

Manufacturing Certificate
CMC Shanghai No.02220105

Instruction Manual

TYPE LWGY

Turbine Flow Sensor



SHANGHAI NO.9 AUTOMATION INSTRUMENTATION CO., LTD.

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Read This Manual Carefully Before Installation & Operation

Please well keep the Quality Certificate that also provides Flow Coefficient and Accuracy of the Flow Sensor

1. General Description

This manual is applicable for installation, application and maintenance of Type LWGY Turbine Flow Sensor designed and made by SAIC No.9.

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The company reserves the rights to the explanation and modification of this manual, which is subject to change without prior notice

LWGY Turbine Flow Sensor (hereinafter refers to as Flow Sensor) is a certain kind of flow rate measuring instrument, it is used to measure volumetric flow of liquid which is fully and continuously passing through enclosed pipelines. The flow sensor outputs the pulse signal that is proportional to the passing fluid volume, being combined with other flow calculating meters it can be used in instant flow, total flow measurement and control.

To meet the user's requirements, LWGY Series Flow Convertors can be attached to Flow Sensor to get different functions, such as standard DC signal output, pulse output, total flow display, instant flow display and flow percentage indication etc.

The Convertor Usage refers to other chapters.

Turbine Flow Sensor is mainly suitable for clean and low viscosity fluid measurement, for instance, water, light petrol items and some chemicals.

The Product refers to the Standard: JB/T9246 , Q/TDSM 21

Read this Manual carefully before installation and operation; and operate it per Manual.

Any opinions related to installation, operation and requisition, or any comments for meter improving form users that are different from what is described in this Manual, please don't hesitate to contact us.

2. Technical Specifications

Unless otherwise stated, this Turbine Flow Sensor is made in line with the following technical specifications.

- 1) Specifications for nominal diameter, nominal pressure, maximum pressure loss and flow range are shown on Table 1

Table 1 Turbine Flow Meter Technical Specifications

Type	Nominal Diameter	Flow Range (m ³ /h) (Qmax: Up-limit)						Nominal Pressure PN(MPa)	Max pressure loss (kPa)
		Tolerance ±0.2%		Tolerance ±0.5%		Tolerance ±1.0%			
		min	max	min	max	min	max		
LWGY-4	4					0.04	0.25	6.3	≤120
LWGY-6	6			0.1	0.6	0.1	0.6	6.3 16* 25* 40*	≤80
						0.08	0.8		
LWGY-10	10			0.2	1.2	0.2	1.2		
						0.16	1.6		≤50
LWGY-15	15	1	4	0.6	4			1.6 2.5 4.0* 6.3*	≤35
				0.5	5				
LWGY-25	25	1.6	10	1.6	10				
				1	10				
LWGY-32	32	2.5	16	2.5	16			1.6 2.5 4.0* 6.3*	≤25
				1.6	16				
LWGY-40	40	3	20	3	20				
				2	20				
LWGY-50	50	6	40	6	40			1.6 2.5 4.0* 6.3*	≤25
				4	40				
LWGY-65	65	10	60	10	60				
				8	80				
LWGY-80	80	16	100	16	100			1.6 2.5 4.0* 6.3*	≤25
				12	120				
LWGY-100	100	25	160	25	160				
				20	200				
LWGY-125	125	40	250	40	250			1.6 2.5 4.0* 6.3*	≤25
				30	300				
LWGY-150	150	50	300	50	300				
				40	400				
LWGY-200	200	100	600	100	600			1.6 2.5 4.0* 6.3*	≤25
				80	800				
LWGY-250	250	160	1000	160	1000				
			0	120	1200				

Note: 1. This company is also working for special Turbine Flow Sensor (flow meter) design per users' needs
2. Flow Range 10:1 is regarded as Wide Range (see Type code "K" on Type Code Table)
3. * as special order

Note: If nominal pressure (pressure classification) is not within the Type Code table, its nominal pressure code will be specially regarded as "Z; to specify the Nominal Pressure and Standard meanwhile.

- 2) Medium to be measure: liquid
- 3) Medium viscosity range: ≤5mPa·s

- 4) Fluid temperature: -20~+120 °C
- 5) Ambient temperature: -25~+55 °C
- 6) Relative humidity: ≤80%
- 7) Wetted parts materials:
 - Housing, Guide: SUS304
 - Vane: Stainless Steel: 2Cr13;
 dual metallographic Stainless Steel SUS329J1;
 Others (specified by user)
 - Axis/Bearing: regular (stainless steel /graphite)
 regular (harden alloy/jewel)
 friction-resist: (harden alloy/bearing)
 friction-resist: (harden alloy/ceramic bearing)
 others: specified by user
- 8) Installation Style: horizontal pipelines
- 9) Connection: LWGY-4~25, PN6.3: 55° non-sealed pipe thread (G Thread)
 LWGY-6~25, PN16, 25 : Bushing Joint
 LWGY-32~250: Flange connection
 - Note: (1) Flange specifications; see Chapter 5 “Dimensions & Installation Reference”
 - (2) Other connections or flange specification are also available on user’s request
- 10) Power Supply & Output Signal: please see Chapter 4 “Pre-Amplifier” and other contents for “Convertor”

