



TPD Series In-line Ultrasonic Flow Sensor

User Manual



User Manual (V1.1)

Shanghai Xunyun Technology Co., Ltd.

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1. INTRODUCTION

XY-TEK is a technology innovation enterprise specializing in the research, development, production, and sales of ultrasonic flow sensors. We are committed to providing accurate, stable, and reliable flow sensors for liquid flow rate measurement in medical devices, biopharmaceuticals, new energy, and industrial automation industry, helping enhance the automation, digitalization, and intelligence of liquid flow monitoring systems.

XY-TEK TPD series inline ultrasonic flow sensors feature a compact design, it can measure and output flow rate without external circuit systems. With no moving parts inside, TPD flow sensors has mechanical wear and no the measurement drift issues, ensuring stable and reliable flow rate measurement even during 24/7 continuous operation. At the same time, the TPD flow sensor generates negligible additional pressure loss to the measured liquid, making it suitable for applications with high requirements for system pressure and flow stability.

Product Features

- 1.High accuracy and high stability
- 2.Bidirectional liquid flow rate measurement with bubble detection function
- 3.Circuitry integrated within the flow sensor, no external computing systems, compact in size
- 4.No clogging, no turning, no dead angles, low fluid pressure loss
- 5.Provides standard output for seamless integration with customer systems

Common Applications

- 1.New Energy: Liquid mixing and proportioning, coolant circulation systems
- 2.Semiconductor: CMP, slurry mixing, wet etching, wafer/mask cleaning, electroplating, cooling systems
- 3.Industrial Automation: Spraying equipment, cooling systems, lubrication systems, liquid delivery systems, water treatment and wastewater treatment systems
- 4.Biopharmaceuticals: Chromatography, upstream and downstream feeds, filtration

1.1 Symbols and Abbreviations

Symbols and Abbreviations	Description
	Warning! This safety symbol precedes important information that must be strictly followed to prevent injury and fatal danger.



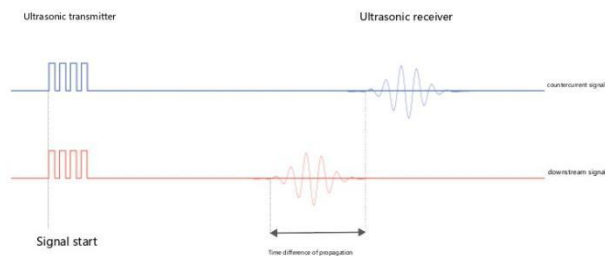
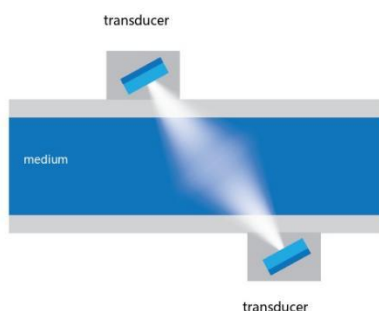
Attention

Attention! This safety symbol appears before critical operation information that must be strictly followed to prevent equipment damage or hazardous consequences.

1.2 Working Principle

XY-TEK TPD series ultrasonic flow sensor can be connects to the user's existing liquid tubing through an adapter for accurate flow rate measurement. The TPD flow sensor adopts ultrasonic transit-time difference technology, providing excellent flow rate measurement accuracy and reliability.

During measurement, two piezoelectric (PZT) crystals inside the sensor are positioned downstream and upstream, alternately sending and receiving ultrasonic signals. Ultrasonic waves propagate directly into the liquid in an anti-current manner. The flow of the liquid affects the propagation of the ultrasonic waves, ensuring that the transmission time of the ultrasonic waves in the counter-current direction is always greater than that in the downstream direction. By accurately analyzing the time difference in transmission between these two directions and based on its proportional relationship with the liquid flow rate, the sensor can quickly and accurately calculate the volumetric flow rate of the liquid, providing users with reliable and accurate flow data.



1.3 Packing List

Items		Detailed Description
1	Flow Sensor	
2	Flow Sensor Cable (standard 5m)	
3	6-Pin Terminal	
Optional Accessories		Detailed Description
1	USB Data Converter	
2	USB 2.0 Printer Cable	

2. TECHNICAL SPECIFICATIONS

2.1 Measurement Accuracy and Repeatability

Product Model	Flow Range	Measurement Accuracy ^[1]	Repeatability ^{[2][3]}
TPD004M1	0 - 6L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.
TPD008M1	0 - 15L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.
TPD012M1	0 - 30L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.
TPD015M1	0 - 50L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.
TPD020M1	0 - 100L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.
TPD025M1	0 - 160L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.
TPD032M1	0 - 250L/min	0-0.3L/min : 6mL/min 0.3-6L/min : $\pm 2\%$ RD	$\pm 0.1\%$ F.S.

