LGB Series
Orifice Flowmeter
(Orifice Throttling Device)

Installation Manual

Thanks for your reading.

LGB series Orifice Flowmeter (Orifice Throttling Device) is the critical product of our company with core technology. In order to improve the properties of product, we have never stopped to advance its reliability, stability, practicality and the convenience of operation.

We will be highly appreciative if any user could discover and point out any mistake or omission from the Manual, we will amend the same in the Manual of next version.

Table of contents

1 General

1.1 Introduction

LGB series Orifice Flowmeter (Orifice Throttling Device) is appropriate for flow measurement and process control in the petroleum, chemical, natural gas, metallurgy, iron and steel, power, water, pharmaceutical, textiles, beverage, energy, environmental protection and urban public utilities and other industries.

Measure flow rate by the principle of differential pressure is the most reliable method of the world, and throttling device is one of the most representatives. Base on the accumulation of lots of practice experience, throttling device is the unique in all flowmeters of which could estimate the relationship between flow quantity and output signal, as well as its measuring error without any actual flow calibration.

Built-in type flange tapping orifice flowmeter (Built-in type flange tapping orifice throttling device, patent number ZL2004 2 0033761.9) is one patented product of our company, which solved several possible problems of traditional orifice flowmeter such as difficult installation, low concentricity between flanges and orifice plate as well as its sealing gasket, high measurement error, bad sealing performance between orifice plate and flanges, and leakage happens easily.

The integrated orifice flowmeter was direct assembly by differential pressure transmitter and orifice throttling device, which could leave out the pipe laying project for pressure impulse at site, also improved the dynamic property, decreased the maintain jobs and failure rate, reduced the costs of purchasing and operation.

All products under LGB series orifice throttling device could be manufactured into the integrated type.

Our company conducts the production and service for LGB series orifice flowmeter strictly accordance with the quality management system of GB/T 19001-2016 / ISO 9001:2015. All used design & calculation software are in accordance with relevant international and national standard, which is impartial and authoritative.

1.2 Features

(1) The orifice Flowmeter has high measurement accuracy, which is easy to install and with low cost, could be widely used in flow measurement for various medium.

(2) Standard nozzle flowmeter has the characteristics of high temperature resistance, high pressure resistance, impact resistance, prevent of flashing, long service life, wide measurement range and high accuracy, which is suitable for the flow measurement of steam, liquid ammonia and large flow rate conditions. The nozzle flowmeter includes standard nozzle and venturi nozzle, and the standard nozzle includes ISA 1932 (standard nozzle) and long-radius nozzle total two types.

(3) Venturi Flowmeter has the characteristics of low pressure loss, high accuracy, short meter run and long sevice life .

(4) Balanced orifice flowmeter is a kind of new type differential pressure type flowmeter, which is digestion and absorption from the technology of foreign balanced flowmeter then developed by our company, and is equivalent with advanced foreign technology. The flowmeter has the

characteristics of high accuracy, short meter run, low pressure loss, large range ratio, excellent repeatability and stability, resistant to dirt and not prone to blockage, wide measurement range and wide range of application.

(5) Conical entrance orifice, 1/4 Circle orifice, Double orifice, they are suitable for flow quantity measurement of medium fluid at low Reynolds condition. They are widely used for measuring the flow rate of liquid and gases with large viscosity and low flow rate.

(6) Segmental orifice, Eccentric orifice, they have the characteristics of not prone to clogging and short meter run. They are suitable for the flow measurement of the gas and liquid with dust or impurities. For example coal gas.

1.3 Principle

If the throttling elements of before calibration are geometrically similar with those completed and with same operation condition, then the numerical relationship between static pressure difference and fluid flow could be derived through continuity equation and Bernoulli's equation according to the known parameters. The relationship could be calculated according to the below fundamental formula:

Mass flowrate: $q_m = \frac{C}{\sqrt{1-\beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{2\Delta P \rho_1}$

Volume flowrate: $q_v = \frac{C}{\sqrt{1-\beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{\frac{2\Delta P}{\rho_1}}$

Where: q_m ---- Mass flowrate, *kg/s*

q_v ---- Volume flowrate, m^3/s

C ---- Discharge coefficient

ε ---- Expansibility (expansion) factor

β ---- Diameter ratio, $\beta = \frac{d}{D}$

d ---- Diameter of the orifice under working conditions, *m*

D ---- Upstream intemal pipe diameter under working conditions, *m*

ρ_1 ---- Fluid density under working conditions, kg/m^3

ΔP ---- Differential pressure, *Pa*

As shown in Figure 1.3.1, install a throttling element (for example Standard Orifice) in the fluid-filled pipe, the upstream and downstream sides will generate static pressure difference when fluid flow past.

The differential pressure value ΔP could be converted to standard current signal by differential pressure transmitter, then display the flow rate or total rate by display instrument.

Orifice Flowmeter consists of orifice plate, pressure pipe and differential pressure transmitter total three ports.

Diagram of standard orifice flowmeter principle is shown in Figure 1.3.1.

Diagram of standard orifice flowmeter assembly is shown in Figure 1.3.2.

Diagram of throttling element pressure loss is shown in Figure 1.3.3.

