

# PCWL Series Turbine Flow Meter

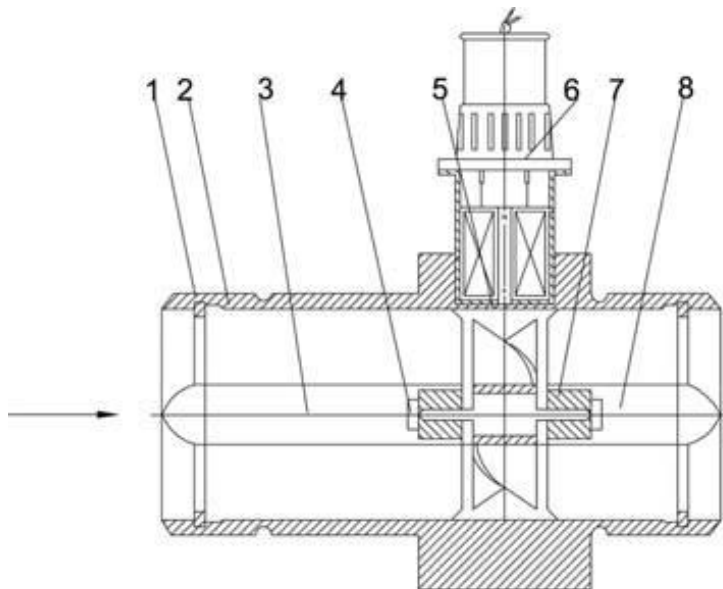
## Introduction

TUF is the main kind of impeller flow meters which also include anemometer, water meter and so on. It consists of sensor and converter. The converter feels the average flow of the liquid by rotor blades and deduces the flow rate or total flow. The rotor speed can be detected by machinery, induction and photoelectricity, then displayed and transmitted the record by readout station. It is said that Americans have published the first patent of TUF and the patent in 1914 shows that the flow of TUF is related to frequency. The first TUF was developed in 1938 and was used to measure the flow of fuel oil on the plane. It was not really used in industrial area until World War II due to the badly demand of high precision and fast response flow meter used in jet engines and liquid jet fuel. Now, it has widely been used in many departments of petroleum, chemical industries, scientific research, defense and measuring.

Among flow meters, TUF, Volumetric flow meters and Ke Type Quality Flow meters are the products with excellent repeatability and precision. At the same time TUF has its distinguished features, such as simple structure, light weight, less processing parts, convenient maintenance, high circulation ability, adaptability of high parameters and so on when compared with other two kinds of flow meters.

PCWL series turbine flow meter is a new generation kind of flow meter that absorbed the advanced technologies of flow meter at home and abroad, been optimized designed to have so many characteristics, such as simple structure, light weight, high precision, good reiteration, sensitive reaction, easy installation and using. It is widely used in the sealed pipelines which doesn't have corrosion function on SS 1Cr18Ni9Ti, 2Cr13, corundum  $Al_2O_3$ , and cemented carbide and have no fiber, particle and so on, the liquid with viscosity less than  $5 \times 10^{-6} m^2/s$  under working temperature, if the viscosity of the liquid is more than  $5 \times 10^{-6} m^2/s$ , then the flow meter can be used after calibration. If it is equipped with other display devices with special functions, it can also do quantity control, excessive alarm and so on. It is really perfect in flow measurement and energy saving.

## Working principle



1-Fastener ; 2-Housing; 3-Forward guide parts ; 4-Thrust washer ; 5-Impeller  
6-Magnetic induction signal detector ; 7-Bearing; 8-Rear guide parts

Pic1

The picture is the structure of TUF sensor, from which shows that the impeller rotates under the pressure of liquid when measuring liquid flow through the sensor. The speed is proportional to the average flow velocity in pipelines and the periodical moving of impellers change the magnetic resistance of magnetolectricity converter. Then the magnetic flux in detecting coil changes periodically, producing electromotive force or electrical impulse signal which is amplified by amplifier and sent to display.