Notes:

[1]Measurement accuracy: $\pm 2\%$ RD (Reading). During on-site testing, the same liquid type, liquid temperature, and liquid pressure as those used in the factory calibration are required to achieve this measurement accuracy.

[2]Repeatability: $\pm 0.1\%$ FS (full scale). This indicator needs to be achieved under stable liquid flow conditions. When there are pulsations or fluctuations in the flow, the repeatability will be affected.

2.2 Calibration Conditions

The flow sensor is calibrated at the factory according to the following standard conditions:

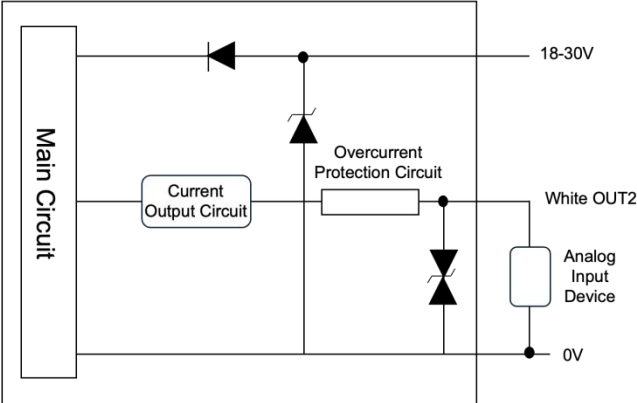
- Liquid: Water ($22^{\circ}\text{C} \pm 3^{\circ}\text{C}$) (Default)

2.3 Tubing Connection Methods

- Process Connection: G Thread
- Seal Type: O-ring

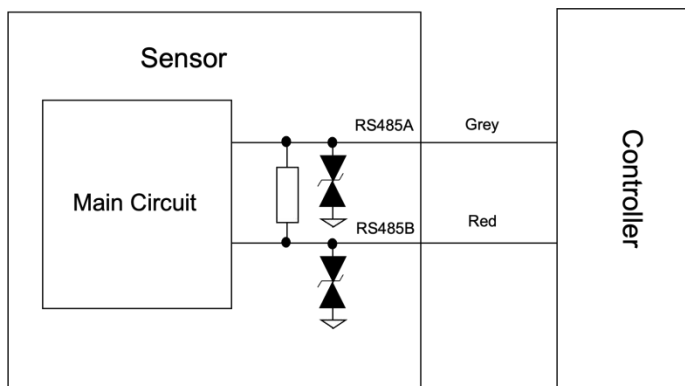
G Thread Specifications and Dimensions (For Installation)			
Model	Female G Thread Size	Seal Specification (Installation)	Thread Engagement Depth (Male Steel Pipe Thread), mm
TPD004M1	G 1/4	Rubber Flat Gasket, OD 12 × ID 6 × T 2.5–3.0 mm	12.5
TPD008M1	G 3/8	Rubber Flat Gasket, OD 15 × ID 8 × T 2.5–3.0 mm	12.5
TPD012M1	G 1/2	Rubber Flat Gasket, OD 19 × ID 11 × T 2.5–3.0 mm	13
TPD015M1	G 3/4	Rubber Flat Gasket, OD 24 × ID 14 × T 2.5–3.0 mm	16.5
TPD020M1	G 1	Rubber Flat Gasket, OD 30.5 × ID 18.5 × T 2.5–3.0 mm	16.5
TPD025M1	G 1	Rubber O-ring, ID 30 × C/S 3.1 mm	16.5
TPD032M1	G 1 1/4	Rubber Flat Gasket, OD 40 × ID 3 × T 3.0 mm	16.5

2.4 Sensor Interface

Interface Type	Detailed Specifications
Current Output	Three current output modes are available: 4-20mA, 0-20mA, 0-24mA. For voltage conversion, the output can be grounded by the load, and the load resistance is not greater than 600 Ω. 

RS485 Interface

RS-485 bus operation: supports up to 12 sensors.



