



## Operating Instructions

### Tube-11

### Vibrating Rod Level Switch

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# Contents

<b>1 INTRODUCTION .....</b>	<b>- 2 -</b>
1.1 BRIEF DESCRIPTION .....	- 2 -
1.2 OPERATING PRINCIPLE .....	- 2 -
1.3 APPLICATION .....	- 2 -
<b>2 CONFIGURATION AND CHARACTERISTIC.....</b>	<b>- 3 -</b>
2.1 CONFIGURATION .....	- 3 -
2.2 CHARACTERISTIC.....	- 3 -
<b>3 INSTALLATION .....</b>	<b>- 4 -</b>
3.1 BEFORE INSTALLATION.....	- 4 -
3.2 HORIZONTAL INSTALLATION .....	- 4 -
3.3 VERTICAL INSTALLATION .....	- 5 -
3.4 FILLING OPENING .....	- 6 -
3.5 PRESSURE/VACUUM .....	- 6 -
3.6 MOISTURE .....	- 6 -
<b>4 CONNECTING TO POWER SUPPLY .....</b>	<b>- 7 -</b>
4.1 SAFETY INSTRUCTIONS .....	- 7 -
4.2 CONNECTION CABLE .....	- 7 -
4.3 WIRING DIAGRAM .....	- 7 -
4.4 WIRING PROCEDURE .....	- 7 -
<b>5 SETUP .....</b>	<b>- 8 -</b>
5.1 INTERNAL STRUCTURE .....	- 8 -
5.2 SENSITIVITY ADJUSTMENT .....	- 8 -
5.3 MODES SWITCH.....	- 8 -
5.4 SIGNAL LAMP .....	- 8 -
5.5 SIGNAL FUNCTION TABLE .....	- 9 -
<b>6 FAULT ANALYSIS AND MAINTENANCE .....</b>	<b>- 10 -</b>
6.1 FAULT ANALYSIS .....	- 10 -
6.2 EXCHANGING THE ELECTRONICS .....	- 11 -
6.3 INSTRUMENT REPAIR.....	- 11 -
<b>7 TECHNICAL DATA.....</b>	<b>- 12 -</b>
<b>8 DIMENSIONS .....</b>	<b>- 13 -</b>
<b>9 STORAGE AND TRANSPORT .....</b>	<b>- 15 -</b>
9.1 PACKAGING .....	- 15 -
9.2 TRANSPORT .....	- 15 -
9.3 STORAGE.....	- 15 -

## 1 Introduction

### 1.1 Brief description

Tube-11 is the first made-in-China Vibrating Rod Level Switch that is designed with double vibration rods, it is suitable for granular, powdery and fine-grained bulk solids with bulk densities as low as  $0.02\text{g/cm}^3$ , such as PVC, sodium hydroxide, lime, sand, soil, coal, dust, sugar, grain, bean, etc. For tall and narrow silos, Vibrating Rod Level Switch with the suspension cable is also available. The robust design is highly reliable and with industry-leading performance and specifications.

Jiwei has been granted 3 invention patents (NO.ZL201510009538.3, ZL201510059187.7, ZL201610511184.7) on Tube-11 Vibrating Rod Level Switch, as well as 3 utility patents (NO.ZL201520215527.6, ZL201920496471.4, ZL201921754721.6).

### 1.2 Operating principle

The probe of Tube-11 Vibrating Rod Level Switch is designed with double vibration rods. The inner vibration rod nests with the outer vibration rod. When resonant frequency of inner and outer vibration rods is finely adjusted to the same value, both reliability and sensitivity of the Vibrating Rod Level Switch are at extremely high level. The innovative developed technology enables the sensor to detect fine-grained solids with density as low as  $0.02\text{ g/cm}^3$ . The piezoelectric devices are utilized for vibration drive and detection. When vibration frequency of the inner and the outer vibration rod is finely adjusted to the same value, it results in the resonance of both inner and outer vibration rods. Until the vibration rod comes into contact with application medium, resonant frequency of the outer vibration rod will change, therefore destroying the resonant condition. Vibration amplitude of the probe will substantially decrease. The output signal from piezoelectric detection device will also decrease accordingly. An integrated electronic circuit is designed to analyze the amount of decrease and output a switch signal.

### 1.3 Application

Tube-11 is designed for granular and coarse bulk solids, such as PVC, sodium hydroxide, lime, cement, sands, soil, coal, dust, flour, sugar, salt, grains and beans.