The flow equation of TUF can be divided into two kinds, practical flow equation and theoretical equation. Practical Flow Equation

$$q_v = f/K \quad \text{Formula 1}$$

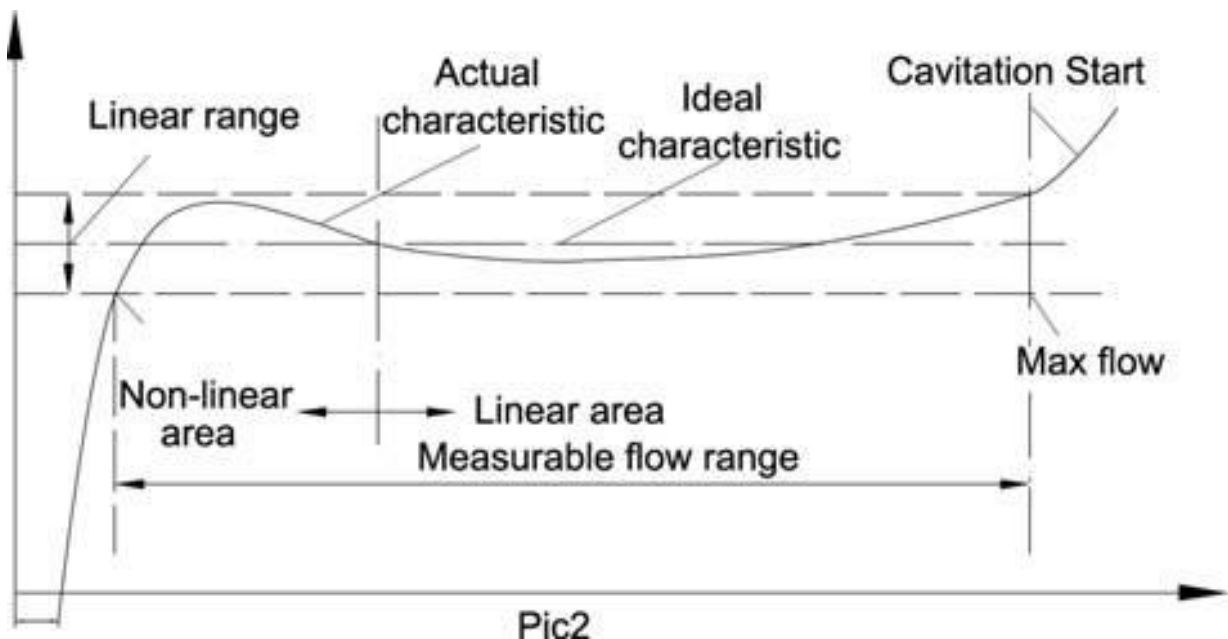
$$q_m = q_v \rho \quad \text{Formula 1}$$

$q_v, q_m$ -----Volume Flow, m<sup>3</sup>/s, Mass Flow, kg/s;

$f$ -----The output frequency of flow meter, Hz;

$K$ -----Meter factor, P/m<sup>3</sup>

The relation curves between meter factor and flow rate (or pipeline Reynolds no.) are as picture 2. From it, meter factor can be divided into two periods, linear period and nonlinear period. The linear period occupies 2/3 of working period, and its characteristics have relations with the structure dimension of sensor and fluid viscosity. In nonlinear period, the fluid viscosity resistance influences much under friction. The meter factor changes quickly with flow rate when it under the minimum flow of the sensor. Pressure loss and flow rate can be approximately looked as square relationships. When the flow rate exceeds the maximum flow, cavitation should be avoided. The similar structure TUF characteristic curves have the similar shape, and it is only different in the system error level.



The meter factor of sensor gets from flow calibration device. It ignores the principle of sensor internal fluid, seeing sensor as a black clincher and confirm the conversion coefficient according to input flow and output frequency pulse signal, so that it can be used in practice. But attention, the transfer coefficient (meter factor) has conditions that the calibration conditions is for reference, if deviated from this.

## Product features

1. High accuracy, usually reach  $\pm 1\%R$ 、 $\pm 5\%R$ , or even reach  $\pm 0.2\%R$  for high-precision type;
2. Good repeatability, can reach 0.05%-0.2% in short term, if regular calibration or online calibration can get an extremely high accuracy, so it is preferred in trade;
3. Pulse signal output, suitable for total flow measurement and computer connection, no zero drift, strong anti-jamming capability;
4. High frequency signal (3-4kHz), strong signal resolution;
5. Wide range, middle and big diameter can reach 1:20, and small diameter can reach 1:10;
6. Compact structure, easy installation and maintenance, strong flow capacity;

