



## Operating Instructions

### Fork-11 Tuning Fork

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## 1 Introduction

### 1.1 Brief description

Fork-11 Tuning Fork Level Switch is specially designed for powdery and fine-grained bulk solids, such as sands, fine raw materials in chemical industry, flours, salts etc., successfully handles lightweight media applications that are difficult to measure or detect like fine low density media with density of  $0.008\text{g/cm}^3$ . Fork-11 offers maximum reliability in a wide application range.

### 1.2 Operating principle

Fork-11 Tuning Fork Level Switch probe is based on a tuning fork harmonic resonance. It utilizes piezoelectric devices to drive the fork to vibrate and detect the changes of vibration. The fork vibrates in resonant frequency when it is in air. Once the fork comes into contact with application medium, the vibration amplitude of the fork will decrease substantially. Output from the detecting piezoelectric device will decrease accordingly. An integrated circuit is designed to analyze the amount of decrease and output a switch signal. By reasonably increasing the area of tines and precisely adjusting harmonic resonance, Jiwei Fork-11 Tuning Fork Level Switch offers great reliability and sensitivity. Therefore, it makes Fork-11 the best level switch for ultra-low-density media.

### 1.3 Application

- (1) EPP and EPS processes in foam molding machines and plastic forming machines.
- (2) Zircon sand and petroleum coke.
- (3) Ultra-low density particles and powders.
- (4) After spraying PTFE on the fork, it is especially suitable for fumed silica ( $\text{SiO}_2$ ) level measurement. The density of fumed silica is as low as  $0.01\text{g/cm}^3$ , and the lowest detectable density of Fork-11 is  $0.008\text{g/cm}^3$ , which fully meets the measurement requirements of fumed silica working conditions.

## 2 Configuration and characteristic

### 2.1 Configuration

As Fig.1 shown, Fork-11 consists of the components:

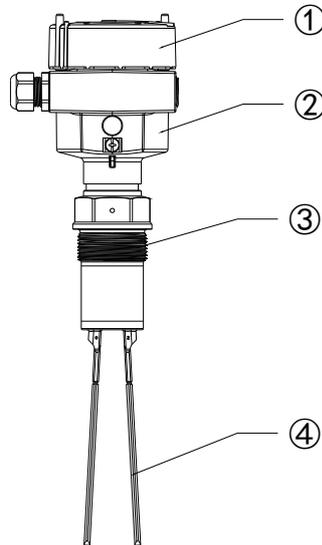


Fig. 1: Fork-11 Configuration

① Housing cover    ② Housing with electronics    ③ Process fitting    ④ Tuning fork

### 2.2 Characteristic

- (1) Reasonable design of tines and precisely adjusted of fork resonant frequency. Fork-11 can be used in light powders and flakes with bulk densities as low as  $0.008\text{g/cm}^3$ .
- (2) Particularly suits for level measurement of powdery, fine-grained bulk solids, can effectively avoid buildup.
- (3) Industry-leading performance for high temperature industrial environments, can tolerate process temperature up to  $400^\circ\text{C}$ .
- (4) Strong self-diagnostic function helps to accurately locate the fault.
- (5) Easy installation and maintenance free.
- (6) With CE certificates, gas and dust Flameproof Enclosure and Intrinsic Safety certificates.
- (7) Made of strong corrosion resistant material 316L.

## 3 Installation

### 3.1 Before installation

Before installation, please make sure that all parts of the instrument are suitable for the existing process conditions. In order to ensure the instrument works normally after installation, please be aware of process pressure, process temperature as well as the chemical properties of the medium.

### 3.2 Horizontal Installation

#### (1) Protective sheet installation

In order to achieve a very precise switching point and to ensure measurement validity, Fork-11 can be installed horizontally. If measurement error allows within a few centimeters, recommend mounting Fork-11 approx. 20° inclined to the vessel bottom and keeping the tuning fork vertical to avoid measurement error caused by material build-up. In the measurement of fast filling stream material, it is necessary to mount a suitable protective sheet to ensure the instrument works reliably. As Fig. 2 shown.

