

ZNC-LUX Swirl Flow Meter



1. Overview

The **ZNC-LUX Series Swirl Flowmeter** integrates a swirl flow sensor and a volume corrector into one compact unit, capable of simultaneously measuring gas temperature, pressure, operating and standard volume flow rates, as well as totalized flow. Utilizing advanced technologies such as differential dual piezoelectric sensors and integrated pressure and temperature sensors, this product represents a leading level of technical performance in China. It offers high accuracy, excellent stability, strong anti-interference capability, and no rotating or moving parts—making it simple to maintain. It is an ideal measuring instrument for gas metering in industries such as **petroleum, chemical, electric power, and metallurgy**.

The product complies with **JJG 1121-2015** *Verification Regulation of Swirl Flowmeter*, **GB/T 36241** *Swirl Flowmeter for Gas*, and explosion-proof standards **GB 3836.1-2010** and **GB 3836.4-2010**.

2. Product Features

- No mechanical moving parts, corrosion-resistant, stable and reliable, long service life, and requires no special maintenance over long-term operation.
- Equipped with a new signal detection circuit that effectively identifies and processes measurement signals, eliminating interference caused by pressure fluctuations and pipeline vibrations, thus improving measurement accuracy.
- Intelligent flowmeter integrates the flow sensor, microprocessor, pressure sensor, and temperature sensor into a built-in, compact unit, enabling direct measurement of flow, pressure, and temperature with real-time automatic compensation and compressibility factor correction.
- Dual-sensor detection technology enhances signal strength while suppressing vibration-induced interference from pipelines.
- Features a Chinese character dot-matrix LCD display with abundant digits, providing intuitive and convenient reading of operating flow, standard flow, totalized flow, and medium pressure and temperature.
- Uses EEPROM technology for easy parameter configuration, permanent storage, and capability to store historical data for up to one year.
- Multiple output functions: supports three types of pulse signals, two 4–20mA analog signals, and RS485 communication with **MODBUS protocol** compatibility.
- Provides multi-parameter alarm output, with user-selectable options.

- The meter head can be rotated 360° for flexible installation and easy use.
- Pressure and temperature inputs are sensor-based with strong interchangeability—sensors of the same specifications can be directly replaced for easy maintenance, calibration, and use.
- Low power consumption; supports internal battery or external power supply.

3. Structure and Working Principle

3.1 Flowmeter Structure

The flowmeter is composed of the following seven basic components (see Figure 1):

1. Swirl Generator

Made of aluminum alloy, it features spiral blades with a specific angle, fixed at the front end of the flowmeter's contraction section. It forces the fluid to generate strong swirling motion.

2. Flowmeter Body

The main casing with integrated flanges and flow channels of specific geometry. Depending on the operating pressure, the body can be made of cast aluminum alloy or 304 stainless steel.

(See Figure 1)

3. Intelligent Flow Totalizer

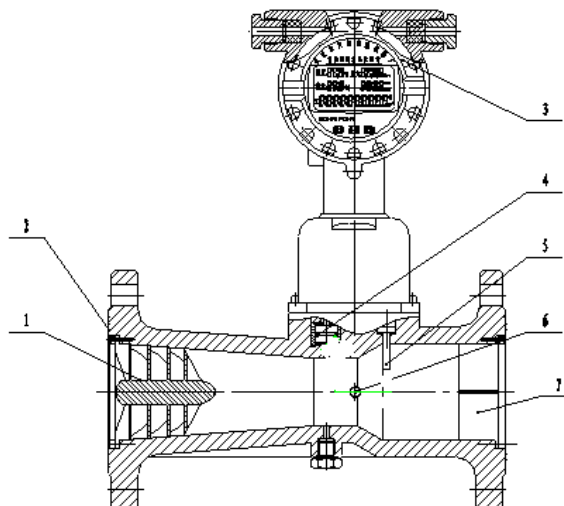
This unit consists of analog channels for temperature and pressure detection, a digital channel for flow detection, a microprocessing unit, LCD drive circuitry, and other auxiliary circuits. It is also equipped with external signal output interfaces.

4. Temperature Sensor

Uses a **Pt1000 platinum resistance element** as the temperature-sensitive component. Within a certain temperature range, its resistance has a defined correlation with temperature.

5. Pressure Sensor

Employs a **diffused silicon Wheatstone bridge** as the sensing



element. The resistors on the bridge arms change under external pressure. With a defined excitation current, the potential difference at the output terminals is proportional to the external pressure.