## 2 Configuration and characteristic

### 2.1 Configuration

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

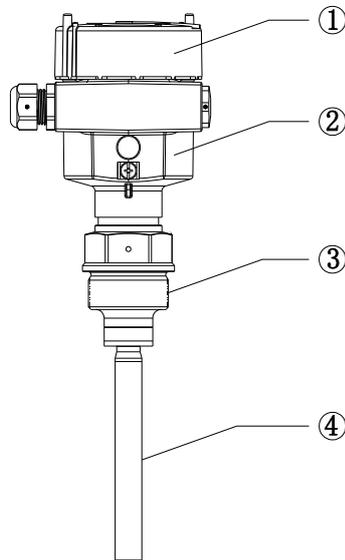


Fig.1 Tube-11 Configuration

① Housing cover    ② Housing with electronics    ③ Process fitting    ④ Probe

### 2.2 Characteristic

- (1) First made-in-China Vibrating Rod Level Switch that is designed with double vibration rods.
- (2) High sensitivity thanks to the fine adjustment on the resonant vibration frequency; suitable for virtually all applications in granular bulk solids. The innovative developed technology enables the sensor to detect fine-grained solids with density as low as 0.02 g/cm<sup>3</sup>.
- (3) An industry leading product that can tolerate high process temperature up to 250°C, and ultra-high temperature up to 400°C (Water/air cooling).
- (4) Excellent in the precipitates interface measurement of liquids.
- (5) Larger redundancy to avoid buildup and highly reliable for strong viscosity and adhesiveness medium.
- (6) Strong self-diagnostic function to accurately locate the fault. Abrasion resistant and highly robust double-rods design.
- (7) Unaffected by changes of product properties (maintenance-free).
- (8) A number of options are available for customizing the meter to the needs of the user including a version to detect precipitates interface (separation layers) within a liquid.
- (9) Easy installation and no calibration.
- (10) With CE certificates, gas/dust Flameproof Enclosure and gas/dust Intrinsic Safety certificates, and IP66/IP67 Ingress Protection.
- (11) Strong anti-corrosion probe with 316L and 318 S13.

### 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

To achieve a precise switching point and to ensure measurement validity, Tube11 can be installed horizontally. If measurement error allows within a few centimeters, recommend mounting Tube-11 approx.20°inclined to the vessel bottom to avoid buildup. To protect the probe from direct impact damage, a protection sheet should be installed above the vibration rod, and must be longer than intrusion depth (horizontally), so the vibrating rod does not protrude directly into the filling stream.

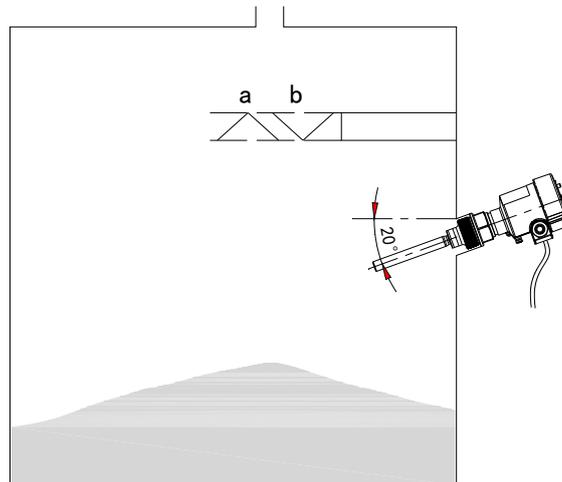


Fig. 2 Protective sheet installation+

a: Protective sheet for fine-grained bulk solids

b: Concave sheet for abrasive solids

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 (a) to protect the probe from impacting or being bent by filling materials, and “a” must be longer than the probe intrusion length.

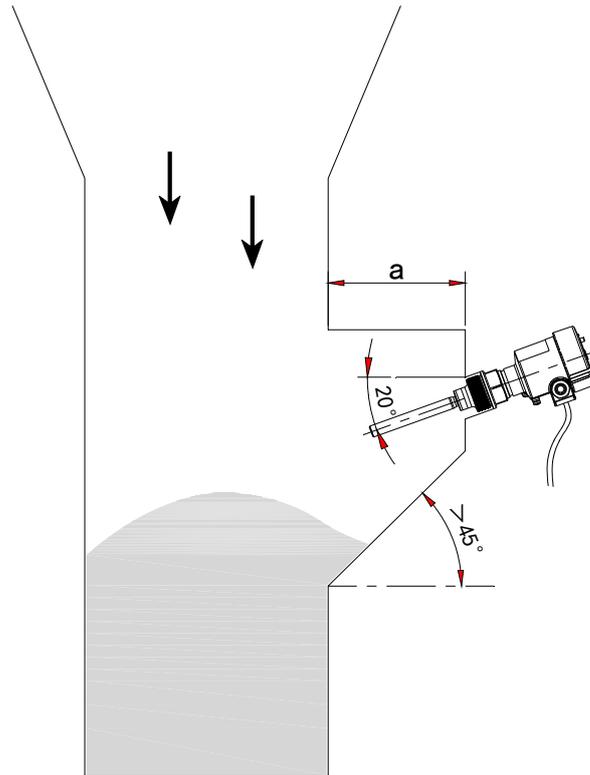


Fig. 3 Recess installation

### 3.3 Vertical installation

For vertical installation, install level switch at a distance of  $d/6$  from the vessel wall as showing in Fig. 4.