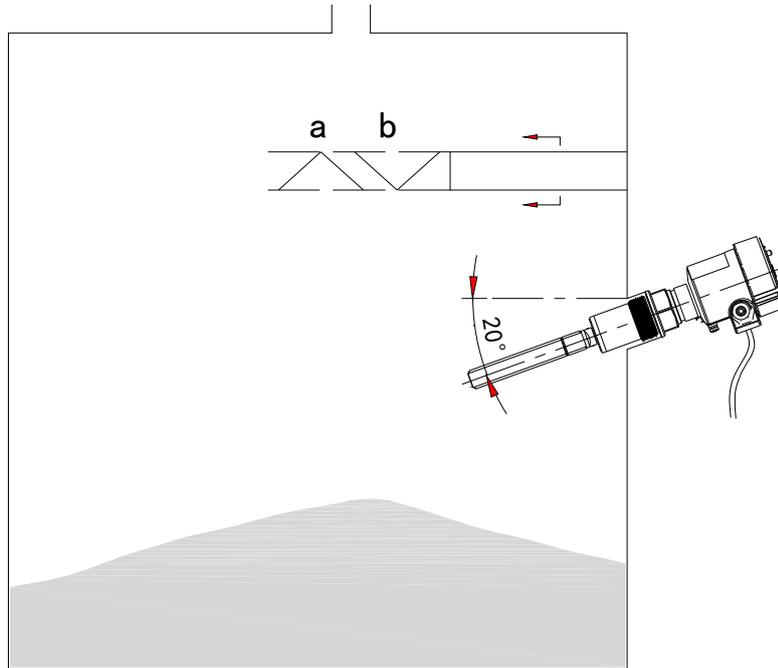


Fig. 2: Protective sheet installation

- a: Protective sheet for fine-grained bulk solids
- b: Concave protective sheet for abrasive solids

To protect the probe from direct impact damage, a protection sheet should be installed above the vibration fork, and must be longer than the intrusion length (horizontally). Generally, protection sheet can be a convex shape (inverted “V” section) as in Fig.2 (a). If the medium is coarse and abrasive, the sheet should be concave shape (erected “v” section) as in Fig.2 (b), so medium could stack up a bit in concave area.

#### (2) Recess installation

In situation where medium is high-density or lumpy, and medium fills in vertically downwards, it will impact the probe, to ensure the endurance of instrument and reliable measurement, instrument should be mounted in a recess portion of the container showing as Fig.3 to protect the probe from impacting or being bent by filling materials, and “a” must be longer than the probe intrusion length.

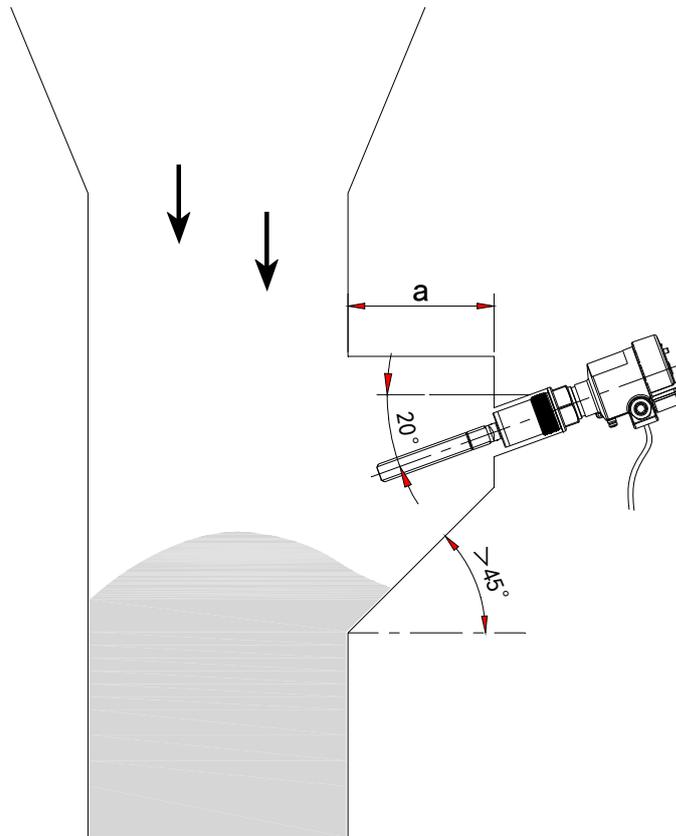


Fig. 3: Recess installation

### 3.3 Mounting direction

Please make sure the gap between fork bodies has the same direction as medium flow. According to Fig.4, to avoid measurement error caused by medium resistance, tuning fork should be mounted in such a way that the surfaces of the blades are parallel to the product movement.