6. Piezoelectric Crystal Sensors

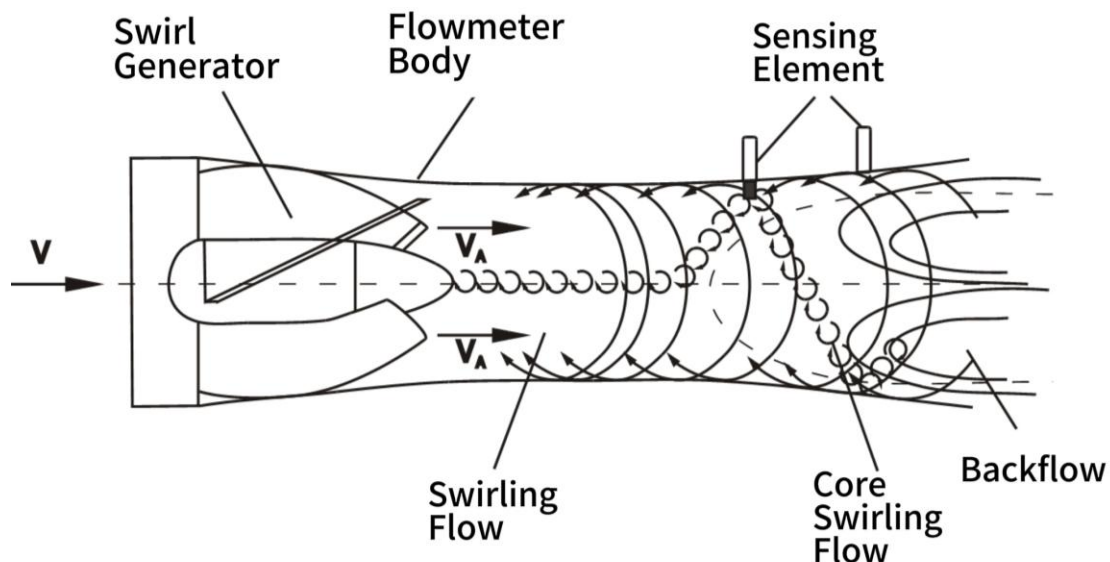
Mounted at the throat near the expansion section of the body, they detect the frequency signal generated by the swirl precession motion.

7. Flow Straightener (De-swirler)

Fixed at the outlet section of the flowmeter body, its function is to eliminate residual swirling flow to minimize interference with downstream instruments.

3.2 Working Principle

When fluid enters the flow sensor axially (see Figure 2), the swirl generator forces it into a rotating motion. A central vortex flow is then formed, which advances through the Venturi section. Upon reaching the contraction zone, the sudden narrowing accelerates the swirling flow. As it enters the expansion section, the flow undergoes forced precessional secondary rotation due to the backflow effect.



(See Figure 2)

At this point, the **rotation frequency of the swirling flow is proportional and linear to the fluid velocity**. The weak electrical signals generated by the **dual piezoelectric sensors** are differentially amplified, phase-compared, filtered, and shaped to produce:

- One pulse signal proportional to the fluid velocity
- One discrimination signal



The totalizer receives these signals, processes them to eliminate interference based on the discrimination logic, and then counts the valid flow pulses. The result is the **volumetric flow rate under operating conditions**, which is then integrated over time to compute the **total volume under operating conditions**.

4. Main Technical Specifications and Functions

4.1 Technical Specifications

Table 1:

Nominal Diameter (DN, mm)	Flow Range (m ³ /h)	Nominal Pressure (MPa)	Accuracy Class	Max Pressure Loss	Body Material
15	0.3 ~ 9	1.6; 2.5; 4.0; 6.3; 10	1.5; 1.0	4.0	≤6.3 MPa: Aluminum Alloy >6.3 MPa: Stainless Steel
20	1.2 ~ 15			3.5	
25	2.5 ~ 30			2.5	
32	4.5 ~ 60			3.5	
40	7 ~ 100			4.0	≤4.0 MPa: Aluminum Alloy ≥6.3 MPa: Stainless Steel
50	10 ~ 150			4.0	
65	20 ~ 280			3.9	
80	28 ~ 400			3.9	
100	50 ~ 800			6.5	
125	100 ~ 1500			11.0	
150	150 ~ 2250			13.0	≤2.5 MPa: Aluminum Alloy ≥4.0 MPa: Stainless Steel
200	360 ~ 3600			16.0	

Notes:

1. The stated **accuracy class** refers to the **system accuracy after temperature and pressure compensation**.
2. The **maximum pressure loss** values are measured **at atmospheric pressure using dry air** (density approx. 1.2 kg/m³).

4.2 Standard Reference Conditions

Pressure: 101.325 KPa, Temperature: 293.15 K

4.3 Operating Conditions

Ambient Temperature: -30°C to +60°C

Relative Humidity: 5% to 95%

Atmospheric Pressure: 86 KPa to 106 KPa

4.5 Medium Conditions

a. Medium Temperature: -20°C to +80°C



b. Measured Media: Natural gas, city gas, various combustible gases, air, alkanes, and inert industrial gases.

Warning: Strictly prohibited from measuring explosive gases such as acetylene, oxygen, or hydrogen directly.

4.6 Electrical Performance Specifications

4.6.1 Power Supply:

- A. External Power Supply: +24VDC $\pm 15\%$, ripple $< 5\%$, Applicable for 4–20mA output, pulse output, alarm output, RS-485, etc.;
- B. Internal Power Supply: One 3.6V lithium battery (ER26500). When voltage drops below 3.0V, undervoltage indication appears.