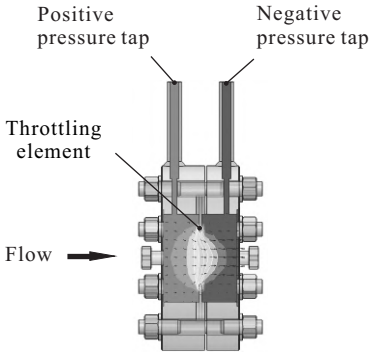


Figure 1.3.1 Orifice Flowmeter principle diagram

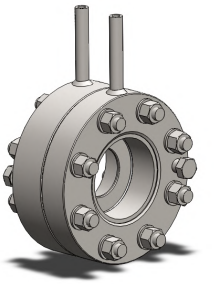


Figure 1.3.2 Orifice Flowmeter assembly diagram

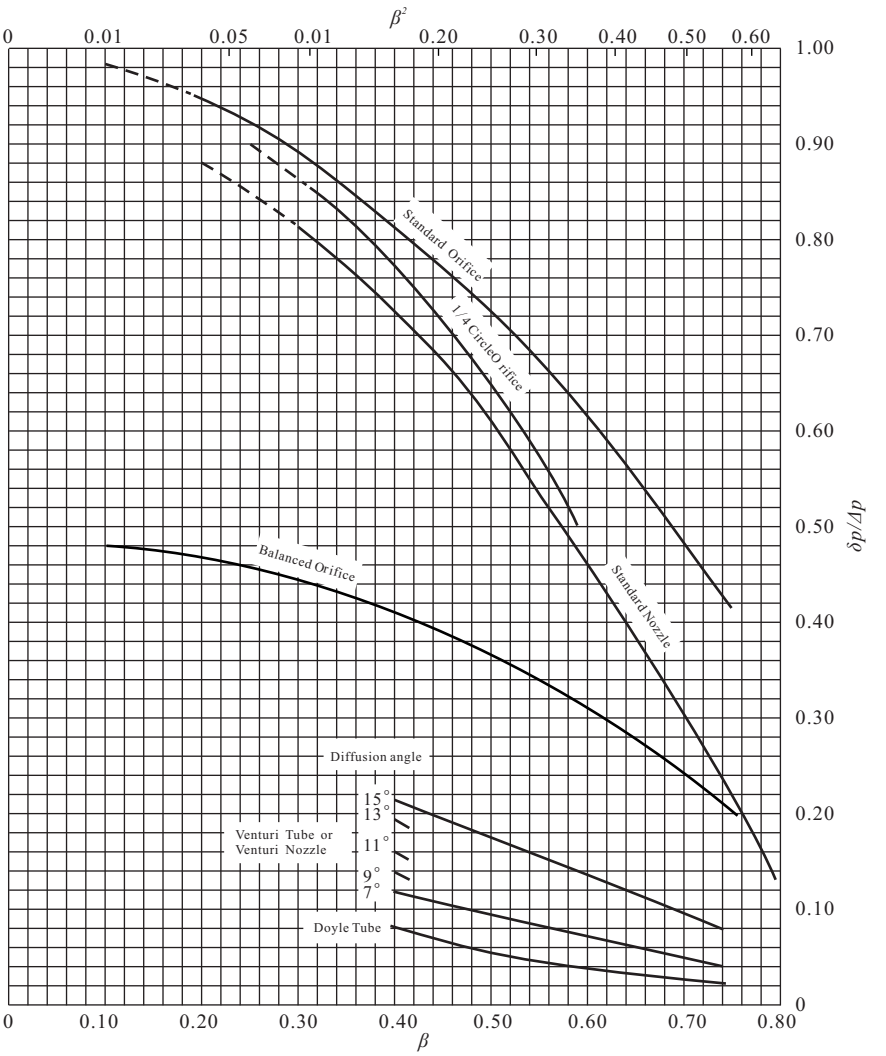


Figure 1.3.3 Diagram of throttling element pressure loss

2 Specification

Category	Type	Pressure taps	Model	Main technical specification		Scope of application	
				Nominal size (mm)	Nominal press. (MPa)	Diameter ratio	Reynolds number range
Orifice Flowmeter	Standard Orifice	Corner taps, Chamber	LGBH-□/□	50~1000	1.0~32.0	$0.1 \leqslant \beta \leqslant 0.75$	$0.1 \leqslant \beta \leqslant 0.75$, $Re_D \geqslant 5000$ $\beta > 0.56$, $Re_D > 16000\beta^2$
		Corner taps, Drill holes	LGBZ-□/□				
		Radius taps	LGBJ-□/□				
		Flange taps	LGBF-□/□	50~1600	1.0~32.0	$0.1 \leqslant \beta \leqslant 0.75$	$Re_D \geqslant 5000$ & $Re_D \geqslant 170\beta^2 D$ (D for the pipe diameter, mm)
	Built-in Orifice	Flange taps	LGBFC-□/□	50~600	1.0~32.0	$0.1 \leqslant \beta \leqslant 0.75$	$Re_D \geqslant 5000$ & $Re_D \geqslant 170\beta^2 D$ (D for the pipe diameter, mm)
	HP Lens Orifice	Corner taps, Drill holes	LGBTZ-□/□	15~600	16.0~42.0	$0.1 \leqslant \beta \leqslant 0.75$	$0.1 \leqslant \beta \leqslant 0.75$, $Re_D \geqslant 5000$ $\beta > 0.56$, $Re_D > 16000\beta^2$
	Little Orifice	Corner taps, Chamber	LGBXH-□/□	25~40	1.0~16.0	$0.23 \leqslant \beta \leqslant 0.7$	$0.23 \leqslant \beta \leqslant 0.5$, $Re_D \geqslant 40000\beta^2$ $0.5 \leqslant \beta \leqslant 0.7$, $Re_D \geqslant 10000$
	Balanced Orifice	Corner taps, Chamber	LGBPHH-□/□	15~1500	1.0~42.0	$0.25 \leqslant \beta \leqslant 0.9$	$200 < Re_D \leqslant 10^7$
		Radius taps	LGBPHJ-□/□				
		Flange taps	LGBPHF-□/□				
		Flange taps, Hidden orifice	LGBPHFC-□/□				
	¼ Circle Orifice	Corner taps, Chamber	LGBRH-□/□	25~40	1.0~16.0	$0.245 \leqslant \beta \leqslant 0.6$	$250 < Re_D \leqslant 10^5\beta$
		Corner taps, Drill holes	LGBRZ-□/□				
		Flange taps	LGBRF-□/□	50~500			
	Conical entrance Orifice	Corner taps, Chamber	LGBVH-□/□	25~500	1.0~16.0	$0.1 \leqslant \beta \leqslant 0.316$	$80 \leqslant Re_D \leqslant 2\times10^5\beta$
		Corner taps, Drill holes	LGBVZ-□/□				
	Segmental Orifice	Flange taps	LGBQF-□/□	100~350	1.0~16.0	$0.3 \leqslant \beta \leqslant 0.8$	$100 \leqslant D \leqslant 125$, Re_D Upper limit unlimited $125 \leqslant D \leqslant 350$, $Re_D > 10000$ $100 \leqslant D \leqslant 350$, $Re_D > 80D$ (D for the pipe diameter, mm)
	Eccentric Orifice	Corner taps, Chamber	LGBPXH-□/□	100~1000	1.0~16.0	$0.46 \leqslant \beta \leqslant 0.84$	$2\times10^5\beta^2 \leqslant Re_D \leqslant 10^6\beta$
		Corner taps, Drill holes	LGBPXZ-□/□				

3 Parameters

Nominal size (DN)	DN15~DN1600（mm） 1/2 inch ~ 64 inch
Nominal pressure (PN)	PN1.0~PN42.0（MPa） Class150 ~ Class2500
Applicable medium	Liquid, Gases and Steam
Temperature range	−40~+450℃
Throttling element	Standard Orifice, Built-in Orifice, HP Lens Orifice, Little Orifice, Balanced Orifice ¼ Circle Orifice, Conical Entrance Orifice, Segmental Orifice, Eccentric Orifice
Pressure taps	Flange taps, Corner taps-Chamber, Corner taps-Drill holes, Radius taps, Special taps
DP transmitter	Smart differential pressure transmitter of made by ROSEMOUNT, YOKOGAWA,SIEMENS,Endress+Hauser etc.
Measurement span ratio	6:1, 10:1, More than 10:1
System uncertainty	±0.5%, ±1.0%, ±2.0%
Element material	304, 304L, 316, 316L, Other
Flange material	20, 16Mn, 35CrMo, 304, 316, Other
Power supply	Transmitter: 24V.DC Flow display device: 220V.AC or 24V.DC
Transmitter output	4~20mA.DC (Digital communications required minimum 250 Ω load resistance)
Explosion-proof class	Exia Ⅱ CT2~Exia Ⅱ CT6 Exd Ⅱ CT2~Exd Ⅱ CT6
Protection grade	IP65
Allowable vibration acceleration	≤1.0g
Ambient temperature	−25~+55℃ (Outside this range, please declaration)
Humidity	45~85%

4 Model and suffix codes

● Name: Orifice Flowmeter (Orifice Throttling Device)　　Model: LGB－PN□/DN□

Model	Suffix Codes	Description
LGB	……	Orifice Flowmeter (Orifice Throttling Device)
Structure	……	Split structure
	Y ……	Integrated structure
	F ……	Pipe flange type
	H ……	Welding type
	YF ……	Integrated structure, Pipe flange type
	YH ……	Integrated structure, welding type
Throttling element type	……	Standard Orifice
	T ……	Lens Orifice
	X ……	Little Orifice
	PH ……	Balanced Orifice
	R ……	¼ Circle Orifice
	V ……	Conical entrance Orifice
	S ……	Double Orifice
	Q ……	Segmental Orifice
	PX ……	Eccentric Orifice
Type of pressure taps	H ……	Corner taps, Annular chamber
	Z ……	Corner taps, Drill holes
	J ……	Radius taps
	F ……	Flange taps
	FC ……	Hidden Orifice, Flange taps
Nominal pressure (MPa) (or Class Level)	－（1.0～42.0） ……	PN1.0～PN42.0
	－（150 LB～2500 LB）……	Class150～Class2500
Nominal size (mm) (or NPS-inch)	/（15～1600） ……	DN15～DN1600
	/（1/2 "～64 "） ……	1/2 inch～64 inch
Optional codes	－□□□□□	Optional specification

● Example

＊ Simplify the specification code: LGBFC-1.6/100

Representation: Orifice Throttling Device, Built-in orifice plate, Flange taps, Nominal pressure is 1.6MPa, Nominal size is 100 mm. Other specification parameters technical information described in the relevant documents (such as instrument data table, design calculations).

