

Manufacturing Certificate  
CMC Shanghai No.02220105

# Instruction Manual

**TYPE LL**

**Roots Flow Meter**



 **SHANGHAI NO.9 AUTOMATION INSTRUMENTATION CO., LTD.**

A/SS VERSION; 2002.08  
YLJ-B003-C-Z

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# 1. General Description

This manual is for the installation, application and maintenance of Type LL Roots Flow Meter 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**

LL Roots Flow Meter (hereinafter refer to as Roots Flow Meter or Flow Meter) is a certain kind of volumetric flow measuring meter, used in enclosed pipeline that is fully filled with continuous flow of liquid. The flow meter is attached with on-site mechanical counter with no electrical supply, from which readings of volumetric flow in total can be directly and clearly obtained. It is easy and reliable in operation with high measuring accuracy, and it is also robust and durable. Among others, each set of flow meter is equipped with unified rotating- round- number output shaft, it can be used with Optical-Electrical Pulse Converter for electrical pulse signal output; if connected with Digital Flow Totalizer, datum remote reading and surveillance are capable.

Series Type LL Roots Flow Meter made by this company is shown below:

1. Regular Type;
2. LL-D Sand-Proof Type: Bearing made by Powder Metallurgy method for Sand-Proof, suitable for measuring crude oil with high sand content, Nominal Diameter: 50~300mm;
3. LL-F Stainless Steel Typ: wetted parts are made of stainless steel, suitable for measuring crude oil with high water content, Nominal Diameter: 15mm~100mm;
4. LL-H High Accuracy Type: made by special technology with measuring accuracy up to Class 0.2, Nominal diameter: 150~300mm;

Roots Flow Meter is suitable for high viscosity liquid flow measuring, like crude oil, diesel and other petrol items

Product Standard: Q/TDSM01-2014

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

To ensuring product quality, the some components of Flow Meter has been run in, and tested, so the number of the no-reset totalizer is nonzero, it's highest number is not less than 1.

## 2. Type Selection Code

Type Selection Code

Item & Contents	CODE						Example
<b>Roots Flow Meter</b>	LL-						<b>LL-</b>
<b>Nominal Diameter (mm)</b>							<b>50</b>
15		15					
25		25					
40		40					
50		50					
80		80					
100		100					
150		150					
200		200					
250		250					
300		300					
<b>Feature Code</b>							<b>D</b>
Regular			A				
Sand-Proof			D				
Stainless Steel			F				
Light Oil			C				
<b>Materials</b>							<b>0</b>
(determined by Feature Code)				0			
Special needs				9			
<b>Nominal Pressure</b>							<b>B</b>
PN1.6				A			
PN2.5				B			
PN4.0				C			
PN6.3				D			
PN2.0				E			
PN5.0				F			
<b>Accuracy</b>							<b>2</b>
Class 0.2					2		
Class 0.5					3		
<b>Output</b>							<b>A</b>
None						A	
Pulse Output (Optional LPJ-120D)						B	
4-20mA Output (Optional LPJ-120D/FI)						C	
<b>Display</b>							<b>3</b>
2-row Small Character Wheel Counter, Pointer, with Zero Return (only for LL-15~40 & PN1.6 LL-50~100)						1	
Big Character Wheel Counter						3	
Electronical Flow Convertor						D	

**Example:** LL-50D0B2A3 denoting:

**Roots Flow Meter:**LL; **Nominal Diameter:** 50mm; **Feature:** Sand-Proof;

**Nominal Pressure:** PN2.5MPa; **Accuracy Class** 0.2; **Output:** no;

**Display:** Big Character Wheel Counter

### 3. Technical Specifications

This Flow Meter is made with specifications below, unless otherwise stated or being specially needed:

- 1) Type, Nominal Diameter: see Table 1
- 2) Medium to be measured: liquid
- 3) Medium Viscosity range: 3 mPa.s to 500mPa.s
- 4) Maximum Pressure loss: <0.04MPa, when viscosity is 3mPa.s
- 5) Ambient Temperature: -20°C to 60°C
- 6) Flow Meter Installation Style: Upright, installed in horizontal pipeline
- 7) Connection: Flange; Flange standard and main specification see Section 5 “Dimensions & Installation Reference”
- 8) Materials of Wetted Parts:
  - Housing, Up-cover, Low-cover: Cast Steel
  - Rotor: Aluminum Alloy or Cast Iron
  - Drive Gear: Steel or Cast Iron
  - Seal Ring: Oil-durable rubber

Note : All metal material of Wetted Parts in the Type LL-F are Stainless Steel

Table 1

Model	Nominal Diameter DN(mm)	Nominal Pressure PN(MPa)	Maximum Flow Rate Qmax(m³/h)	Tolerance		Medium Temperature range °C	Remote Output- Shift Rotating Speed m³/r	Pulse Equivalent L/P
				Range Ratio				
				5:1	10:1			
LL-15	15	6.3	2.5	±0.2%	±0.5%	0~120	0.001	0.001
LL-25	25		6					
LL-40	40		16					
LL-50	50	1.6 2.5 4.0 6.3	25			0~80	0.1	0.1
LL-80	80		60					
LL-100	100		100					
LL-150	150		250					
LL-200	200		400					
LL-250	250		600					
LL-300	300	1000						

Note 1: Pulse Equivalent is designated to the Pulse Equivalent of LPJ-12 Series Optical-Electrical Convertor made by this company as complementary device to this flow meter; input 1 rotating round to LPJ-12 Convertor, it outputs 1000 pulses

Note 2: Other connections or flange specification are also available on user's request

Note 3: Type LL-H's Tolerance is ±0.1% when the range ratio is 3:1

Note 4: The specifications of the Electronical Flow Convertor see its name board and relevant instruction manual

## 4. Working Principle & Fundamental Structure

### 1) Working Principle

When fluid to be measured passing through flow meter measuring-body, a pressure difference is developed between its inlet and outlet that makes Roots Rotor rotating as shown on Fig.1; see Fig.1(a), both two Roots Rotors are influenced by the pressure difference with rotating torques, and rotating in directions as shown; see Fig.1(b), a Measuring Chamber is established between one Rotor and Housing Wall, this Rotor rotating is going on due to pressure difference, then Measuring Chamber is being opened to outlet, see Fig.1(c), liquid in Chamber is being displaced; another Rotor is not able to rotate by itself due to the pressure difference balance, but it is driven by Driving Gear to continue its rotating to the position as shown in Fig.1(d); another Measuring Chamber is established, and after further rotating its liquid is displaced again; the Driving Gear alternatively changing the rule of driving or being driven; so a pair of Rotors is rotating under pressure difference, and being driven with each other via Driving Gear, which makes Measuring Chambers one by one and liquid drain continuously; the volume of Measuring Chamber is known, and each rotation by Rotor makes 4 measuring Chambers, so the fluid volumetric flow passing through the flow meter is proportional to Roots Rotor rotating turns; by use of Reducer, Sealing and Accuracy Trimming Mechanisms which are linked with Roots Rotor Shaft, Rotor rotating turns are transferred to the Counter for fluid volumetric flow accumulation measuring;

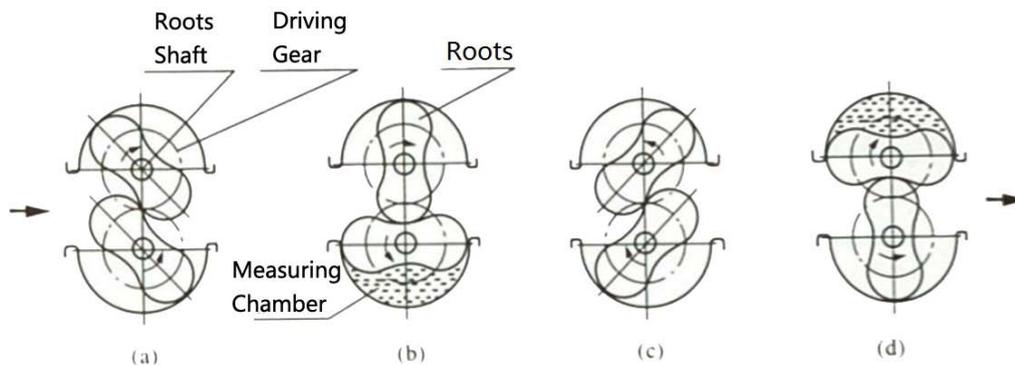


Fig.1 Roots Flow Meter Working Principle

### 2) Fundamental Structure

Roots Flow Meter mainly consists of three parts; measuring, seal-connecting, and calculating parts, as shown in Fig.2, 3, 4, and 5;