## Basic parameters and technical performance

### 1. Technical performance

<b>Diameter and connection</b>	4, 6, 10, 15, 20, 25, 32, 40 Thread connection
	(15, 20, 25, 32, 40) 50, 65, 80, 100, 125, 150, 200 Flange connection
<b>Accuracy</b>	$\pm 1\%R$ , $\pm 0.5\%R$ , $\pm 0.2\%R$ (Special order)
<b>Turndown ratio</b>	1:10; 1:15; 1:20
<b>Material</b>	SS304, SS316 (L) etc.
<b>Medium temperature</b>	-20~+110℃
<b>Environmental conditions</b>	Temperature -10~+55
	Relative humidity 5%~90%
	Atmospheric pressure: 86~106kPa
<b>Output signal</b>	Sensor: Pulse frequency signal, Low level $\leq 0.8V$ High level $\geq 8V$
	Transmitter: Two wire 4~20mADC Current signal
<b>Power supply</b>	Sensor: +12VDC, +24VDC (Optional)
	Transmitter: +24VDC
	Local display: 3.2V with 3.2V Lithium battery
<b>Signal wire</b>	STVPV3×0.3 (Three wire), 2×0.3 (Two wire)
<b>Transmission distance</b>	$\leq 1000m$
<b>Signal cable connection</b>	Hirschmann connector, Explosive type: Inner thread M20×1.5
<b>Explosive-proof</b>	Basic type: Non-explosive proof
	Explosive proof: Exd II BT6
<b>Protection level</b>	IP65

## 2. Measurement range and working pressure

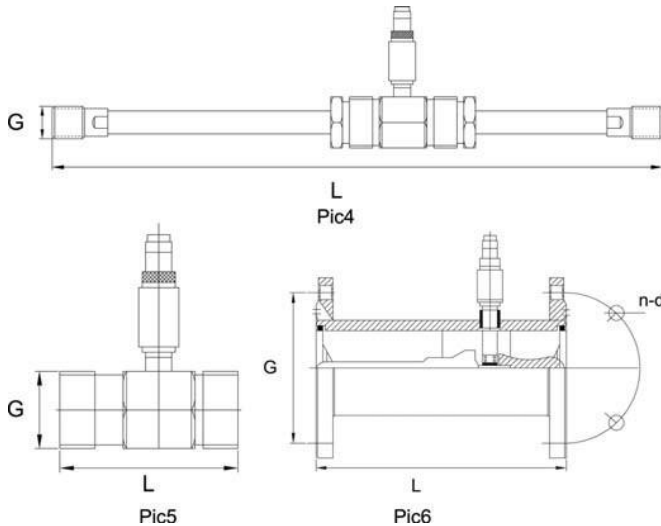
Diameter (mm)	Normal flow range (m <sup>3</sup> /h)	Extended flow range (m <sup>3</sup> /h)	Normal pressure (MPa)	Pressure rating (MPa) (Flange connection)
DN 4	0.04 ~ 0.25	0.04 ~ 0.4	6.3	12, 16, 25
DN 6	0.1 ~ 0.6	0.06 ~ 0.6	6.3	12, 16, 25
DN 10	0.2 ~ 1.2	0.15 ~ 1.5	6.3	12, 16, 25
DN 15	0.6 ~ 6	0.4 ~ 8	6.3, 2.5 (Flange)	4.0, 6.3, 12, 16, 25
DN 20	0.8 ~ 8	0.45 ~ 9	6.3, 2.5 (Flange)	4.0, 6.3, 12, 16, 25
DN 25	1 ~ 10	0.5 ~ 10	6.3, 2.5 (Flange)	4.0, 6.3, 12, 16, 25
DN 32	1.5 ~ 15	0.8 ~ 15	6.3, 2.5 (Flange)	4.0, 6.3, 12, 16, 25
DN 40	2 ~ 20	1 ~ 20	6.3, 2.5 (Flange)	4.0, 6.3, 12, 16, 25
DN 50	4 ~ 40	2 ~ 40	2.5	4.0, 6.3, 12, 16, 25
DN 65	7 ~ 70	4 ~ 70	2.5	4.0, 6.3, 12, 16, 25
DN 80	10 ~ 100	5 ~ 100	2.5	4.0, 6.3, 12, 16, 25
DN 100	20 ~ 200	10 ~ 200	1.6	4.0, 6.3, 12, 16, 25
DN 125	25 ~ 250	13 ~ 250	1.6	2.5, 4.0, 6.3, 12, 16
DN 150	30 ~ 300	15 ~ 300	1.6	2.5, 4.0, 6.3, 12, 16
DN 200	80 ~ 800	40 ~ 800	1.6	2.5, 4.0, 6.3, 12, 16



Pic3

## Installation size

According to the diameter, using thread or flange connections to install the sensor. Please see Pic4, Pic5 and Pic6 for the installation method, and please see the table for the installation size.