Pulse Output

Pulse output, two modes: PNP, NPN

Maximum output current 100mA

Minimum load resistance is related to operating voltage

Recommended: 12V-250 Ω , 15V-500 Ω , 24V-1000 Ω , 30V-1200 Ω

Maximum pulse output frequency: 10 kHz.

When using "pulse equivalent" setting, the lower limit is:

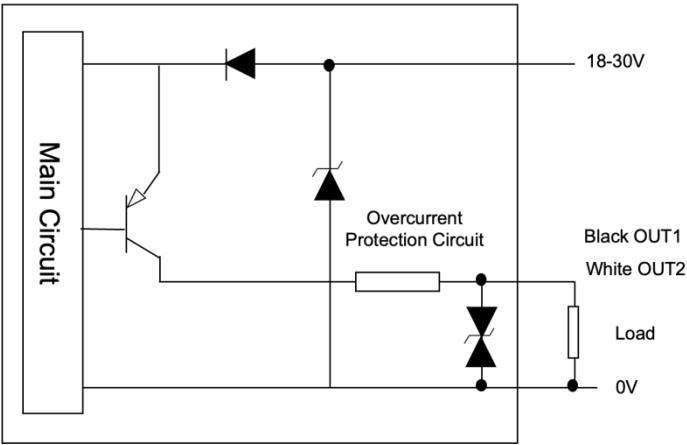
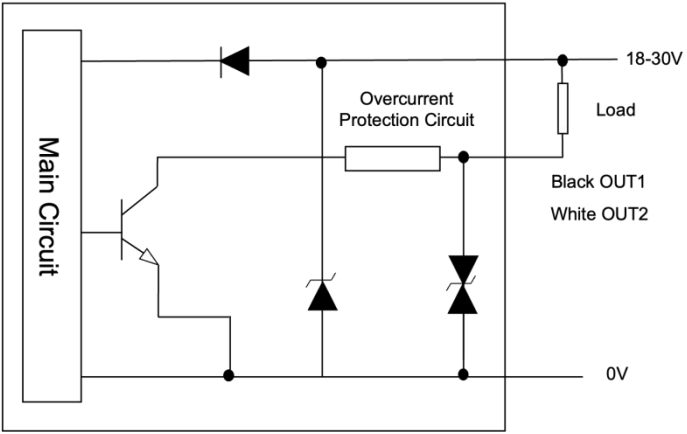
$$\frac{1}{10000/(Flow_{max}/60)}$$

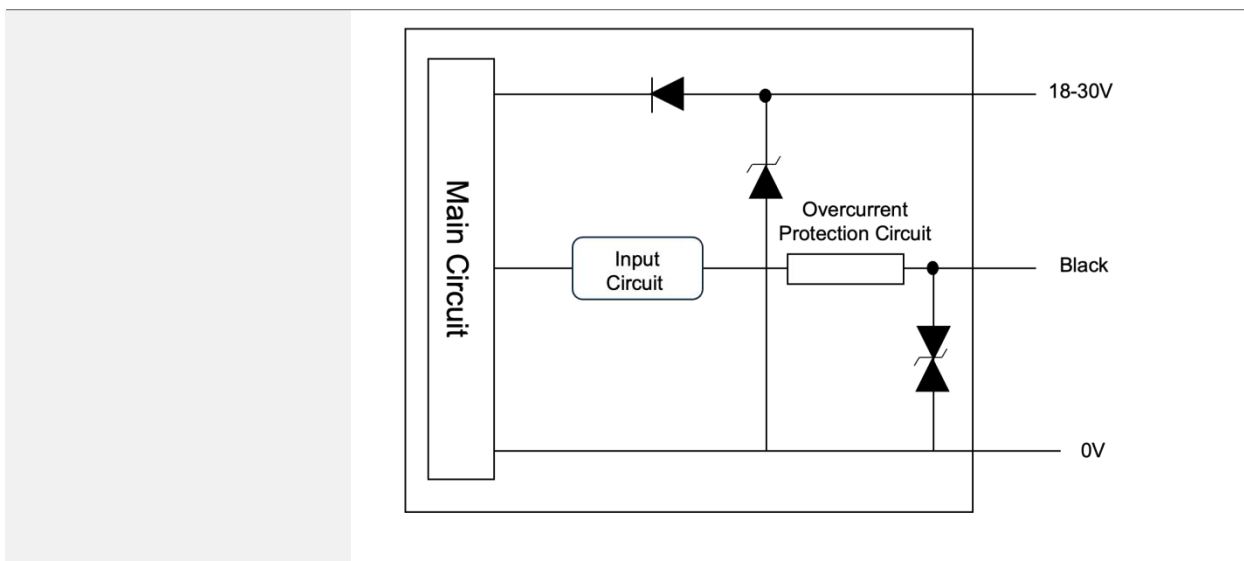
When using "number of pulses per 1 mL" setting, the upper limit is:

$$\frac{10000}{Flow_{max}/60}$$

Where $Flow_{max}$ is the maximum flow rate in mL/min.