A. Measuring part is composed of Housing, a pair of Roots Rotors (containing Roots, Shafts and Driving Gears), Up-cover and Low-cover, which form flow measuring chamber; Roots Rotors are mounted on Up and Low Covers with bearings for nimble rotating; 2 Driving Gears are driving and being driven with each other, and a proper gap without scratch between them is ensured during rotation; Thrust Bearing made of harden alloy is set at cover low part, which are used not only for Rotor weight supporting, but also for Rotor up/down position adjusting to ensure gaps among Rotors, up/low covers and separate plat shifts in the middle;

Housing has two different structures, single- housing and double-housing; the double-housing is composed of inner and outer covers; inner housing containing measuring parts is fixed by bolts

within outer cover; measuring parts together with inner housing can be easily taken out for maintenance convenience;

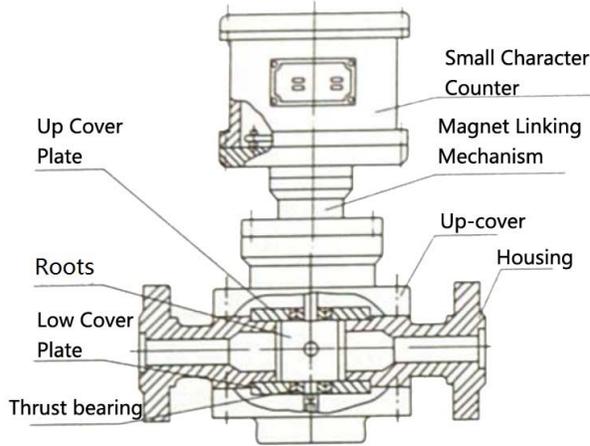
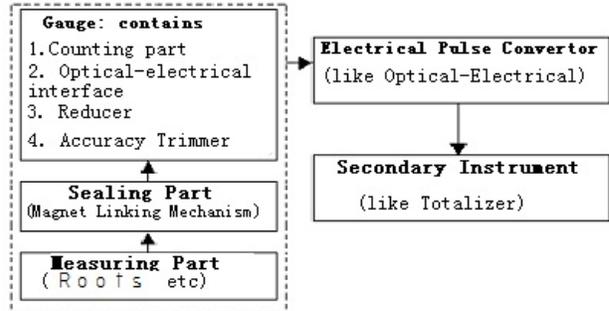


Fig. 2 Flow Meter Structure (1)



1. Arrow denoting moving or signal transfer route  
2. Flow Meter itself is within dotted-line-frame  
Fig. 3 Roots Flow Meter Structure Diagram (1)

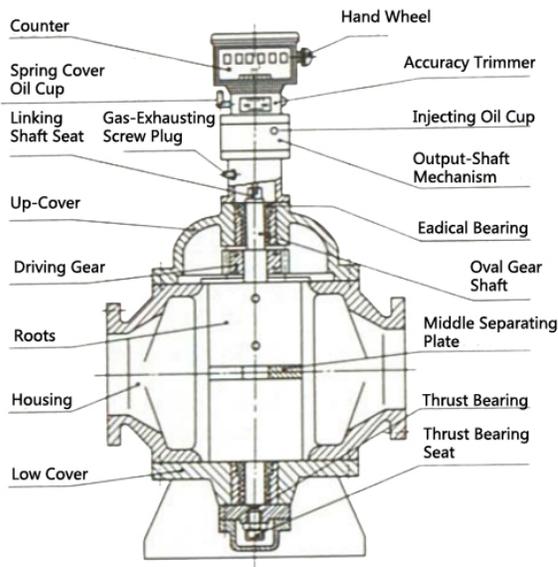
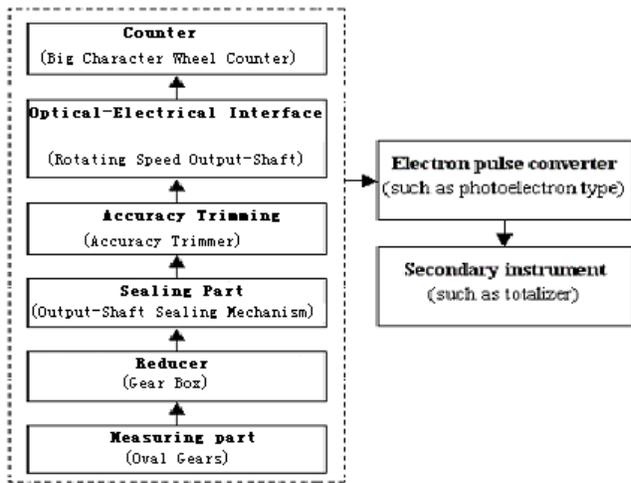


Fig.4 Flow Meter Structure (2)



1. Arrow denoting moving or signal transfer route  
2. Flow Meter itself is within dotted-line-frame  
Fig.5 Roots Flow Meter Structure Diagram (2)

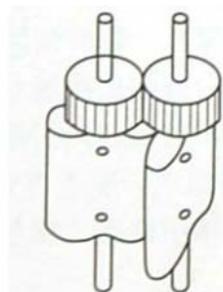


Fig.6 Single Roots Structure

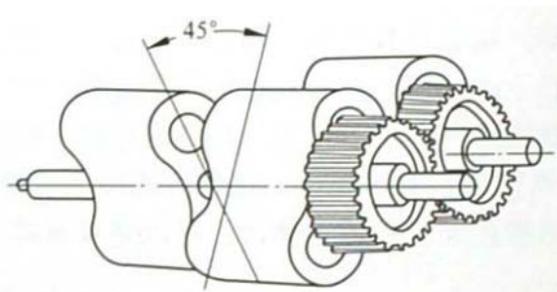


Fig.7 Double Roots Structure

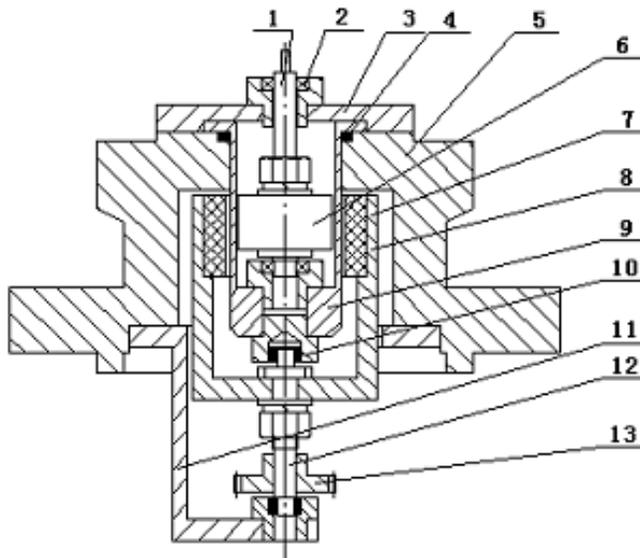
Roots Rotor can be divided in two structural styles; one is Single Roots Structure, while the other is Double; see Fig. 6 and Fig.7; Double Roots Structure is used in big diameter flow meters for vibration and noise reduction; two Roots in double structure are dislocated with 45° angle difference and being isolated by separating plate in the middle that is fixed on Roots Housing.

Wetted Parts for Roots Flow Meter are connected by Bolts, their contacting surfaces being sealed by oil and temperature-durable rubber O rings to prevent fluid leakage;

B. Seal-connecting part is used for Roots Rotor Shaft rotating transfer and fluid leakage blocking along with the Shaft; there are two structures for this purpose:

Magnet Linking and Output-Shaft Sealing Mechanism;

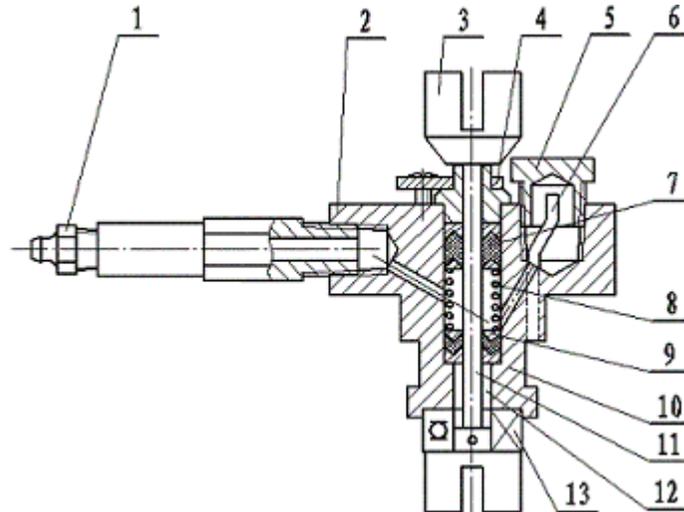
Magnet Linking Mechanism is attached with a sealing sleeve to prevent flow meter leaking; External Magnet outside Sleeve is driven by Roots Shaft via Gears, Internal Magnet and its Shaft inside Sleeve is then driven by magnetic force, Shaft rotating is being transferred out; see Fig.8:



- |                          |                           |
|--------------------------|---------------------------|
| 1. Internal Magnet Shaft | 2. Bearing                |
| 3. Cover Plate           | 4. Seal Ring              |
| 5. Connecting Body       | 6. Internal Magnet        |
| 7. External Magnet       | 8. Magnet Seat            |
| 9. Oil Isolating Sleeve  | 10. Graphite Bearing      |
| 11. Thrust Seat          | 12. External Magnet Shaft |
| 13. Gear                 |                           |

Fig.8 Magnet Linking Mechanism

Output-Shaft Sealing Mechanism is transferring motion via a smooth shaft mounted on Sealing Seat; Sealing is maintained by two pairs of Butterfly-Style Seal Rings between shaft and Sealing Seat; in order to reduce moving friction between Shaft and Seat, to minimize Seal Ring wear & tear and to get better sealing results, Oil Nozzle is set on the Seal Seat for lubricating oil injection; see Fig.9:



- |                      |                            |
|----------------------|----------------------------|
| 1. Oil Injection Cup | 2. Sealing Seat            |
| 3. Moving Fork       | 4. Pressing Plate          |
| 5. Screw Plug        | 6. Linking tube            |
| 7. Seal Ring         | 8. Spring                  |
| 9. Pressing Ring     | 10. Oil Seal Pressing Ring |
| 11. Shaft            | 12. Graphite Bearing       |
| 13. Thrust Bearing   | 14. Pressing Cover         |

Fig. 9 Output-Shaft Sealing Mechanism

C. Calculating part is used to reduce Roots Shaft rotating speed to an appropriate extent, which is then counted by Counter for fluid total flow measuring; calculating part has two styles in structure:

**Small Gauge Counting Mechanism:** it contains 2 parts, Reducing Gear Box and Small Character Wheel Counter.

Reducing Gear Box, through a trains of gear to reduce the speed from the roots, with changeable double-gear component for accuracy trimming.

Small Character Wheel Counter displays a running account total of the quantity of liquid product delivery on two rows of character wheel, and a pointer. The low row of 4-digit character wheel and the pointer can be reset through a reset button on the front of the unit. The another 6-digit character wheel on the top can't be reset.

All of them are assembled within one Housing; on the Housing, interface for electrical pulse convertor is arranged.

**Big Gauge Counting Mechanism:** it contains 3 parts, Accuracy Trimmer, Electrical Pulse Convertor Interface Gear Box (Optical-Electrical Gear Box), Big Character Wheel Counter; 3 parts are independent; Speed reducing function with Big Gauge Counting Mechanism is partly achieved by Gear Transmission Mechanism mounted in the front of Output-Shaft Sealing Mechanism, which

makes the Big Character Wheel Counter be a unified component that can be used in flow meters of different nominal diameters with no transmission ratio limitations;

Trimmer is actually in super-clutch style, from which, in total,  $\pm 6\%$  accuracy trimming can be obtained;

5-digit Big Character Wheel on Big Character Wheel Counter can be cleared to ZERO; it is used in oil distributing operation during a certain period of time or just in one-time oil delivery with time or batch based volumetric flow quantity display; 7-digit Small Character Wheel can not be cleared to ZERO, which is used for total volumetric flow continuous calculation; both Big and Small Character Wheel are rotating synchronously.; ZERO returning for Big Wheel can be made by a manual-operated wheel available on the right of the Counter;

Table 2 below shows standard configuration for Roots Flow Meter of different types

Table 2 Roots Flow Meter Standard Configuration

No.	Type	Roots Style	Sealing Style	Calculation Device
I	LL-15,LL-25 LL-40~50A,PN1.6	Single Roots Rotor	Magnet Linking Mechanism	Small Gauge Counter Mechanism
II	LL-80~100, PN1.6	Double Roots Rotor	Magnet Linking Mechanism	Small Gauge Counter Mechanism
III	LL-50A,PN2.5~PN6.3	Single Roots Rotor	Output shaft Sealing Mechanism	Accuracy Trimmer; Optical-Electrical Gear Box; Big Character Wheel Counter
IV	LL-80~100, PN2.5~PN6.3 LL-150~300	Double Roots Rotor	Output shaft Sealing Mechanism	Accuracy Trimmer; Optical-Electrical Gear Box; Big Character Wheel Counter

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## 5. Dimensions & Installation Reference

### 1) Outline and installation dimensions

Roots Flow Meter dimensions, installation reference and flange connections are shown on attached drawings and tables; for Flow Meter pipeline Flange Standard, please refer to section 2 of this Chapter;

**Note: Bolt length is to be figured out by user as per pipeline actual connection;**

- A. Dimensions and Installation Reference for Flow Meters in Configuration No. I & No. II , see Fig.10 and Table 3;
- B. Dimensions and Installation Reference for Flow Meters in Configuration No. III , see Fig.11 and Table 4;
- C. Dimensions and Installation Reference for Flow Meters in Configuration No. IV , see Fig.12 and Table 5;

### 2) Pipeline Flange for Flow Meter

On Tables above, Flange Size for installation of the Flow Meter is listed; Pipeline Flange for Roots Flow Meter designed and made by this company is in compliance with the National Machinery Industry Standard below:

- a) PN1.6MPa to 2.5MPa: JB/T79.1-94 (Integral steel pipe flanges with flat face) (Series 2)
- b) PN4.0 MPa to 6.3MPa: JB/T79.1-94 (Integral steel pipe flanges with male and female face) (Series 2 for female face)

**Note: Flanges in line with other standards can also be supplied at user's options.**

### 3) Pipeline Flange for User's Pipeline

- a) PN1.6 MPa to 2.5MPa: JB/T81-94 (Slip-on-welding plate steel pipe flanges with raised face) (Series 2)  
Or JB/T82.1-94 (Steel pipe welding neck flanges with raised face) (Series 2)
- b) PN4.0 MPa to 6.3 MPa: JB/T82.2-94 (Steel pipe welding neck flanges with male and female face) (Series 2)

### 4) User may follow the following standard for Flange sealing gasket:

JB/T87-94(Asbestos-rubber gasket for pipeline flange):

Asbestos-rubber gasket for raised face pipe flange or male and female face pipe flange.

**Note: Flanges in line with other standards can also be supplied at user's options;**

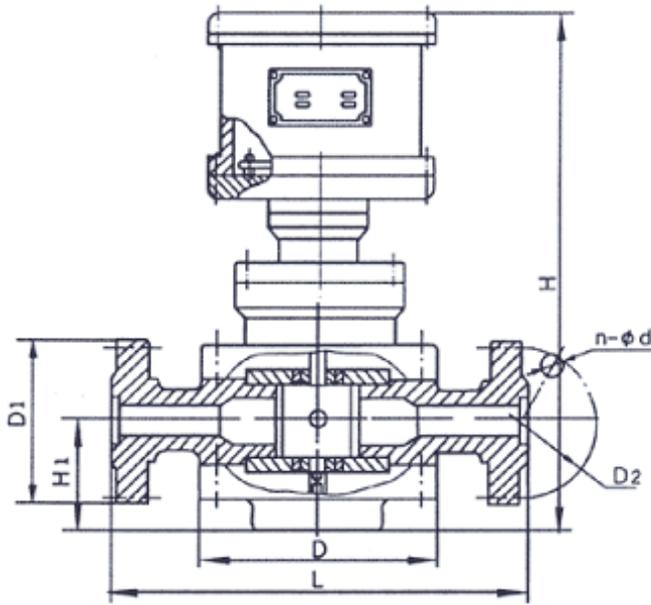


Fig.10 Flow Meter Dimensions (1)

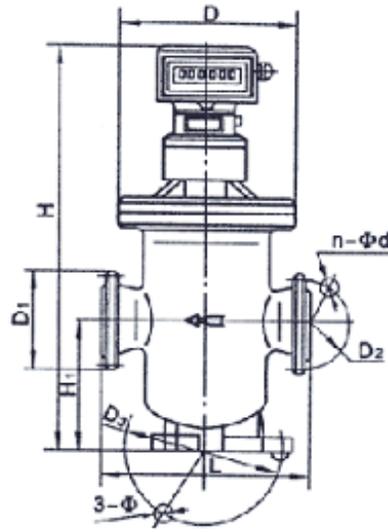


Fig.11 Flow Meter Dimensions (2)

**Table 3 Dimensions & Installation Reference (1)**

Unit: mm

Size Type	Height H	Center Height H1	Big Plate Diameter D	Flange Distance L	Flange Out- Diameter D1	Bolt Hole Center Circle D2	Bolt Hole- Diameter n-Φd	Connection Bolts n-Md1	Weight (kg)
LL-15, PN6.3	316	73	Φ150	260	Φ105	Φ75	4-Φ14	4-M12	15
LL-25, PN6.3	356	93	Φ150	260	Φ135	Φ100	4-Φ18	4-M16	24
LL-40, PN6.3	370	110	Φ216	300	Φ165	Φ125	4-Φ23	4-M20	43
LL-50A, PN1.6	526	179	Φ216	300	Φ160	Φ125	4-Φ18	4-M16	52
LL-80, PN1.6	635	225	Φ300	400	Φ195	Φ160	8-Φ18	8-M16	106
LL-100, PN1.6	710	268	Φ350	460	Φ215	Φ180	8-Φ18	8-M16	155