Diameter (mm)	L (mm)	G	D (mm)	d (mm)	孔数
4	295	G1/2			
6	330	G1/2			
10	450	G1/2			
15	75	G1	Ø65	Ø14	4
20	80	G1	Ø75	Ø14	4
25	100	G5/4	Ø85	Ø14	4
32	140	G2	Ø100	Ø14	4
40	140	G2	Ø110	Ø18	4
50	150		Ø125	Ø18	4
65	170		Ø145	Ø18	4
80	200		Ø160	Ø18	8
100	220		Ø180	Ø18	8
125	250		Ø210	Ø25	8
150	300		Ø250	Ø25	8
200	360		Ø295	Ø23	12

Pic4 PCWL-4~10 Structure and install dimension diagram

Pic5 PCWL-15~40 Structure and install dimension diagram

Pic6 PCWL-50~200 Structure and install dimension diagram

## Installation precaution

### 1. Installation location

In order to ensure the accurate measurement of the turbine flow meter, you must choose correct installation location and methods.

- **Requirement of the strait pipe:**

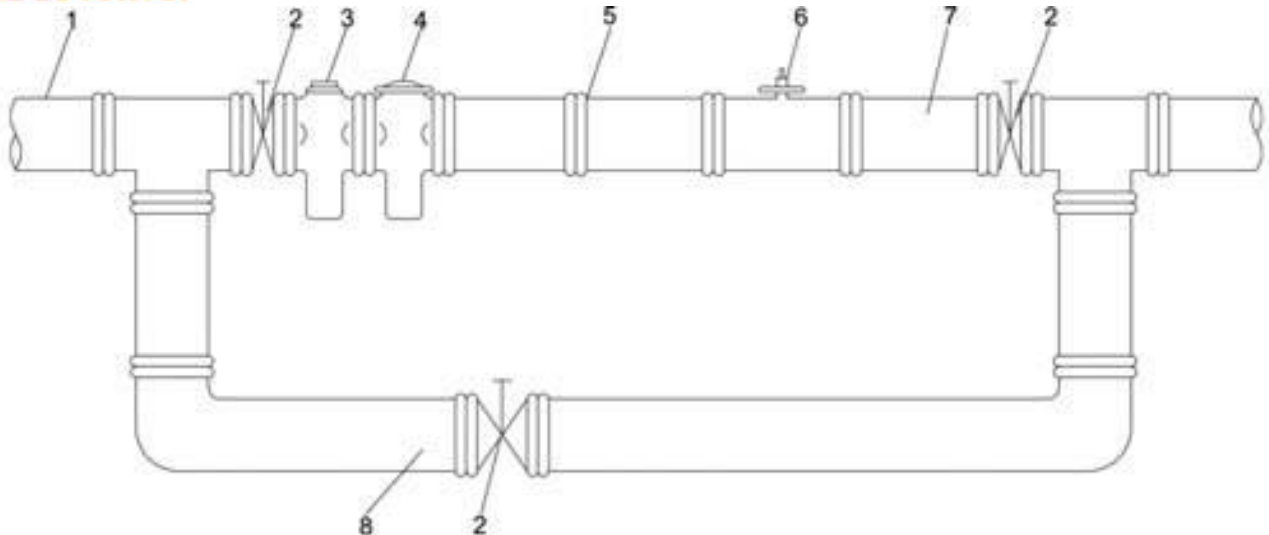
The flow meter must be installed in the horizontal pipe (pipe inclination within 5%), the flow meter axis should be concentric with the pipe axis, and the flow direction must be the same. Flow meter upstream pipe length must be more than 2D of straight pipe diameter. If the installation site is allowed, we recommend the upstream straight pipe 20D, downstream is 5D.

- **Piping requirements:**

The inner diameter of the upstream and downstream piping must be the same with flow meter inner diameter at the flow meter installation place.