Note: Due to display digit limitations, parameters beyond the display range are recommended to be set via host computer software.

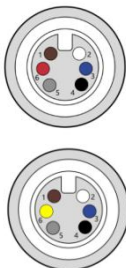
	PNP (default)  NPN (optional) 
Digital Input	Configurable for zero-point calibration, volume zeroing, start filling, etc. Grounding time must be greater than 20ms.



2.5 Electrical Specifications and Connections

Electrical Parameters	Detailed Specifications
Operating Voltage	18-30VDC
Current Consumption	24V power supply, current consumption <30mA without external load; With external load, current consumption >30mA, but cannot exceed 100mA.
Electrical Connections	6-Core Cable (Flying leads at the End)

Cable Color and Function Assignment

Male connector (cable)	Core	Color	Function
	1	Brown	Voltage Input (18-30VDC)
	2	White	OUT2: Current Output / Pulse Output / DO Alarm (NPN/PNP)
	3	Blue	Ground (GND)
	4	Black	OUT1: Pulse Output / DO Alarm (NPN/PNP) / DI (Clear Accumulated Volume, Zero Calibration, Start Filling)
	5	Gray	RS485A
	6	Red/Yellow	RS485B

2.6 General Parameters

General Parameters	Detailed Specifications
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Measurement Principle	Ultrasonic transit-time method
Measurable Liquids	Water, chemical solutions, oil, glue, grinding fluid, etc. (excluding large solid particles and air bubbles)
Calibration	Manufacturer default calibration: 22°C±3°C (water)
Sensor Housing	Stainless Steel / PPS Plastic
Liquid Temperature	0°C - 70°C
Ambient Temperature	0°C - 60°C
Storage Temperature	-20°C - 70°C
Operating Humidity	10% - 90% RH (Non-condensing)
Protection Rating	IP65

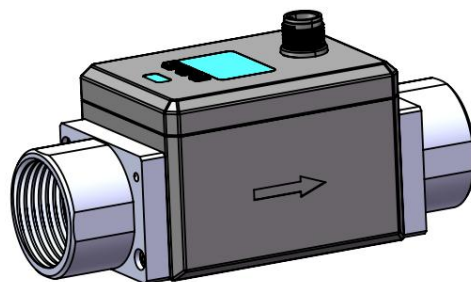
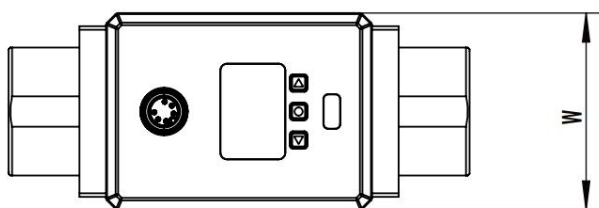
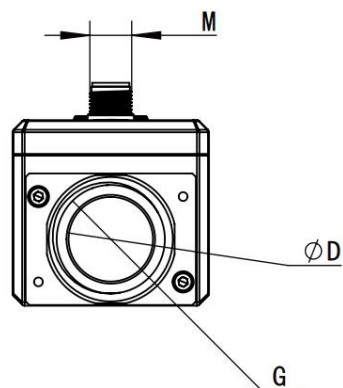
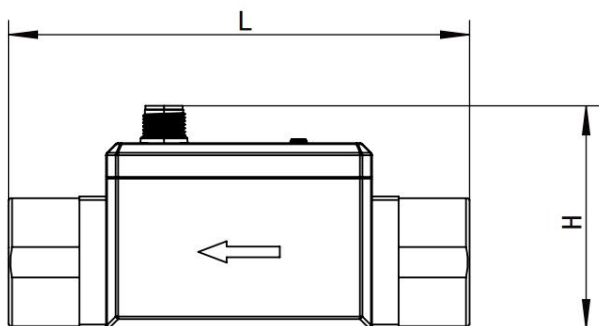
2.7 Scope of Supply and Accessories

