parameters

2.1 Power supply and output interface



2.2 Functional parameters

Installation form	Clamp type	Flange connection type	Plug-in type
illustration			
Sensor			
Measuring media	liquid/gas/steam		
Caliber	DN15～DN300	DN15～DN400	⩾DN300
Pressure class	⩽PN4.0MPa	PN 1.6MPa，2.5MPa，4.0MPa，6.3MPa, 10.0MPa，16.0MPa ANSI 150LB，300LB，600LB，900LB，1500LB，2500LB	⩽PN1.6MPa
Temperature range	-40℃～350℃		-40℃～130℃
Body meterial	Carbon steel，304，316L，Hastelloy alloy		
Probe material	304，316L，Hastelloy alloy		
Explosion proof type	Exd II CT4，Ex ia II CT4		
Protection class	IP65，IP67，IP68		
Measuring accuracy	±1.0%（standard），±0.5%（customized）		
Range ratio	1:10～1:20		
Converter			
Conveter type	One-piece type/split type		
Converter design number	S50	S51	S60
Function	Conventional	Compensational，With temperature and voltage compensation circuit	DSP technology
Power supply	24V DC , 3.6V（Battery power supply）		24V DC
Communication	HART , RS485（Modbus）		HART
Housing material	Aluminum housing（standard），316L housing		
Measuring parameters	Instantaneous flow rate /total flow	Instantaneous flow rate/total flow Optional temperature and pressure measurement	Instantaneous flow rate/total flow
Temperature and pressure compensation	—	Able to connect to temperature and pressure inputs	—

Signal output	(4～20) mA, Pulse output
Protection class	IP65, IP67
Power consumption	≤5W
Environment condition	
Temperature	-30 ℃～60℃
Relative humidity	5%～90%
Atmospheric pressure	(40～106) kPa

3.Installation instructions

The installation position and method of the flow meter directly affect the service life of the flow meter, and even permanently damage the flow meter. Please refer to the following items during installation.

3.1 Requirements for front and rear straight pipe sections

When installing the flow meter, it is necessary to ensure the minimum requirements for the front and rear straight pipe sections, as shown in Figure 3. Otherwise, it will seriously affect the measurement accuracy and even cause the flow meter to malfunction。

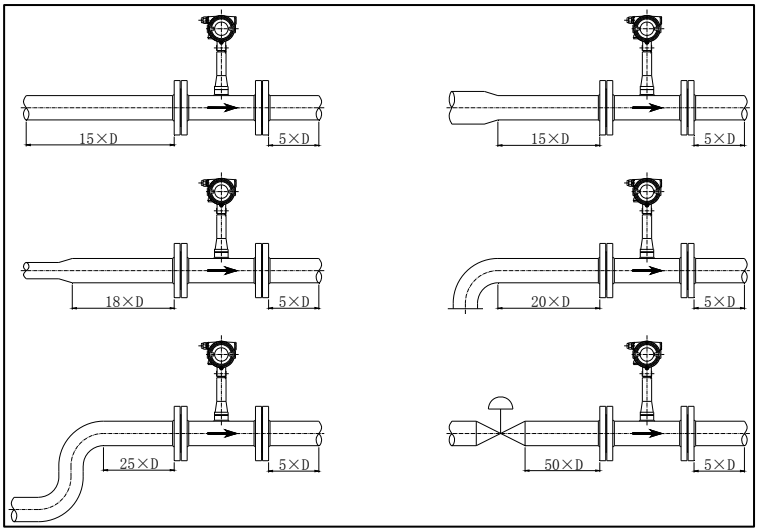


Figure 3: Length of straight pipe sections at the inlet and outlet of the flow meter (D refers to the nominal diameter of the flow meter).

3.2 Installation of high-temperature pipelines

When the instrument is installed in a horizontal pipeline and the medium temperature is above 180 ℃, it is recommended to choose a split flow meter or use a side mounted flow meter, that is, the head of the flow meter is at an angle of 45 ° to 60 ° in the vertical direction, otherwise excessive temperature will damage the signal converter. The correct side installation method is shown in Figure 4.