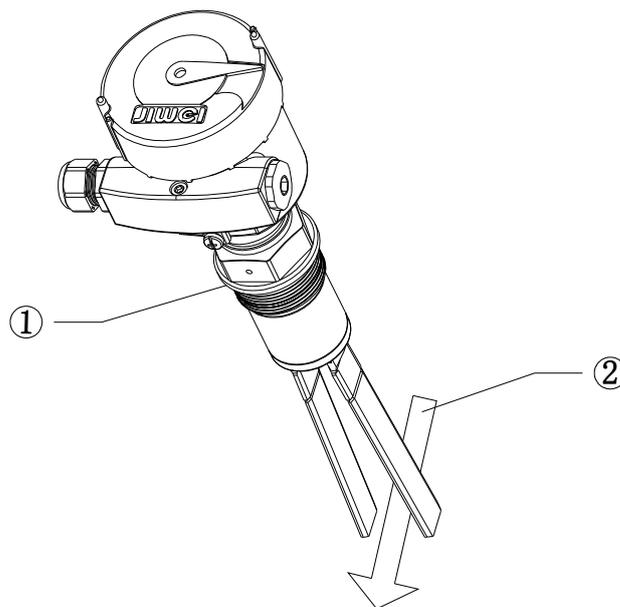


Fig. 4: Flow orientation of the tuning fork

① Marking with screwed version    ② Direction of flow

### 3.4 Avoid Mounting at Filling Opening

As shown in Fig.5, please avoid installing the instrument near inlet point so that the vibration fork does not protrude directly into filling stream. It will prevent instrument from filling impact damage or generating false signals.

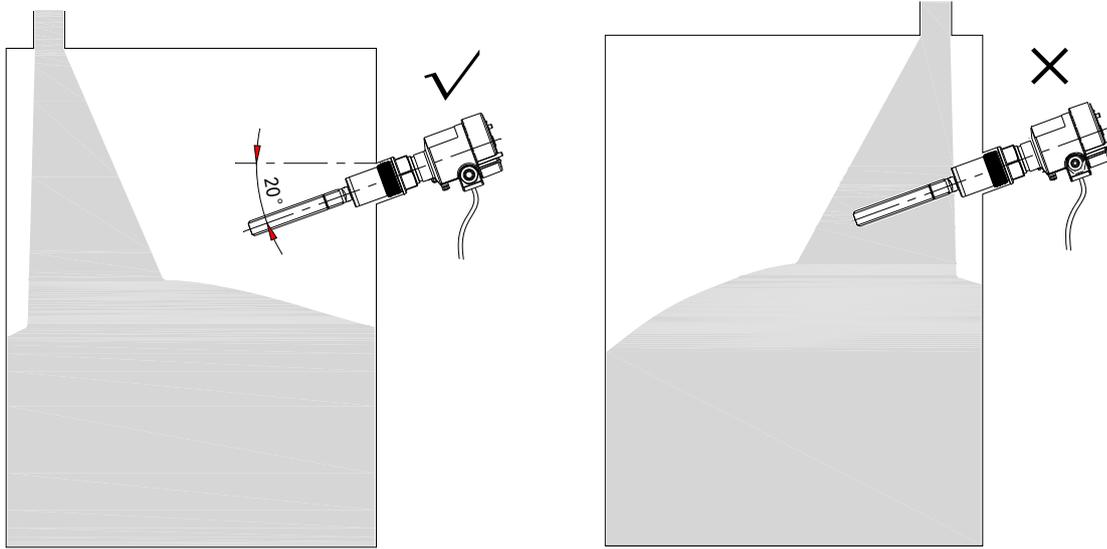


Fig.5: Avoid mounting at filling opening

### 3.5 Pressure/Vacuum

The process fitting must be sealed if there is high pressure or low pressure in the vessel or pipeline. Before mounting, please check if the seal material is suitable for the existing process conditions such as process pressure and process temperature.

### 3.6 Moisture

When the instrument is mounted in outdoors or high humidity areas, please lead the connection cable downwards in front of cable entry, thus the rain and condensation water can drain off and give your instrument additional protection against moisture penetration. See Fig. 6 as reference.

