Orifice Plate Flowmeter

USER MANUAL

1 Function and Application

There are many ways to measure the flow of medium through the pipeline, but the most widely used is the throttle device, its use has a long history, in the international and domestic have been standardized in the petroleum, chemical, metallurgy, power, light Spinning, research and other industries in the production process, a large number of use of various types of throttle device for fluid flow measurement, control and regulation, throttle device has a simple structure, solid, reliable, stable performance, high accuracy, Low price and other advantages, and thus the throttle devices has more advantages than other flow meter.

Throttle device should be used with differential pressure transmitter, flow range is continuously adjustable, and it can output standard signal (0~10mAD、C 或 4~20mAD、C) then input to secondary instrument, it shows the instantaneous flow and total flow of the fluid. If input the standard signal to the industrial control machine, you can automatically print the instantaneous flow and total flow. It provides a great convenience for the users.

Throttle devices include standard throttle devices (including standard orifice, standard nozzles, standard venturi tube), and nonstandard throttling devices (including quarter-round nozzles, quarter-hole plates, perforated plates, double hole plate, round hole plate, tapered inlet orifice, etc.), the way for orifice taps are ring chamber taking pressure, flange pressure, when the fluid Reynolds number lower or contain impurities, you can choose non-standard throttle device.

2 Structure

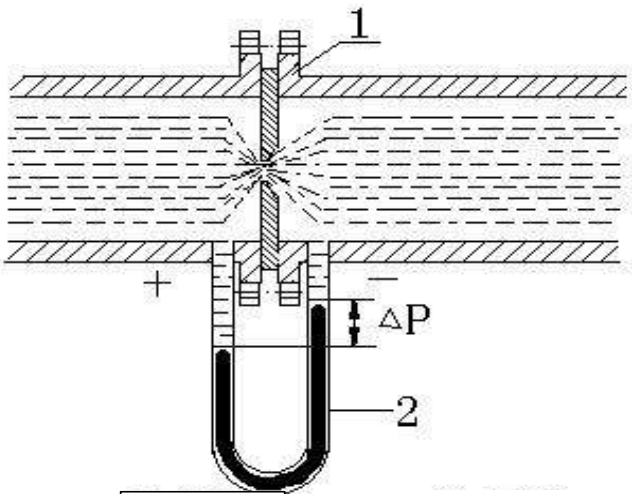
(1) Flange pressure throttle device: consist of the pressure flanges, throttle parts, seal rings and fasteners, equipped with the secondary instrument can display the instantaneous flow and total flow.

(2) Ring chamber taking pressure of the throttle device: consist of the flanges, ring chamber, throttle parts, seal rings and fasteners, equipped with secondary instrument can display the instantaneous flow and cumulative total.

3 Working Principle and Main Structure

3.1 Principle

Throttling device is artificially cause throttling for the fluid in the pipe (see pic 1). When the measured medium through the throttle device, resulting in a local contraction, stream concentration, the flow rate increases, the static pressure decreases, so the throttle in the flow of the throttle device The upper and lower sides of the pieces produce a static pressure difference. The static pressure difference between the flow and a certain function, the greater the flow, the greater the static pressure difference, so by measuring the differential pressure method, you can measure the flow.



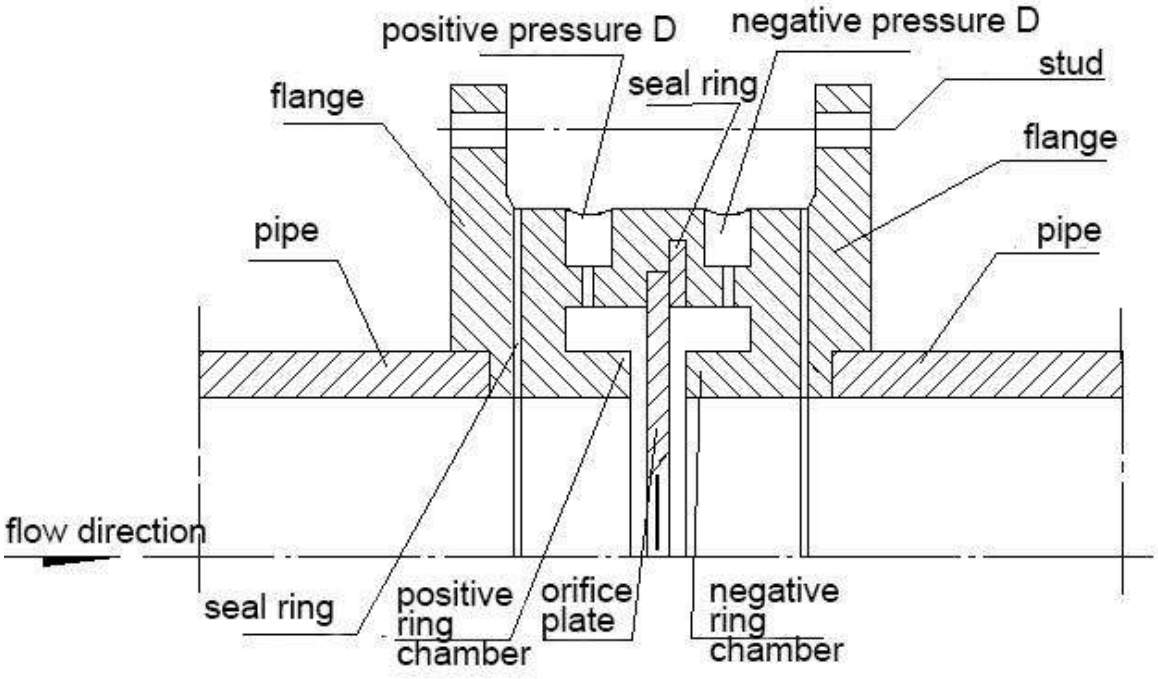
1 throttle parts 2 differential pressure transmitter

