

# Installation of Metal Pipe Rotor Flowmeter

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**Abstract:** Because of its advantages of simple structure, wide range of measurement, high reliability and convenient maintenance, metal tube rotor flowmeter is widely used in the testing and automatic control of the liquid of national defense, chemical industry, petroleum, metallurgy, electric power, environmental protection, medicine and light industry. When the repeatability of the measured flow is large, the design of the metal pipe rotor flowmeter is proposed. Some questions have been found out after the exploration of the correct installation and use of the metal tube rotor flowmeter, and the installation of the metal tube rotor flowmeter is expounded, and some metal tube rotor flow meters are found Installation skills.

**Keywords:** Flow Tube, Float, Rotor Flowmeter, Metal Tube, Pointer

## I. OVERVIEW

Flow meters and flow meters are one of the most common and important instruments used in industrial measurements. With the progress of the times and the development of society, the accuracy, scope and repeatability of flow measurement is also getting higher and higher. In order to meet the needs of various industries, a variety of flow meters have been put out one after another, commonly used in oil, natural gas, chemical, water treatment, food, beverage, pharmaceutical, power, metallurgy, pulp and paper, building materials and other industries.

## II. MEASURING PRINCIPLE OF METAL TUBE ROTAMETER

As the medium (gas or liquid) flows through an upright cylindrical cone in the flow tube, the guided rotor floats upwards (as in Figure 1.1). For a given position, when the float buoyancy  $A$  acts on the rotor, the damping force  $W$  is in equilibrium with the rotor weight  $G$ . The position of the rotor at this point represents the flow rate at that time and indicates the instantaneous value of the flow rate at each height of the rotor. And through the magnet in the rotor coupled with the magnet of the indicator, connected to transmit to the indicator, so that the pointer of the indicator rotates, so that the size of the reactor flow value changes.

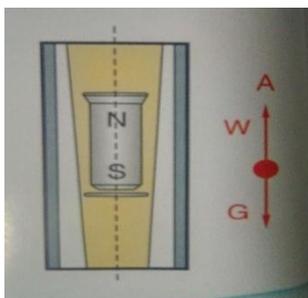


Figure 1.1 Principle diagram

## III. MAIN STRUCTURES

### A. Sensor

The meter consists of two components, the sensor and the indicator.

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### B. Indicators

The height position of the float is transmitted to the dial by means of a lever mounted on a high-precision ball bearing in the indicator. The flow rate is reflected by the magnetic coupling principle. The indicator housing is aluminum alloy.

The flow meter has the advantage of an indicator with local reading and a transmitter with signal output inside the indicator when remote data transmission is required.

### C. Electrical signal output structure

The indicator, if equipped with a transmitter, allows the flow to be precisely. proportionally to a standard current signal of 4-20mA. Later it is intrinsically safe and can be used in explosive hazardous situations. The transmitter system is carefully adapted.

## IV. SOME OF THE PROBLEMS ENCOUNTERED AND HOW TO SOLVE THEM

### A. The difference between the flow values on the standard discs detected are small resulting in an unattractive engraved dial

Solution: Due to the installation of 20 orifice diameter flow range of 2.5-25m<sup>3</sup> / h metal tube rotameter process, through the bell-type gas flow standard device to detect the value of the standard disk on the distance are small and scale distance is small, the empty space is also small, no matter how to adjust the size of the float large diameter, the length of the upper stop and lower stop, the value on the standard disk are relatively dense, not beautiful. So choose a different cone than the tube, with tape to the upper flow tube, lower flow tube and cone than the tube glued together, put on the measurement seat, the dial attached to the measurement tube, the measurement has to show the number, record the data to see if the data obtained meet the requirements. After trying many different sizes of tapered tubes, we finally found the most suitable 1/10 tapered tube, and then welded, deburred and polished it.

### B. The range of pointer rotation is small

Metal tube rotameter pointer solution: sometimes the pointer rotation range is not very wide, so when the float in the measurement tube high and low movement, the pointer cannot turn the maximum range, then you need to go to adjust the pointer tightness. First, use a screwdriver to loosen the top wire of the pointer, and then clamp the pointer column with pliers to screw the adjustment valve below it to a certain angle when the pointer range becomes larger, and finally restore the original state. This is the best range of measuring flow pointer rotation, if not repeat the previous operation.