**Table 4 Dimensions & Installation Reference (2)**

Unit: mm

Size Type	Height H	Center Height H1	Big Surface Diameter D	Base Bolt Position D3	Base Bolt Hole Size 3-Φ	Flange Distance L	Flange Out-Diameter D1	Bolt Hole Center Circle D2	Bolt Hole Diameter n-φd	Connection Bolt n-Md1	Weight (kg)
LL-50, PN2.5	940	237	Φ300	Φ240	3-Φ18	360	Φ160	Φ125	4-Φ18	4-M16	128
PN4.0							Φ160	Φ125	4-Φ18	4-M16	129
PN6.3							Φ175	Φ135	4-Φ23	8-M20	130
LL-80, PN2.5	1037	289	Φ400	Φ370	3-Φ23	460	Φ195	Φ160	8-Φ18	8-M16	228
PN4.0							Φ195	Φ160	8-Φ23	8-M16	229
PN6.3							Φ210	Φ170	8-Φ23	8-M20	231
LL-100, PN2.5	1100	318	Φ425	Φ370	3-Φ23	500	Φ230	Φ190	8-Φ23	8-M20	280
PN4.0							Φ230	Φ190	8-Φ23	8-M20	282
PN6.3							Φ250	Φ200	8-Φ25	8-M22	286

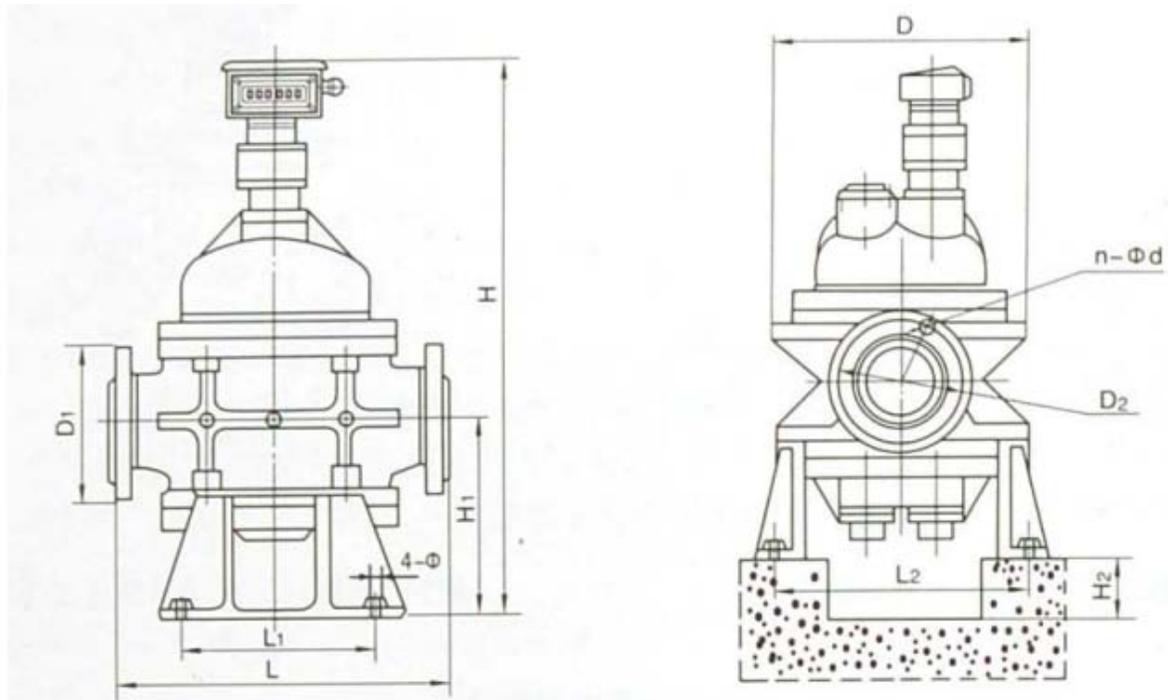


Fig.12 Flow Meter Dimensions (3)

**Table 5 Flow Meter Dimensions & Installation Reference (3)**

Unite: mm

Size Type	Height H	Center Height H1	Big Surface Diameter D	Base Bolt Position L1×L2	Base Bolt Hole Size 4-Φ	Flange Distance L	Flange Out- Diameter D1	Bolt Hole Center Circle D2	Bolt Hole Diameter n-φd	Connection Bolt n-Md1	Base Depth H2>	Weight (kg)
LL-150A PN1.6	1467	462	Φ470	350×360	4- Φ 25	650	Φ280	Φ240	8-Φ23	8-M20	60	460
PN2.5							Φ300	Φ250	8-Φ25	8-M22		470
PN4.0							Φ300	Φ250	8-Φ25	8-M22		470
PN6.3							Φ340	Φ280	8- Φ34	8-M30		490
LL-200 PN1.6	1528	488	Φ500	570×440	4- Φ 27	700	Φ335	Φ295	12-Φ23	12-M20	100	625
PN2.5							Φ360	Φ310	12-Φ25	12-M22		640
PN4.0	1540	500	Φ 520				Φ375	Φ320	12-Φ30	12-M27		650
PN6.3							Φ405	Φ345	12-Φ34	12-M30		670
LL-250 PN1.6	1731	576	Φ670	580×840	4- Φ 27	1000	Φ405	Φ355	12-Φ25	12-M22	100	1562
PN2.5			Φ425				Φ370	12-Φ30	12-M27	1578		
PN4.0			Φ445				Φ385	12-Φ34	12-M30	1595		
PN6.3			Φ470				Φ400	12-Φ41	12-M36	1620		
LL-300 PN1.6	1936	680	Φ670	580×840	4- Φ 27	1000	Φ460	Φ410	12- Φ25	12-M22	100	1780
PN2.5			Φ485				Φ430	16-Φ30	16-M27	1800		
PN4.0			Φ510				Φ450	16- Φ34	16-M30	1825		
PN6.3			Φ530				Φ460	16-Φ41	16-M36	1860		

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## 6. Roots Flow Meter Installation

### 1) Installation Site and Environment

- a) Indoor installation for the Flow Meter is recommended; if outdoor, certain necessary protecting measures must be taken to prevent it from being damaged by raining and sun beam that will cause surface rusty, glass aging and raining leaking into the meter;
- b) To avoid installation at the place where temperature is too high or too low, humidity is high, corrosive atmosphere or strong vibration exist; in case Optical-Electrical Converter is attached to the Meter, to avoid magnetic-field interference measures shall be taken into account;
- c) Convenience access for Meter operation, reading and care shall also be considered during installation;

### 2) Complementary equipment for the Flow Meter

- a) Roots Flow Meter is very sensitive to solid impurities fluid contains, which will generally cause Bearing & Gear abnormal wear and tear, or more seriously cause Rotor stalled, Pin broken or Roots smashed; So if fluid containing solid impurities, Filter shall be installed at upstream of Roots Flow Meter; Filter inlet/outlet pressure gauges should be mounted for filter blocking judgment by pressure difference monitoring;
- b) If Fluid to be measured contains gas, Air Eliminator should be installed at upstream of Flow Meter to separate gas from liquid for more accurate measuring purpose.
- c) In addition, pressure gauges are needed not only for filter but also for Flow Meter itself; Pressure gauges at up and down stream of Flow Meter shall be mounted for pressure loss monitoring during the fluid passing through it;
- d) There is no restriction for straight pipes at up/down stream of Roots flow Meter; So location and position for installation can be determined just by operation convenience regardless straight pipe limit consideration;
- e) It is better to mount a thermometer within the flow meter outlet pipe for fluid temperature monitoring;
- f) If Signal remote-transfer is needed, the Flow Meter should be attached with related Optical-Electrical Pulse Convertors and secondary instruments; for this purpose, please refer to their relevant instruction manuals;
- g) For some fluids with high viscosity, when the whole pipeline operation is stopped, they might be solidified within pipeline and/or Flow Meter; so it can be considered to add externally thermal preservation for Flow Meter;