● Optional specifications

Item	code	Description
–	……	Additional specifications (Optional)
Structural composition	1 ……	Throttling element, annular chamber
	2 ……	Throttling element, annular chamber, flange
	3 ……	Throttling element, annular chamber, flange, meter run
	4 ……	Throttling element, annular chamber, flange, meter run, rear connecting flange
	5 ……	Throttling element, annular chamber, flange, meter run, front and rear connecting flange
Transmitter type	A ……	Common differential pressure transmitter
	B ……	Smart differential pressure transmitter
	C ……	Imported smart differential pressure transmitter
	D ……	Multi-parameter flow transmitter
	E ……	Import multi-parameter flow transmitter
Wetted material	0 ……	316
	1 ……	Hastelloy
	2 ……	Monel
	3 ……	Tantalum alloys
	4 ……	Other materials (Be separately identified)
Display mode	0 ……	No display meter
	1 ……	Simulation display meter
	2 ……	Digital display meter
Explosion-proof	0 ……	No requirement
	1 ……	Intrinsically safe
	2 ……	Explosionproof
Electrical connection	0 ……	G ½"
	1 ……	NPT ½"
	2 ……	M20×1.5
Power supply mode	0 ……	24V.DC
	1 ……	Built-in lithium battery
	2 ……	Solar cell

● Example

＊ Complete specification code: LGBYF-1.6/100-2C02210

Representation: Integrated Orifice Flowmeter, flange taps, nominal pressure is 1.6MPa, nominal size is 100 mm. It consisits of standard orifice, carrier ring and flange. Equipped with EJA110A smart differential pressure transmitter, the wetted material is 316, Digital display meter, Explosionproof, Electrical connection is NPT ½" female, Powered by 24V.DC.

5 Structure diagram

5.1 Orifice throttling device

1. Orifice Throttling Device, Standard type, Flange taps, Built-in orifice plate, Model: LGBFC-□/□

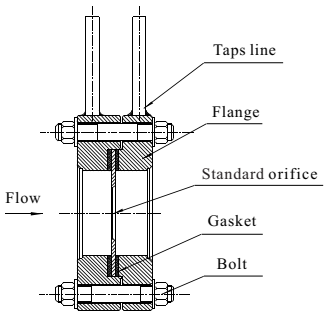


Figure 5.1.1 (a)

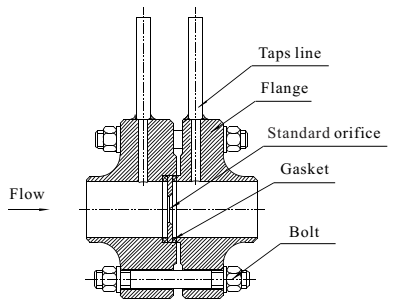


Figure 5.1.1 (b)

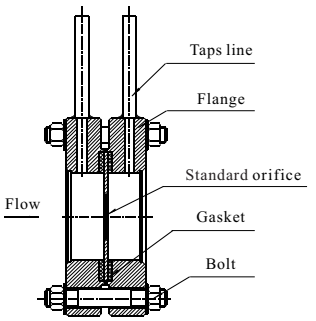


Figure 5.1.1 (c)

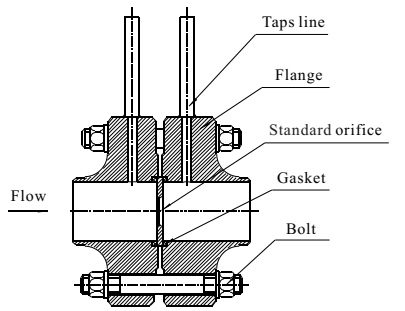


Figure 5.1.1 (d)

2. Orifice Throttling Device, Standard type, Corner taps, Annular chamber, Model: LGBH-□/□

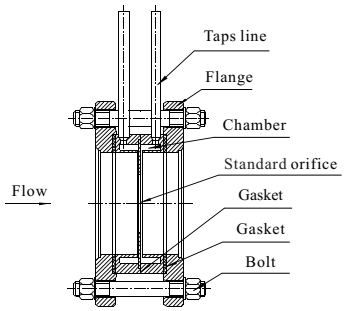


Figure 5.1.2 (a)

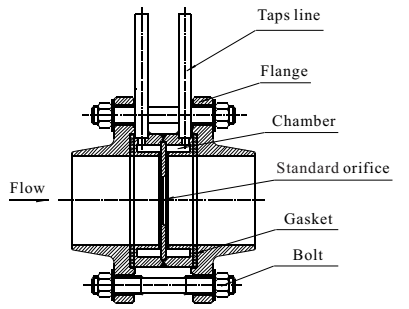


Figure 5.1.2 (b)

3. Orifice Throttling Device, Standard type, Flange taps, Model: LGBF-□/□

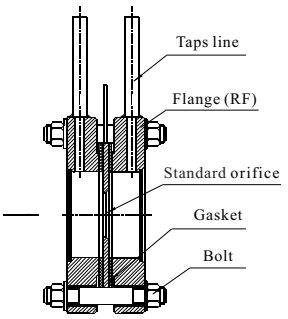
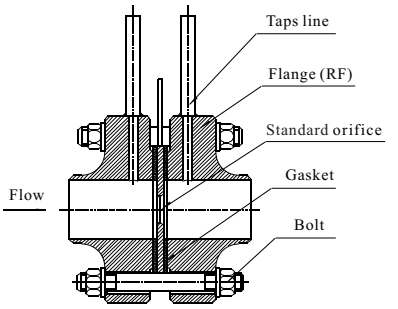


Figure 5.1.3 (a)



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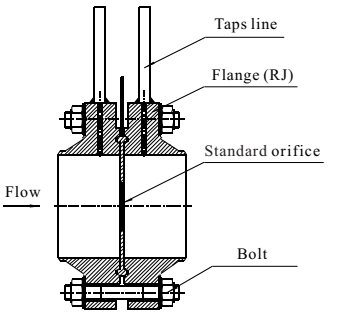


Figure 5.1.3 (c)

4. Orifice Throttling Device, Pipe flange type, Flange taps, Model: LGBFF-□/□

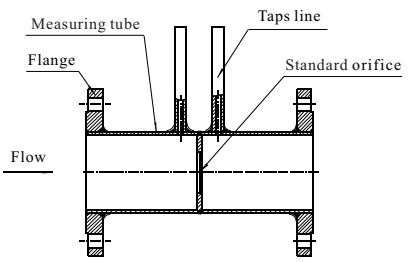


Figure 5.1.4 (a)

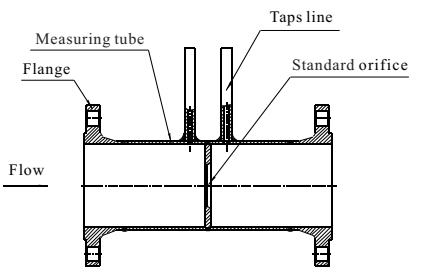


Figure 5.1.4 (b)

5. Orifice Throttling Device, Pipe flange type, Radius taps, Model: LGBFJ-□/□

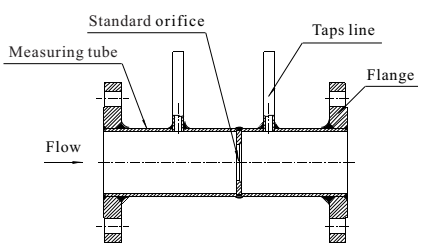


Figure 5.1.5 (a)

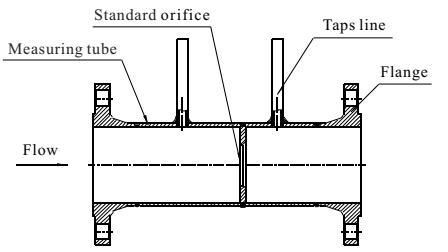


Figure 5.1.5 (b)