Pic 1 Throttle device

3.2 Structure

We have many kinds of products and orifice taps, for example:

（1）Standard orifice plate, ring chamber taking pressure (see pic 2)



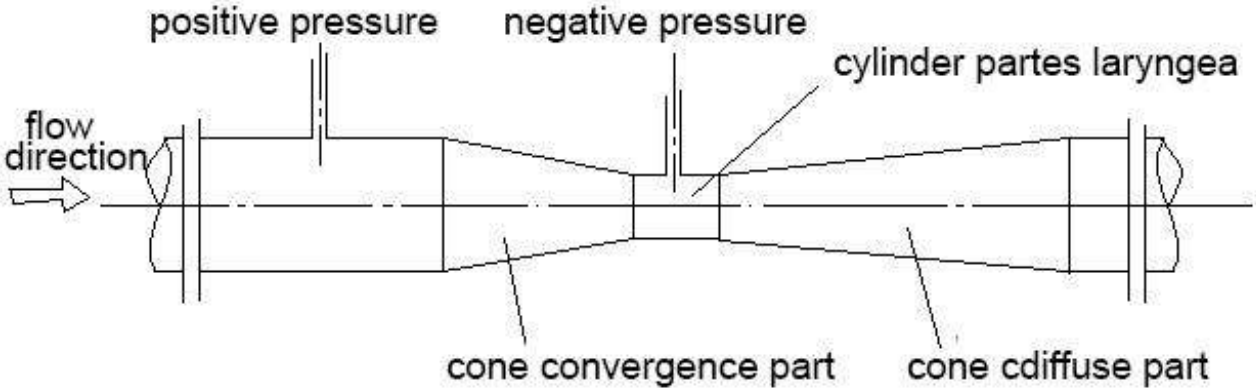
Pic 2 ring chamber pressure standard orifice plate

（2）Standard orifice plate, flange pressure (see pic 4)

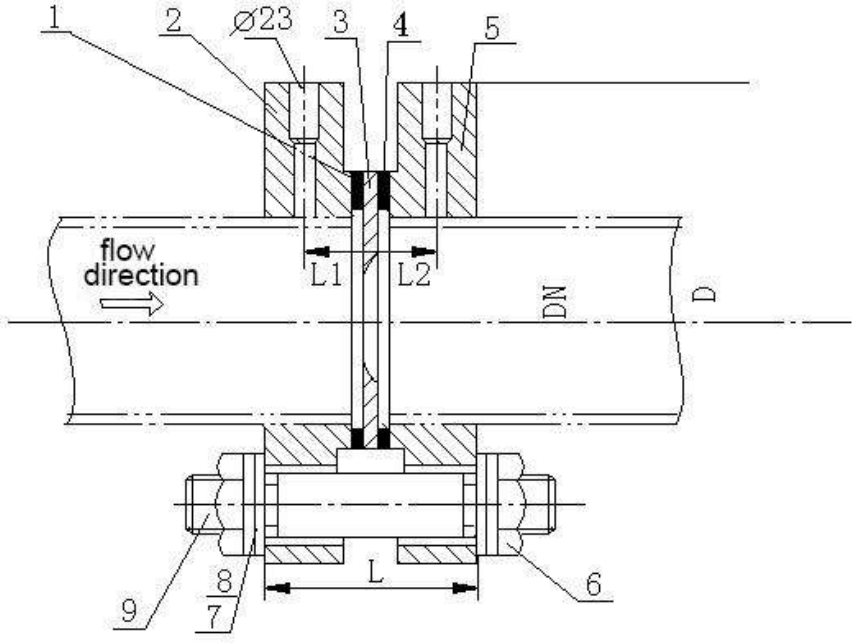
Open the pressure hole in the flange outer(straight hole) or side(inclined hole) of center line from the orifice plate on the upper and lower 25.4mm, it's the flange pressure way, easy to install and convenient.