Code for Type

Items & Contents	Code										Example	
Turbine Flow Sensor	LWGY											LWGY-
Nominal Diameter (mm) 4 (G Thread Connection) 6 (G Thread Connection) 10 (G Thread Connection) 15 (G Thread Connection) 25 (G Thread Connection) 32 40 50 65 80 100 (125) 150 200 250		4 6 10 15 25 32 40 50 65 80 100 125 150 200 250										15
Feature Code (Axis/Bearing) Regular(stainless/Graphite) Regular (Harden Alloy/Jewel) Friction-Resist (Harden Alloy/Bearing) Friction-Resist(Harden Alloy/Ceramic) Others (specified by user)			A A C C Z							DN: 25-250 4-15 25-250 4-15		A
Material (Vane) Stainless Steel Cr13 dual metallographic Stainless Steel SUS329J1 Others (specified by user)				0 1 9								1
Nominal Pressure PN1.6 PN2.5 PN4.0 PN6.3 PN2.0 PN5.0					A B C D E F							D
Accuracy Class0.2 Class0.5 Class1.0 Class1.5							2 3 4 5					3
Output None Pulse 4-20mA standard electrical signal RS485 Pulse(with regular amplifier LWF-T)								A B C D T				C
Display None On-site Instant Flow/ Percentage (TBL) On-site Total Flow accumulated (TBT) On-site Instant/Total Flow (TBS) With self-power supply: On-site Instant/Total Flow (TBS/G)									0 1 2 3 4			3
Explosion-proof: None Explosion-proof (dIIBT4)										/D		/D
Special Flow Special Flow Wide Range (10:1)											MaxFlow -K	

Example: **LWGY-15A1D3C/D** denoting: Turbine Flow Sensor; Nominal Diameter: 15mm, Feature Code: Regular (harden alloy Axis/jewel Bearing); Material: stainless steel SUS329J1; Pressure Class: PN6.3MPa; Accuracy Class: 0.5; Output 4-20mA DC signal; Display: on-site Instant/Total Flow (Type TBS) Explosion-proof: isolated

3. Fundamental Structure & Working Principle

1) Fundamental Structure

The Flow Sensor mainly consists of Housing, front-Guide, Axis, Vane, back-Guide, Pressing Rings and Amplifier with magnetic-electrical inducing convertor.

The front-Guide and back-Guide are fixed by Pressing Ring into the Housing with the Axis mounted on them; several radiating-shaped Strips on the Guide are playing the role of flow trimming that makes the fluid flow basically in parallel with the axis.

Vane attached with bearing is mounted on the Axis, which is rotating nimbly; there are Blades evenly-distributed on the Vane; when liquid is passing through, it forces the blades that makes vane rotating.

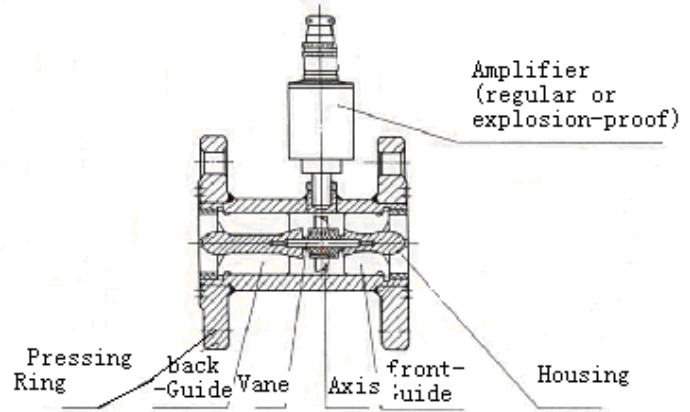


Fig.1 Structural Diagram for Turbine Flow Sensor

2) Working Principle

When the fluid to be measured is passing through the Sensor, the Sensor vane rotates due to the fluid kinetic energy, which periodically changes the magnetic impedance in the magnetic-electrical converting system that makes a periodic variation of the magnetic flux passing through the coil and generates electrical pulse signals. Within certain flow range, the vane rotating speed is proportional to the fluid flow, i.e. the number of electrical pulse is proportional to the flow; the pulse signal is fed to the amplifier, then amplified signal for flow/total flow display or calculations by the secondary instruments.

Within measuring range, the total number of output pulse from Sensor is proportional to the total flow volume passing through the Sensor; its ratio is called Meter Coefficient, and denoted by ξ (times/L). Each Sensor was actually calibrated to obtain its Meter Coefficient; when the pulse frequency “f” and total pulse number within a time period “N” are available, and they are respectively divided by Meter Coefficient ξ (times/L), instant flow q (L/s) and total flow Q (L) can be obtained as follows:

$$q=f/ \xi \dots\dots\dots (1)$$

$$Q=N/ \xi \dots\dots\dots (2)$$

Note: sometimes, “K” is also used as a symbol for Meter Coefficient, instead of ξ
 Well keep the Sensor “Quality Certificate” that records Meter Coefficient ξ and Accuracy which are very important application data for the Sensor.