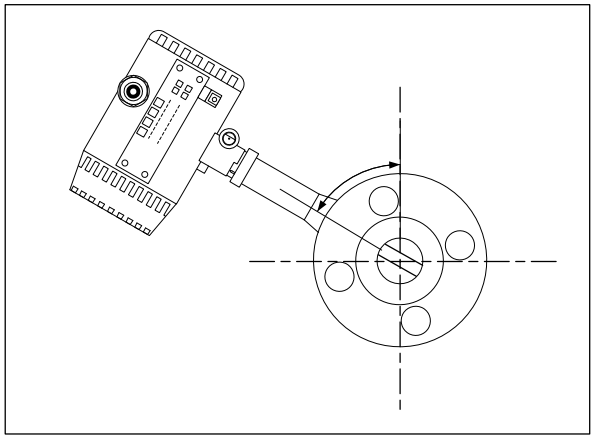


Figure 4 Installattion of High Temperature Pipeline (Temperature>180 ℃)

3.3 Installation of gas or steam pipelines

When the measuring medium is gas or steam, the instrument should be installed at the position shown in Figure 5 and cannot be installed at the lowest point of the pipeline. At the lower part of the pipeline, liquid may accumulate and form water vapor two-phase flow, leading to increased measurement errors and even inability to function properly. In addition, when steam is turned on at the lower part of the pipeline, water hammer impact may occur, damaging the triangular column or probe.

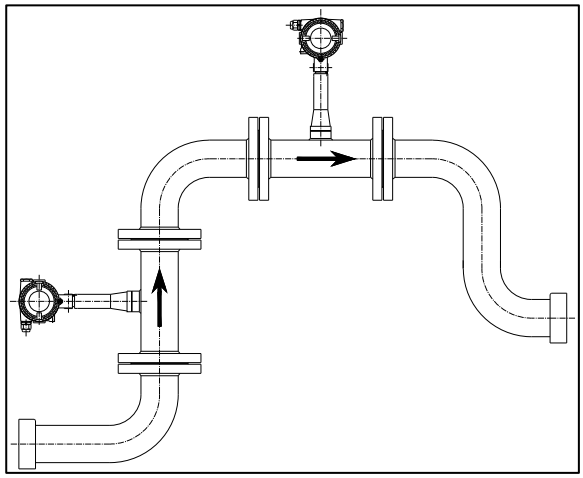


Figure 5 Gas or Steam Pipeline Installation

3.4 Liquid pipeline installation

When measuring liquid, the pipeline should be filled up with the liquid, and the instrument should be installed at the position shown in Figure 6, not at the highest point of the pipeline. At the higher part of the pipelines, bubbles may accumulate, seriously affecting measurement accuracy. When the instrument is installed in a vertical pipeline, the direction of liquid flow cannot be from top to bottom, otherwise it will cause insufficient pipe, seriously affecting measurement accuracy, and may cause the flow meter to not work properly.

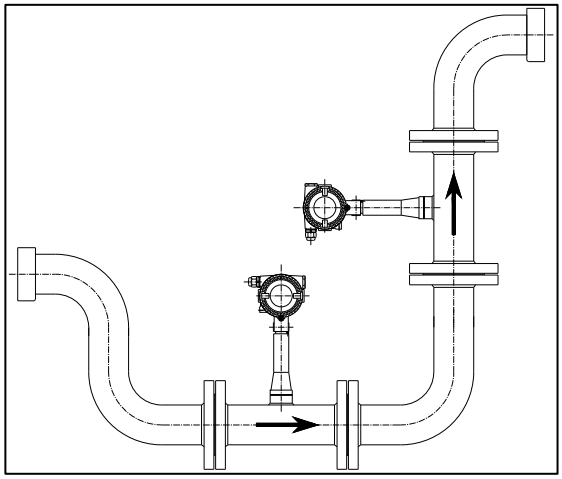


Figure 6 Liquid Pipeline Installation

3.5 Insulation layer thickness

When insulation is required for pipelines, the thickness of the insulation layer for the instrument part cannot exceed 50mm, as shown in Figure 7. An excessively thick insulation layer can increase the temperature of the converter and easily cause damage to the signal converter.

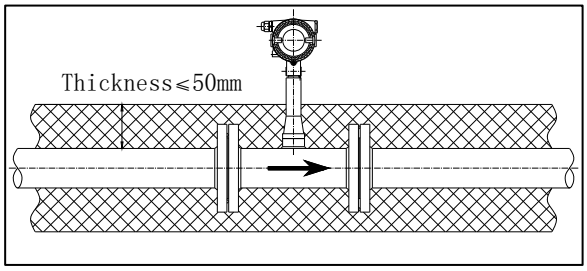


Figure 7 Insulation layer thickness

3.6 Maintenance space

During installation, a minimum clear space of 200mm or more must be left above the flowmeter for disassembly and maintenance, as shown in Figure 8.