（3）Standard nozzle, ring chamber taking pressure (see pic 5)

（4）Standard venturi (classical venturi) tube structure (see pic 3)

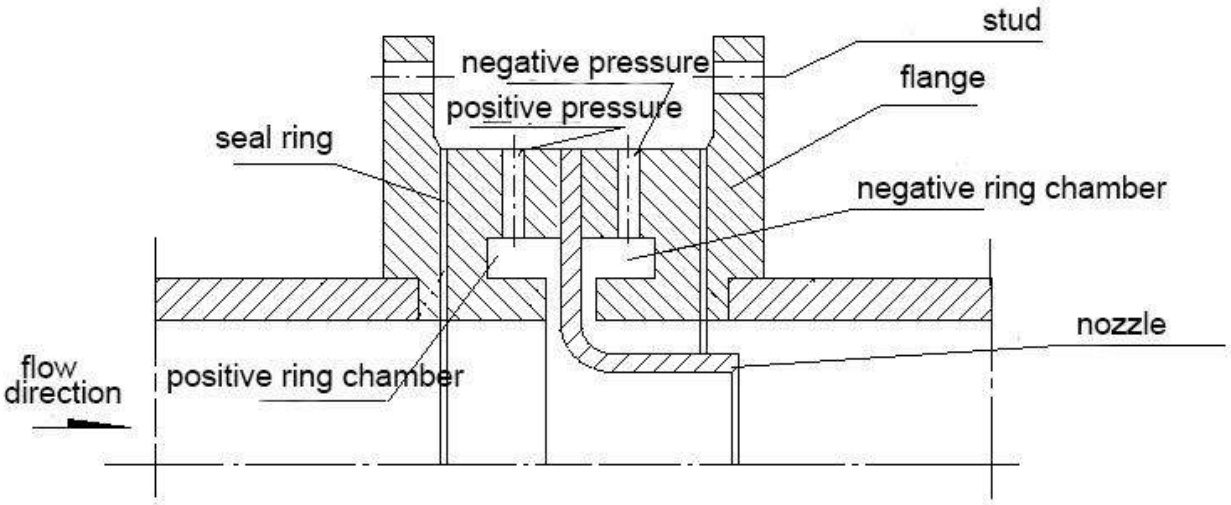


Pic 3 standard venturi (classical venturi) tube structure



1、4—upstream and downstream seal ring 2—upstream pressure flange 3—orifice plate
5—downstream pressure flange 6—spring seal ring 8—seal ring 9—stud

Pic 4 flange pressure throttle device



Pic 5 Ring chamber taking pressure standard nozzle structure

4 Basic Parameters

4.1 Executive standard
Design, manufacture and installation comply with the international standard ISO5167-1 (1991) (national standard GB / T2624-93), British standard BS1042 and other standards.

4.2 Nominal diameter（mm）：25、40、50、65、80、100、125、300、350、400、450、500、600、700、800、900、1000、1200。

4.3 Nominal pressure（MPa）：0.6、1.0、1.6、2.5、4.0、6.3、10.0、16.0

4.4 Accuracy：
(1) On the standard orifice, the standard nozzle: a variety of factors affecting the measurement error, if the installation suitable for the relevant provisions of international standards ISO5167-1 (1991), the accuracy level can reach 1 ~ 1.5%.
(2) For non-standard orifice (such as double orifice plate, round hole plate, orifice plate, etc.), because the test data is not sufficient, there is no "standard" can be checked, it should be completed after the design and manufacture of calibration. (Usually calibrated liquid flow with water; and air calibration gas flow) can be calibrated to achieve the accuracy (basic error) level 1 ~ 1.5%, if without calibrated, only empirical data, design, the accuracy is about ±2.5%.

5 Installation, use and adjustment
5.1 Basic requirements for installation:
（1） Throttle device should check the throttle device number and size before installation and must meet the requirements of pipe installation location.
（2） The new piping system, must be washed in the pipeline and sweep the line after

the installation of throttle device to prevent clogging within the debris or damage throttle device.

（3） Note that the direction of the throttle installation, marked with "+" one end should be connected with the upstream fluid pipe, labeled "-" one end should be connected with the downstream fluid pipe .

（4） The distance ex between the center line of the throttling device and the center of the pipe, the center line of the throttle device and the center line of the upstream side and the downstream side pipe shall be less than or equal to：$\frac{0.0025D}{0.1+2.3\beta^4}$

（5） Throttling device installed in the pipeline, should ensure that its end and pipe axis vertical, vertical error shall not exceed ± 1.

（6） Clamping the throttle device with the gasket (including the ring chamber and the flange, between the ring chamber and the throttle part), after clamping, shall not protrude the inner wall of the pipeline.

（7） Throttle device installation must be tight, does not allow a leak phenomenon exists. Therefore, the installation work must be carried out before the pipeline pressure test.

（8） Flange pressure throttle device, if the flange using convex plate flat welding flange (see pic 4), you must first work in the pipe section of the hole and with the pressure on the flange on the pressure hole alignment, and then welding pipe section.

5.2 Requirements for piping:

(1) The length of the upstream pipe section adjacent to the throttling device shall be at least 2D in a circular tubular shape, and any diameter on any plane shall not differ by more than 0.3% from the pipe diameter D.