4. Pre-Amplifier

This chapter only covers the Flow Sensor that adopts type LWF-T Pre-amplifier. Explosion-proof pre-amplifier and convertor will be described in separate manuals.

The amplifier attached to the Sensor detects the Vane rotation signal, amplifies it and generates pulse output. Unless otherwise stated, the Sensor combined with regular pre-amplifier is suitable for the general purpose. When explosion-proof is required,

explosion-proof pre-amplifier is needed; in addition, if on-site display and standard current output is required, different convertors are to be specified in the order;

The structure of regular pre-amplifier is as shown on Fig.2; the amplifier detecting coil is induced by the Vane rotation to generate the AC signal; amplified signal coming out as its output; the amplifier is mounted on Sensor Housing by M14x1 Thread; output is transmitting via the signal connecting plug;

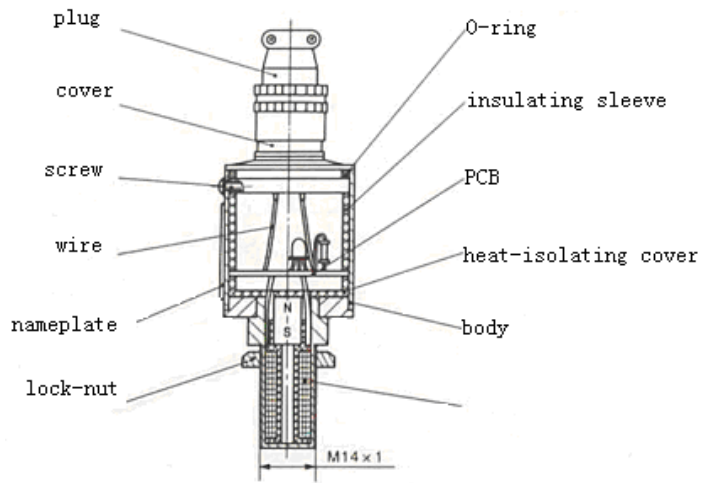


Fig. 2 LWF-T Regular Pre-amplifier structural diagram

1) Working Principle

The Amplifier first stage is a circuit for voltage amplifying with parallel negative feedback and a constant-current-diode as its load. Its output circuit is an Emitter Follower by compounded transistors. Good temperature stability, high gain and adequate loading capability are its advantages. The principle circuit is as shown on Fig.3

2) Specifications

Frequency range: 10~5000Hz

Output signal :

a. Wave Form: Square

b. Amplitude (Load resistance 10k Ω): Low electric level \leq 1V;

High level: (Power Supply Voltage minus 2) V

Power Supply: 12V~24V DC

Consumption: less than 50mW

Ambient temperature: -25~+50 $^{\circ}$ C

Environmental relative humidity: 35%~85%

5. Dimensions & Installation Reference

1) Dimensions for LWGY-4~25, PN6.3: shown on Fig.4 and Table 2.

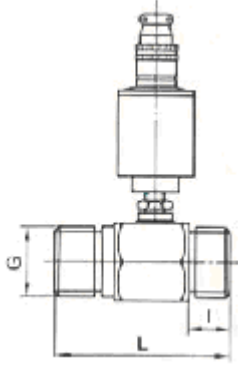


Table 2 Dimensions for LWGY-4~25, PN6.3

Type	G	L (mm)	L (mm)	Weight (kg)
LWGY-4	G1/4"	7	40	0.4
LWGY-6	G3/8"	11	42	0.5
LWGY-10	G1/2"	16	55	0.6
LWGY-15	G1"	18	75	1.0
LWGY-25	G1 1/4"	23	100	1.5

Fig.4 Dimensions for LWGY-4~25

2) Dimensions for LWGY-6~25, PN16, PN25, PN40 (Bushing Fix): shown on Fig.5 and Table 3.