Name	Detailed Specifications
Scope of Supply	TPD Series Flow Sensor
	User Manual
	Factory Calibration Report
Required Accessories	6-core Shielded Cable (Standard Length 2m, Optional 5m)
Optional Accessories	USB Data Converter (for connecting the sensor to the computer)
	Flow Viewer Flow Monitoring Software
	USB 2.0 Cable (Connecting USB Data Converter to the computer)

2.8 Sensor Dimensions

Model	L*W*H (mm)	G Thread	Flow Passage Diameter d	Electrical Connection (M)
TPD004M1	107*42*50	G 1/4	Ø4	M12 x 1
TPD008M1	112*42*50	G 3/8	Ø8	M12 x 1
TPD012M1	112*42*50	G 1/2	Ø12	M12 x 1
TPD015M1	130*45*62	G 3/4	Ø15	M12 x 1

TPD020M1	130*50*62	G 1	Ø20	M12 x 1
TPD025M1	130*55*63	G 1	Ø25	M12 x 1
TPD032M1	130*62*70	G 1 1/4	Ø32	M12 x 1



3. SAFETY PRECAUTIONS

Please read this user manual carefully before using the flow sensor and accessories

- Upon initial unpacking, please check that the equipment is complete and undamaged, and store it properly
- Installation and subsequent operation must ensure that all environmental conditions meet the requirements in "4. Technical Specifications" of this manual
- If the flow sensor is not connected correctly as required, the user shall bear the relevant risks
- To prevent breakage or damage, do not drop the flow sensor, which may affect the measurement accuracy

3.1 Operators

Operators should meet the following conditions and strictly abide by the relevant regulations:

- (1) Qualified personnel who have been trained
- (2) Technicians authorized by the factory
- (3) Familiar with and understand the relevant operating procedures and documents

3.2 Applications

(1) XY-TEK TPD in-line flow sensor is only used for liquid flow rate measurement.

(2) The USB data converter is used for communication between the flow sensor and the computer.

The Flow Viewer software can help users adjust the flow sensor parameters to suit specific applications and troubleshooting.

(3) It is forbidden to use the flow sensor and data converter in situations unrelated to the above purposes, otherwise it may cause damage to the equipment.

3.3 Workplace Conditions

Before using the flow sensor, ensure that:

- (1) The temperature and pressure conditions meet the sensor's operating conditions
- (2) The equipment is installed correctly and securely

The flow sensor is not suitable for the following situations:

- (1) Gas flow measurement
- (2) Explosive liquid flow measurement
- (3) Outdoor environment
- (4) Metering control equipment used for billing

3.4 Product Safety

The flow sensors, XY-TEK Flow Viewer flow monitoring software, USB data converters and other accessories provided by XY-TEK all comply with applicable safety regulations. Users should ensure that the above devices are installed and operated in a safe manner. All devices have undergone rigorous testing before leaving the factory to ensure safe use.

Note:

- Only users who have read and fully understood this user manual may modify the flow sensor parameters
- Before modifying the parameters, please be sure to back up the original configuration of the flow sensor
- It is strictly forbidden to disassemble the internal structure of the flow sensor or USB data converter without authorization;
- It is necessary to ensure that the flow sensor and USB data converter are protected from the humid environment.

4. FLOW SENSOR USE

4.1 Flow Sensor Wiring Connection

The flow sensor cable connection usually has the following two situations:

(1) The flow sensor needs to be connected to the data acquisition device or PLC and powered by a separate power supply

- Power off
- Ground the blue wire of the sensor cable and connect the brown wire to 12-30VDC (refer to “4.5 Electrical Specifications and Connections”).
- Connect other necessary output/input wires to the data acquisition device or PLC (refer to “4.5 Electrical Specifications and Connections”).
- Power on
- **Unused exposed wires should be cut off to avoid short circuits**  Attention

(2) Connect the flow sensor to the computer via a USB data converter

- Connect the flow sensor to the USB data converter
- Connect the USB data converter to the computer, which powers both the USB data converter and the sensor
- If necessary, connect the USB data converter to an external controller (such as a data acquisition device or PLC)