### 3) Flow Meter Installation

- a) The Flow Meter pipeline arrangement is as shown in Fig.13

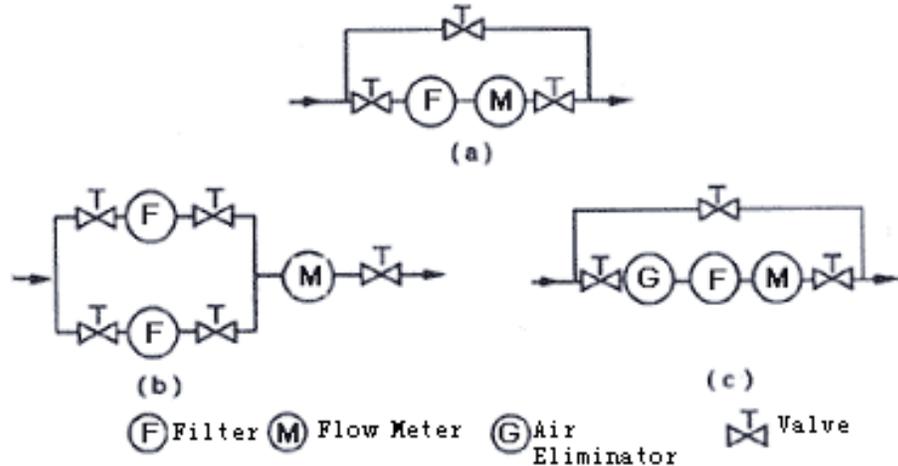


Fig.13

Roots Flow Meter must be installed upright and within horizontal pipelines only; For operation and maintenance reason, to ensure that flow in pipeline will not be interrupted during maintenance, by-pass pipe is needed, as shown on Fig.13 (a); if there is much impurities in the fluid, the filter needs frequent cleaning; in that case, to minimize any affection to the flow meter working, two filters being installed in parallel for alternative operation and cleaning is usually required; such pipeline arrangement refers to Fig.13(b); Fig.13(c) shows Air Eliminator being installed; If flow meter no interruption measurement is required or the maximum flow rate is higher in pipeline, two or more flow meters to be installed in parallel are applicable; each flow meter can be arranged as shown on Fig.13, even with a shared by-pass pipeline;

b) Flow Meter and its Auxiliaries shall be double-checked before installation including:

- (1) Type and Specifications;
- (2) Inlet/Outlet and flow direction marks;
- (3) Out-appearance with visibly damaging that may cause malfunction in operation;
- (4) No foreign objects within the Flow Meter chamber
- (5) Rotating meter rotor by hand or with unbroken wooden stick to see if it moves nimbly, meanwhile, the Counter shall rotate too, with ZERO returning in good condition;

**Important: Safety first when rotating by hand**

- c) Welding for all thermo-wells, pressure gauge connections and other related pipes around the flow meter shall be finished before its installation; all equipment and pipes need cleaning before mounting; be sure no welding residues and foreign objects are left in the pipelines;
- d) Pipeline Wipe-Off should be carried out before flow meter and filter installation; Flow meter or filter can be replaced by straight pipe during the time;
- e) Flow meter must be installed both vertically and horizontally as required; Filter and Eliminator should be arranged horizontally with reference to the Flow Meter horizontal level; check flow direction marks on each equipment that must be in line with fluid actual flowing direction; Flange gap shall be evenly distributed with proper gasket thickness, gasket is not allowed to be extended internally into the pipe;

- f) To avoid any additional external force from pipeline to the flow meter due to improper installation; to ensure no drawing force at the two ends of flow meter exerted by pipe line in preventing the flow meter from being deformed;
- g) Valves for flow rate adjusting should be arranged at flow meter down stream;
- h) Check the flowing direction marked on the flow meter is in line with the fluid flowing direction in the pipeline; measures for reversing-flow prevention are necessary so as to avoid damage caused by flow meter reversing;
- i) Valves, like by-pass valves that may affect the flow meter measuring correctness, should be cared by necessary leak-proof or other checking measures in order to secure accuracy;

4) Complementary Optical-Electrical Converter to be mounted

This section is only for the usage of Optical-Electrical Converter

**Note: Turn the Power off before Optical-Electrical Converter wiring and maintaining to avoid personal injury and equipment damage;**

- a) According to the adopted Type, wiring the terminal as shown in Fig.14
- b) For explosion-proof Optical-Electrical Converter, wiring and sealing as per explosion-proof requirements;

**Note: oppositely wriing for power, or pulse output being wrongly connected to power terminal may cause irrevocable damage; therefore, make every thing clear before wiring and double-checked them prior to power applying;**

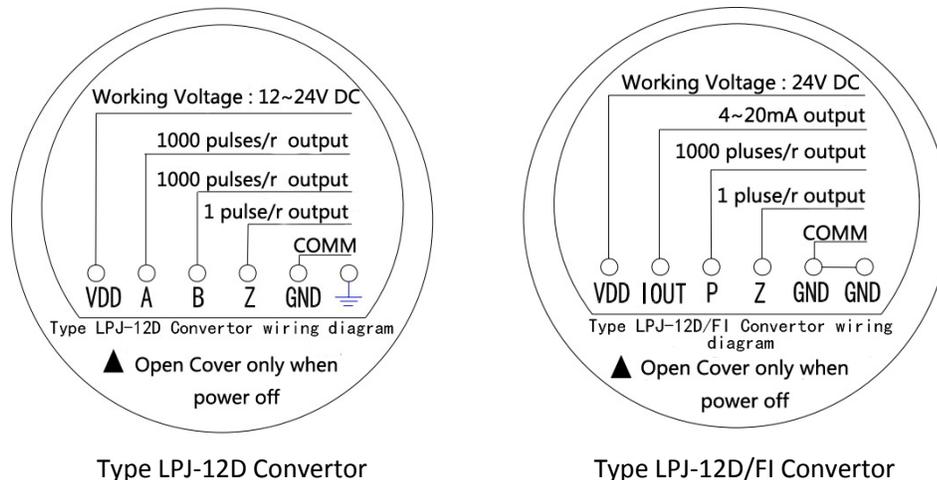


Fig.14 Wiring Terminals for Optical-Electrical Pulse Converter

- c) to place the Converter on the Flow Meter connector carefully, as shown in Fig.15; to ensure the pin inserting into the shaft slot, to align the Pin with Slot in advance; softly insert the converter connector into the connecting hole; as shown on Fig.15(b), when Surface A and Surface B being contacted perfectly, it means the Pin is into the Slot, then fasten the Nut to fix the Converter; if Surface A and B do not meet (as shown in Fig.15c ), it means Pin being stalled by the Slot, take out the Converter and try to do it again;

To push the Converter in with strong force is not allowed; furthermore, to fasten the Nut prior to two Surfaces contacting is prohibited.

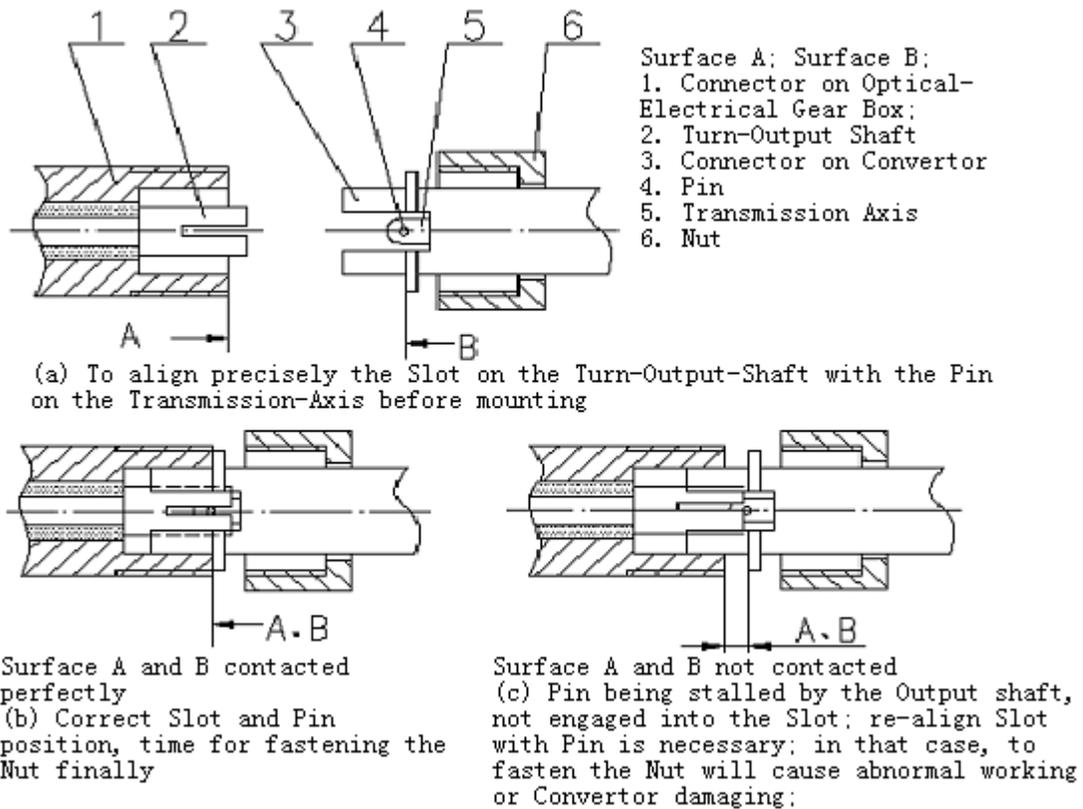


Fig. 15 Optical -Electrical Pulse Converter Installation

**Note: Nut is used for Converter fixing, to fasten it to the bottom just by hand turning, no tool being used;**

**Note: Converter will work improperly, or its inside components may be damaged if fastening the Nut before Surface A and B being contacted perfectly;**

d) More details regarding the installation of Optical-Electrical Pulse Converter and other secondary instruments, please read their instruction manuals respectively;