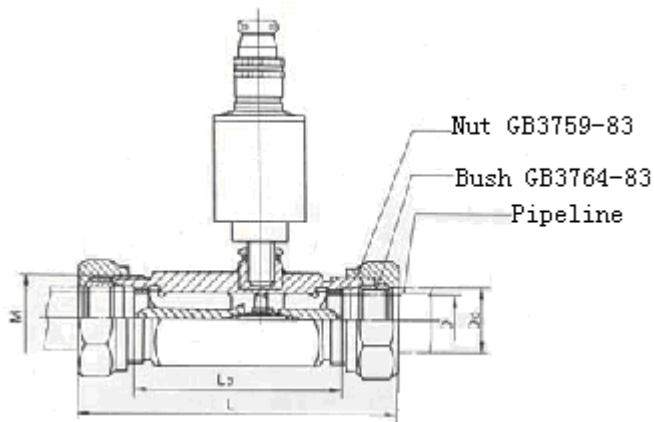


Fig.5 Dimensions for LWGY-6~25, PN16, PN25, PN40

Table 3 Dimensions for LWGY-6~25, PN16, PN25, and PN40

Type	L ₀ (mm)	L (mm)	D ₀ (mm)	D (mm)	M (mm)	Weight (kg)
LWGY-6	42	82	12(14)	6	M18×1.5(M22×1.5)	0.8
LWGY-10	55	97	16(18)	10	M22×1.5(M27×1.5)	1.0
LWGY-15	75	126	25	15	M33×2 (M36×2)	1.5
LWGY-25	100	155	32(42)	25	M42×2 (M52×2)	2.0

Note: with Parentheses (), it means for PN40MPa connection

Specifications for Nut and Bush is determined by D₀ and nominal pressure

3) Dimensions for LWGY-32~250, PN1.6, PN2.5: shown on Fig.6 and Table 4

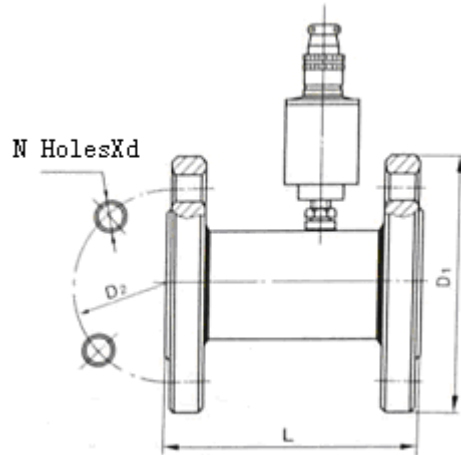


Fig.6 Dimensions for LWGY-32~250

Table 4 Dimensions for LWGY-32~250

Type	D ₁ (mm)	D ₂ (mm)	D (mm)	N (mm)	L (mm)	Weight (kg)
LWGY-32	140	100	18 (18)	4	120	
LWGY-40	145 (145)	110 (110)			140	7
LWGY-50	160 (160)	125 (125)			150	9
LWGY-65	180 (180)	145 (145)		4(8)	180	
LWGY-80	195 (195)	160 (160)	18 (23)	8	200	14
LWGY-100	215 (230)	180 (190)			220	21(22)
LWGY-125*	245 (265)	210 (220)	18 (26)	8	250	
LWGY-150	280 (300)	240 (250)	23 (25)	8	300	36(44)
LWGY-200	335 (360)	295 (310)			360	57(70)
LWGY-250	405 (425)	355 (370)		25 (30)	12	400

Note: 1. Pipeline Flange Standard as per JB/T81-94 (PN1.6, PN2.5) or JB/T82.2-94(PN4.0, PN6.3)

2. With Parentheses (), it means Flange for nominal pressure 2.5MPa

3. With *, it means special order

4) Pipeline connection for the Flow Sensor

Tables above show the main dimensions for pipeline connection. The pipeline connection for the Turbine Flow Sensors designed and made by this company is in accordance with the following Standard:

(1)LWGY-4~25, PN6.3 Sensor: Pipe Thread Connection with non-thread sealing (GB/T 7037)

(2)LWGY-6~25, PN16, 25, 40 Sensor: Bushing Fix connection (Nut GB/T 3759); (Bush GB/T 3764)

(3)LWGY-40~250 Sensor: Flange Connection with plane surface sealing (JB/T 75)

Note: All supply for pipeline fittings like flange, connecting tube, sealing wash, bolt, nut and bush are user's responsibility. If a supply from this company is requested, please specify it in order.

6. Installation

1) Site conditions:

- Within Sensor specifications for temperature and humidity;
- No vibration and no measuring pipeline vibration;
- No strong heat radiation and no radioactivity for sake of amplifier;
- To avoid external magnetic field disturbance to the measuring circuit of amplifier; if unavoidable, a shield for amplifier is necessary;
- If Explosion-proof is required, replace the amplifier by LWF-11A(B) that is explosion-proof one;
- The Sensor should be located at a place where access for operation and maintenance is convenient;

2) Installing position:

Sensor in horizontal position; always within the horizontal pipeline; the flow direction must be in line with arrow direction for flow indicated on the sensor nameplate;

3) Pipeline arrangement for the Sensor:

(1) At up and down stream of the Sensor, certain straight segment pipeline should be arranged so as to eliminate fluid velocity distribution distortion and vortex flow in the pipeline.