6. Orifice Throttling Device, Welding type, Flange taps, Model: LGBHF-□/□

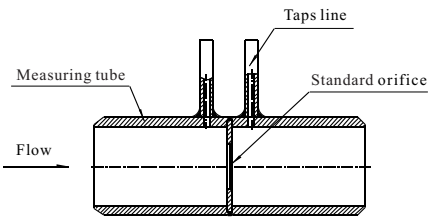


Figure 5.1.6

7. Orifice Throttling Device, Welding type, Radius taps, Model: LGBHJ-□/□

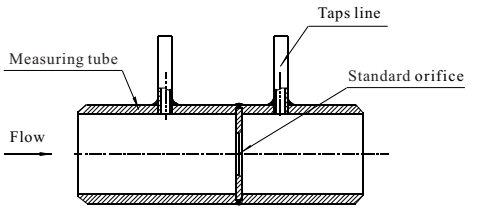


Figure 5.1.7

5.2 Integrated orifice flowmeter

1. Integrated Orifice Flowmeter, Standard type, Corner taps, Chamber, Model: LGBYH-□/□

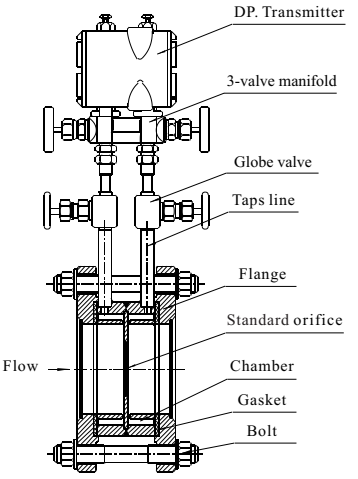


Figure 5.2.1

2. Integrated Orifice Flowmeter, Standard type, Flange taps, Model: LGBYF-□/□

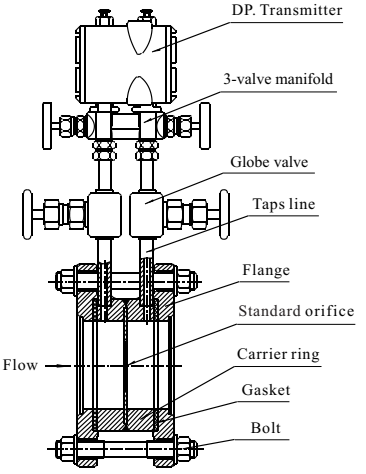


Figure 5.2.2 (a)

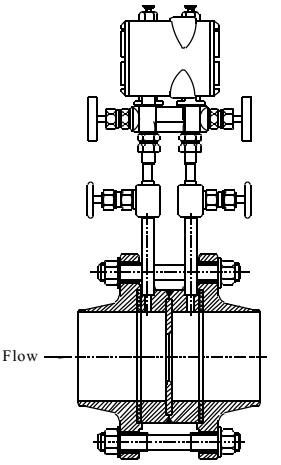


Figure 5.2.2 (b)

3. Integrated Orifice Flowmeter, Pipe flange type, Flange taps, Model: LGBYFF-□/□

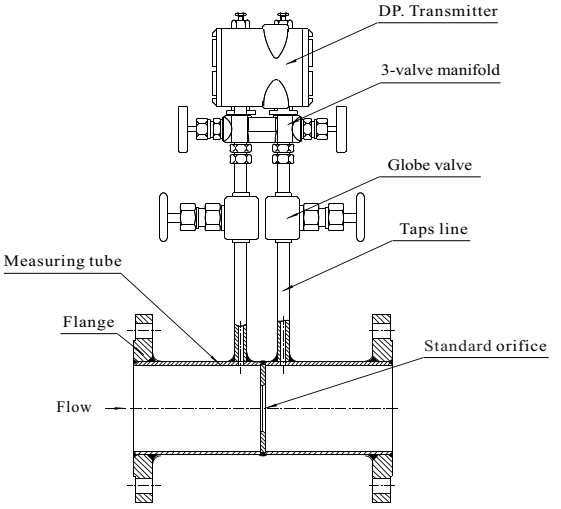


Figure 5.2.3 (a)

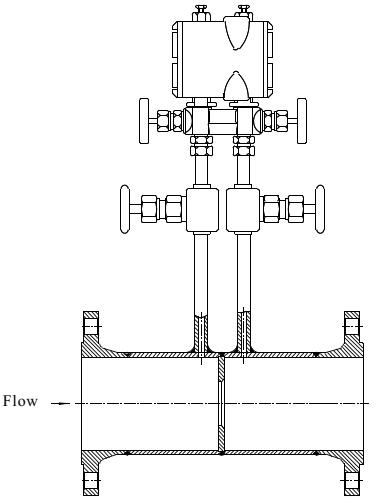


Figure 5.2.3 (b)

4. Integrated Orifice Flowmeter, Pipe flange type, Radius taps, Model: LGBYFJ-□/□

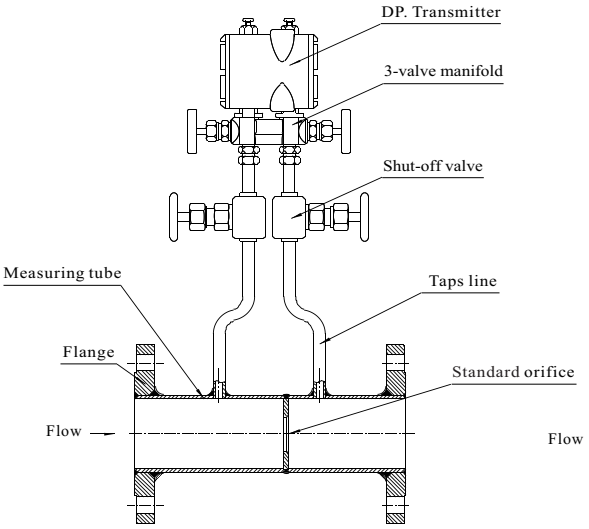


Figure 5.2.4 (a)

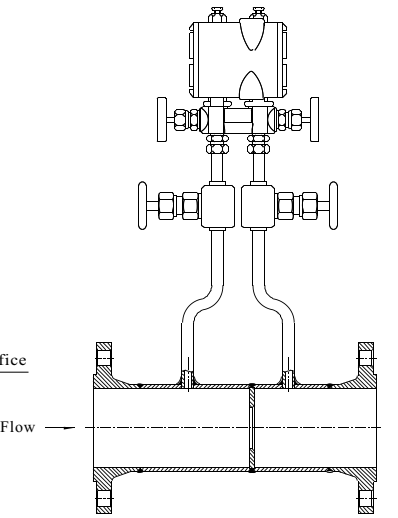


Figure 5.2.4 (b)

5. Integrated Orifice Flowmeter, Welding type, Flange taps, Model: LGBYHF-□/□

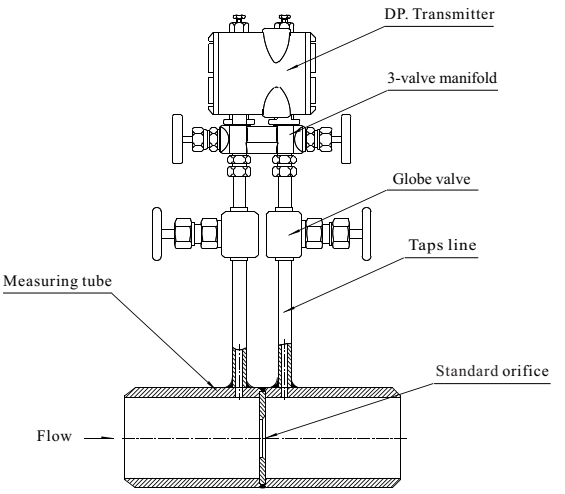


Figure 5.2.5

6. Integrated Orifice Flowmeter, Welding type, Radius taps, model: LGBYHJ-□/□

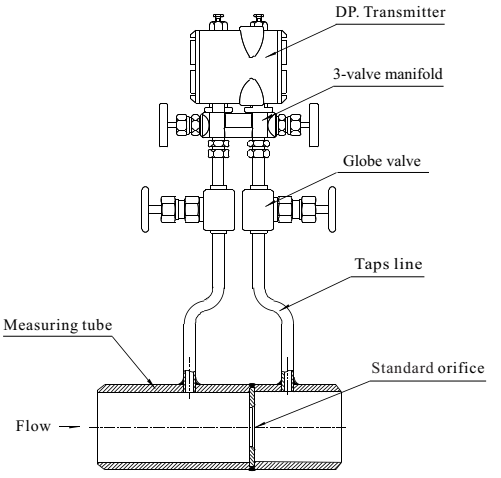


Figure 5.2.6

6 Installation

6.1 Installation requirements

(1) Orifice Flowmeter should be installed in the cleaned pipe and the seal gasket must not broke into the pipeline.