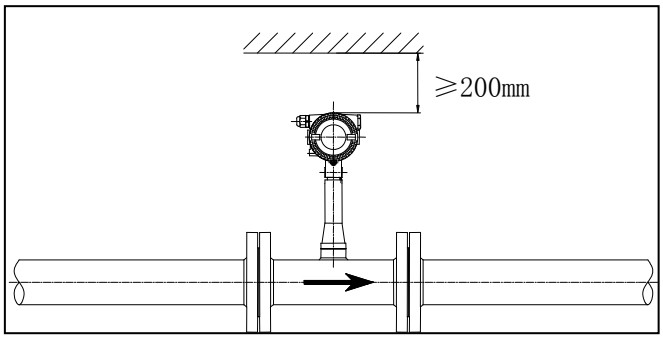


Figure 8 Maintenance space

3.7 Installation of plug-in flow meters

Firstly, weld the installation base onto the pipeline, and then install each part from bottom to top. Ball valves may not be installed, as shown in Figure 9.

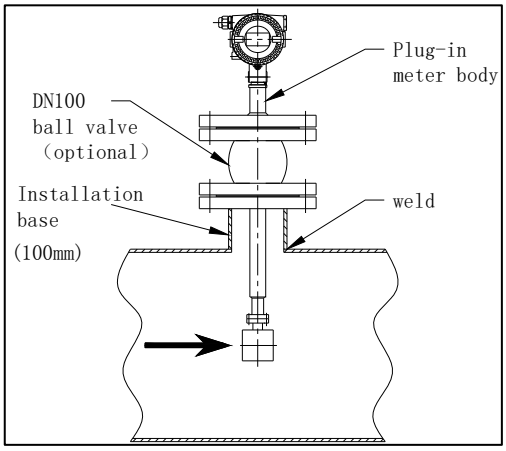


Figure 9 Installation diagram of plug-in flow meter

3.8 Installation of split flow meter

The installation of the split flow meter body is the same as that of the one-piece flow meter. The installation base of the converter must be firmly fixed on the wall, inside the box, or on the instrument bracket. The maximum transmission distance between the converter and the sensor is 5m, and the connecting cable is shielded cable. Try to shorten the cable length as much as possible according to actual needs to reduce signal attenuation and external interference. See Figure 10.

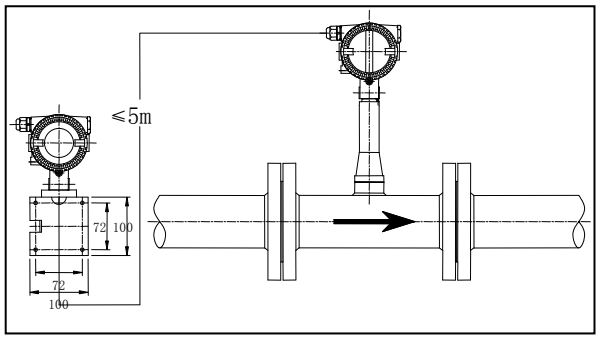


Figure 10 Installation diagram of split flow meter

3.9 Avoiding Vibration

The installation position of the flow meter should avoid vibration, as the vibration of the pipeline can affect the measurement. If necessary, supports can be installed on both sides of the instrument on the pipeline or flexible connections can be used to isolate the instrument from the vibration source.

3.10 Long pipeline installation

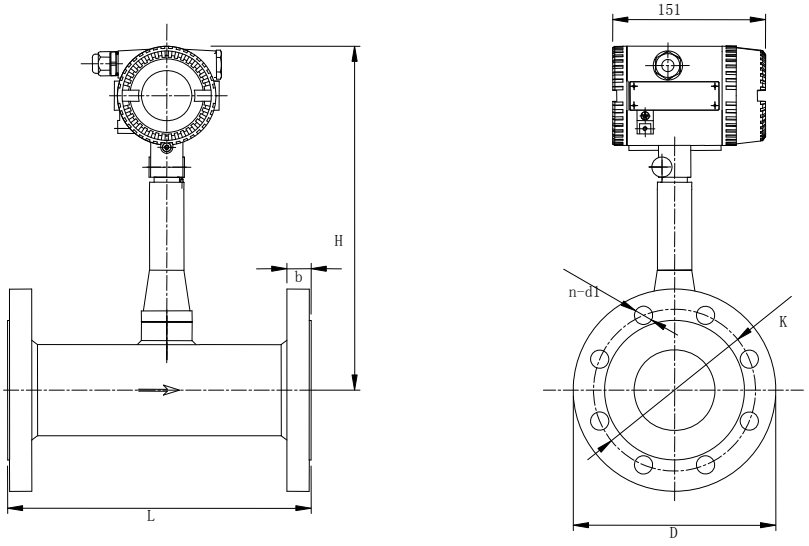
In longer pipelines, considering the possibility of pressure fluctuations at zero flow rate, which may cause mismetering, it is recommended to install gate valves before and after the flow meter. Generally, the valves used for switches are installed at the front end of the instrument, and the valves used for adjustment are installed at the back end of the instrument.