- **Bypass pipe requirements:**

In order to guarantee that the maintenance does not affect the normal use of the medium, shut-off valve (globe valve) should be installed in front and rear of the flow meter pipe, and the bypass pipe should be setup at the same time. The flow control valve should be installed in the downstream of the meter, during the work status, all the upstream shut-off valves must be fully open, to avoid portion of fluid in upstream produce unsteady flow phenomena. (Please see Pic7)



1 - entrance; 2 - valve; 3 - filter; 4 - cool down; 5 - upstream straight pipe ;  
6 - sensor; 7 - downstream pipe section; 8 - bypass

Pic7

Upstream Baffles type	Single Elbow	Two 90°elbow at same plane	Two 90°elbow at different plane	Concentric tapered tube	Fully open valve	Half open valve	Downstream side length
L/DN	20	25	40	15	20	50	5

● **The external environment requirements:**

The flow meter is better to be installed indoor. If it must be installed outdoors, it must be adopt sunscreen, rain and lightning protection measures, to avoid affect the service life.

● **Medium containing impurities requirements:**

In order to ensure the life of the flow meter, the filter should be installed in front of the flow meter straight pipe.

● **Installation place:**

The flow meter should be installed in place of easily for maintenance, without strong electromagnetic interference and thermal radiation.

● **Installation welding requirements:**

Matched flange should be welded to the front and rear pipe. Welding with flow meter is not allowed! The pipeline welding slag and other dirt should be strictly cleared before installing the flow meter. Preferably with a diameter pipes (or bypass tube) in place of the flow meter to purge the pipeline, to ensure that the flow meter will be from damage during use. When the flow meter is installed, the gasket between the flanges can not be recessed in pipe.

● **Grounding requirements:**

The flow meter should be grounded, to share the strong power system grounding wire is not allowed.

● **Requirements for explosion-proof products:**

To ensure the instrument use normally, you should review environment of the use of explosion-proof meter consistent with the explosion-proof requirements, and the installation process should strictly comply with the requirements of the national explosion-proof products, the user should not change the explosion-proof system connections, and are not allowed to open the meter. Selection within the specified range of flow rates to prevent over speed, to obtain the desired accuracy and to ensure normal service life. The debris, welding slag, rocks, dust, etc. should be cleaned before installing the flow meter;



recommend to install an 5-micron mesh filter in upstream to block the droplet and the sand. When flow meter in operation should open the front valve slowly and then open the rear valve, to prevent the instantaneous impact of air to the detriment of the turbine. Adding lubrication oil should follow the instruction, and the refueling times depend on the medium cleanliness, usually 2-3 times a year. Because of the pressure test, purge pipe or exhaust, the turbine flow meter overdrive, and reverse flow may cause damage to the flow meter. During the operation, to open the front and back cover or change the parameters is not allowed, otherwise it will affect the normal operation of the flow meter. Install the gasket carefully to ensure that there is no protrusion into the pipe, to prevent interference of the normal flow measurement. Collect the pressure from the pressure tapping when calibrating the flow meter.

● **Places that should not use the turbine flow meter:**

Fluid containing impurities, such as circulating cooling water, river water, sewage water fuel; flow changes rapidly, such as boiler water systems, air hammer gas supply system; When measuring liquid, pipeline pressure is low, but the flow is very heavy; the instrument downstream pressure may be close to the saturated vapor pressure, the risk of cavitation, such as liquid ammonia from the high slot by potential is outflow freely, the meter should not be installed at the outfall; Welding machines, motors, relay with contacts nearby, those places have exist serious electromagnetic interference; shortage of upstream and downstream straight pipe length, such as a ship's cabin; boiler water supply system, such as frequently pump start and pump stop, to impact of the impeller, the sensor will quickly damage; corrosive or abrasive medium selection should be cautious, better contact and consult the manufacturer.

## **Usage precaution**

### **1. Start and close procedure**

Without bypass pipe flow sensor installation: firstly in moderate opening to open the upstream valve of the flow sensor, and then slowly open the downstream valve. Run a period of time (e.g. 10 minutes) with a smaller flow rate, then fully open the upstream valve, then open downstream valve in the large opening, adjusted to the desired normal flow.

The sensor equipped with bypass pipe, first fully open by-pass pipe valve, in moderate opening to open the upstream valve, slowly open the downstream valve, shut down bypass valve in small opening degree, the instrument is running for some time. Then fully open the upstream valve, shut off the bypass valve fully (to ensure no leakage), and finally adjust the downstream valve opening to desired flow rate.

### **2. Fluid with low and high temperature enabled**

The pipeline must drain the moisture before the cryogenic fluid is in operated. It must be run for 15 minutes through a small flow rate, and then increased gradually to normal flow. Stopped-flow should move slowly. To make sure the temperature of the pipe is close to ambient temperature. The operation of the high temperature fluid is similar.