Precautions



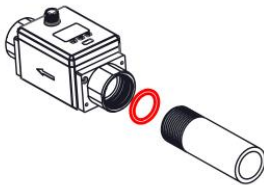
- Ensure the connector used is compatible with the measurement system
- Ensure the flow sensor connector is dry when powering on
- Avoid damaging the pipeline system when installing the flow sensor
- Check the plug and pins for damage before connection
- Do not use if any part of the sensor is damaged

4.2 Flow Sensor Installation

When integrating TPD series flow sensors into a liquid system, the following should be noted:

- Ensure that the tubing adapter used corresponds to the size of the TPD series flow sensor.
- Air in the tubing can cause measurement errors or interrupt ultrasonic coupling.
- Ensure there is no dirt or residue in the flow path.
- If necessary, clean the TPD series in-line flow sensor before connecting the adapter to the tubing.

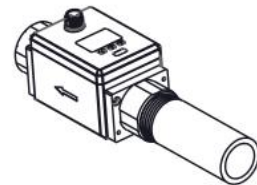
Step1: Insert the O-ring into the sensor flange groove.



Step2: Tighten the matching steel pipe clockwise until the O-ring is compressed.



Step3: Repeat for the opposite end of the sensor.



4.3 Flow Sensor Operation

- Ensure the tube is filled with the liquid to be measured when starting the measurement
- Ensure there are no air bubbles in the flow path and connect the sensor power
- After powering on, the sensor will immediately begin flow measurement and output data.

Before starting flow measurement:



- (1) Before each measurement, check the cable, connector, and pins for breakage or damage. If any damage is found, stop using the flow sensor immediately and contact after-sales service
- (2) Ensure the liquid temperature is consistent with the flow sensor's factory calibration temperature.

4.4 Zero Point Calibration

Ensure the flow sensor is correctly connected to the liquid tubing and that the tubing is filled with liquid without air bubbles. Completely stop the liquid flow and perform zero-point calibration using the following method:

- Connect the flow sensor to the PLC device and send a command via 485 to start zero-point calibration.
- Connect the flow sensor to the USB data converter and start zero-point calibration using the XY-TEK Flow Viewer flow monitoring software.
- Start zero-point calibration via the screen buttons.

4.5 Flow Sensor Adjustment and Calibration

To ensure measurement accuracy meets customer requirements, all flow sensors are set according to the application requirements provided by the customer before leaving the factory. In addition to factory calibration service, users can also perform calibration operations on-site. For detailed calibration procedures or technical support, please contact the XY-TEK after-sales service team at info@xy-tek.cn

4.6 Factors Affecting Measurement Accuracy

(1) Temperature

Temperature fluctuations affect how sound travels through fluids, it is necessary to ensure the flow sensor operates at the same temperature it was calibrated at. Keep the liquid temperature within $\pm 5^{\circ}\text{C}$ ($\pm 9^{\circ}\text{F}$) of the calibration temperature. If the temperature difference exceeds this range, it is recommend to re-calibrate the flow sensor and updating its correction factors to maintain accuracy.