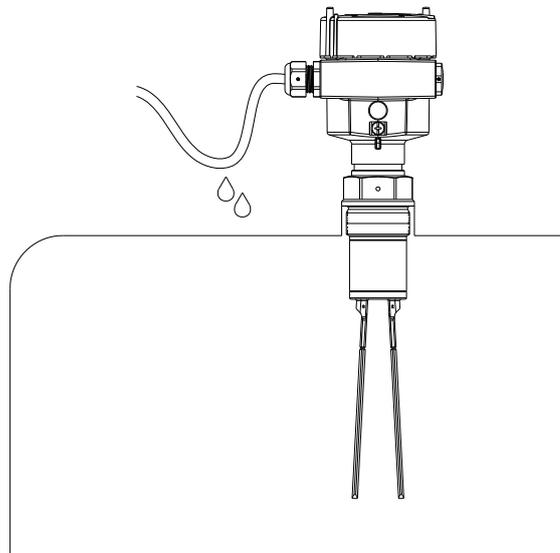


Fig. 6 Against moisture penetration

## 4 Connecting to power supply

### 4.1 Safety Instructions

- (1) In consideration of safety, wiring is only allowed in the complete absence of line voltage.
- (2) You must follow the corresponding installation regulations for Ex applications.

### 4.2 Cable connection

In general, Fork-11 uses a general cable with round cross-section. To ensure its sealing effect, the outer diameter is 5-9mm.

If you are using cable with a different diameter or cross-section, please use a matched cable bolt, and be aware of new cable's sealing ability.

### 4.3 Wiring diagram

Please wire safely according to the following diagrams (Figure 7-8).

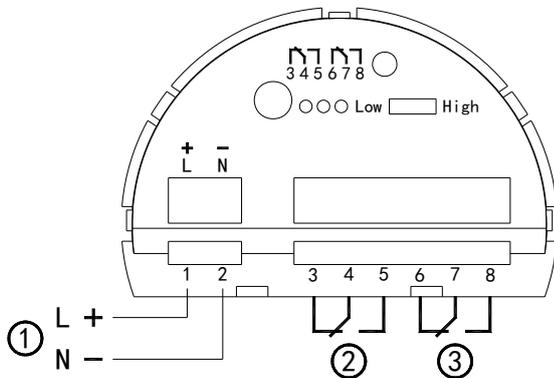


Fig. 7: Relay output

- ①: Voltage supply
- ②③: Relay signal output, DPDT

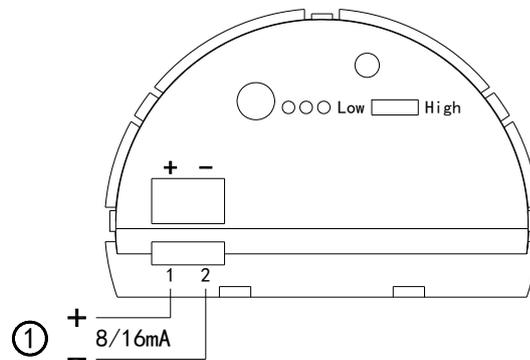


Fig. 8: Two-wire output

- ①: Voltage supply/8/16mA signal output

### 4.4 Wiring procedure

For Ex instruments, the housing cover may only be opened if there is no explosive atmosphere present. Proceed as follows:

- (1) Unscrew the housing cover.
- (2) Loosen the locknut on the cable gland.
- (3) Remove about 10cm (4in) of the cable mantle, strip about 1cm(0.4in) of insulation from the ends of the individual wires.
- (4) Insert the cable into the housing through the cable entry.
- (5) Unscrew the terminals with a screwdriver.
- (6) Insert the wire ends into the open terminals according to the wiring diagram.
- (7) Tighten the terminals with a screwdriver.
- (8) Check the hold of wires in the terminals by lightly pulling on them.
- (9) Tighten the locknut on the cable gland and fasten the seal ring.
- (10) Screw the housing cover.

## **4.5 Inlet Pipe, Cooling Air Pressure, and Airflow Specifications (Applicable only to the ultra-high temperature version of the Fork-11 Tuning Fork Level Switch)**

### **4.5.1 Inlet Pipe Specifications**

Standard PU tubing with a specification of 6×4 mm (outer diameter 6 mm) should be used.

### **4.5.2 Connecting the Inlet Pipe**

Cut the end of the PU tube flat and insert it fully into the quick connector until it reaches the bottom. Then, tighten the locking nut securely.

### **4.5.3 Recommended Cooling Air Pressure**

It is recommended to use an air pump with an output pressure of 8 bar.

### **4.5.4 Minimum Cooling Airflow**

Attach the provided whistle to the exhaust nozzle, ensuring that the whistle's air outlet side is tightly pressed against the outer wall of the nozzle. Gradually increase the cooling air inlet flow until the whistle emits a sound. The corresponding air flow at this point is the minimum required cooling airflow.

### **(1) 4.5.5 Installation and Safety Instructions**

When the Fork-11 is not installed vertically, ensure that the air inlet hole on the flange is positioned vertically downward.