### **3. Other precaution**

Open and close the valve should be as gentle as possible, If the opening and closing is automatically, it is best to use the "two-stage open, two-stage to close" to prevent fluid sudden impact impeller or even water hammer damage to the impeller.

Check the flow sensor downstream pressure. When the pressure of the pipe is not high, observe downstream pressure of the sensor under maximum flow in the early stage during the operation, otherwise it should take measures to prevent cavitation.

The sensor's factor is calibrated through the standard device. Due to the long term use, bearing wear and other reasons will change the meter factor, should be regularly offline or online check, if the flow is out of the allowable range, the sensor should be replaced.



To some measurement medium, such as refined oil pipeline, to replace the oil or disable, the need to regularly sweep line pigging. The sweep line pigging fluid flow direction, flow, pressure and temperature should be comply with the provisions of the turbine flow meter, otherwise it will reduce accuracy even damage.

To ensure the flow meter will work in long-term, to strengthen the check of the instrument's running, once found the abnormal, take measures to exclude it timely. To monitor the impeller rotation, such as hear unusual sounds, monitoring and detection coil output waveform by oscilloscope, if there is abnormal waveform, should be removed the meter and check the sensor's internal parts promptly. If there is an unusual occurrence, should check the meter immediately. Keep the filter clean, the block of the filter should be determined by calculating the inlet and outlet of the differential pressure. Exhaust the gas which is escape from the liquid regularly.

### **Storage and transportation**

The sensors should be packed in wooden box (small-caliber instrument is available use cartons), freely jump in the box are not allowed. Handle with care when transporting, does not allow rough handling. Storage sites shall comply with the following conditions:

- 1 Protect from rain and moisture
2. Do not subject to mechanical vibration or conflict
3. Temperature range -20 °C to +55 °C
4. Relative humidity is less than 80%
5. Environment without corrosive gases

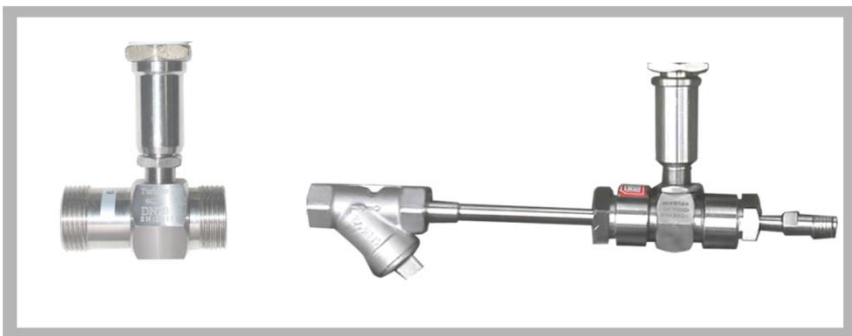
### **Unpacking precautions**

After unpacking, check the packing list files and attachments are complete. Manual 1 set, copy of the inspection certificate 1set, 1 set of packing list. In order to properly handle, please observed the sensor, is there any damages arising during the transportation. Hope that the users can keep a "certificate of authenticity", and do not lose it, otherwise it is impossible to reset the meter factor.

### **Order information**

Before to order the right turbine flow meter, the user should notice the pipe diameter, working pressure, working temperature, flow range, medium type and environment too choose suitable specification. If here is explosive-proof, please pay attention to the explosive-proof level.

Note: If you have special request, you can put it forward when you take delivery of the gauges. For the related meter, please refers to relevant information or consult with our technical team for support. If you need cable for transferring the signal, please specify the type and the length.