(2) The difference between any diameter of the downstream straight pipe section and the average diameter of the upstream straight pipe section shall not be greater than 3% within the length of at least 2D from the upstream end of the primary device.

(3) The minimum length of the pipe section to be guaranteed upstream and downstream of the throttle is related to the form of the upstream resistance element and the diameter of the throttle ratio β .(see table 1)

(4) In the vicinity of the throttle (including the front and rear straight pipe), the media must be filled with pipes, if you need to install isolation valve, you should choose the gate valve and fully open in operation, if installed valve, the regulator should be installed in the downstream 5D straight after the pipe section.

Diameter ratio $\beta \leqslant$	The upstream side of the flow block formation and the shortest straight pipe length (DN multiple)							Downstream length of the shortest straight pipe (including all the resisting parts in the table)
	A single 900 elbow or tee (fluid only flows from a branch pipe)	Two or more 90^0 elbows on the same plane	Two or more 90^0 elbows on the different plane	Reducing pipe(from 1.5D to 3D the length 2D becomes to D)	The involute tube (from 0.5 to D length 1D become to 2D)	Ball valve fully open	Full bore ball valve or gate valve	
0.20	10(6)	14(7)	34(17)	5	16(8)	18(9)	12(6)	4(2)
0.25	10(6)	14(7)	34(17)	5	16(8)	18(9)	12(6)	4(2)
0.30	10(6)	16(8)	34(17)	5	16(8)	18(9)	12(6)	5(2.5)
0.35	12(6)	16(8)	36(18)	5	16(8)	18(9)	12(6)	5(2.5)
0.40	14(7)	18(9)	36(18)	5	16(8)	20(10)	12(6)	6(5)
0.45	14(7)	18(9)	38(18)	5	17(9)	20(10)	12(6)	6(3)
0.50	14(7)	20(10)	40(20)	6(5)	18(9)	22(11)	12(6)	6(3)
0.55	16(8)	22(11)	44(22)	8(5)	20(10)	24(12)	14(7)	6(3)
0.60	18(9)	26(13)	48(24)	9(5)]	22(11)	26(13)	14(7)	7(3.5)
0.65	22(11)	32(16)	54(27)	11(6)	25(13)	28(14)	16(8)	7(3.5)
0.70	28(14)	36(18)	62(31)	14(7)	30(15)	32(16)	20(10)	7(3.5)
0.75	36(18)	42(21)	70(35)	22(11)	38(19)	36(18)	24(12)	8(4)
0.80	46(23)	50(25)	80(40)	30(15)	54(27)	44(22)	30(15)	8(4)

All diameter ratio β	resisting parts	The length of the shortest straight pipe on the upstream side
	Diameter ratio greater than or equal to 0.5 symmetrical spur diversion tube	30(15)
	Diameter sleeves and jacks with diameters less than or equal to 0.03D	5(3)
	Diameter between 0.03D and 0.13D thermowells and jacks	20(10)

Note: 1. The value without brackets is the value of "zero added uncertainty".
2. With the value of brackets is "0.5% additional uncertainty" value.

Table 1

5.3 Requirements for pressure pipe:

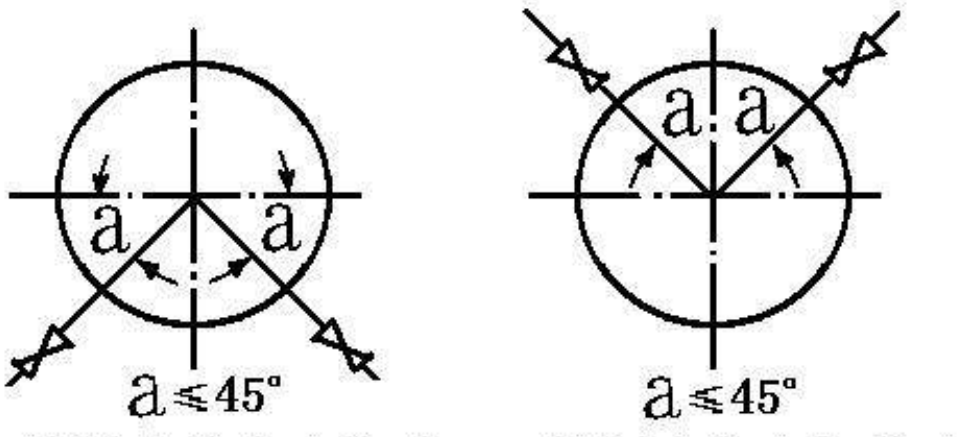
(1) The pressure pipe should be measured according to the nature and parameters of the use of pressure, corrosion-resistant materials, the diameter shall not be less than 6mm, the length of the best within 16m, depending on the nature of the fluid to be measured, the minimum diameter of different lengths please reference to Table 2.