#### 5) Check after Installation

Check Flow Meter and its auxiliaries before actual operation;

a) Check the Flow Meter newly-installed, adjustment with oil passing is applicable; if by-pass pipe available; let the fluid pass through it first; when dirty fluid is almost passing away, then switching the fluid to the Flow Meter; if by-pass pipe is not available, appropriate measures should be taken during adjustment of oil passing, such as just to replace the flow meter by straight pipe, then restore it after dirty fluid is over;

b) If secondary instruments are equipped, their wiring correctness and reliability need check; when explosion-proof optical-electrical converter is used, carefully check the following items, like sealing device, leading cable sealing, rubber ring, explosion-proof terminal box, switch and cables to ensure they are perfect, no damage, no electrical leakage, and all in good contacting condition;

c) Check Flow Meter working properly; per its flow range, checking it from low to high flow rate by listening to its working sound, which should be smooth and not too noisy, checking

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its Counter, pulse convertor and secondary instrument, all of which should be in good condition;

- d) Check other equipment within the pipeline to be sure they are all working properly;
- e) Check by-pass valve and other valves, any leakage of which may affect the flow meter measuring correctness;
- f) Check the Counter ZERO return performance when operation stops;
- g) If on-site calibration equipment is available and on-line calibration is needed, on-line calibration can be made;
- h) After Installation, open pipeline pumps and valves slowly from small to big;

**Note: Flow Meter Calibration and Sealing Test by Water are not allowed;**

## 7. Roots Flow Meter Operation

To understand Flow Meter technical performance and application notes is necessary before operation.

- 1) Flow Meter attached with Big Character Wheel Counter: clear the counter to zero prior to use; at the time, counter displays 0 (top-row 7-digits counter is not influenced)

For Zero Return, hold the Zero-Return hand-wheel by right hand and push it to the Counter left, after rotating slightly, you will feel hand-wheel be hooked, turn the wheel clockwise, all digital wheels turn from big to small until all become Zero, hand-wheel ejecting; Big Character Wheel of Counter starting counting from zero; if hand-wheel not ejected, slightly turning it forward or backward to let it be ejected;

If not all Character Wheel at Zero, repeat Zero-Return again; during hand-wheel turning, moving it slightly to secure all Character Wheel are engaged;

**Note: Without Zero return, or no manual wheel ejection, Counter works improperly;**

**1. No Zero Return, when Counter operation is going on;**

**2. If Counter LBS-II is attached, see its own instruction manual for reference;**

- 2) If secondary instrument is attached to the flow meter, switch the instrument power on first;

- 3) Open the flow meter inlet valve first, let the fluid fully fill in the pipe and flow meter, then open the outlet valve gently to see whether the flow meter is working properly; if yes, to increase the flow to the required rate gradually;

**Note: In some cases, solidified fluid may fully fill within the pipeline, it takes time for melting; flow meter will work properly only when melting fluid is flowing; it usually takes a long time;**

Note: To ensure the fluid fully filling in the measuring pipe of flow meter, it is necessary to fully open its inlet valve; adjusting flow rate by outlet valve and sustain certain pressure in the flow meter outlet;

- 4) During operation, gas within the flow meter measuring chamber must be eliminated; otherwise its measuring accuracy will be affected; loosing the gas exhaust- screw- plug for gas exhausting (see Fig.4); when gas being completely exhausted, softly turn the Plug on until no liquid overflowing can be see; not turn the plug too tight that will cause sealing surface damaging.

- 5) Be sure, flow rate is within its measuring range, fluid pressure/temperature are also within their maximum working ratings;

**Note: when Series LPJ-12 Optical-Electrical Pulse Convertor is used, listed below is a Table for reference Flow Meter maximum flow rate vs. output pulse frequency:**

Table 6

Type		LL-15	LL-25	LL-40	LL-50A	LL-80	LL-100	LL-150A	LL-200	LL-250	LL-300
Max Flow Rate	m <sup>3</sup> /h	2.5	6	16	25	60	100	250	400	600	1000
	L/s	0.694	1.667	4.444	6.94	16.67	27.78	69.44	111.11	166.67	277.78
Max Frequency Hz		694	1667	4444	694	1667	2778	694	1111	1667	2778

If on-site display only, running watch can be used for maximum flow calculation.

**Note: Optimum flow rate working range is 20%~80% of the maximum flow rate.**

- 
- 6) To lubricate the Accuracy Trimmer, by frequently filling 20# Mechanical Lubricating Oil into the Spring cap type lubricating cup; Oil filling interval is about 10 days;  
If flow meter not working for long time, lubricating it first;
  - 7) For the hydraulic oil nipple on the Output Shaft Sealing Mechanism, it needs glycerol to be pressured in, 10 days each time with 2ml glycerol;  
Oil Gun and glycerol are packed with Flow Meter as accessories for Ex-works;
  - 8) Filter needs frequent cleaning to avoid blockage and pressure loss; cleaning interval may be determined by its inlet/outlet pressure difference; if any filtering grid broken is found, replace it in time;
  - 9) If operation stop is required, to shut off the outlet valve first, to prevent flow meter from being damaged by reversing fluid flow;

**Note: At any time, opening or closing valves softly to avoid impact to Flow Meter or its auxiliaries caused by fluid flow rate sudden change;**

- 10) What Roots Flow Meter displays is volumetric total flow of fluid under measuring conditions; if the temperature or pressure changes considerably during measuring, additional deviation occurs; if the compression or expansion coefficient for the Fluid is known, revision can be made as following;

Fluid Volume-Temperature revision by formula below:

$$Q_{ts} = Q_i \times [1 - \alpha (t_i - t_s)] \dots \dots \dots (1)$$

where

- $Q_{ts}$  is the Fluid volume in standard temperature
- $Q_i$  is the Fluid volume in measuring (in working status during measuring)
- $\alpha$  is the volume expansion coefficient of the liquid to be measure; unit  $1/^\circ\text{C}$
- $t_i$  is the liquid temperature in measuring status; unit:  $^\circ\text{C}$
- $t_s$  is the liquid temperature in standard status; unit:  $^\circ\text{C}$

In general, for mineral oil, volumetric expansion coefficient  $\alpha = 6.4 \times 10^{-4} (1/^\circ\text{C})$ , It shows temperature variation has big influence on fluid volume; because  $10^\circ\text{C}$  temperature changing will cause about 0.64% volume change for the fluids with same mass;

Fluid Volume-Pressure revision by formula below:

$$Q_{ps} = Q_i \times [1 + \gamma (P_i - P_s)] \dots \dots \dots (2)$$

where

- $Q_{ps}$  is the Fluid Volume at standard pressure
- $Q_i$  is the Fluid Volume when measuring (under measuring condition)
- $\gamma$  is the compression coefficient of liquid to be measured; Unit:  $1/\text{Pa}$  or  $\text{m}^3/\text{N}$
- $P_i$  is the Liquid pressure under measuring condition; Unit: Pa
- $P_s$  is the Standard pressure: Unit: Pa

In general, for liquid, volumetric compression coefficient  $\gamma = 6 \times 10^{-10} (1/\text{Pa})$ , It shows pressure changing of 1Mpa will cause about 0.06% volume change for the fluids with same mass;

*Note:*

- (1) Standard Pressure and Temperature normally refer to  $P_s = 0.101325\text{MPa}$  (absolute pressure);  $t_s = 293.15\text{K}$  (absolute temperature) =  $20^\circ\text{C}$
- (2) For  $\alpha$  and  $\gamma$  of different fluid, please refer to related manual or materials;
- (3) Revision for both temperature and pressure at the same time are applicable;

For much higher accuracy measuring, in addition to temperature and pressure revision, deviation trimming can also be made through deviation trimming formula below:

$$Q_i' = Q_i \times (1 - E) \dots\dots\dots (3)$$

where

- $Q_i'$  is the Volume reading after trimming
- $Q_i$  is the Fluid Volume when measuring
- E is the Flow Deviation at the measuring point, measuring points beyond calibration points can be obtained by interpolation method in mathematics;