- a inner diameter of the straight segment is corresponding to Sensor nominal diameter
- b the minimum length for the up-stream straight segment is determined by the existing up-stream flow restriction items, recommendation in general :

Concentrically- tapered-off-pipe : $L=15D$

One 45° Elbow: $L=20D$

Right angel Elbow: $L=40D$

Identical-plane dual 45° Elbow: $L=25D$

Spatial dual 45° Elbow: $L=30D$

Fully-open throttle valve: $L=20D$

Semi-open throttle valve: $L=50D$

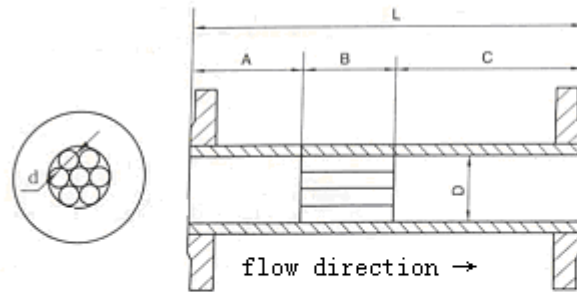
D above means Sensor nominal diameter

- c length for Sensor down-stream straight segment: $L>5D$

- d if necessary, Flow-Trimming-Device should be mounted within the straight segment; the device is as shown on Fig.7

(2) To ensure nominal diameter consistence among up/down-stream straight segment, flow-trimming-device and Sensor; to ensure same concentric axis be aligned as a reference with each part during installation; to ensure there is no rim objects like accumulating materials, washes, thermometer protecting tubes on the inner wall of the up/down-stream straight pipelines.

Note: for description convenience, the Sensor and up/down stream straight pipeline segment including flow-trimming-device is totally called as Sensor system hereinafter:



L- FTD total length ($L \geq 10D$)
 B-Trimming Bunch (tube or strip) length ($2D \sim 3D$)
 D-Sensor inner diameter; n- number of tube/strip; d-tube inner diameter ($B/d > 10$)
 A-Trimming Bunch up-stream straight tube length ($2D-3D$)
 C-Trimming Bunch down-stream straight tube length ($>5D$)

Fig.7 Flow-Trimming-Device (FTD)

(3) Typical arrangement for Sensor pipeline, as shown on Fig.8

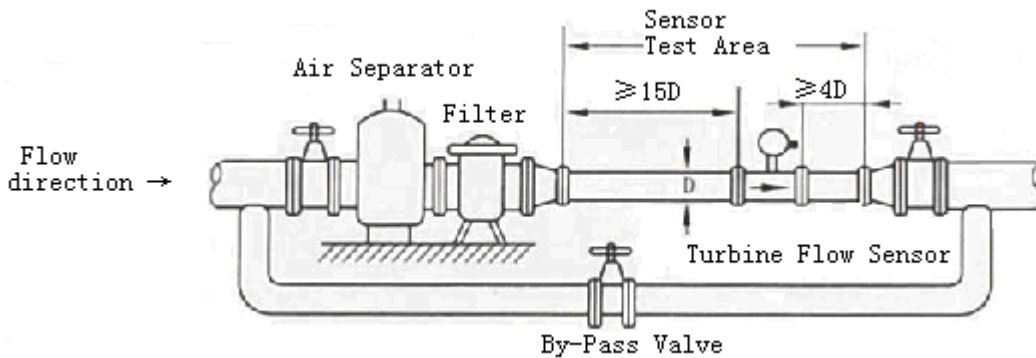


Fig.8 pipeline arrangement for Sensor

- (4) If the fluid to be measured contains solid impurities, it is necessary to arrange a Filter in the up-stream of Sensor system; the Filter shall be located at a certain distance from the Sensor to minimize the affection on it due to the passing flow speed variation. The location of Filter is also considered at its dismounting convenience for cleaning. The filtering numbers is about 20-60, in general, the bigger the Sensor diameter, the less the filtering numbers;
- (5) If the fluid to be measured appears gasified easily, or the fluid may mix with gas during the process, Air Separator (Air Eliminator) shall be installed at the up-stream of the Sensor System.
- (6) The Valve for flow adjusting shall be installed at down-stream of the Sensor System.
- (7) For the Sensor maintenance needs, Cut-off valves shall be set at up and down-stream of the Sensor, By-pass pipeline is also necessary to keep the flow passing uninterrupted during maintenance; to ensure there is no flow leakage in the by-pass pipeline in keeping the measuring accuracy
- (8) To secure the Back-Pressure at down-stream of the Sensor, especially in measuring liquids that may easily gasified. The Back-Pressure can also be calculated by the following formula:

$$p_a \geq 2\Delta p + 1.25p_v \dots \dots \dots (3)$$

where

- p_a is the Back-Pressure down-stream
- Δp is the Pressure loss when maximum flow passing through the Sensor
- p_v is the Saturated steam pressure of the liquid to be measured at its maximum working temperature

To achieve the above- mentioned Back-pressure and avoid gasification, it is necessary to install appropriate vales (Back-pressure Valve, Restricting Valve or Reducer) at the down stream of the Sensor;