(2) The pressure pipe should be laid vertically or tilted, the inclination shall not be less than 1:12. For high viscosity fluid, its inclination should be increased. When the differential pressure signal transmission distance more than 30m, the pressure pipe should be segmented tilt, and in each of the highest and lowest points were installed assembly

and settler.

(3) In order to avoid distortion of the differential pressure transmission, positive and negative pressure pipe should be as close as possible to laying, cold areas should also take anti-freeze measures, can be used electric or steam insulation, but to prevent the measured medium overheating vaporization and pressure in the tube produce gas to create false pressure.

(4) When the throttle device is installed on the vertical pipe, the pressure port position can be arbitrarily selected on the plane of the pressure taking device. Throttle device installed in the horizontal or inclined main pipe pressure port position shown in pic 6



measuring of liquid measuring of gas

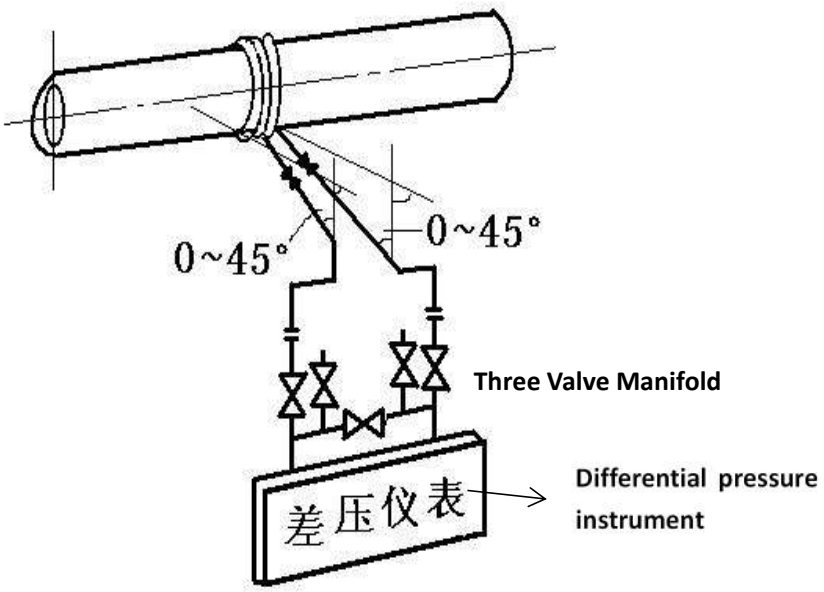
Pic 6 pressure port

connecting pipe internal diameter / connecting pipe length / medium	﹥16，000	16，000~45，000	45，000~90，000
Water、steam、dry gas	7~9	10	13
Wet gas	13	13	13
Low, medium viscosity oil	13	19	25
Dirty liquid or gas	25	25	38