3.11 Gas-liquid two-phase flow

If the measured medium is gas-liquid two-phase, a gas-liquid separation device should be installed at the front end of the instrument.

4. Installation dimensions

4.1 Flange connection type



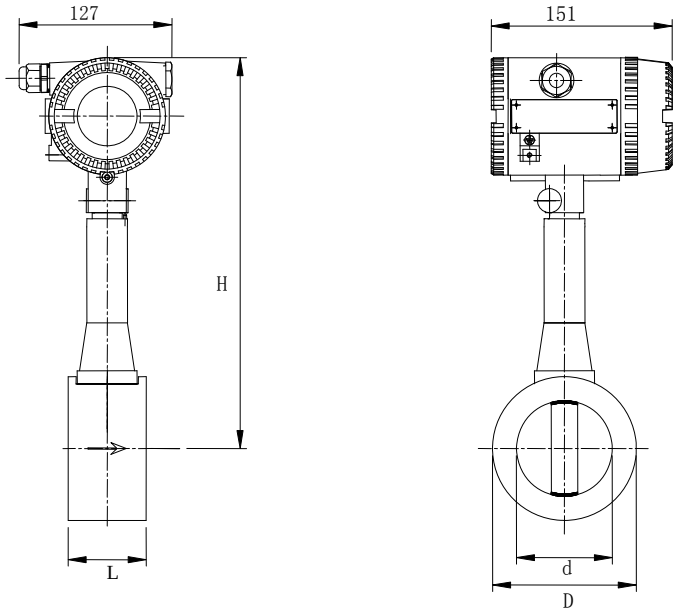
National standard series

Nominal diameter mm	Nominal pressure MPa	Length mm	Height mm	Outer diameter of flange mm	Bolt hole center distance mm	Bolt aperture mm	Quantity of bolt	Flange thickness mm	Weight kg
DN	P	L	H	D	k	d1	N	b	Weight
15	4.0	150	312	95	65	14	4	14	5
20	4.0	150	312	105	75	14	4	16	5
25	4.0	150	312	115	85	14	4	16	5
32	4.0	155	312	140	100	18	4	18	6
40	4.0	160	318	150	110	18	4	18	7
50	4.0	175	320	165	125	18	4	20	9
65	4.0	175	328	185	145	18	8	22	10
80	4.0	200	335	200	160	18	8	24	13
100	1.6/4.0	250	345	220/235	180/190	18/22	8	22/26	14/18
125	1.6/4.0	250	360	250/270	210/220	18/26	8	22/28	20/26
150	1.6/4.0	300	372	285/300	240/250	22/26	8	24/30	25/34
200	1.6/2.5	350	400	340/360	295/310	22/26	12	26/32	45/66
250	1.6/2.5	450	425	405/425	355/370	26/30	12	28/35	67/106
300	1.6/2.5	500	455	460/485	410/430	26/30	12/16	32/38	77/123

ANSI series

Nominal diameter mm	Nominal pressure LB	Length mm	Height mm	Outer diameter of flange mm	Bolt hole center distance mm	Bolt aperture mm	Quantity of bolt	Flange thickness mm	Weight kg
DN	Cl s	L	H	D	k	d1	N	b	Weight
15	150	200	315	88.9	60.5	15.9	4	11.2	5
	300			95.2	66.5	15.9		14.2	5
	600			95.3	66.5	15.9		20.6	5
	900			120.6	82.5	22.3		28.8	8
25	150	200	315	108	79.4	15.9	4	14.2	6
	300			124	88.9	19		17.5	7
	600	220		124	88.9	19		23.9	7
	900	240		149.3	101.6	25.4		34.8	11
40	150	200	320	127	98.4	15.9	4	17.5	9
	300			155.6	114.3	22.6		20.6	11
	600	235		155.6	114.3	22.6		28.8	12
	900	260		177.8	123.9	28.4		38.2	17
50	150	200	322	152.4	120.6	19	4	19.1	10
	300			165	127	19	8	22.4	12
	600	240		165	127	19		31.8	14
	900	300		215.9	165.1	25.4		44.5	27
80	150	200	335	190.5	152.4	19	4	23.9	18
	300			209.5	168.3	22.2	8	28.4	22
	600	265		209.5	168.3	22.2		38.2	26
	900	305		241.3	190.5	25.4		44.5	35
100	150	250	344	228.6	190.5	19	8	23.9	20
	300			254	200	22.2		31.8	29
	600	315		273.1	215.9	25.4		44.5	41
	900	340		292.1	234.9	31.7		50.8	51
150	150	300	371	279.4	241.3	22.2	8	25.4	33
	300			317.5	269.9	22.2	12	36.6	50
	600	365		355.6	292.1	28.4		54.2	82
	900	410		381	317.5	31.7		62	107
200	150	350	433	343	298.4	22.2	8	28.4	—
	300			381	330.2	25.4	12	41.1	—
	600	415		419.1	349.3	31.8		62	—
	900	470		469.9	393.7	38.1		69.9	—
250	150	450	458	406.4	362	25.4	12	30.2	—
	300			444.5	387.3	28.4	16	47.7	—
	600	470		508	431.8	35.1		69.9	—
300	150	500	483	482.6	431.8	25.4	12	31.8	—
	300			520.7	450.8	31.7	16	50.8	—
	600			558.8	489	35.1	20	72.9	—