(2) Pressure taps position is shown in Figure 6.1.1.

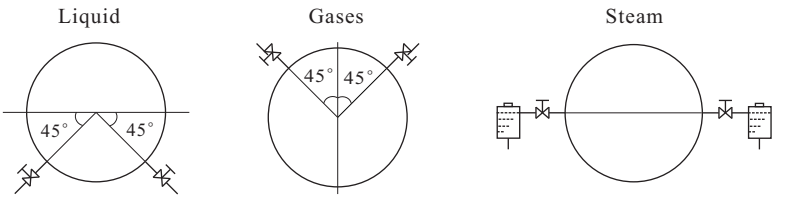


Figure 6.1.1 Pressure taps position

(3) Pressure guide tube

The material of pressure guide tube should be confirmed according to the properties of medium as well as its parameter; the ID of tube should not less than 6mm and length should less than 16m. The suggested ID and length of pressure guide tube for different medium as shown in the below table.

The inner diameter and length of pressure guiding tube

Measured fluid / Inner diameter / Length	Water Water vapor Dry gases	Wet gases	Oil with low or medium viscosity	Dirty liquids or gases
≤ 16 m	7 mm	13 mm	13 mm	25 mm
> 16 ~ 45 m	10 mm	13 mm	19 mm	25 mm
> 45 ~ 90 m	13 mm	13 mm	25 mm	38 mm

Guide pressure tube should be vertical or inclined installation, and the slope should not less than 1:12, and the slope should be increased if the fluid with high viscosity. The guide tube should be segment tilted when its length over 30m, and extra gas collector (or vent valve) and settler (or drain valve) should be installed at the both of highest and lowest location. The positive and negative pressure guide tube should be laying as closer as possible, because the signal distortion might be happened if two tubes with different temperature. The antifreeze protection should be added for those pressure guide tube of applied in cold region. The operator should pay attention to prevent the overheating when heating or heat preservation by electricity of steam, otherwise the fluid in pressure guide tube might be evaporation and produce the false differential pressure.

(4) Globe valve

One globe valve could be installed on the pressure guide tube of near with orifice flowmeter. If there is condenser was installed on signal pipeline then there should be one globe valve to be equipped at the location of near with condenser. The globe valve should have the same performance of pressure resistance and corrosion resistance with the measurement pipe. The flow area of globe valve should not less than the area of pressure guide tube. The structure of globe valve should be able to prevent the gather of gases or liquid, to avoid the impeding of transmission of differential pressure signal.

(5) Condenser

Condensers could realize the condensation of steam in the pressure guide tube, to make the condensed liquid level of positive and negative pressure guide tube could be the same, and maintain the constant.

(6) Gas collector

If the measured medium is liquid, then the gas collector (or vent valve) should be installed at the highest position of each pressure guide tube, to collect and regular discharge the gases in pressure guide tube. If the installation location of differential pressure transmitter is higher than main pipeline, then the installation of gas collector (or vent valve) will be more important, the valve of gas collector could be either automation or manual operated and could realize the regular discharge.

(7) Settler

If the measured medium is gases or liquid, then the settler (or drain valve) should be installed at the lowest position of each pressure guide tube, to collect and regular discharge the dirt in pressure guide tube or water in gas pressure guide tube. The valve of settler could be either automation or manual operated and could realize the regular discharge.

(8) Isolators and isolation solution

The isolator was used to measure the medium which is with high viscosity, corrosion, easy to freeze and solids easy precipitated, it could protect the differential pressure sensing element of transmitter to not in contact with the measured medium directly. The two isolators should be as closer as possible to the pressure taps and to be installed at the same level. When the fluid is not flowing, the interface of measuring liquid and isolation liquid must be at the same level.

(9) Injection system

In order to prevent the measured medium get into the pressure guide tube when measure the dirty or dangerous fluid, the injection system could provide the constant pressure through positive and negative pressure guide tube and inject some clean fluid (water, air) into the main pipe to instead of the isolation system.

There are three kinds of different injection system: (a) to blow the clean gas into the main pipe when fluid is gas; (b) to blow the clean gas into the main pipe when fluid is liquid; (c) to blow the clean liquid into the main pipe when fluid is liquid. Figure 6.1.2 is injection system schematic diagram.

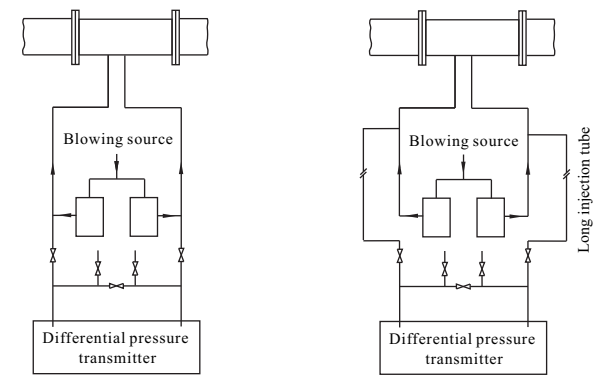


Figure 6.1.2 Injection system schematic diagram

The injection system should could ensure the measured fluid of main pipe to not get into the pressure guide tube, and the relationship between flow rate and differential pressure signal will not be changed by the injection. Therefore, the control of injection amount is very important to the system, and the injection flow meter should be installed if necessary to monitor the stability of injection amount. For the positive and negative pressure guide tube system of applied injection isolation method, the uniform of pressure resistance in two pressure guide tubes, as well as its valves, is very important.

6.2 Installation of differential pressure signal pipeline

Bases on the properties of measured fluid and the relative position of orifice flowmeter and differential pressure transmitter, there are several kinds of different installation methods as below:

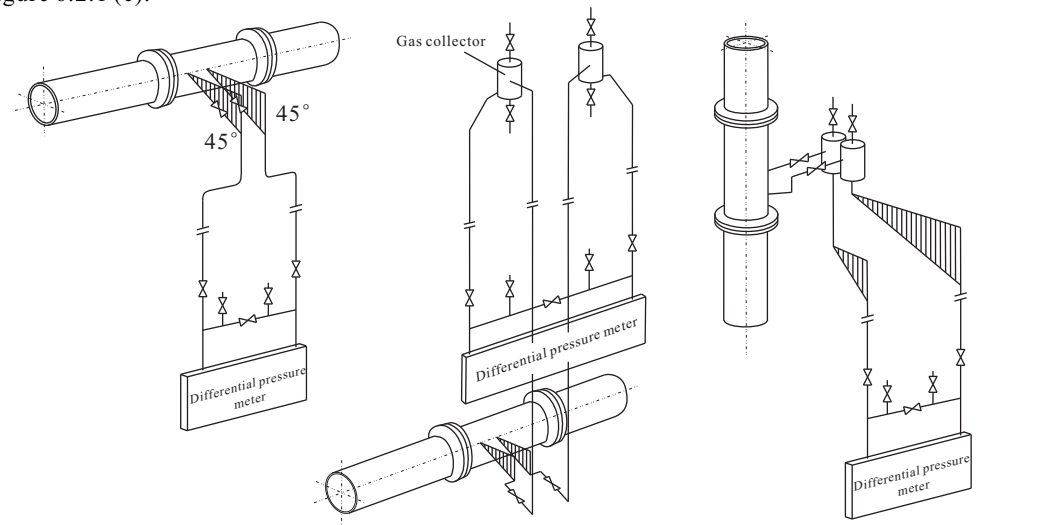
6.2.1 Flowrate measurement of clean liquid

When the measured fluid is a cleaning liquid, the method of installation of the signal pipeline is shown in figure 6.2.1.