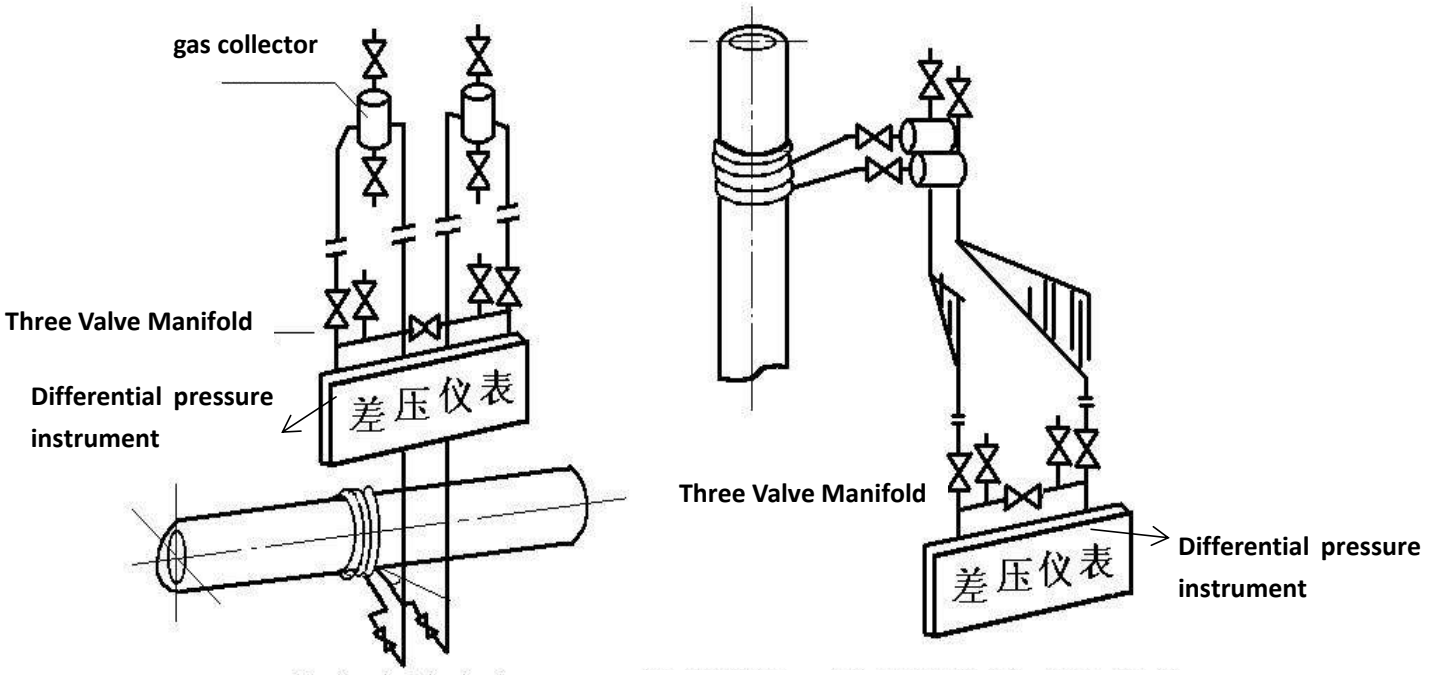
Table 2

(5) Take the pressure out of the short tube should be in the same level. If the throttle is installed on the vertical pipe, the distance between the pilot short pipe (vertical line, direction), which affects the zero point of the differential pressure transmitter, should be corrected by "zero point migration".
(6) Throttle part, pipe, differential pressure transmitter in a variety of circumstances have specific provisions of the installation, see pic 7 to pic 9.

The measured fluid is a clean liquid, the differential pressure signal pipeline installation shown in Pic 7