Electric telemeter pointer solution: move the positioner to a distance of 1mm from the chip, rotate the pointer and a pointer line on the positioner coaxial and parallel, tighten the two thimbles on the positioner to play a fixed role.

### C. Light jittering of the pointer

Possible causes: Generally speaking, it is caused by the undulation of the medium (gas or liquid) in the flow tube.

Solution: You can choose the flow tube material with higher friction force that is to increase the friction to the vibration, which can eliminate or weaken the slight vibration of the medium in the flow tube. You can also increase the guide size of the float and reduce the fit gap to weaken the vibration.

#### ***D. Moderate jittering of the pointer***

Possible causes: Generally speaking, because of the active form of the medium caused, usually due to the unstable operating pressure of the medium and lead to burst of gas, sometimes open the valve too fast, then should be different due to the caliber of the application of the corresponding valve opening speed, can be through the pressure stabilization or flow stabilization device to suppress or amplify the gas damping of the metal tube rotameter.

Solution: In order to obtain a standard stable atmospheric pressure airflow, the drainage method can generally be used, and the difference in liquid level between the high level tank and the storage cylinder must be kept constant.

#### ***E. The pointer shakes violently***

Possible causes: rotameter pressure, temperature, flow and the actual form and the user gives the medium pulsation, pressure does not match or gas running state is not consistent, sometimes the user provides a larger pressure data, and the actual existence of large differences make the rotameter over the measurement of the scope.

#### ***F. If the card float how to adjust the length of the upper and lower stops***

Possible cause: Due to the detection process, the float falls when the detection is completed with greater force, resulting in the float not going up when the air valve is opened.

Solution: You need to use vernier calipers to measure the length from the place where the float is stuck to the bottom of the measuring tube plus 2mm to be the correct length of the lower stop, then it will not be stuck to the float. You need to choose a long enough lower stop, use vernier calipers to measure out the appropriate size, use angle grinder to cut the excess part, then install the lower stop into the float will not be stuck.

#### ***G. Rotor flow meter pointer pointing to a position does not move***

Failure reason: The float of the rotameter is stuck. Generally speaking, when the bell-type gas flow standard device is used to test the metal tube rotameter, the valve opens too fast when the bell is lowered, which makes the float impact upward rapidly and causes the stop gear to deform and jam the float. However, it may be because the float guide rod is not in a straight line with the center of the upper and lower stops, which does not exclude the float from jamming.

Solution: During the whole installation process, you can take off the snap spring, take out the deformed stop and reshape it or get a new one, and check whether the center of the guide rod and the float can be aligned, if it is not in a straight line, immediately calibrate it. Finally, the float, the upper stop and lower stop into the flow pipe, the flowmeter will be rotated up and down a certain angle to see if the float is smooth and not stuck. In addition, the installation of metal pipe rotameter, must be installed vertically or horizontal installation, can not be tilted. Otherwise, it is easy to cause the card table, to the measurement error.

#### ***H. No matter how to screw the positioning sleeve, the watch head is still active***

Solution: The installation process to screw the flow tube and the head firmly, no matter how to screw the positioning set with pliers, the dial are active, and later found that the need to screw the top wire into the screw hole to play a fixed role, the connection between the flow tube and the head tightened, the head will not be active.

#### ***I. How to prevent damage to the float during transportation***

Solution: For fear of damage to the float during transportation, cut the packing tape to a length twice the distance from the upper stop to the flange surface and a width twice the diameter of the small flange hole, insert the cut packing tape into the symmetrical flange hole of the stop, all the way to the upper face of the float, so that the float does not move around when the rotameter is turned up and down.

#### ***J. The maximum detected flow rate is between 30 and 40***

Possible cause: Due to small float large diameter.

Solution: The detected flow maximum is between 30-40, making the value on the dial very dense and unattractive, and the large diameter of the float needs to be adjusted. Use vernier calipers to measure the large diameter before modification, calculate how large the diameter should be increased, use a tool to gently smash the edge of the float tip plane, because there are magnets inside, so the large diameter of the float can be larger, smashed to the appropriate position, and then put it into the flow tube to test, see if the maximum flow can reach more than 70 or 80, if it is qualified, and vice versa, repeat the above operation.

#### ***K. Distance between cover and dial***

Solution: Since some of the meter cover will be pressed to the pointer after buckling, resulting in no matter how the float moves up and down in the flow tube the pointer will not change, so one is to cut the length of the pointer short by a certain length (use the lathe to turn away part of it), and the other is to change the length or shape of the screw.