4.2 Clamping type



Nominal diameter mm	Nominal pressure MPa	Length mm	Height mm	Outer diameter of body mm	Weight kg
DN	PN	L	H	D	Weight
15	4.0	65	316	39	4
20	4.0	65	316	50	4
25	4.0	65	318	57	4
32	4.0	65	318	65	5
40	4.0	65	306	75	5
50	4.0	65	311	87	6
65	4.0	65	321	109	7
80	4.0	65	326	120	8
100	4.0	65	342	149	9
125	2.5	65	355	175	11
150	2.5	65	368	203	13
200	2.5	100	398	259	22
250	1.6	100	423	312	31
300	1.6	120	448	363	40

5. Determination of flow range and caliber

The actual available flow range of the flowmeter needs to be determined through calculation, and the following operating parameters must be clearly defined first:

- Media name, composition, and status;
- Maximum, commonly used, and minimum flow rates under working conditions;
- Maximum, common, and minimum working pressure and temperature.

5.1 Gas medium

The measurement of gas flow rate by flow meters is generally not affected by medium pressure and temperature. The selection of instrument caliber can be based on the operating flow rate of air. The range of air operating flow rate is shown in Table 1.

caliber	measuring range (m^3/h)	optional measuring range (m^3/h)	notes
DN15	5～30	5～36	The reference conditions for the applicable flow range in the table are: Temperature T_0=20℃ Absolute pressure P_0=0.1013MPa Density ρ_0=1.205kg/m^3 Viscosity u_0=15mm^2/s
DN20	6～50	6～60	
DN25	9～60	8～120	
DN32	13～130	11～170	
DN40	18～180	18～290	
DN50	30～300	30～400	
DN65	50～500	50～700	
DN80	70～700	70～1000	
DN100	110～1000	100～1750	
DN125	150～1500	140～2800	
DN150	200～2000	200～3700	
DN200	400～4000	320～7500	
DN250	600～6000	550～13000	
DN300	1000～10000	800～18400	

Table 1 Air Flow Range under Operating Conditions

Gas name	Density (kg/m^3)	Gas name	Density (kg/m^3)
dry air	1.2050	H2	0.0838
C2H2	1.0950	CH4	0.6680
NH3	0.7190	C2H6	0.3324
O2	1.3320	C3H8	1.8687
CO	1.1650	C4H10	2.5192
CO2	1.8430	N2	1.1656
F2	1.6627	Ne	0.8388
C2H4	1.1747	NO	1.2490
C3H6	1.7838	NO2	1.9153

Table 2 Common Gas Density (0.1013MPa, 20℃)

5.2 Liquid media

The measurement of liquid flow rate by flow meter can refer to Table 3.

Caliber	Measurement range (m^3/h)	Notes
DN15	0.3～3.2	(1)The liquid in the table is water. (2) The reference conditions for the applicable flow range in the table are: density ρ 0=1000kg/m3 (3) The maximum flow rate of liquid should generally be ≤ 7m/s.
DN20	0.8～10	
DN25	1.0～12	
DN32	1.5～20	
DN40	2.0～30	
DN50	3.0～50	
DN65	6.0～80	
DN80	10～130	
DN100	20～200	
DN125	30～300	
DN150	45～450	
DN200	90～900	
DN250	120～1200	
DN300	180～2000	

Table 3 Flow Range of Liquid (ν=1cSt)