Instrument below the pipe

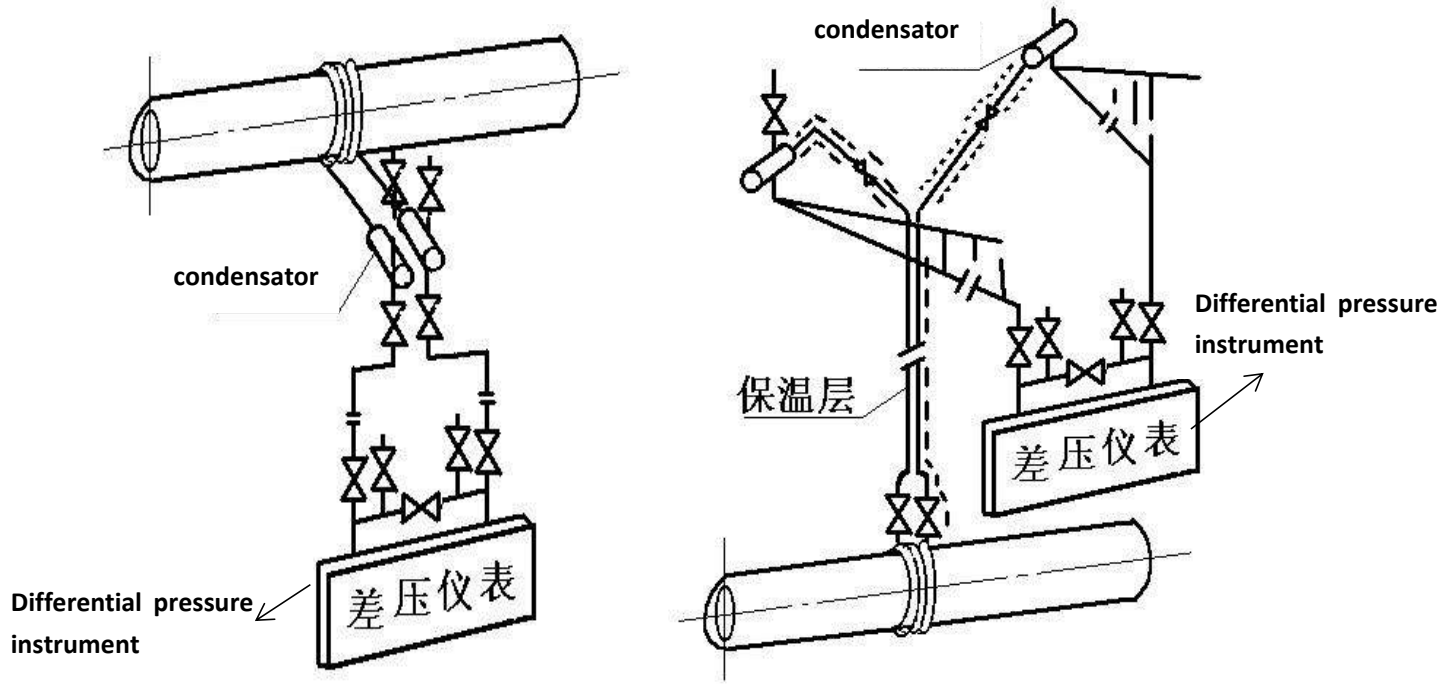


Instrument above the pipe

Vertical pipe, the fluid is high temperature liquid

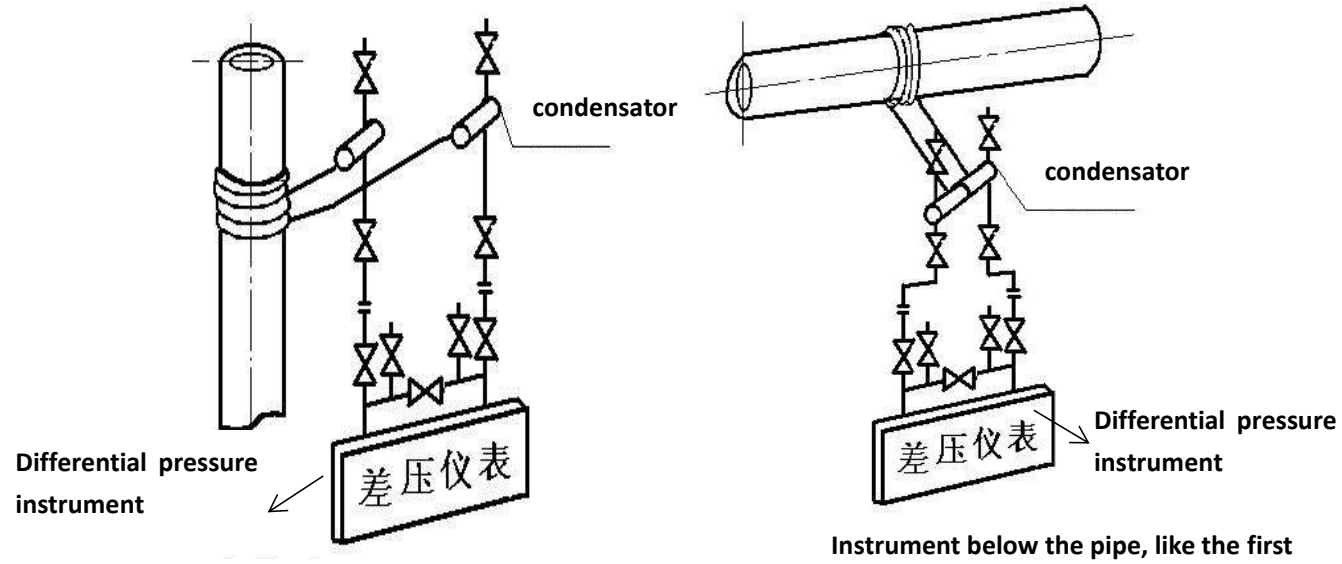
Pic 7

When the measured fluid is steam, the differential pressure signal pipeline installation method is shown in Pic 8