4.6.2 Power Consumption:

- A. External Power: $< 2W$
- B. Internal Power: Average consumption of 1mW, continuous operation for more than two years.

4.6.3 Pulse Output:

- A. Operating condition pulse signal: The flow sensor's detected signal is isolated and amplified via optocoupler. High level $\geq 20V$, low level $\leq 1V$;
- B. Calibration pulse signal: Compatible with IC card valve controllers. High level $\geq 2.8V$, low level $\leq 0.2V$.
The pulse volume can be set from 0.001 m^3 to 100 m^3 . When selecting this value, ensure pulse frequency $\leq 1000\text{Hz}$;
- C. Calibration pulse signal via optocoupler isolation and amplification: High level $\geq 20V$, low level $\leq 1V$.

4.6.4 RS-485 Communication (Optically Isolated):

- A. RS-485 interface allows direct networking with host computers or secondary displays for remote monitoring of medium temperature, pressure, and compensated standard volume flow and total volume;
- B. Compatible with HW-I data collectors to form a telephone network communication system. One collector can manage 15 flowmeters;
- C. Compatible with HW-II data collectors to form a broadband network communication system. Data transmitted via Internet. One collector can manage 8 flowmeters.

4.6.5 4–20mA Standard Current Signal (Optically Isolated):

Proportional to standard volume flow. 4mA corresponds to $0 \text{ m}^3/\text{h}$, 20mA corresponds to the maximum standard volume flow (configurable via level-1 menu).

Supports two-wire or three-wire systems; flowmeter automatically detects module and outputs accordingly.

4.6.6 Control Signal Outputs:

- A. Low-limit alarm signal (LP): Optically isolated, configurable alarm levels. Working voltage: +12V to +24V, max load current: 50mA;
- B. High-limit alarm signal (UP): Optically isolated, configurable alarm levels.



Working voltage: +12V to +24V, max load current: 50mA;

C. Valve shutoff alarm output (BC terminal, for IC card controller): Logic circuit output. Normal: low level $\leq 0.2V$; Alarm: high level $\geq 2.8V$, load resistance $\geq 100k\Omega$;

D. Battery undervoltage alarm output (BL terminal, for IC card controller): Logic circuit output. Normal: low level $\leq 0.2V$; Alarm: high level $\geq 2.8V$, load resistance $\geq 100k\Omega$;

4.7 Real-Time Data Storage Function

4.7.1 To meet data management requirements, the flowmeter provides real-time data storage in one of the following selectable modes:

A. Daily records: Logs standard volume flow and total volume at 00:00 daily for the last 5 years;

B. Monthly records: Logs monthly standard volume flow and total volume for the last 5 years;

C. Time interval records: 1200 entries of timestamped temperature, pressure, standard volume flow, and total volume.

4.7.2 Stored data can be retrieved via computer for report generation and curve analysis.

4.8 Network Communication Management Software

When paired with a data collector, the flowmeter can communicate via telephone line or broadband. The management software enables data reading, parameter setting, and comprehensive flowmeter network management.

4.8 Explosion-proof Marking: Exd IIB T6 Gb

4.9 Protection Level: IP65

4.10 Pressure Loss

The actual pressure loss of the flowmeter can be calculated by the following formula:

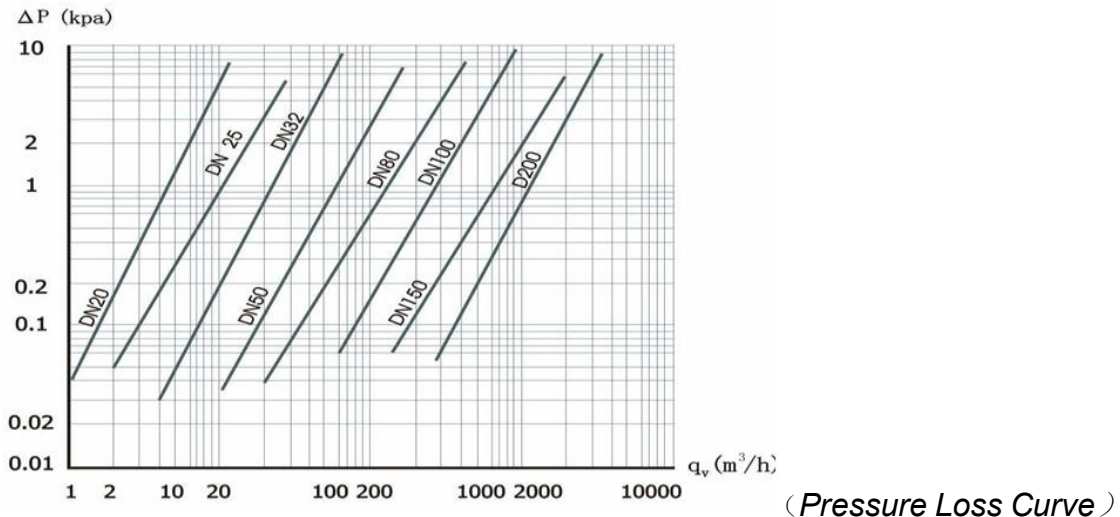
$$\Delta P_1 = \frac{\rho}{1.205} \Delta P \dots\dots\dots(1)$$

Where:

ΔP_1 – Actual pressure loss of the flowmeter (KPa);

ρ – Density of the measured medium (kg/m^3);

ΔP – Pressure loss curve of the flowmeter when using dry air as the medium (see chart below).