## Troubles and shooting

<p>No display when the fluid flow normally, total counter words numbers are not increase</p>	<ol style="list-style-type: none"> <li>1. Check the power supply cable, fuse, functional switch and signal wire, is there any open circuit or poor contact.</li> <li>2. Check the printed board inside the meter, connectors is contact or not.</li> <li>3. Check the inspecting coil</li> <li>4. Check the sensor internal fault, above 1) to 3) check confirmed normal or exclude fault, but the fault still there, it is in the sensor's flow channel, check the impeller whether touch sensor's inner wall, any stuck, axis and bearing have any stuck or broken.</li> </ol>	<ol style="list-style-type: none"> <li>1. Exclude fault by Ohmmeter</li> <li>2. Replace the printed board by the new one, then check the fault board carefully.</li> <li>3. Mark the coil's location on the sensor's body, unscrew the testing head, using an iron tablet below the testing head to make it move fastly, if the counter's number is not increase, then should check the coil whether disconnect or weld desoldering.</li> <li>4. Remove foreign parts, clean or replace the damaged parts, blowing or hand toggle the impeller, should be no friction sound. After replacing the bearings and other parts should be recalibrated, and get a new meter factor.</li> </ol>
<p>Without reducing the flow operation, but the flow was gradually decreased</p>	<p>Check the fault in following order:</p> <ol style="list-style-type: none"> <li>1. Filter is blocked, if the filter differential pressure is increases, the debris has been blocked</li> <li>2. The valve on the flow sensor tube loose, and the valve opening automatically reduces.</li> <li>3. The impeller is disturbed by the debris or there is foreign stuff stuck the bearing clearance, resistance is increased and slow deceleration</li> </ol>	<ol style="list-style-type: none"> <li>1. Clean the filter</li> <li>2. From the valve handwheel adjustment is effective or not, to confirm repair or replace.</li> <li>3. Remove the sensor and clean it, re-calibrate the meter if necessary</li> </ol>
<p>Fluid is not move, flow display is zero or unstable display value</p>	<ol style="list-style-type: none"> <li>1. Transmission line shielded is poorly ground, outside interference signal is mixed input of instrument.</li> <li>2. The pipe is vibrate, the impeller is vibrate with the pipe, generate the wrong signal.</li> <li>3. The shut-off valve is not closed enough, there is a leak, in fact the meter shows the leakage volume.</li> <li>4. The internal circuit board of the display device or the deterioration of electronic components damaged, generated the interference.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the shield, the terminals are well grounded</li> <li>2. Reinforcement the pipelines, or equipped with bracket in front and rear of the sensor to prevent vibration</li> <li>3. Repair or replace the valve</li> <li>4. To take "short-circuit" or step-by-step examination, to determine the source of interference, and find the fault reason.</li> </ol>
<p>The display values are different from experience value</p>	<ol style="list-style-type: none"> <li>1. Sensor's internal faults, such as by fluid corrosion, wear serious, debris hindered make the impeller rotation disorders, meter factor changes, the blade was corroded or shock, top deformation, affecting the normal magnetic field lines cut, the output signal of the detection coil disorders, meter factor changes; fluid temperature is too high or too low, shaft and bearing expansion or contraction, gap is too large to change the impeller rotation unusal, and change the meter's factor.</li> <li>2. Sensor is insufficient pressure, appear cavitation, affect the rotation of the impeller</li> <li>3. Pipeline flow reasons, it is not equipped with a check valve, reverse flow, bypass valve is not locked, there is a leak upstream from the sensor to a larger flow rate distribution distortion (such as caused by upstream valve is fully opened) or the viscosity of pulsating liquid changes caused by temperature changes. Etc.</li> <li>4. Internal fault</li> <li>5. The permanent magnet materials lose the magnetic field, magnetic weakened to a certain extent also affect the measured value.</li> <li>6. The actual flow rate exceeds the rated flow range.</li> </ol>	<ol style="list-style-type: none"> <li>1. ~ 4) Find out the cause of the failure, and according to the reason find the settlement.</li> <li>5. The reason for replace of excitation failure</li> <li>6. Replace the appropriate sensor</li> </ol>

## Order table

Model								Explanation	
PCWL-	□	/□	/□	/□	/□	/□	/□		
Diameter	4							4mm	
	6							6mm	
	10							10mm	
	...							.....	
	50							50mm	
	...							.....	
	200							200mm	
Type	N	Basic, +12V Power supply, Pulse output, High level $\geq 8V$ Low level $\leq 0.8V$							
	A	4~20mA 2 wire current output, Remote transmitter							
	B	Battery operated Local display							
	C	Local display/4~20mA 2 wire current output							
	C1	Local display/RS485 Communication protocol							
	C2	Local display/HART Communication protocol							
Accuracy	05	0.5 Grade							
	10	1.0 Grade							
Turbine type	W	Extended range							
	S	Standard							
Material	S	SS304							
	I	SS316(L)							
Explosion-proof		No marks, None explosion type							
	E	Explosion type (Exm II CT6 or Exd II BT6)							
Pressure rating	N	Regular	Please refer to measuring range and working pressure table						
	H(X)	High pressure							

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## Contact us

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