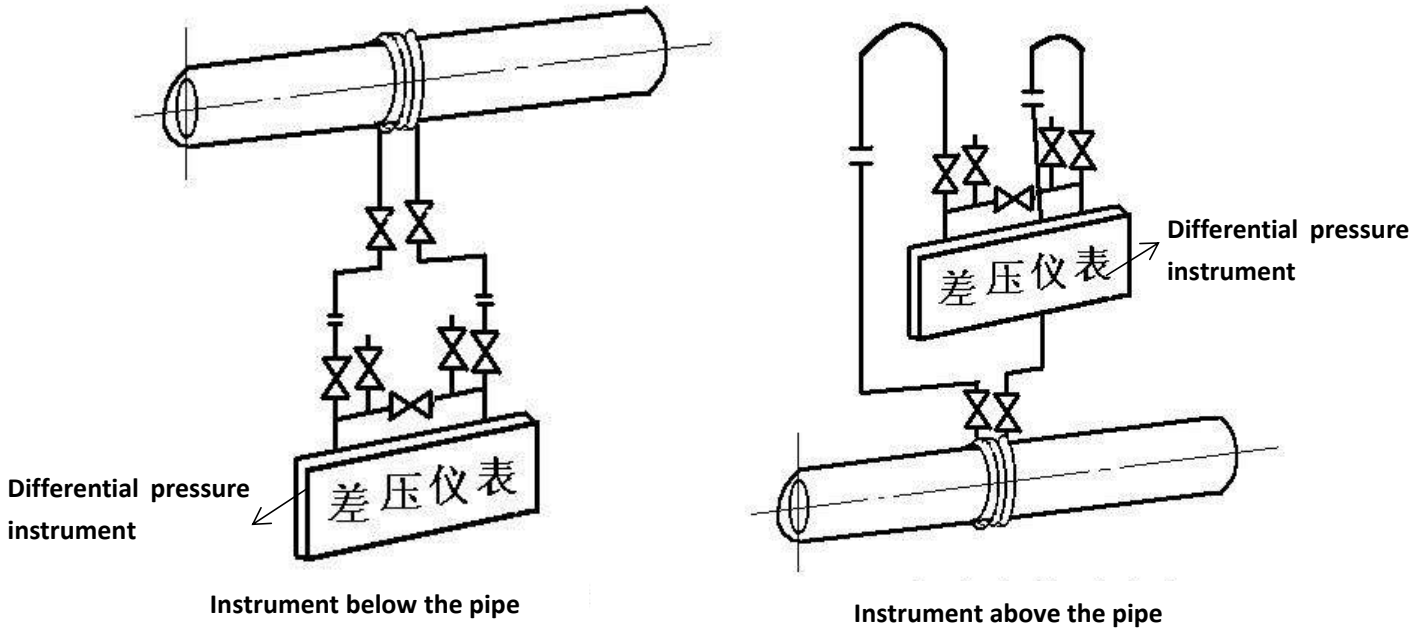
Instrument below the pipe

Instrument above the pipe

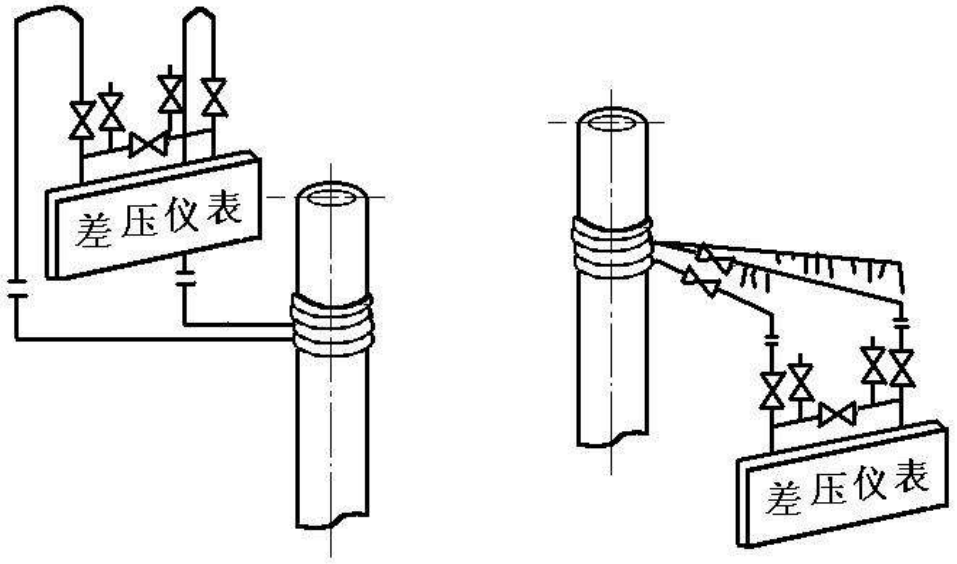


Pic 8

When the measured fluid is clear dry gas, the differential pressure signal pipeline installation method is shown in Pic 9



Differential pressure instrument



c 垂直管道，仪表在取压口上方 d 垂直管道，仪表在取压口下方

Pic 9

5.4 Use and Adjustment

(1) Throttle devices must be used with differential pressure or differential pressure transmitter to know the flow. In order to facilitate the adjustment of the zero in the field, must be in the differential pressure transmitter pressure tube at the installation of "three valve group", see the use of the transmitter instructions.

(2) In order to detect the true differential pressure value, in addition to the correct laying pressure pipe (see 5.3) also need to make pressure within the pipeline pressure medium (transfer fluid static pressure value) to maintain a single phase Phase or gas phase) state, that is, the measured liquid medium flow, must be filled with liquid filled with pressure, not mixed with gas; measured gas flow, the tube must be filled with gas, not condensation liquid, this can be set up gas collector or settlement (Periodic discharge) or liquid in the gas (periodic removal).

(3) Whether the design parameters of the throttle device are consistent with the actual parameters are directly related to the measurement accuracy. When the throttle device is put into use, if the measured parameters are within the range of the parameters, the measurement accuracy will not exceed the design accuracy, but if not Parameter is far from the design parameter range (assuming throttle device and differential pressure transmitter selection, manufacturing, installation are in line with the requirements) is likely to provide the design parameters are wrong, should change the design parameters, redesign the throttle device.

(4) Changes in the use of process conditions lead to changes in fluid parameters, should be used temperature, pressure, automatic tracking compensation, otherwise it will bring measurement error. Currently on the market there have been many types of intelligent flow display instrument, you can enter the media temperature, pressure, the standard state of the medium density, compression factor. The flow coefficient (outflow coefficient) ensures accurate measurement of the throttle device.

6 maintenance and repair and troubleshooting

Throttle device work more reliable, common fault is to take the mouth of the plug, the pressure pipe blockage or leakage, you can often clean or blow the suction pressure, pressure tube, tighten the sealing connection. When the ambient temperature is below 0 ℃, the pressure tube should be wrapped insulation layer or laying heat pipe. Measure the high temperature medium should be added to the condenser or isolator, to prevent high temperature media into the differential pressure transmitter pressure vessel.

7 Supply Complete Set

7.1 Instrument complete set

(1) flange pressure throttling device, including throttle part, pressure flange, take the pressure pipe and fasteners.

(2) ring chamber pressure throttling device, including throttle part, ring, flange, take the pressure pipe and fasteners.