4.11 Electrical Interface

The standard electrical interface is **internal thread M20×1.5**.

Other thread types can be **customized upon request**.

5. Selection and Installation

5.1 Flowmeter Selection

During the selection process, two fundamental principles must be adhered to:

1. Ensure production safety
2. Guarantee measurement accuracy

To achieve this, three key selection parameters must be determined:

- The maximum, minimum, and normal flow rates for both short-term and long-term use (mainly used to select the nominal diameter of the instrument)
- The design pressure of the measured medium (mainly used to select the nominal pressure rating of the instrument)
- The actual operating pressure (mainly used to select the pressure rating of the pressure sensor)

Selection guidelines:

- a. When the measured flow is given as the actual operating volume flow, the appropriate nominal diameter can be directly selected from the flow range table;
- b. When the measured flow is given as the standard volume flow under standard conditions, convert the standard volume flow Q_N to actual operating volume flow Q_v first, then select the corresponding nominal diameter according to the flow range in the technical parameter table;
- c. If two different nominal diameter flowmeters can cover both the minimum and maximum flow rates, choose the smaller diameter if the pressure loss is



allowable;

d. Ensure the actual minimum flow Q min is not lower than the lower limit flow of the selected nominal diameter flowmeter;

e. Special requirements for flow range or nominal pressure can be negotiated upon ordering.

Selection calculation formula:

$$Q_V = \frac{Z}{Z_N} \cdot \frac{P_N}{P + P_a} \cdot \frac{T}{T_N} \cdot Q_N = \frac{Z}{Z_N} \cdot \frac{101.325}{P + P_a} \cdot \frac{T}{293.15} \cdot Q_N$$

Where:

- T, P, and Pa have the same meanings as above,
- Q is the actual volume flow,
- Qn is the standard volume flow,
- Z/Zn values are listed in Table 2.

Due to large calculation step sizes, the data in the table are for reference only. The table data are calculated assuming a real relative density of natural gas Gr=0.600, and molar fractions of nitrogen and carbon dioxide are both 0.00. When the medium pressure is below 0.1 MPa, Z/Zn=1 can be used for estimation.