(1) The differential pressure transmitter is preferably installed under the orifice flowmeter, as shown in figure 6.2.1 (a) , to prevents the gas in the liquid get into the pressure guide tube and differential pressure transmitter. If necessary, extra exhaust valve could installed on the highest position of pressure guide tube.

(2) If the differential pressure transmitter has to be installed at the above of the orifice flowmeter, then the pressure taps guide tube should be inclined downwardly, the gas collector (or the exhaust valve) installed on the highest position of pressure guide tube, as shown in figure 6.2.1 (b).

(3) If the orifice flowmeter was installed on vertical pipe, then the zero displacement might be happened because of positive and negative pressure guide tube with different heights. In this case, the user could enquiry from our company and we are pleased to provide the technical service. We recommend installing the isolator for the liquid with high temperature. As shown in figure 6.2.1 (c).



(a) Meter below the pipe (b) Meter at the above of the pipe (c) Vertical pipes, the fluid to be measured with high-temperature

Figure 6.2.1 The signal line installation diagram of measuring clean liquid flow

6.2.2 Flowrate measurement of clean dry gases

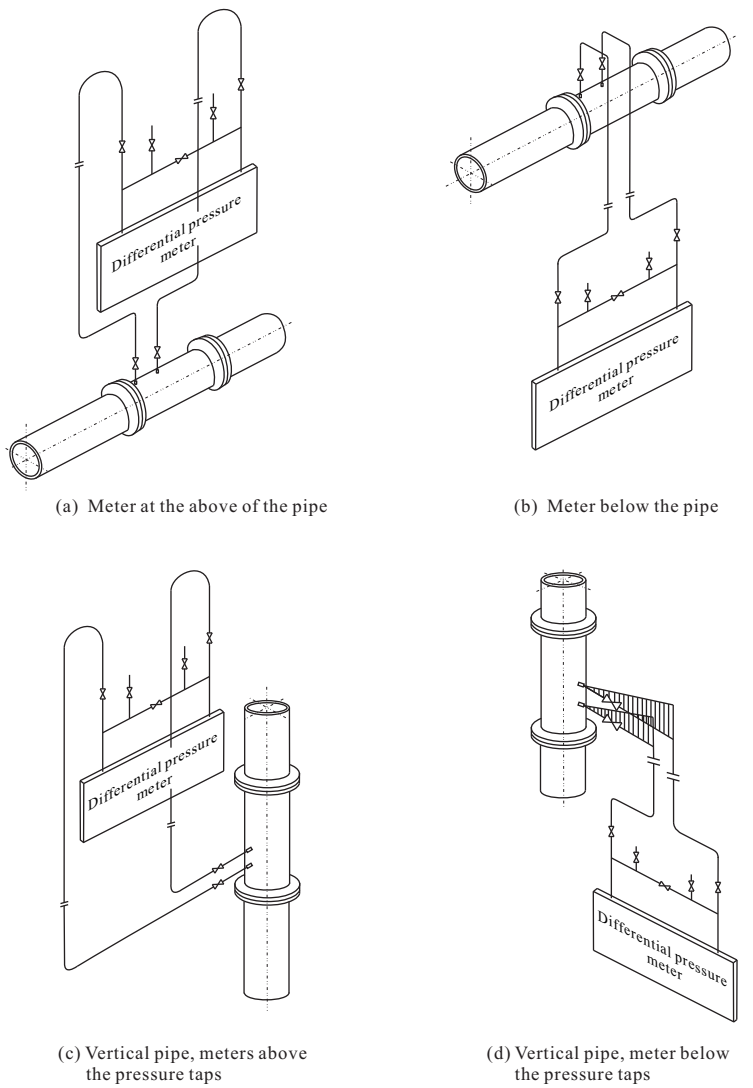
When the measured fluid is clean dry gases, the method of installation of the signal pipeline is shown in figure 6.2.2.

(1) The differential pressure transmitter is preferably installed above the orifice flowmeter, as shown in figure 6.2.2 (a).

(2) If the differential pressure transmitter has to be installed under the orifice flowmeter, the pressure guide tube should be bent upwardly then downwardly, as shown in figure 6.2.2 (b).

(3) If orifice flowmeter was installed on vertical pipes, differential pressure transmitter is located above the taps, the tubing installation can be conducted in accordance with figure 6.2.2 (c).

(4) If orifice flowmeter was installed on vertical pipe, differential pressure transmitter is located under the taps, the tubing installation can be conducted in accordance with figure 6.2.2 (d).



(a) Meter at the above of the pipe

(b) Meter below the pipe

(c) Vertical pipe, meters above the pressure taps

(d) Vertical pipe, meter below the pressure taps

Figure 6.2.2 The signal line installation diagram of measuring clean dry gas flow

6.2.3 Flowrate measurement of clean wet gases

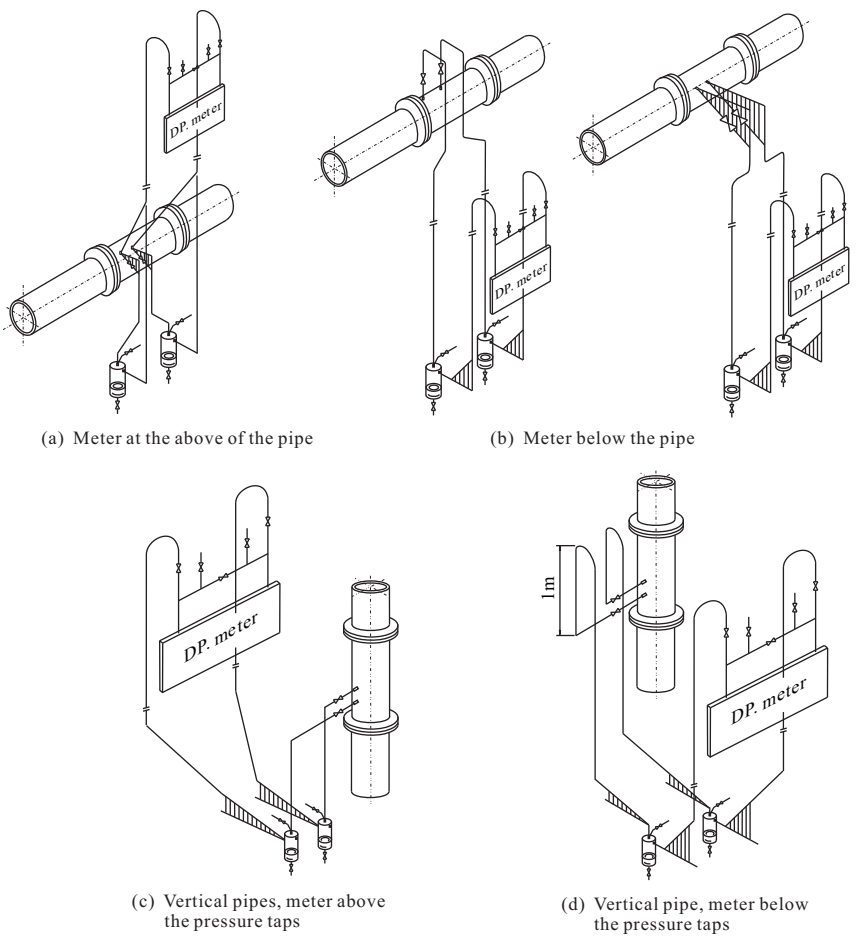
When the measured fluid is clean wet gases, the method of installation of the signal pipeline is shown in Figure 6.2.3.

(1) Differential pressure transmitter is preferably installed above the orifice flowmeter, and install the settler (or drain valve) at the lowest position of the guide pressure tube, as shown in Figure 6.2.3 (a).

(2) If the differential pressure transmitter has to be installed under the orifice flowmeter, then the settler (or drain valve) should be installed at the lowest position of the guide pressure tube, as shown in Figure 6.2.3 (b).

(3) If orifice flowmeter was installed on vertical pipe, differential pressure transmitter is located above the pressure taps, then the settler (or drain valve) should be installed at the lowest position of the guide pressure tube, the tubing and installation could be carry out in accordance with figure 6.2.3 (c).