- 11) during operation, surveillance is needed, like listening to the flow meter working sound in checking if it is in normal running; if it sounds abnormal, or its Counter is stalling, hopping or not running, stop the operation immediately;
- 12) Periodically cleaning, Flow Meter calibration after a period time of working are necessary, calibration cycle generally is once a year. During cleaning if part wearing or tearing is found, repair or part-replacement must be made; re-calibration is necessary after that;
- 13) Accuracy trimming:

If accuracy is found declining in calibration, accuracy trimming to the flow meter can be made;  
*Note:*

*What we mentioned here for the accuracy trimming is actually the adjusting of Deviation Curve position for the whole flow meter; it means to add an trimming quantity on the reading of each flow measuring point, however it does not change the fundamental deviation of the flow meter; for instance, a flow meter, its 3 flowing points are 20%Qmax, 40%Qmax and Qmax with deviation of -0.6%, -0.3% and -0.5% respectively; trimming for it now is +0.45%; after trimming, deviations for these 3 points are changed into -0.15%, +0.15%, and -0.05%, it conforms with Accuracy Class 0.2 for the flow meter;*

*In our technical terms, accuracy over tolerance refers the difference between maximum and minimum deviation is bigger than 0.4% (for Class 0.2) or bigger than 1% (for Class 0.5); under such circumstance, it is not possible to adjust the deviation to the extent that makes it be within fundamental tolerance in accuracy trimming; at this point, flow meter cleaning and maintenance seems necessary; so it doesn't make sense in assuming that the flow meter deviation is over its tolerance in case that just one flowing point for the flow meter being calibrated;*

**Note: Flow Meter calibration shall be made only by qualified quantitative management institute or organization; re-sealed by lead-seal after accuracy trimming.**

a. Small Gauge Mechanism Accuracy Trimming

Turn off 4 Hex-screws (M6) on Case for Gauge fixing; take off the Case; turn off Nut for changeable Gears fixing (see Fig.16); along with slot on Bottom Plate of Gear Box, slightly move changeable Gear and moveable Shaft; take out Wash, changeable Gear, replace it by needed Changeable Gear, move Shaft internally; check two pairs of Gears being engaged with proper gap, restore Wash and fasten Nut; put on Case, fasten Hex-screws; check Bevel-Gears being engaged properly;

**Note: Changeable Gears and Trimming Table are to be provided by this company separately.**

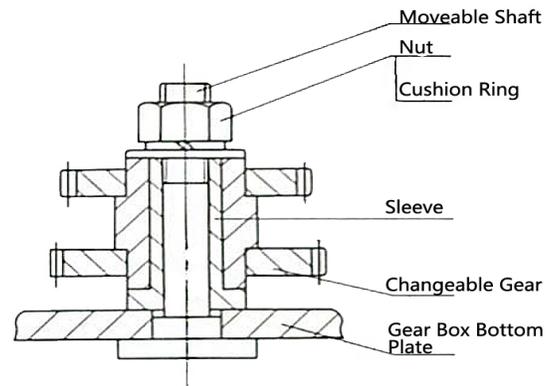


Fig.16 Changeable Gear Structure Scheme

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b. Big Character Wheel Mechanism Accuracy Trimming

Turn off two screws on the fixing cover on the right of Accuracy Trimmer, take off cover, turn the adjusting pole by screw driver for trimming as per “+”, “-“directions (see Fig.17) The trimming resolution is about 0.06% per grid and 1.08% per turn; according to the trimming quantity to adjust it with corresponding turns and grids; being satisfied, put the cover on and fasten the screws;

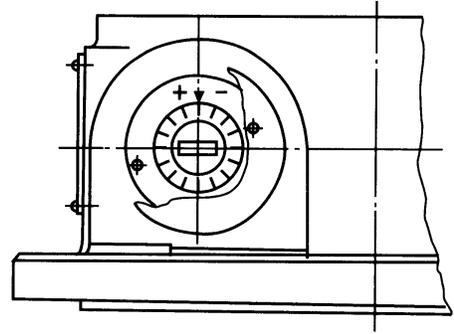


Fig.17 Accuracy Trimmer Adjusting

14) Following Wrong Operations are strictly prohibited:

- a. Medium that is corrosive to flow meter, like water, is used for inspection or calibration;
- b. Flow Meter is operated at its maximum flow rate range and/or at its highest working temperature for long time;
- c. Rough operation and tough repair in any case;

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## 8. Roots Flow Meter Maintenance & Cares

### 1) Daily Care

In addition to description in Section 6) and 7) of Chapter 6 for daily care, Flow Meter maintenance can be made as per below Section 2 “Trouble & Shooting” for disassembly, cleaning, lubricating and restore; all parts need to be washed and cleaned prior to restoring; Gear engagement portions for Counting Mechanism, Accuracy Trimmer need grease lubrication; 20# mechanical lubricating oil for axis, shaft and bearing;

### 2) Common Troubles & Shooting

Flow Meter installing/dismantling and maintenance must be carried out by professionals or those who are well trained in this respect, otherwise equipment damage and even personal injury may happen;

Flow Meter trouble may be caused by several different roots, which should be attentively checked and analyzed; especially some trouble roots might be from trouble of other parts; for instance, Big Character Wheel gear broken is usually caused by Wheel stall; if same trouble occurs frequently it means actual trouble root has not been found out yet, further analysis is necessary;

After being dismantled from flow meter for repair, each component needs to be check by hand rotating of shaft or gear; to make sure, no stalling, crashing or sliding; if necessary, hold Output Shaft or Gear by another hand, Input Shaft, at this time, is not rotatable; before Roots Rotor being taken out, move driving gear of Rotor for checking no crash;

#### a. Trouble checking sequence

If fluid can not pass through the flow meter, Counter can not count or run, the steps below may be taken for pipeline and flow meter check or repair:

- (1) If no medium passing or abnormal counting: check the power supply first; if power failed, the pump being stopped for a long time or the pipeline with no thermal keeping, medium was solidified that caused the flow meter abnormal working; in this case, warming-up and wiping-off in the pipeline and fixing the power for pump on;
- (2) Check the pump output capacity, if not adequate, replace it;
- (3) Check filter if it is blocked by misled objects with no medium passing; if it is, cleaning the filter;
- (4) If above mentioned possibilities are ruled out and trouble still exists, please follow the steps below for further checking;
  - a) taking out mechanical counting mechanism from flow meter, checking pin or screw for Reducer Gear fixing if it is loosing, and checking Reducer Gear engagement condition;
  - b) dismantle flow meter from pipeline; take out magnetic sealing mechanism; check if internal/external magnets being loosen, or poor engagement between external magnet gear and output gear, or any fixing screw loosing;
  - c) Take off up-cover, check fixing Pins for driving gears and output gears;
  - d) Take out Roots Rotor with axis; after cleaning, check Rotor surface if there is any scratch;
  - e) Any bearing or thrust-bearing damage;
  - f) Any steel ball broken;

#### b. Common wearing parts in trouble and treating

- (1) Bearing wear often occurs because flow meter is rotating at high speed, or mud and sand particles within petrol items might enter into measuring chamber causing bearing quick wearing; if bearings are damaged, replace them;
- (2) Driving Gears are also working at high speed for long time; Gears are being worn much more quickly if flowing liquid contains much impurity particles; For LL-150 -300 Flow Meter, driving gears are fixed on wheel by bolts; LL-15-100 Flow Meter driving gears are fixed directly on the shaft; if Gears are worn, replace them by new ones; during replacing, sustain certain gap between Roots; scratching with each other is not allowed; gap even distribution should be kept; fix them firmly on axis by screws and then drill hole for Pin fixing match;
- (3) Thrust-Bearing wearing will cause scratching with wearing among Roots end-surface, middle isolating plate and low cover plate surface; open the low cover, adjust adjustable-bolts to separate these surfaces with certain gaps, fasten fixing Nut; if Thrust Bearings is seriously damaged, replace it;
- (4) Scratching between Roots and Housing inner wall due to bearing wearing, Roots replacement is needed since Housing, in general, will not be worn easily; Roots replacing is basically similar to Driving Gear;
- (5) O-rings for every part may easily wear and tear although they are made of Oil-durable rubber; due to the long time pressing they are aging and deforming; poor sealing causes Medium leaking; so they need to be replaced in time; All O-rings adopted by this Roots Flow Meter are standardized that are commercially available on the market;  
(O Rings for Flow Meter Ex-works are made of fluorinate-rubber)

Apart from above-mentioned troubles, please read Table 7 for other troubles shooting;