- (2)** The cooling air must be connected and operating while the probe is still at ambient temperature, before placing the Fork-11 into service under actual working conditions.
- (3)** A continuous and uninterrupted supply of cooling air must be maintained during operation.
- (4)** If it is necessary to stop the cooling air supply, ensure that the vibrating rod of the Fork-11 has returned to ambient temperature before cutting off the air.
- (5)** During normal operation, high-temperature gases will be discharged from the exhaust port. Do not place any non-heat-resistant objects or materials near the exhaust outlet, and do not cover or block the port.
- (6)** A high-temperature warning label should be applied near the exhaust port to prevent potential burns to personnel.
- (7)** During non-operational periods, to prevent dust, rainwater, or other debris from entering through the exhaust port, a 6×4 mm soft air tube may be temporarily attached, tied at the end, and sealed.

## 5 Setup

### 5.1 Internal structure

See Fig. 9 and 10 as references.

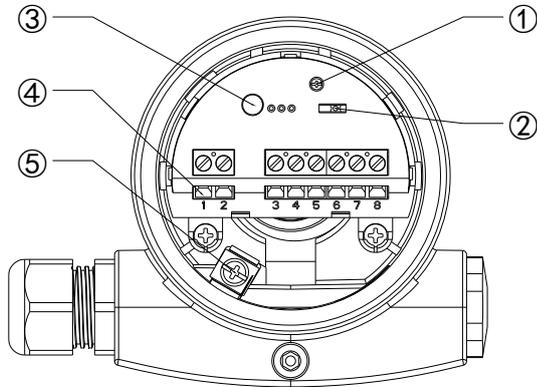


Fig. 9: Relay output

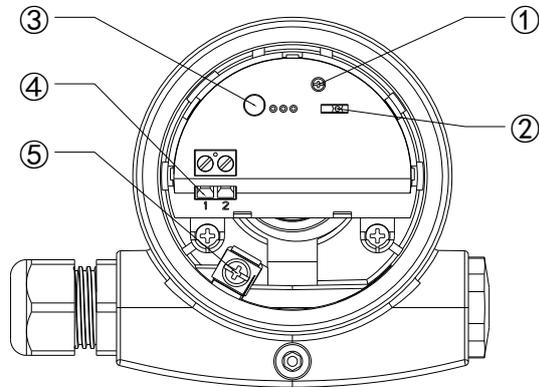


Fig. 10: Two-wire output

① Sensitivity adjustment    ② Mode switching    ③ Signal lamp    ④ Connection terminals    ⑤ Ground terminal

### 5.2 Sensitivity adjustment

Through adjusting the sensitivity switch on the control panel of Fork-11 makes it better to adapt to the measured medium. As default setting, the potentiometer is set to the right end position, medium with density of  $\geq 0.02\text{g/cm}^3$  can be detected. For very light-weight medium, should turn the potentiometer to the left end position (the lowest measurable density is  $0.008\text{g/cm}^3$ ), thus, the detection is more sensitive and more reliable.

Warning: The equipment is precise instrument, by default, the sensitivity adjustment potentiometer is set to the right end position, which meets the requirement to measure medium with density of  $\geq 0.02\text{g/cm}^3$ ; or, the production engineers adjust the sensitivity adjustment potentiometer to an optimal position according to customer's feedback. Therefore, clients do NOT need to readjust the sensitivity adjustment potentiometer. If the readjustment is in great requirement after testing, you must screw the potentiometer VERY CAREFULLY AND GENTLY with professional and matched screwdriver. To avoid the sensitivity adjustment potentiometer damage permanently (the red light flashes to report warning) and send back to the original factory to maintain, strictly forbid using general tools to adjust the potentiometer roughly and rudely.

### 5.3 Modes adjustment

For overflow protection and dry run protection, it should be combined with the practical requirements of the occasion to adjust mode switch (High/Low). You can set the required mode according to the "Signal function table" in section 5.5.

### 5.4 Signal lamp

Signal lamp for indication of the switching status:

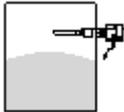
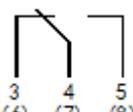
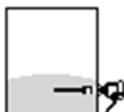
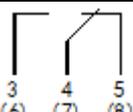
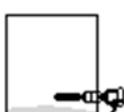
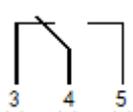
- Green = normal
- Red = alarm

• Red (flashing) = fault

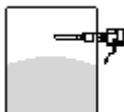
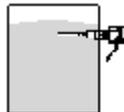
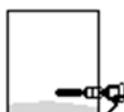
### 5.5 Signal function table

Table 1 and 2 list the relay and the two-wire output signal corresponding to the level status.