- (9) To take necessary measures to prevent the liquid reversing-flow;
- (10) Thermometers and Pressure Gauges should be set up at the up and down stream of the Sensor where turbulence will not disturb the Sensor;
- (11) In some cases, it is suggested to install multiple Turbine Flow sensors in parallel:
 - a. If the flow varying range is over the Sensor rating, several Sensors with same or different nominal diameters can be used;
 - b. when uninterrupted flow measurement is required; several Sensors in parallel can be used alternatively

4) Installation

- (1) Check the Sensor and its auxiliaries before installation
 - a. type and specification check
 - b. inlet, outlet and flow direction check
 - c. check the Sensor Vane rotating nimbly and freely; for the big sensor by finger turning; for the small one by blowing air from your mouth
- (2) the recommended connection between sensor and pipeline is shown on Fig.9 and Fig.10; the connection for PN16 and PN25 Sensor as per Fig.5 by using Bushing fix; Seal Ring materials should be applicable to the fluid to be measured, no corrosion, and no chemical reaction occurs; Seal-Ring outer/inner diameter shall be in such a size that it will not stick out into the pipeline even if it might be installed eccentrically;
- (3) all equipments need cleaning prior to installation; to ensure no welding residues or foreign objects are left in the pipeline;
- (4) in case of newly-installed pipeline wiping-off, Sensor and Filter should be replaced by straight pipes in advance, restore them after wiping-off

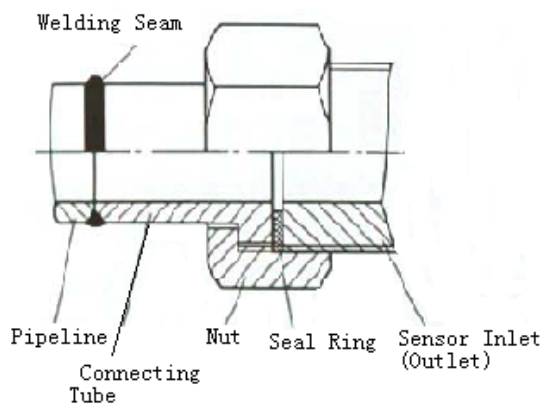


Fig.9 Connecting Diagram

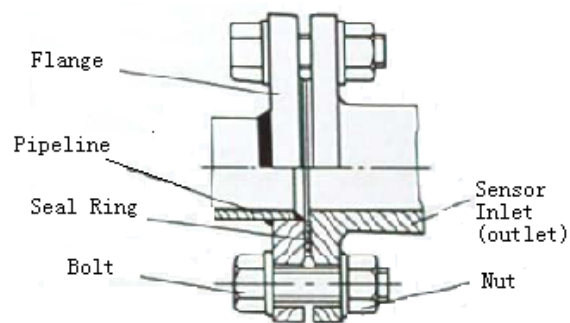


Fig.10 Connecting Diagram

5) LWF-T Regular Pre-amplifier

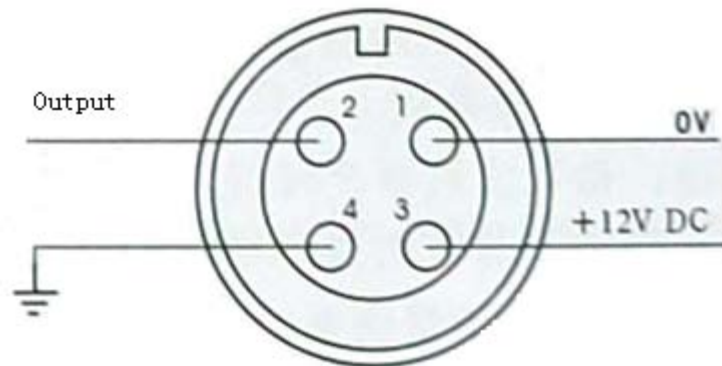


Fig.11 LWF-T Wiring Terminal

- (1) Installation: Attach it to the Sensor Housing by hand- screwing it into the Housing connecting seat with M14x1 threads, and then fasten the lock-nut properly;
- (2)Wiring: For Output Signal transmission, 3-core-metal-shielded cable shall be used with metal shield connecting to the ground; terminals in plug refer to Fig.11 (also see the label on the amplifier)
- (3) Be sure, when using shielded cable, one point (terminal) being grounded only; normally such one point (terminal) is arranged at the place where Flow Totalizer is located;
- (4) Prevent the output signal cable from being disturbed by the AC power noise; and keep it away from the power loop;
- (5) The Turbine Flow Sensor usually has to be working with the Flow Totalizer, so another end of the signal cable needs to be connected to Totalizer; therefore, it is also necessary to make settings on Totalizer such as Pulse equivalent, Flow unit, operation status etc. please carefully refer to the Totalizer Instruction Manuals in doing so;

Note: 1. to prevent the amplifier from being damaged: make wiring when power off; to ensure wiring correctness;

6) Check after installation:

Check Sensor and Totalizer and make following things ready before flow measuring:

- (1) Pipeline cleaning; no solid impurities that will make trouble to sensor; liquids for cleaning purpose should pass through the by-pass pipeline rather than Sensor; or refer to Section 4)/(4) of this Chapter to use straight segment pipes instead of Sensor;
- (2) Check the correctness of electrical connecting/wiring
- (3) Turn the Totalizer power on, softly open the up-stream valve when the down-stream adjusting valve is closed, to check if any leakage in the pipeline; at the time no flow will be displayed on Totalizer.
- (4) Softly open the down-stream adjusting valve for a suitable flow to confirm the Totalizer displaying normally;
- (5) To make sure no vibration occurs at the pipes in which the Sensor is located;

- (6) To make sure the Back-Pressure at Sensor down-stream is satisfied with the specifications; meanwhile, to make sure the liquid to be measured is fully occupying the measuring pipelines.
- (7) To confirm no leakage is found on the valves within the by-pass pipeline and on other valves that will affect the flow measuring.
- (8) In case that on-site-calibration equipment is available or on-line-calibration is requested, on-line calibration may be carried out before actual operation.

7. Operation

- 1) The Sensor had been calibrated by water at normal atmospheric temperature prior to its ex-works; at the time, following data are given on its Quality Certificate , they are Sensor coefficient, linearity (accuracy), frequency with related instant flow (flow rate), and deviation. if the fluid to be measured with a viscosity which is quite different from that of water at normal atmospheric temperature, trimming to the coefficient or using actual fluid under actual working condition for calibration is necessary; such trimming may not be considered if the measuring accuracy requisition is not higher than Class 0.5 and the fluid viscosity in working status is no more than 5mm²/s; it is recommended to keep the fluid temperature and pressure unchanged during measuring period due to the Sensor viscosity sensitivity; the viscosity of fluid used for re-calibration should be in line with that of fluid to be measured; to calibrate the Sensor in actual working condition or similar condition, then to figure out Meter Coefficient or deviation.
- 2) Turn the Totalizer power on, open Sensor up-stream valve; Until the liquid is fully occupying pipeline and Sensor, there shall be no pulse output from the Sensor, “zero” instant flow is displayed on the Totalizer with flow accumulation display remaining unchanged;

Note: during measurement, up-steam valve is normally fully open so as to avoid accuracy affection caused by fluid flowing status changing;
- 3) Open the down-stream flow adjusting valve to reach the required flow, be sure, the flow in the pipeline is within the Sensor measuring range.

Note: not to open the valve suddenly, such open will result in an impact to the Vane causing its sudden rotating at high speed.
- 4) The total volume flow and instant flow of the fluid passing through the Sensor be displaying on the Totalizer

Note: The temperature, pressure and flow of the fluid to be measured must not be out off the limitations/range being indicated on the Sensor nameplate or being given by this manual;
- 5) The output pulse number from the Sensor is proportional to the fluid total volume in its working status (working temperature and pressure), if the Totalizer is not trimmed (compensated), it just displays the fluid total volume/instant flow in such status; the total volume in standard status can be obtain via the formula below:

$$Q_s = Q_i \times [1 - \alpha (t_i - t_s)] [1 + \gamma (p_i - p_s)] \dots \dots \dots (4)$$

where

- Q_s is the Fluid volume in standard status
- Q_i is the Fluid volume in measuring (in working status during measuring)
- α is the volume expansion coefficient of the liquid to be measure; unit 1/°C
- γ is the volume compressing coefficient of the liquid to be measure; unit 1/Pa
- t_i p_i is the liquid temperature and pressure in measuring status; unit: °C, Pa
- t_s p_s is the liquid temperature and pressure in standard status; unit: °C, Pa

- 6) For more accurate measuring, deviation trimming can be done as below:

$$Q_i' = Q_i \times (1 - E_i) \dots \dots \dots (5)$$

where

- Q_i' is the Fluid Volume after trimming
- E_i is the instrument deviation at the flow measuring point; measuring points beyond the calibrating points can be obtain by mathematical interpolation method;

8. Maintenance & Cares

Refer to the steps below for Turbine Flow Sensor maintenance and cares;

If the measuring system for the Sensor is out of order, to check the whole system completely is advised; and what shall be checked (if any), see below