Table 7 Roots Flow Meter frequent troubles and shooting

<b>A. Measuring Chamber Part</b>		
<b>Trouble</b>	<b>Cause</b>	<b>shooting</b>
1.No flow passing flow meter,no counting in Gauge;	1. Filter blockage; 2. misled objects like welding Strips, iron wire, plastic bag, stone that cause Roots stalled	1.cleaning filter; 2.open flow meter up-cover, take out misled objects, clean trimming Roots surface, check filtering grid, change it if broken;
2. Flow Meter working noisy, with accuracy declining;	1. Bearing wear 2. Thrust Bearing wear, Roots shaft goes down causing scratch and wear among oval end-surface, middle isolating plate and low cover plate; 3. Steel ball broken causing scratch among oval surface, middle isolating plate and low cover plate surface; 4. Scratch between Roots Rotors, or Rotor with housing;	1. Replace Bearing; 2.adjust adjustable-bolt;Check thrust bearing with Roots shaft and adjusting-bolt connection, if loosing, make firm connection;  3.If too much wearing in Thrust Bearing, replace it;  4.replace or mending Rootss
3. Sealing leakage;	O ring aging, not effective	Replace O ring

<b>B. Speed-changing &amp; Linking Part (Gear Reducer and output shaft sealing mechanism)</b>		
<b>Trouble</b>	<b>Cause</b>	<b>shooting</b>
1. Gauge no counting, while Roots shaft rotating and fluid normally draining	1. Gear fixing Pin broken or lost; 2.output shaft mechanism long axis broken; 3.Reducer Gear and axis deadlock; 4.Reducer linking “crossing-style” lever slipped from its seat; 5. External/internal magnet being demagnetized causing failed coupling	1. Replace fixing Pin; 2. Replace long axis; 3. Dismantle gear and axis, polish them by grinding sand paper, for nimble matching with gap; 4.Re-aassemble; restore lever to seat; 5.replace external/internal magnets;
2. No glycerol filling can be made for output-shaft mechanism	1. No glycerol filling for a long time causing chamber vacancy, Medium entering and solidifying; 2. poor Oil Gun	1.Clean sealing mechanism chamber, check oil nipple; 2. Use good one
3.Frequent long shaft broken in output sealing mechanism	1. Strong impact force; 2. Trouble from gauge part	1.Open valve gently in operation; 2.check and mend all items related to output shaft sealing mechanism: Accuracy Trimmer, Optical-Electrical Gear Box and Big Character Wheel
4.Output shaft sealing mechanism leaking	1. No frequent glycerol filling causing chamber vacancy to affect sealing; 2. Oil Nozzle sealing rubber aging and expired; 3. Chamber Bowl- Style Seal Ring aging and expired;	1. frequent glycerol filling 2. Replace Oil Nozzle sealing rubber 3. Replace Chamber Bowl- Style Seal Ring

<b>C. Accuracy Trimming part</b>		
<b>Trouble</b>	<b>Cause</b>	<b>Shooting</b>
1. Flow Meter Accuracy declining, repeatability deviation bigger	1.Moving lever or Eccentric Lever Wearing; 2. Cover or Base Bearing holes Wearing;	1.Replace Moving lever or Eccentric Lever; 2.Replace cover and Base
2.Output Shift not running	The Axis $\phi 5$ on the Driving Plate being separated from Driving Plate;	1.Replace Driving plate; 2. drill for Pin matching

<b>D. Big Character Wheel Counter Part</b>		
<b>Trouble</b>	<b>Cause</b>	<b>Shooting</b>
1. Digital Wheel no counting;	1.Wheel shaft not ejected; 2.Gear transmission link broken; 3.moving fork or pin lost, broken; 4.Driving Gear broken; 5.Friction sheet with oil causing sliding; 6.Tower-style spring broken or deformed; 7.digit-forwarding wheel stalled with digital wheel end-surface	1. return Zero again and confirm shaft ejected, if not, see below: 2.Adjusting driving Gear; 3.reassemble or replace; 4.find trouble cause, replace; 5.dismount 1 <sup>st</sup> wheel friction sheet, clean it with gasoline; 6.replace; 7. properly make digital-forwarding wheel end-surface shorter with a file, so to keep it a certain gap with digital wheel end-surface;

2. Digital Wheel shaft not ejected	1.wet environment for long time, Digital Wheel shaft rusty; 2.Digital Wheel shaft wearing	1.take out Digital Wheel Shaft , eliminate rusty by fine iron oxide sand paper; oil lubricated; 2. Replace;
3. Poor Zero Return	1. Gap between first wheel and adjusting screw too big; 2. moving fork broken within digital wheel or first wheel; 3.pin for digital wheel shaft and sleeve lost	1. adjust adjustable-screw to keep its gap with first wheel about 0.2 -0.3 mm; 2.dimount digital wheel or first wheel, replace moving fork; 3. replace pin;
4. Gear Transmission Mechanism broken	1. Axial Gap between Zero Return positioning component and Pressing Ring too big, causing spring exposed and deadlocked; 2.insufficient hardness for Digital Wheel shaft causing Zero Return Slot deformation with wheel and shaft deadlocked ; 3. Too big gap for Gear Transmission Mechanism assembly;	1.replace positioning component spring; adjusting its gap to about 0.1mm by washes;  2. mending digital wheel hole or shaft; or just replace them;  3. gap check and adjusting;

<b>E. Flow Meter Accuracy Declining</b>		
<b>Trouble</b>	<b>Cause</b>	<b>Shooting</b>
1. Negative deviation (Flow Meter Readings is less than actual value)	1. Flow being over flowing range;  2. Medium viscosity seems lower ;  3.Trouble from Measuring Chamber or Trimmer parts	1.Use the Meter within its Range; or use Meter with bigger nominal diameter; 2. re-calibration made by liquid with similar viscosity and adjust Accuracy Trimmer; 3. check these parts (details as per above) and shoot troubles;
2. Positive deviation (Flow Meter Reading is more than actual value)	1.Flow with bigger fluctuation;  2. Medium mixed with gaseous;  3. Medium viscosity seems higher,	1.Minimize pipeline vibration to make flow with less fluctuation; 2. Equipped with Eliminator; Or repair it if it is existing; 3. re-calibration made by liquid with similar viscosity and adjust Accuracy Trimmer;

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## 9. Transportation & Storage

1) Flow Meter should be stored in the warehouse where it is dry, ventilated and without corrosive atmosphere; for flow meters with packing taken-off, be careful, no foreign objects entering into the measuring chamber and no damaging on Flange surface;

### 2) Return Transportation

If return flow meter for maintenance, calibration or commissioning by this company, please send it directly to us or via competent transportation agents;

- a) Be attached with written documents describing return reason and purpose in details; such as for repair or calibrating, Meter Type, Serial No., application condition, trouble situation, together with contact person name, address and phone no. etc.
- b) Properly packing the product with above documents and sending them to our Sales Department; anyway, written documents sent to us by post are also acceptable;  
**Note: use the original Ex-work packing by this company is strongly recommended**
- c) If some parts are found missing within the return products 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.
- d) Return Address:

Salse Department SAIC No.9  
No.157 Changji Rd., Anting , Jiading , Shanghai , PR. China  
Zip Code: 201805  
Phone: 86-21-59577980  
Fax: 86-21-59564732

## 10. Key Points for Ordering

To make sure that the fluid to be measured is suitable for Roots Flow Meter measuring; all technical specifications are acceptable before ordering. You can read this Manual or consult our sales people and professionals in advance for details;

### 1) Following points shall be noted for ordering

- a) Flow meter Type; Nominal Pressure and Accuracy
- b) Fluid to be measured: its name, viscosity, regular pressure, temperature, flow rate, Minimum/Maximum flow rate;
- c) Complementary equipment, like Filter, Eliminator, Optical-Electrical Pulse convertor, Totalizer etc. all of them can be ordered from us at the same time;
- d) If you have any special needs, please contact our Sales Department for negotiation;

### 2) Complementary Products Brief Descriptions

- a) LPG Filter: nominal diameter, nominal pressure matching
- b) LPX Air Eliminator: nominal diameter, nominal pressure for matching , Nominal diameter ranging:  $\phi$  50-  $\phi$  300
- c) LPJ Optical -Electrical Pulse Convertor brief description: see Table 8

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d) Flow Totalizer brief description: see Table 9

Table 8 LPJ Optical -Electrical Pulse Convector brief description

Type	Function Brief
LPJ-12D	Explosion-Proof ; Output Signal: 1 pulse/round; 90° Phase- lag double-way pulse signal: 1000 pulses/round
LPJ-12D/FI	Explosion-Proof ; Output Signal: 1 pulse/round and 1000 pulses/round; 4~20mA Current Signal

Table 9 Flow Totalizer brief description

Type	Function Brief
XSJ-39A (Series)	Simultaneous display for Total Flow, Instant Flow Rate; 4-20mA Current Output; Quantification Control & Filling, Power Failure Data Protection

## 11. Package Contents

Complete package contains:

- 1) Flow Meter 1 set
- 2) Instruction Manual 1 Copy
- 3) Quality certificate 1 Original
- 4) High Pressure Gun for Oil Lubricating 1 set  
(For Flow Meter with Big Character Wheel Counter Only)

The end.