**Table 1 Relay (DPDT) electronics module**

	Installation location	Relay status	Signal lamp
(High) Overfill protection		 Relay energized	Green
(High) Overfill protection		 Relay de-energized	Red
(Low) Dry run protection		 Relay energized	Green
(Low) Dry run protection		 Relay de-energized	Red
Fault	Any location	Relay de-energized	Flashes red

**Table 2 Two-wire electronics module**

	Installation location	Output Current	Signal lamp
(High) Overfill protection		8mA	Green
(High) Overfill protection		16mA	Red
(Low) Dry run protection		8mA	Green
(Low) Dry run protection		16mA	Red
Fault	Any location	<2.3mA	Flashes red

**Safety note:**

When testing the function of Fork-11, do NOT hold the fork body by hands, it may damage the sensor, even distort the fork body.

## 6 Fault analysis and maintenance

### 6.1 Fault analysis

The operator of the instrument is responsible for taking suitable inspections to rectify faults.

Fork-11 offers maximum quality and reliability. Nevertheless, faults may occur during operation.

These may be caused by the following:

- Electronics module
- Voltage supply
- Installation location
- Vibrating fork body

When faults occur, the first inspection to be taken is to check the output signal. In many cases, the causes can be determined this way and the faults rectified. See Table 3 as references.

**Table 3 Fault analysis**

Fault type	Fault analysis	Fault rectification
Fork-11 signals error reporting under dry run protection or overfill protection	Operating voltage too low	Check operating voltage
	Electronics defective	Push the mode switch inversely, if instrument then changes the mode, the tuning fork may be covered with buildup or mechanically damaged. If the switching function is in the correct mode, instrument still is faulty, return the instrument for repair.
		Push the mode switch inversely, if instrument then does not change the mode, the electronics module may be defective, please exchange the electronics module.
	Unfavorable installation location	Mount the instrument at a location in the vessel where no dead zones or mounds can buildup.
	Buildup on the tuning fork	Check the tuning fork if there is buildup and remove it.
	Wrong mode selected	Reset the correct mode on mode switch (overfill protection, dry run protection).
Signal lamp turns red	Damage on the tuning fork	Check if the tuning fork is damaged or extremely corroded.
	Electronics defective	Exchanging the electronics module
	Damage to other parts of the instrument	Exchange the instrument or send it to repair.

Depending on the reason for the fault and the inspections taken, the steps described in chapter “Set up” may have to be carried out again.

## **6.2 Exchanging the electronics module**

If the electronics module is defective, in order to continue using the instrument, it is recommended to replace the electronic module. In Ex applications, you should pay attention to the electronics module with respective Ex approval.

In general, all electronics modules of Fork-11 can be replaced with each other. However, if the electronics module with a different signal output, not the same, you should pay attention to make the appropriate adjustments and select the matching requirements of the electronics module.

## **6.3 Instrument repair**

We offer our customers service including technical consulting, user training, on-site installation and commissioning, product replacement and maintenance as well as on-site technical support, etc. Jiwei's product quality warranty period is one year, the warranty period for your free maintenance, long-term technical support, if you need advice in use, please call the service hotline: +86 755 28407683, you can find the relevant services on our website "[www.jiweimeter.cn](http://www.jiweimeter.cn)".

## 7 Technical data

### Housing

Aluminum die-casting housing	ADC-12
Ground terminal	316L

### Seal

Seal between housing and housing cover	silicone
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### Process fitting

Thread	316L
Flange	316L

### Probe

Tuning fork	316L
Extension tube	316L
Temperature extension tube	316L

### Instrument weight

0.8 ~ 4KG

### Measuring frequency

approx. 140 Hz

### Ambient conditions

Ambient temperature on the housing	-40~80°C
Storage and transport temperature	-40~80°C

### Process conditions

Process pressure	-1~25bar
Process temperature(Normal temperature)	-50~150°C
Process temperature(High temperature)	-50~250°C

### Sensitivity switch (The lowest density)

High density	$\geq 0.02\text{g/cm}^3$
Low density	$\geq 0.008\text{g/cm}^3$

### Modes switch

High	overflow protection
Low	dry run protection

### Switching delay

When immersed	0.5S
When laid bare	1S

### Electronics

Relay (DPDT), Two-wire

### Operating voltage

Relay	20~253VAC/20 ~ 72VDC
Breaking capacity	
Min	50Mw
Max	750VA AC, 54W DC
Two-wire	10~36VDC