(4) If the orifice flowmeter was installed in vertical pipe, the differential pressure transmitter is located under the pressure taps, then the pressure guide tube should leads up 1 meter then bend downwards, as well as to install the settler (or drain valve) at the lowest position of pressure guide tube, the tubing and installation could be carry out in accordance with figure 6.2.3 (d).



(a) Meter at the above of the pipe

(b) Meter below the pipe

(c) Vertical pipes, meter above the pressure taps

(d) Vertical pipe, meter below the pressure taps

Figure 6.2.3 The signal line installation diagram of measuring clean wet gas flow

6.2.4 Flowrate measurement of steam

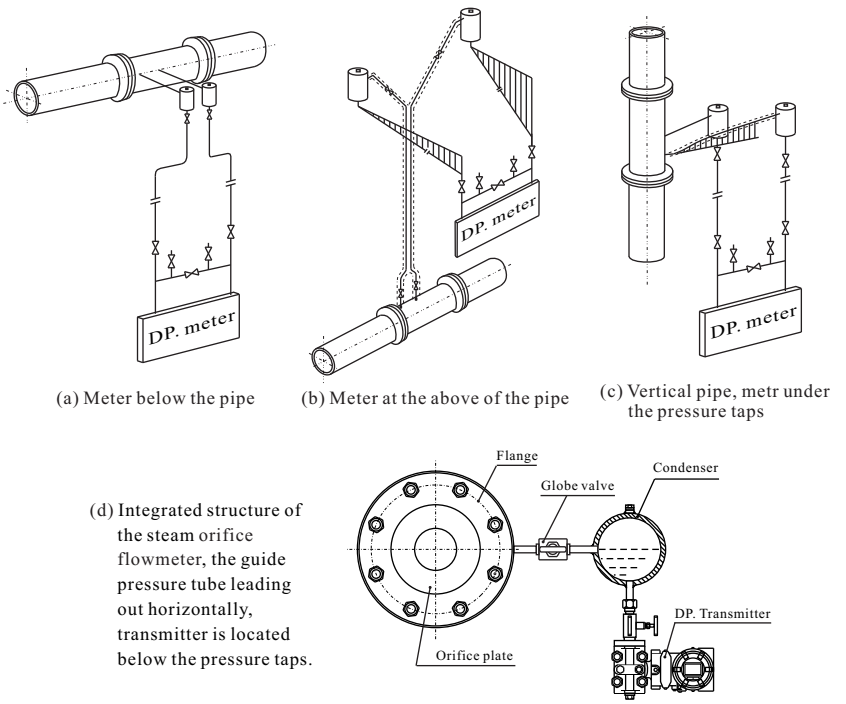
When the measured fluid is steam, the method of installation of the signal pipeline is shown in Figure 6.2.4.

(1) The differential pressure transmitter is preferably installed under the orifice flowmeter, the condenser could be installed at the top of pressure guide tube and there should be an exhaust plugs (or exhaust valve) to be installed in the upper half of condenser, as shown in figure 6.2.4(a).

(2) If the differential pressure transmitter was installed on the above of orifice flowmeter, then the steam pressure guide tube should be upwardly, then bend the condensate pressure guide tube downwards after installed the condenser at the highest position of pressure guide tube. The zero displacement will be happened if the height of positive and negative condenser were different, so the operator should ensure the positive and negative pressure condenser with the same level height. The positive and negative pressure steam pressure guide tube should be laying as close as possible to reduce the influences caused by temperature, and the thermal insulation is suggested for steam pressure guide tubes. As shown in figure 6.2.4(b).

(3) If the differential pressure transmitter was installed in the vertical pipeline, then the zero displacement will be happened if the height of positive and negative condenser were different. The operator could bend the pressure guide tube upward until it parallel and level with upper pressure guide tube, then leading it out horizontally. The operator should ensure the positive and negative pressure condenser with the same level height. The positive and negative pressure steam pressure guide tube should be laying as closer as possible to reduce the influences of caused by temperature, and the thermal insulation is suggested for steam pressure guide tubes. As shown in figure 6.2.4(c).

(4) For integrated type orifice flowmeter, if it was installed on horizontal pipeline, then the pressure guide tube should be horizontal leading out, and the differential pressure transmitter should be located under the pressure taps, as shown in figure 6.2.4(d); if it was installed on vertical pipeline, the operator should carry out the suitable method to avoid the zero displacement, because of the height of positive and negative pressure taps are different.



(a) Meter below the pipe

(b) Meter at the above of the pipe

(c) Vertical pipe, metr under the pressure taps

(d) Integrated structure of the steam orifice flowmeter, the guide pressure tube leading out horizontally, transmitter is located below the pressure taps.

Figure 6.2.4 The signal line installation diagram of measuring steam flow

7 Operation and Maintenance

7.1 Operation

(1) The orifice flowmeter must be supporting the use of the differential pressure transmitter, then the correct flow rate could be obtained. For the adjusting of zero position at site, the extra "three-valves manifold" could be added in the process connection of differential pressure transmitter, the details method of application please refer the instruction of differential pressure transmitter.

(2) In order to measure and obtain the actual value of differential pressure, except the correct lying of pressure guide tube, the keeping of single phase condition (liquid or gas) of pressure guide medium (transmit the static pressure valve of fluid) in tubes is also required, which means the pressure guide tube must be filled by liquid but cannot mixed any gases when liquid flow rate measurement; and the pressure guide tube must be filled by gases but cannot condensed any liquid when gases flow rate measurement. Therefore, the operator could install the gas collector or settler depends on the actual condition, to collect the gases in liquid or liquid in gases, as well as discharge regularly.

(3) If the actual operation condition of orifice flowmeter was deviated with design condition, the changes of operation pressure, operation temperature, fluid density, normal flow rate and scale flow rate etc different factors all will produce some measurement error. However, only if these parameters are still within the scope of designed, then normally the error will not exceed the allowable deviation. If the actual operation condition happened large change and the measurement deviation exceed allowance, our company could recalculate the differential pressure value according to the actual operation condition of provided by user, then to correct the measuring range of differential pressure transmitter, to make the displayed flow rate value could be the correct.

(4) We strongly recommended installing the temperature and pressure automation compensation device for the trade settlement metering of steam and normal gases, to ensure the measurement accuracy for actual flow rate.

(5) For the measurement of liquids and steam, when flowmeter was installed on vertical pipeline or other reasons, and caused the positive and negative pressure guide tube or condensers with different height, then there will be extra measurement deviation existed. Therefore, in the operating, the operator must ensure the condensate in positive and negative pressure guide tube or condensers with the same level height.

7.2 Maintenance

(1) The orifice flowmeter is without any removable components, normally no maintenance was needed.

(2) The pressure taps and pressure guide tube are easily blocked if the medium with high viscosity, easy to freeze, easy to crystallize or with dirties, so the operator should regularly clear the pressure guide tube or check the injection system, to ensure the pressure guide tube is without any leakage or blockage.

(3) The guide pressure tube that installed with gas gathering or settler, the manually or automatically discharge regularly will be recommended.

(4) If the ambient temperature is below 0°C, timely check the thermal insulation of pressure guide tube will be recommended.

8 Accessories

The accessories of orifice flowmeter include taps line, globe valve, 3-valve manifold and the condenser and so on. Their main technical parameters and application is as below.