- a. all valves related to the Sensor calibration
 - b. Filter, Filtering Grid, Air Eliminator
 - c. Pre-Amplifier
 - d. Moving parts or Bearing surface of Sensor
 - e. Other parts for Sensor and pipeline measuring segment
 - f. Calibrating switches and accessories
 - g. Pressure, temperature and density measuring instruments
- 1) Normally after use, the Sensor needs maintenance, within 6 months to 1 year, as well as re-calibration; the interval for calibration depends on Sensor working conditions; if the fluid contains more impurities and daily working time is long, re-calibration shall be made in shorter interval;
 - 2) Disassemble the Pressing Rings at the two ends of Sensor; take off the front/ back Guides and Vane component from the Housing; please keep in mind of their original positions and directions for restoring;
Check Housing, Vane, Axis, Bearing wear & tear, foreign object sticking & accumulating; clean or replace per needs; re-calibration is required after part replacement;
No bending is permitted for Vane and Guides during maintenance; do not strongly wipe off the foreign objects from its parts to prevent them from being damaged.
The output-signal-voltage modulating may be affected by the magnetized Vane Blades that is one of measuring deviation sources; so do not use any magnet for Vane /Blades materials testing/confirming;
Restore all above-mentioned parts to Sensor Housing per their original positions and directions; fasten the Pressing Rings;
If completed, turn the Vane rotating by finger, it should rotate nimbly without any touching or scratching; the gap between the Vane outer-circle and Housing inner-circle should be even; amplifier shall generate output when the Vane is rotating;
 - 3) To check the pre-amplifier: using a fine iron strip (like small file), closing it to the Amplifier detecting coil and softly waving (simulating the Vane moving), there must be an output in the Amplifier; or moving the Amplifier head nearby AC power, there must be a 50 Hz AC signal output from the Amplifier; in both cases if there is no output from Amplifier, replace it by a new one;
 - 4) Before operation, for the re-calibrated Sensor, if Meter Coefficient ξ is changed, do not forget the relevant Setting change on display instruments;
 - 5) Sensor trouble shooting, see Table 5; display instrument wiring and trouble shooting refer to their related manuals

Table 5 Trouble Shooting

Trouble	Possibility Analysis	Trouble-Shooting
No Output	1)no flow 2>wrong wiring 3)Vane stall 4)poor pre-amplifier 5)no or low power to amplifier 6)display instrument trouble	1) confirm flow passing 2) correcting 3) check/clean pipeline impurities or foreign objects; any damaged Vane, Bearings repair or replace 4) replace amplifier 5) supply power or improve power 6) mending display instrument
Output appears when flow is zero	1)strong external electro-magnetic field 2)Vane moving caused by Pipeline vibration	1) check shield cable “grounded” condition ; remove disturbance 2) eliminate pipeline vibration
No display on display instrument; Flow readings not in line with actual flow	1) same as above Trouble 2 2) display instrument trouble 3) display instrument wrong wiring 4) display instrument wrong setting 5) poor amplifier 6) air or steam mixed in pipeline 7) lower outlet pressure 8) higher medium viscosity 9) Bearing wear & tear 10) impurities/dirty on vane 11) poor pipeline arrangement 12) flow over range (more or less) 13) Pipeline leakage 14)pressure/temperature over range	1) see above 2) mending display instrument 3) correcting 4) re-setting 5) mending amplifier 6) arrange an air separator 7) pressure increasing 8) actual flow calibrating; Coefficient modifying 9) replace Bearings 10) cleaning 11) re-arrange 12) adjusting flow within range 13) repair pipelines 14) adjusting pressure, temperature or modifying

9. Transportation & Storage

- 1) The Sensor should be re-packed in condition like original ex-works packing for transportation and moving (to job-site or return for repair) in order to prevent it from being damaged.
- 2) The Sensor should be stored indoor with temperature ranging from 5 to 40°C, relative humidity not exceeding 85%, good ventilation and non-corrosive atmosphere;
- 3) Never attempt to move the Sensor directly by handling the amplifier attached on it;
- 4) Please attach a written description to the return Sensors for calibrating or repair service by this company, expressing requirements or what the trouble is;
- 5) If some parts are found missing within the return Sensors for service, this company is entitled to complete them with new parts and appropriately charge the expense for both completion and repair, unless otherwise the user declares such parts are not needed.

10. Key Points for Ordering

- 1) The following requirements should be clearly expressed by the user for order:
 - (1) Sensor Type: nominal diameter, working style, nominal pressure;
 - (2) Sensor accuracy classification;
 Note: the above 2 items are absolutely necessary
 - (3) Explosion-proof pre-amplifier is needed or not; if needed, please specify for normal or high temperature;
 - (4) Needed accessories, like cables, connecting flanges and bolts etc.
 - (5) If needed, flow display instrument can be ordered at the same time for completing a Sensor Set
 - (6) To secure the correct type to be chosen, please specify name, characteristics (viscosity, density, corrodibility) of the fluid to be measured, working pressure, temperature, normal flow , maximum and minimum flow etc.

2) Briefing on items for forming a Complete Set with Sensor

In order to accomplish different functions, the Turbine Flow Sensor can be matched with relevant Flow Display Instruments;

Table 6 shows briefly the functions of such instruments made by this company:

Table 6 Flow Totalizer Briefing

Type	Function Briefing
XSJ-39A	Make arithmetic operation to the input flow signal (Pulse, current); simultaneously display total and instant flow; power failure protection Optional: Current output; Quantification control
XSJ-39AK	
XSJ-39AI	
XSJ-39AIK	

11. Package Contents

Each Sensor package contains:

- 1) Turbine Flow Sensor 1 set
- 2) Instruction manual 1 copy
- 3) Quality certificate 1 original

The end.