### Cable entry/plug

Cable entry	M20×1.5, 1/2NPT
Plug	M20×1.5, 1/2NPT

### Electrical protective measures

Protection rating	IP66/67
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Overvoltage category	III
Protection class	
Relay	I
Two-wire	II

### **Approvals**

Instruments with approvals can have different technical data depending on the version. For that reason the associated approval documents of these instruments have to be carefully noted. You can find the approvals in the certification area of “[www.jiweimeter.cn](http://www.jiweimeter.cn)”.

### **Ex certificate**

This instrument fulfills the legal requirements of the applicable Ex guidelines. You can find the Ex conformity declaration in the certification area of “[www.jiweimeter.cn](http://www.jiweimeter.cn)”.

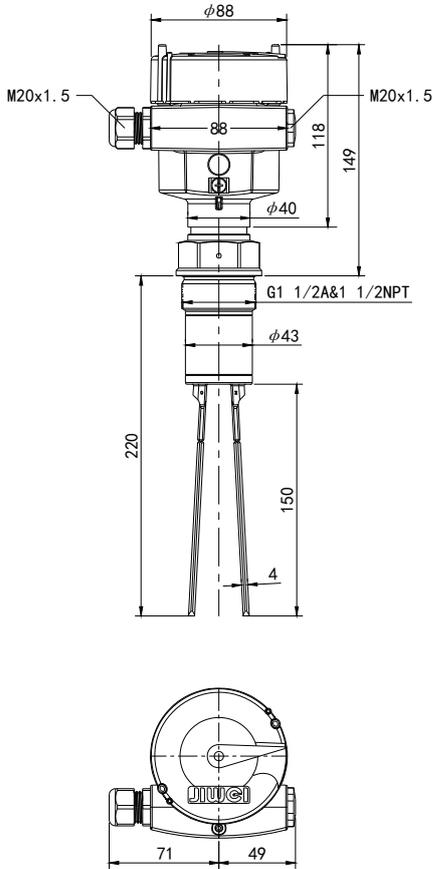
### **Protection rating**

This instrument fulfills the legal requirements of the applicable GB guidelines. The housing version with protection rating IP66/67. You can find the GB conformity declaration in the certification area of “[www.jiweimeter.cn](http://www.jiweimeter.cn)”.

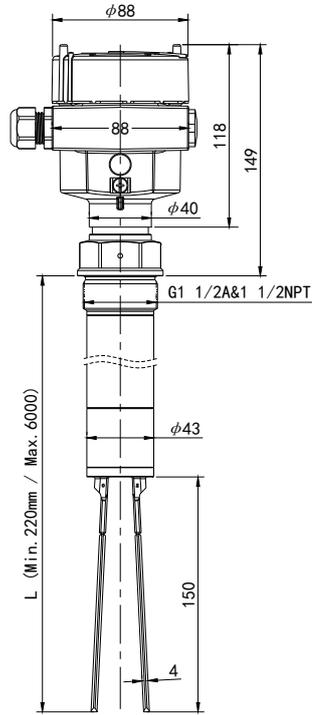


## Fork-11 Threaded Version

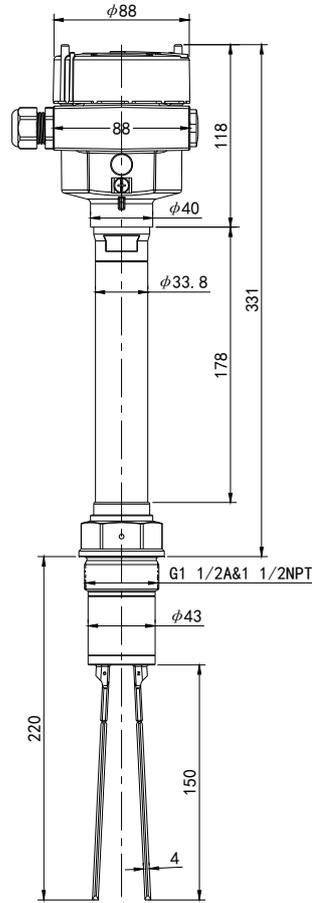
Standard  
(regular temperature)