#### ***L. Rotor flowmeter measurement error is large***

Possible reasons: installation does not meet the requirements; large changes in the density of the liquid medium; gas medium is greatly influenced by temperature and pressure; long-term use and pipeline vibration and other factors.

Installation does not meet the requirements of the solution: on the vertical installation of the rotameter, the vertical inclination should not be greater than 20 degrees. For the horizontally installed rotameter, the level inclination should not be greater than 20 degrees. When installing the metal pipe rotameter, there can be no ferromagnetic objects within 100 mm around, otherwise it will affect the measurement effect.

Solution for large changes in the density of the liquid medium: When detecting the meter, the medium is converted according to the density requirements given by the user and converted to the standard state of water flow for calibration. Therefore, if the density of the medium and the standard state of the water density difference is large, will lead to a large error in the measurement. Can change the density of the medium into the calculation formula, it will be converted into error correction factor, and then multiply the flow meter measured by the correction factor, into the true flow.

Gas medium is greatly affected by the temperature and pressure solution: advocate the use of steady pressure compensation method to obtain the true flow rate. .

Long-term use and pipeline vibration and other factors of the solution: long-term use and pipeline vibration and other factors caused by rotameter sensing magnets, pointers, counterweights and rotating magnets and other moving parts loose, resulting in large errors. Solution: can be verified by hand pushing the pointer. First, the pointer is placed at the RP position to see if the output is 40MA, and whether the flow rate display is 0%, and then follow the scale in turn to verify. If there is any difference, the position of the components can be adjusted. Professional adjustment is generally required, otherwise the position will be lost and will need to be returned to the manufacturer for correction.

#### **M. Valve opening and closing sequence**

Possible causes: There may be iron slag, rust, tiny particles and other debris left in the flow tube from welding.

Solution: In order to prevent the newly installed metal pipe rotameter from clogging failure soon after use. The bypass valve should be opened first, after a period of time, the metal pipe rotameter inlet valve is opened again, the outlet valve is opened and the bypass valve is closed. In addition, should pay attention to the order of the switching valve, on the centrifugal pump for energy transfer material process route, the switch sequence requirements are not high; assume the piston type quantitative pump transfer material, the valve switch sequence reversed (first, first off the bypass valve, then open the inlet valve and export valve. And switch valve time gap and some large, that is, after closing the bypass valve, metal pipe rotameter export valve does not immediately open), often leading to increased pressure in the pipeline, damage to the instrument, some other failures. .

### **V. INSTALLATION NOTES**

A. In order to facilitate the maintenance of the flowmeter to replace and clean the measuring pipeline, bypass piping and bypass valve should be installed on the metal pipe rotameter installed on the process pipeline.

B. At the inlet of the metal pipe float flowmeter, there should be a straight pipe section of more than 5 times the straight pipe diameter, and the outlet should have a straight pipe section of 250mm.

C. If the medium contains ferromagnetic material, then a magnetic filter should be installed. If the medium contains solid impurities, a filter should be installed between the valve and the straight pipe section.

D. When used for gas measurement, the pressure loss of the pipeline should not be less than 5 times the pressure loss of the flowmeter, so that the float can work stably.

E. In order to prevent the deformation of the rotameter caused by the pipeline, the flange of the process pipeline must be coaxial and parallel to the flowmeter flange. In order to avoid the vibration of the pipeline and reduce the axial load of the pipeline, the pipeline support is used. The control valve in the measuring system should be installed downstream of the flowmeter.

F. Detection of gaseous media, assuming that the gas in the outlet of the flowmeter directly to the atmosphere, the valve should be installed at the outlet of the instrument, otherwise it will lead to distortion of the data due to the reduction of gas pressure generated by the float in the flow pipe.

G. When installing the instrument with PTFE lining, the flange nut should not be screwed too tightly asymmetrically at will, so as not to cause deformation of the PTFE lining.

H. If the instrument has a liquid crystal display, the display should be protected from direct sunlight to avoid reducing the service life of the liquid crystal; if the instrument is powered by lithium battery, direct sunlight and high temperature environment ( $\geq 65^{\circ}\text{C}$ ) should be avoided to avoid reducing the capacity of the lithium battery.

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