Zn/Zg 绝对 压力 (MPa)	温度 ℃	-20	-15	-10	-5	0	5	10	15	20	25
0.10		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.20		1.0034	1.0032	1.0030	1.0029	1.0027	1.0025	1.0024	1.0023	1.0021	1.0020
0.30		1.0069	1.0065	1.0061	1.0058	1.0055	1.0051	1.0048	1.0046	1.0043	1.0041
0.40		1.0104	1.0098	1.0093	1.0087	1.0082	1.0078	1.0073	1.0069	1.0065	1.0061
0.50		1.0140	1.0132	1.0124	1.0117	1.0110	1.0104	1.0098	1.0092	1.0087	1.0082
1.00		1.0325	1.0305	1.0286	1.0269	1.0253	1.0238	1.0223	1.0210	1.0198	1.0186
1.50		1.0518	1.0485	1.0455	1.0426	1.0400	1.0375	1.0352	1.0331	1.0311	1.0293
2.00		1.0722	1.0674	1.0630	1.0589	1.0551	1.0516	1.0484	1.0454	1.0426	1.0400
2.50		1.0936	1.0872	1.0812	1.0758	1.0708	1.0661	1.0619	1.0580	1.0543	1.0510
3.00		1.1162	1.1078	1.1002	1.0933	1.0869	1.0810	1.0757	1.0707	1.0662	1.0620
3.50		1.1400	1.1295	1.1200	1.1113	1.1035	1.0963	1.0897	1.0837	1.0782	1.0732
4.00		1.1651	1.1521	1.1405	1.1300	1.1205	1.1119	1.1041	1.0969	1.0904	1.0844
4.50		1.1915	1.1758	1.1618	1.1493	1.1380	1.1278	1.1186	1.1103	1.1027	1.0957
5.00		1.2194	1.2005	1.1839	1.1691	1.1559	1.1441	1.1334	1.1238	1.1150	1.1071
5.50		1.2486	1.2262	1.2067	1.1895	1.1742	1.1606	1.1484	1.1374	1.1274	1.1185
6.00		1.2793	1.2530	1.2302	1.2104	1.1928	1.1773	1.1634	1.1510	1.1399	1.1298
6.50		1.3113	1.2806	1.2544	1.2316	1.2117	1.1942	1.1786	1.1647	1.1522	1.1411
7.00		1.3444	1.3091	1.2790	1.2532	1.2308	1.2111	1.1937	1.1783	1.1645	1.1522
7.50		1.3785	1.3381	1.3040	1.2750	1.2499	1.2280	1.2088	1.1918	1.1767	1.1632
8.00		1.4131	1.3673	1.3291	1.2967	1.2689	1.2448	1.2237	1.2051	1.1886	1.1740
Zn/Zg 绝对 压力 (MPa)	温度 ℃	30	35	40	45	50	55	60	65	70	75
0.10		1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.20		1.0019	1.0018	1.0017	1.0016	1.0015	1.0014	1.0013	1.0012	1.0012	1.0011
0.30		1.0038	1.0036	1.0034	1.0032	1.0030	1.0029	1.0027	1.0025	1.0024	1.0023
0.40		1.0058	1.0054	1.0051	1.0048	1.0046	1.0043	1.0041	1.0038	1.0036	1.0034
0.50		1.0077	1.0073	1.0069	1.0065	1.0061	1.0058	1.0055	1.0052	1.0049	1.0046
1.00		1.0176	1.0166	1.0156	1.0147	1.0139	1.0131	1.0124	1.0117	1.0110	1.0104
1.50		1.0275	1.0259	1.0244	1.0230	1.0217	1.0204	1.0193	1.0182	1.0171	1.0162
2.00		1.0376	1.0354	1.0333	1.0313	1.0295	1.0277	1.0261	1.0246	1.0232	1.0219
2.50		1.0478	1.0449	1.0422	1.0396	1.0372	1.0350	1.0329	1.0310	1.0292	1.0274
3.00		1.0581	1.0545	1.0511	1.0480	1.0450	1.0423	1.0397	1.0373	1.0351	1.0330
3.50		1.0685	1.0641	1.0600	1.0563	1.0528	1.0495	1.0464	1.0436	1.0409	1.0384
4.00		1.0789	1.0737	1.0690	1.0646	1.0605	1.0567	1.0531	1.0498	1.0467	1.0438
4.50		1.0894	1.0834	1.0779	1.0728	1.0681	1.0638	1.0597	1.0559	1.0523	1.0490
5.00		1.0998	1.0930	1.0868	1.0811	1.0757	1.0708	1.0662	1.0619	1.0579	1.0542
5.50		1.1103	1.1026	1.0956	1.0892	1.0832	1.0777	1.0726	1.0678	1.0633	1.0592
6.00		1.1207	1.1122	1.1044	1.0972	1.0906	1.0845	1.0788	1.0736	1.0687	1.0641
6.50		1.1310	1.1216	1.1130	1.1051	1.0979	1.0912	1.0850	1.0792	1.0738	1.0689
7.00		1.1411	1.1309	1.1215	1.1129	1.1050	1.0977	1.0910	1.0847	1.0789	1.0735
7.50		1.1511	1.1400	1.1298	1.1205	1.1120	1.1041	1.0968	1.0900	1.0838	1.0780
8.00		1.1609	1.1489	1.1380	1.1279	1.1187	1.1103	1.1024	1.0952	1.0885	1.0823



5.2 Selection Example

Given:

- The actual operating pressure range of a gas supply pipeline is from 0.80 MPa to 1.2 MPa.
- The medium temperature range is from -10°C to +40°C.
- The peak gas supply is a standard volume flow of 2500 m³/h.
- The minimum gas supply is a standard volume flow of 560 m³/h.
- The real relative density of natural gas Gr=0.591.
- Molar fraction of nitrogen Mn=1.6%.
- Molar fraction of carbon dioxide Mc=0.8%.
- Local atmospheric pressure is 101.3 kPa.

The goal is to determine the nominal diameter of the flowmeter.

When the medium pressure is 0.8 MPa and temperature is 40°C, the compression factor Z effect is minimal, corresponding to the peak gas supply period with the maximum volume flow. Conversely, when the medium pressure is 1.2 MPa and temperature is -10°C, the compression factor effect is maximal, corresponding to the valley gas supply period with the minimum volume flow.

Based on Gr=0.591, Mn=1.6%, Mc=0.8%, at gauge pressure P=0.8 and temperature T=40°C, using the formula in SY/T 6143, the ratio $Z_N/Z=1.0127$. Therefore, the maximum actual volume flow is:

$$Q_{\max} = \frac{Z}{Z_N} \cdot \frac{P_N}{P + P_a} \cdot \frac{T}{T_N} \cdot Q_N = \frac{1}{1.0127} \times \frac{101.325}{800 + 101.3} \times \frac{40 + 273.15}{293.15} \times 2500 = 2964.6(m^3 / h)$$

At gauge pressure P=1.2 MPa and temperature T= -10°C, the ratio $Z_N/Z=1.0355$. Therefore, the minimum actual volume flow is:

$$Q_{\min} = \frac{Z}{Z_N} \cdot \frac{P_N}{P + P_a} \cdot \frac{T}{T_N} \cdot Q_N = \frac{1}{1.0355} \times \frac{101.325}{1200 + 101.3} \times \frac{-10 + 273.15}{293.15} \times 5600 = 378(m^3 / h)$$