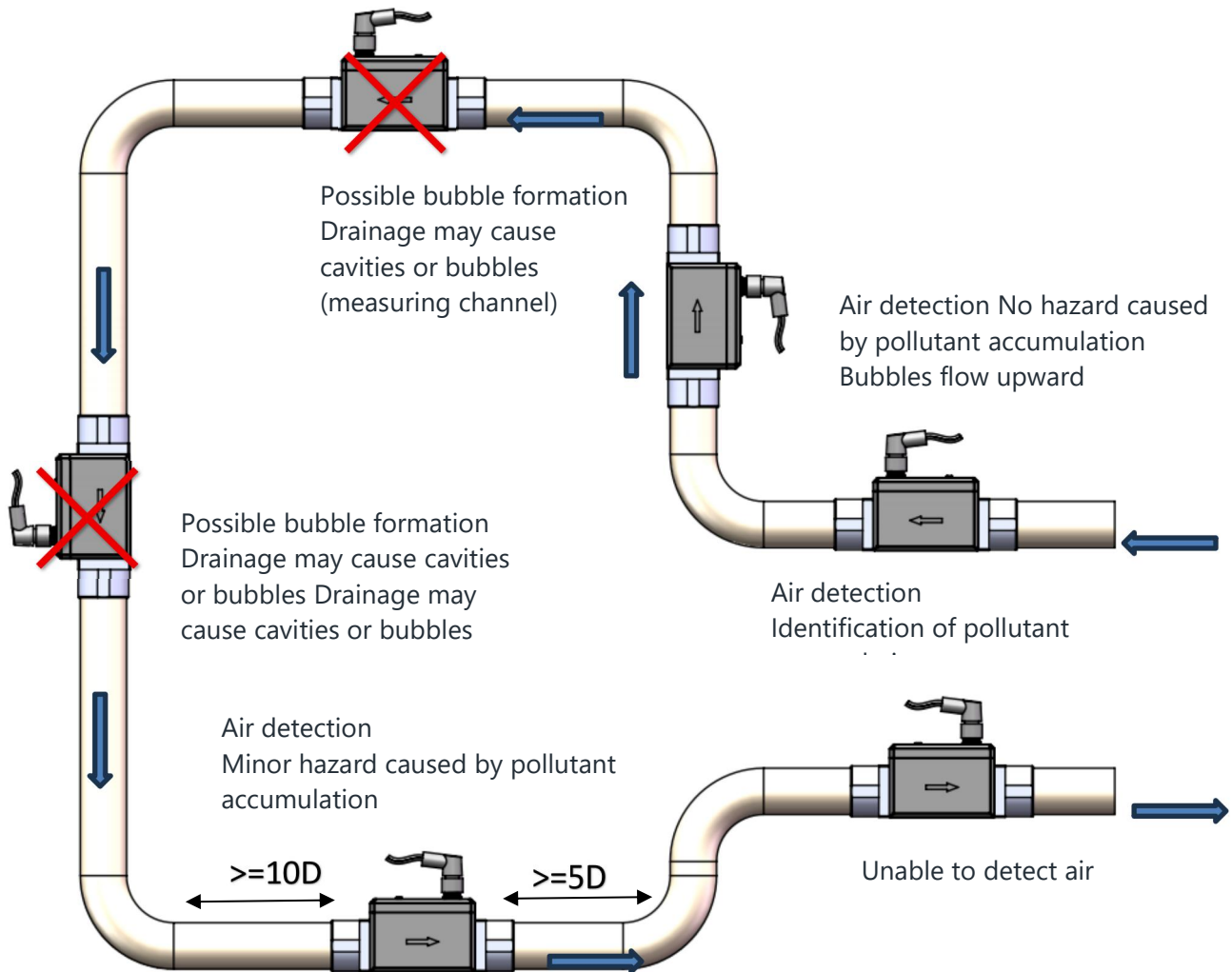
(2) Liquid Type

The flow sensor is factory calibrated using water at $22^{\circ}\text{C} \pm 3^{\circ}\text{C}$ by default. The measurement accuracy can be affected by dissolved substances, air bubbles, or solid particles in the fluid.

(3) Installation Location

To ensure the best flow rate measurement accuracy, the flow sensor should be installed on a straight section of pipeline. Sharp bends or sudden direction changes can disrupt the fluid flow pattern, increasing measurement uncertainty. It is recommend to maintain a straight tubing section at least 10 times the tubing inner diameter before the sensor, and at least 5 times the tubing inner diameter after the sensor.

In fluid filling systems with flow control valves, avoid installing the flow sensor downstream of valves. The pipe section after a valve may run empty between batches, causing the flow sensor to miss measuring part of the flow during the next filling cycle. Instead, install the flow sensor on the positive pressure side created by the fluid pump, or in a location where the tubing remains completely filled with liquid at all times. This prevents air bubbles from interfering with flow rate measurements and ensures consistent, reliable performance.



Sensor inlet direction: straight pipe length must be greater than 10 times the nominal diameter of the sensor

Sensor outlet direction: straight pipe length must be greater than 5 times the nominal diameter of the sensor

4.6 Flow Sensor Cleaning

When cleaning the sensor, ensure that the cleaning agent does not leak into the connector.

It is recommended to use a mild cleaner and cotton swabs to gently wipe the dirt from the clamping area.

Precautions: Attention

- The flow sensor must not be immersed in cleaning or disinfection solutions.
- The flow sensor is not suitable for mechanical cleaning methods.
- The flow sensor must not be subjected to sterilization processes, especially steam sterilization or autoclaving.

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The contents described in this manual are subject to change without notice

2. APPENDIX: UPDATE LOG

Date	Modification Operation	Personnel	Version
2026/01/30	Initial Setup	HY.C	V1.0
2026/05/09	Added 5 new models	HY.C	V1.1