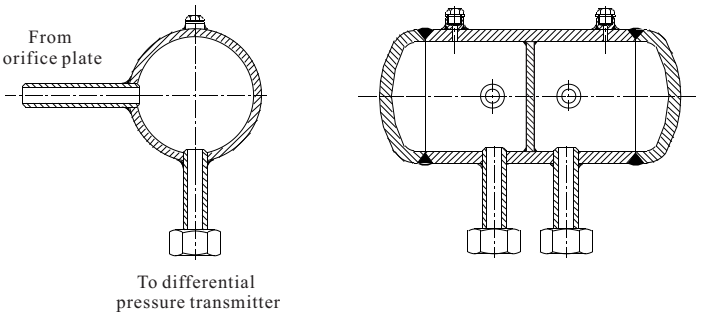
No.	Name	Model	Nominal pressure	Application
1	Condenser	QL-6.3	6.3MPa	To be applied when measure the steam or liquid over 70℃, to avoid the high temperature fluid get into the differential pressure instrument.
		QL-16.0	16.0MPa	
2	Isolator	QG-6.3	6.3MPa	To be applied when measure the fluid with high viscosity, easy-corrosive, easy to freeze or easy precipitated solid, to avoid the fluid get into the differential pressure instrument.
		QG-16.0	16.0MPa	
3	Gas collector	QS-6.3	6.3MPa	To be applied to whenever collection and regular discharge the gases in taps line.
		QS-16.0	16.0MPa	
4	Settler	QC-6.3	6.3MPa	To be applied to whenever collection and regular discharge dirties in pressure guide tube or the water in gases.

■ Model and suffix codes

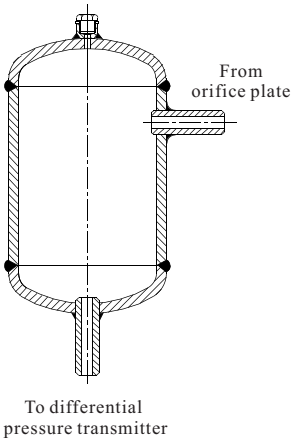
Container	Category	Delimiter	Nominal pressure	Delimiter	Connection mode	Tappings short tube	Description
Q							Accessories
	L						Condenser
	G						Isolators
	S						Gas collector
	C						Settler
		-					Delimiter
			6.3				Nominal pressure 6.3MPa
			16.0				Nominal pressure 16.0MPa
				-			Delimiter
					1		Socket weld type
					2		Butt Weld
					3		Threaded connection type
						1	Φ14
						2	Φ16
						3	Φ18
						4	Φ22
						5	Other

■ Throttling device accessories diagram

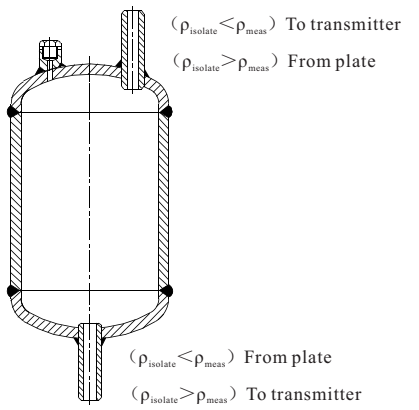
1. Integrated condenser



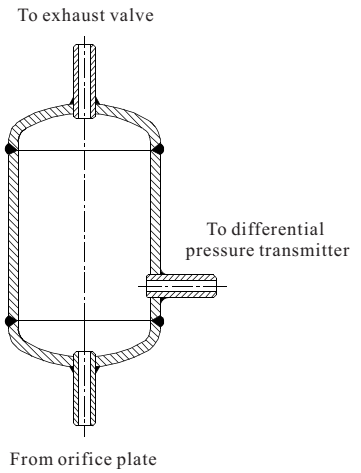
2. Condenser



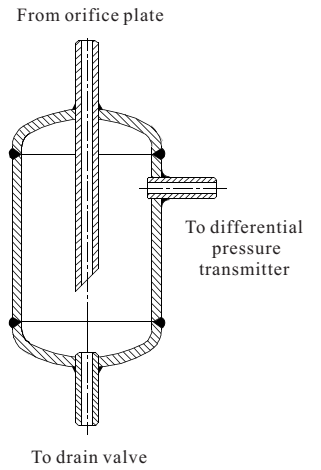
3. Isolator



4. Gas collector



5. Settler



9 Preserve

1. The sturdy wooden case to be used for the packing of orifice flowmeter, the flowmeter should be fixed in the case and avoid any movement. The carefully handling will be suggested and any rude handling will be strict prohibited.
2. The package of orifice flowmeter should meet the requirements for land, sea transport and cargo handling.
3. The storage location of products should comply with the following conditions :
   (1) Waterproof, moisture-proof and will not affected by any mechanical vibration or shock.
   (2) Ambient temperature range: -25°C to +55°C.
   (3) Relative humidity: not more than 80%.
   (4) Environment does not contain corrosive substances.

10 Checking

1. Before unpacking, the user should check the integrity of the external package, then check if the quantity and specification of items in the package is compliance with the packing list, as well as check the completeness of any accessories.
2. Documents dispatch with products :
   (1) Design Calculation Data Sheet × 1
   (2) Installation Manual × 1
   (3) Inspection Certification × 1
   (4) Packing List × 1

Appendix A Recommended straight pipe length

(Applied standard: GB/T 2624.2-2006 / ISO 5167-2:2003)

Values expressed as multiples of internal diameter, D

Diameter ratio β	Upstream (inlet) side of orifice plate																						Downstream (outlet) side of the orifice plate	
	Single 90° bend Two 90° bends in any plane ($S > 30D$) [a]		Two 90° bends in the same plane: S-configuration ($30D \geqslant S > 10D$) [a]		Two 90° bends in the same plane: S-configuration ($10D \geqslant S$) [a]		Two 90° bends in perpendicular planes ($30D \geqslant S \geqslant 5D$) [a]		Two 90° bends in perpendicular planes ($5D > S$) [a, b]		Single 90° tee with or without an extension		Single 45° bend Two 45° bends in the same plane: S-configuration ($S \geqslant 2D$) [a]		Concentric reducer $2D$ to D over a length of $1,5D$ to $3D$		Concentric expander $0,5D$ to D over a length of D to $2D$		Full bore ball valve or gate valve fully open		Abrupt symmetrical reduction		Thermometer pocket or well [c] of diameter $\leqslant 0,03D$ [d]		Fittings (columns 2 to 11) and the densitometer pocket	
1	2		3		4		5		6		7		8		9		10		11		12		13		14	
	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]	A [e]	B [f]
⩽0,20	6	3	10	g	10	g	19	18	34	17	3	g	7	g	5	g	6	g	12	6	30	15	5	3	4	2
0,40	16	3	10	g	10	g	44	18	50	25	9	3	30	9	5	g	12	8	12	6	30	15	5	3	6	3
0,50	22	9	18	10	22	10	44	18	75	34	19	9	30	18	8	5	20	9	12	6	30	15	5	3	6	3
0,60	42	13	30	18	42	18	44	18	65 [h]	25	29	18	30	18	9	5	26	11	14	7	30	15	5	3	7	3,5
0,67	44	20	44	18	44	20	44	20	60	18	36	18	44	18	12	6	28	14	18	9	30	15	5	3	7	3,5
0,75	44	20	44	18	44	22	44	20	75	18	44	18	44	18	13	8	36	18	24	12	30	15	5	3	8	4

NOTE 1 The minimum straight lengths required are the lengths between various fittings located upstream or downstream of the orifice plate and the orifice plate itself. Straight lengths shall be measured from the downstream end of the curved portion of the nearest (or only) bend or of the tee or the downstream end of the curved or conical portion of the reducer or the expander.

NOTE 2 Most of the bends on which the lengths in this table are based had a radius of curvature equal to $1,5D$.

a S is the separation between the two bends measured from the downstream end of the curved portion of the upstream bend to the upstream end of the curved portion of the downstream bend.

b This is not a good upstream installation; a flow conditioner should be used where possible.

c The installation of thermometer pockets or wells will not alter the required minimum upstream straight lengths for the other fittings.

d A thermometer pocket or well of diameter between $0,03D$ and $0,13D$ may be installed provided that the values in Columns A and B are increased to 20 and 10 respectively. Such an installation is not, however, recommended.

e Column A for each fitting gives lengths corresponding to “zero additional uncertainty” values.

f Column B for each fitting gives lengths corresponding to “0,5 % additional uncertainty” values.

g The straight length in Column A gives zero additional uncertainty; data are not available for shorter straight lengths which could be used to give the required straight lengths for Column B.

h $95D$ is required for $Re(D) > 2\times10^6$ if $S < 2D$.