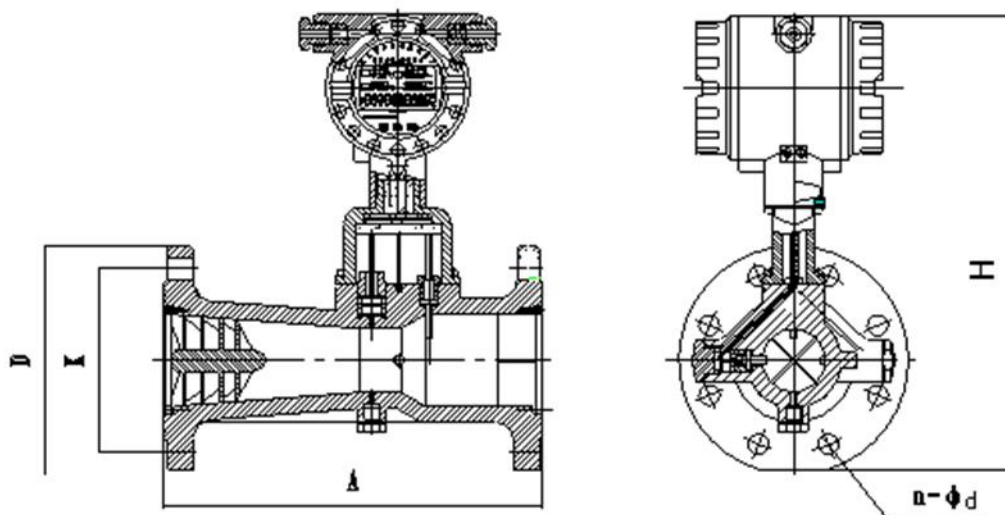
According to Table 1, the appropriate flowmeter nominal diameter is 200 mm, selecting the LUX-200 model flowmeter.

5.3 Model Selection Code Table

Model							Description
LUX	□	I□	I□	I□	I□	I□	
Instrument Type	A						Pulse output
	B						Pulse output + 4-20mA analog output
Nominal Diameter		015					DN15
		020					DN20
		025					DN25

	032					DN32
	040					DN40
	050					DN50
	065					DN65
	080					DN80
	100					DN100
	125					DN125
	150					DN150
	200					DN200
Communication Method	1					None
	2					RS485
	3					Hart
Pressure Rating	N					1.6MPa
	H(x)					High pressure (custom pressure value x)
Body Material	A					Aluminum Alloy
	S					Stainless Steel
Accuracy Class	N					Standard 1.5%
	G(x)					Customized 1.0% (x = specified accuracy)

5.4 Flowmeter Dimensions and Installation Drawings





Dimensions of Aluminum Alloy Flowmeter Body (Nominal Pressure PN1.6MPa)

Model	Nominal Diameter DN	Length A (mm)	Height H (mm)	Flange Diameter D (mm)	Bolt Circle K (mm)	Bolt Holes n×φd (mm)
LUX-15	15	162	285	95	65	4×φ14
LUX-20	20	162	325	105	75	4×φ14
LUX-25	25	182	340	115	85	4×φ14
LUX-32	32	200	345	140	100	4×φ18
LUX-40	40	233	365	150	110	4×φ18
LUX-50	50	233	370	165	125	4×φ18
LUX-65	65	300	390	185	145	8×φ18
LUX-80	80	330	410	200	160	8×φ18
LUX-100	100	410	420	220	180	8×φ18
LUX-125	125	516	445	250	210	8×φ18
LUX-150	150	580	475	285	240	8×φ22
LUX-200	200	700	520	340	295	12×φ22

Dimensions of Stainless Steel Flowmeter Body (Nominal Pressure PN2.5MPa)

Model	Nominal Diameter DN	Length A (mm)	Height H (mm)	Flange Diameter D (mm)	Bolt Circle K (mm)	Bolt Holes n×φd (mm)
LUX-15	15	162	285	95	65	4×φ14
LUX-20	20	162	325	105	75	4×φ14
LUX-25	25	182	340	115	85	4×φ14
LUX-32	32	200	345	140	100	4×φ18
LUX-40	40	233	365	150	110	4×φ18
LUX-50	50	233	370	165	125	4×φ18
LUX-65	65	300	390	185	145	8×φ18
LUX-80	80	330	410	200	160	8×φ18
LUX-100	100	410	420	220	180	8×φ22
LUX-125	125	516	445	250	210	8×φ26
LUX-150	150	580	475	285	240	8×φ26
LUX-200	200	700	520	340	295	12×φ26

Note: Stainless steel flowmeter bodies can be custom-made for PN4.0MPa and PN6.3MPa pressure ratings. The length remains unchanged. Flange specifications comply with **GB/T9124.1-2019**.

5.5 Flow Meter Installation

5.5.1 Installation Precautions

To ensure accurate measurement and reliable operation of the flow meter, the following requirements must be strictly followed:

1. Welding Prohibition

It is strictly forbidden to perform welding directly on the inlet and outlet flanges of the flow meter to prevent internal components from being damaged by high temperatures.