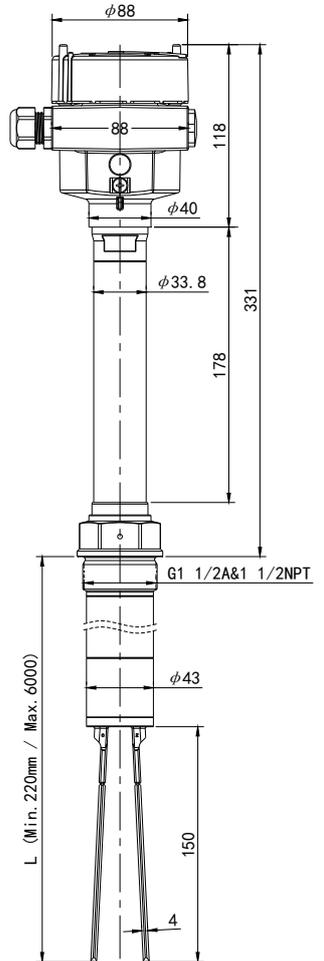
Extended  
(regular temperature)



Standard  
(high temperature)



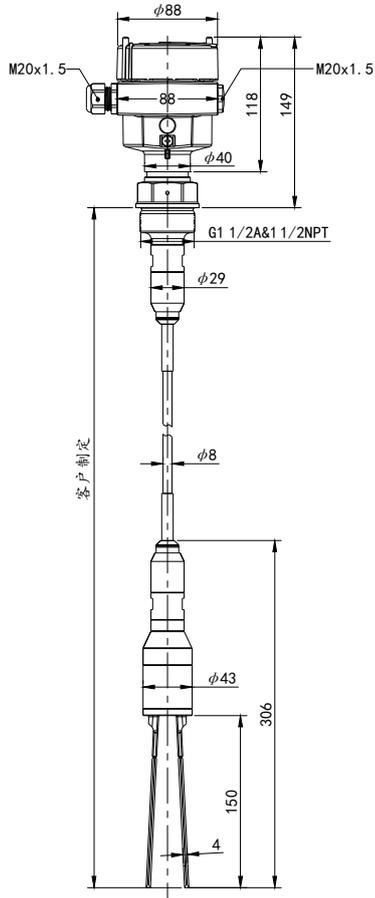
Extended  
(high temperature)



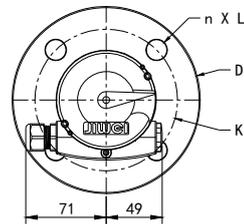
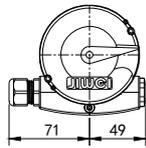
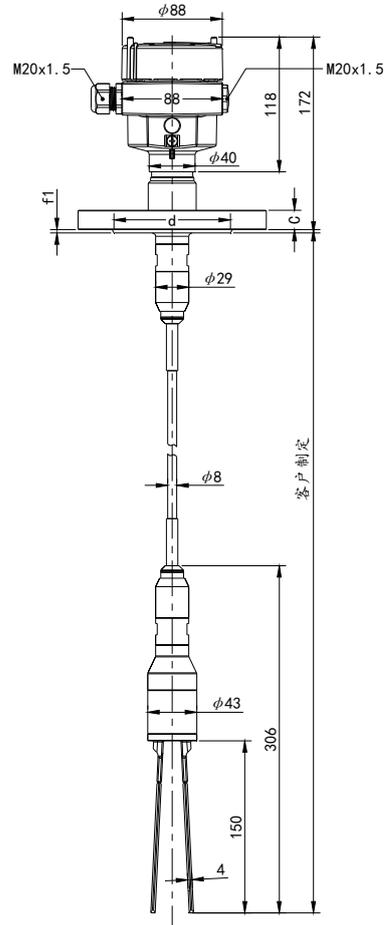


## Fork-11 with Suspension Cable

Thread



Flange



## 9 Storage and transport

### 9.1 Packaging

Your instrument was protected by packaging during transport.

The packaging of standard instruments consists of environment friendly, recyclable carton cover material. The probe is additionally protected with a cardboard cover. For special version, PE foam or PE foil is also used. Please dispose of the packaging material through specialized recycling companies.

### 9.2 Transport

Transport must be carried out under consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the instrument.

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

### 9.3 Storage

The packages must be stored under the following conditions:

- (1) Not in the open
- (2) Dry and dust free
- (3) Not exposed to corrosive media
- (4) Protected against solar radiation
- (5) Avoiding mechanical shock and vibration
- (6) Storage environment
  - Relative humidity: 20~85%
  - Storage temperature: -40~80°C