2. Pipe Cleaning Before Installation

After new pipeline construction or maintenance, the pipeline must be thoroughly flushed to remove all debris before installing the flow meter.

3. Installation Environment

The flow meter should be installed in locations that:

- Are easy to access and maintain;
- Are free from strong electromagnetic interference, mechanical vibration, and thermal radiation;
- If installed outdoors, must be protected from rain and direct sunlight by appropriate sheltering to extend the device's service life.

4. Operating Condition Limitations

The flow meter is **not suitable** for:

- Applications with frequent flow interruptions;
- Severe pulsating flow or pressure fluctuations.

5. Installation Orientation & Flow Direction

- The flow meter can be installed at **any angle** (horizontal, vertical, or inclined);
- Ensure that the **fluid flow direction matches** the arrow marked on the flow meter body.

6. Pipeline Installation Requirements

- The flow meter must be installed **coaxially** with the pipeline;
- Ensure that **sealing gaskets and grease** do not enter the flow meter's inner chamber;
- It is recommended to install **expansion joints or bellows** to prevent mechanical stress or rupture caused by thermal expansion or vibration.

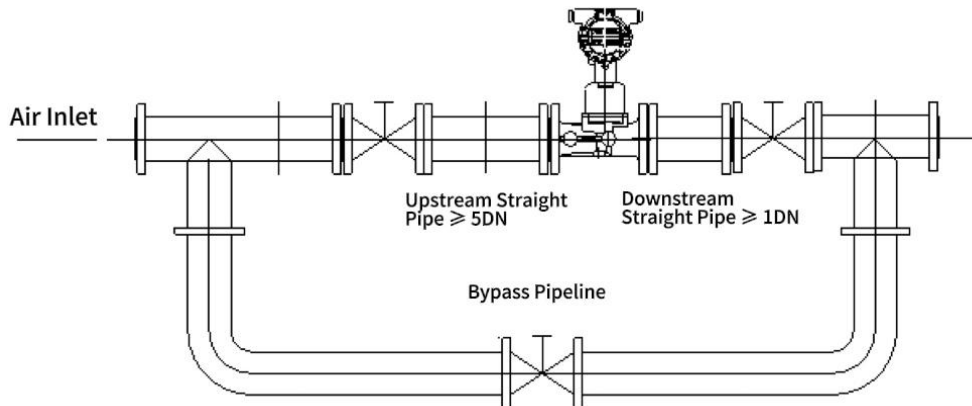
7. Electrical Grounding and Safety

- When using an **external power supply**, the flow meter must be **reliably grounded**;
- Do not share the same grounding system with high-power electrical equipment;
- During installation or maintenance, **do not connect welding equipment's ground wire** to the flow meter body.

8. Bypass Pipeline Installation

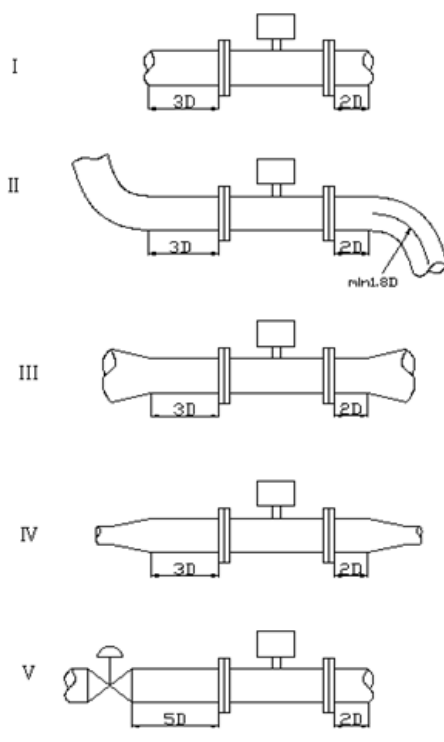
- To ensure uninterrupted fluid delivery and convenient maintenance, a bypass pipeline should be installed as shown in **Figure 4**;
- Maintain at least:
 - **3DN** straight pipe length upstream of the meter;

- 1DN straight pipe length downstream of the meter.



5.5.2 Straight Pipe Requirements

Based on the working principle of the **swirl flowmeter** and its requirements for upstream and downstream straight pipe sections, the necessary lengths for various upstream flow-disturbing elements are specified as follows:

Description	Diagram
Ensure a minimum of 3D straight pipe upstream and 2D downstream from the flowmeter. (D refers to the nominal diameter of the flowmeter.)	
Elbow (Bend Pipe): The straight pipe length upstream must be at least 3D , and downstream at least 2D .	
Reducer (Contraction Pipe): The straight pipe length upstream must be at least 3D , and downstream at least 2D .	
Expander (Expansion Pipe): The straight pipe length upstream must be at least 3D , and downstream at least 2D .	
Valve: If there is a valve on the upstream side, the straight pipe length upstream must be at least 5D , and downstream at least 2D .	



5.5.3 Installation Precautions

- The sensor can be installed in vertical, horizontal, or inclined positions according to the flow direction indicated.
- If the pipeline is long or close to a source of vibration, supports should be installed upstream and downstream of the flowmeter to eliminate the effects of vibration.
- The installation location of the sensor should provide sufficient space for inspection and maintenance, and must meet the environmental requirements of the flowmeter.
- Avoid interference from strong external magnetic fields.
- When installed outdoors, a protective cover should be provided to prevent damage caused by direct sunlight and rain, which may affect the service life of the instrument.
- During pipeline pressure testing, pay attention to the pressure range of the pressure sensor equipped with the intelligent flowmeter to avoid damage due to overpressure.
- Pay attention to installation stress. The upstream and downstream pipelines of the flowmeter should be coaxial to avoid shear stress. The installation position should consider the thickness of sealing gaskets, or install a flexible expansion joint on the downstream side.
- Remove welding slag and other debris from the pipeline before installing the flowmeter.
- When starting operation, open the upstream and downstream valves slowly to avoid damage to the swirl generator caused by sudden high-speed airflow.
- If the flowmeter requires signal transmission, connect the external power supply strictly according to the “Electrical Specifications” (8–24 VDC). **Do not connect 220VAC or 380VAC directly to the signal output terminals.**
- Users must not alter the wiring of the explosion-proof system or tamper with any output cable joints.
- Do not open the rear cover or modify instrument parameters during operation, as this may affect normal performance.
- Regularly check for leakage at the flanges of the flowmeter.

5.5.4 Battery Use and Replacement (For Built-in Battery Models)

Battery Status Display

When the battery indicator shows only one bar, the battery should be replaced within one month.

If only the battery icon is displayed, the battery is completely drained and must be replaced immediately.

Battery Replacement Procedure

Open the back cover of the intelligent flow totalizer, loosen the three screws on the battery cover plate, disconnect the battery connector, remove the old battery, insert the new battery, and reinstall the cover.

5.5.5 Installation Requirements for Hazardous (Explosive) Areas

- The flowmeter must be reliably grounded. The explosion-proof ground must not be shared with the protective ground of high-voltage systems.
- Do not use AC power ground for field test power supply.
- Under no circumstances may the user modify the explosion-proof circuit, components, or explosion-proof type.
- Always disconnect the external power supply before opening the converter cover.

6. Operation Instructions

6.1 Keypad Functions and Display Interface

1. Main Interface (as shown above)

First Row:

- Real-time Pressure
- Real-time Temperature

Second Row:

- Instantaneous Flow Rate

Third Row:

- Cumulative Flow

Keypad Functions (from left to right):

- **First Key:** Return Function (in certain cases, it also serves as an exit/confirmation for parameter changes)
- **Second Key:** Downward Navigation (used to scroll down the menu or decrease numerical values)
- **Third Key:** Upward Navigation (used to scroll up the menu or increase numerical values)
- **Fourth Key:** Enter Function (used to enter menu items or move the cursor to the right)

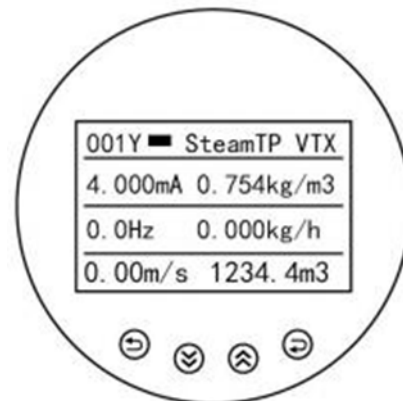


In addition to the main interface, there is an auxiliary interface. Pressing the "Up" or "Down" key on the main interface toggles between the main and auxiliary screens.

2. Auxiliary Interface (as shown below):

Auxiliary Interface Display Content:

- **First Row:** Modbus RTU Address & Protocol Code / Battery Status / Flow Calculation Algorithm
- **Second Row:** Theoretical 4–20 mA Output / Real-time Medium Density
- **Third Row:** Frequency Information / Working Condition Instantaneous Flow
- **Fourth Row:** Flow Velocity / Working Condition Cumulative Flow



The auxiliary screen provides additional information, making it easier for the user to access comprehensive flow data.

Note:

Before delivery, the flowmeter is fully configured based on prior communication. Users can directly install and operate the flowmeter without additional parameter setup.

7 Converter Wiring Diagram

7.1 Terminal Board Wiring Diagram

Terminal	Function	Description
+	DC 18~36V Power +	Power supply +24V
-	DC 18~36V Power -	Power supply -24V
I	4–20 mA Output	Supports both 2-wire and 3-wire systems. Forms a 2-wire loop with “+” terminal.
∩ (P)	Pulse Output	Works in conjunction with Power “+” and “-” terminals
A	RS485 Output A	RS485 communication line A
B	RS485 Output B	RS485 communication line B

Note:

1. When powered solely by an internal battery (without 24VDC external power), **all output functions are disabled**.
2. Once a 24VDC power supply is connected, output functions will **automatically activate**.