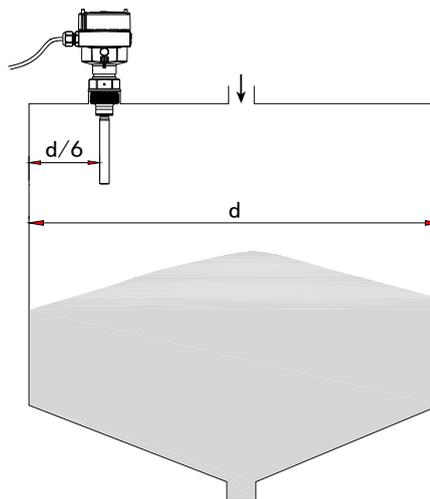


Fig. 4 Vertical installation

### 3.4 Filling opening

Please avoid installing the instrument near inlet point so that the vibration rod does not protrude directly into filling stream. It will prevent instrument from filling impact damage or generating false signals.

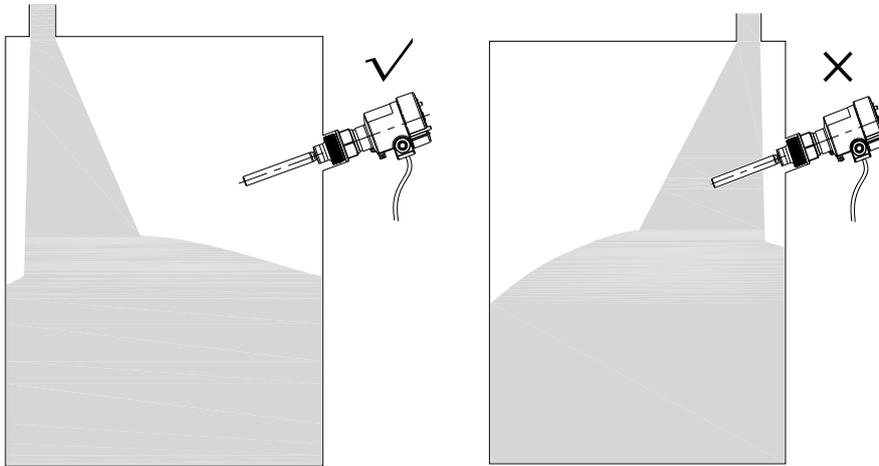


Fig. 5 Avoid mounting at filling opening

### 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.

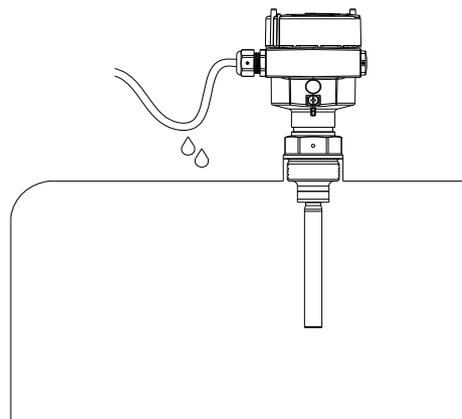


Fig. 6 Moisture mounting

## 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 E x applications.

### 4.2 Connection cable

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

### 4.3 Wiring diagram

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

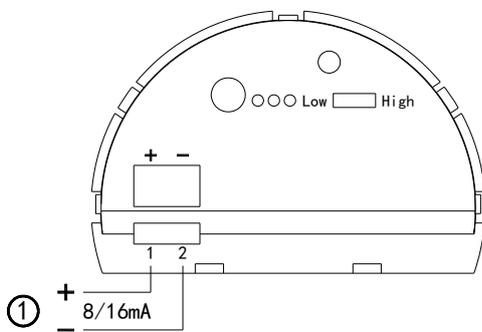


Fig. 7 Relay output

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

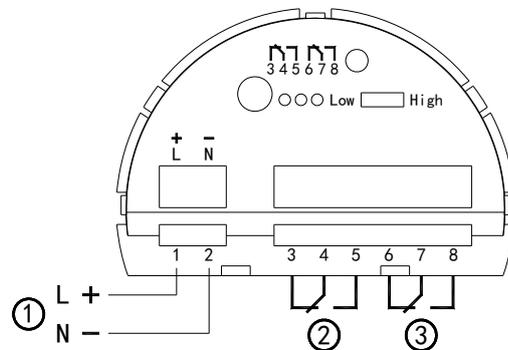


Fig. 8 Two-wire output

- 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.

## 5 Setup

### 5.1 Internal structure

See Fig. 9 and 10.

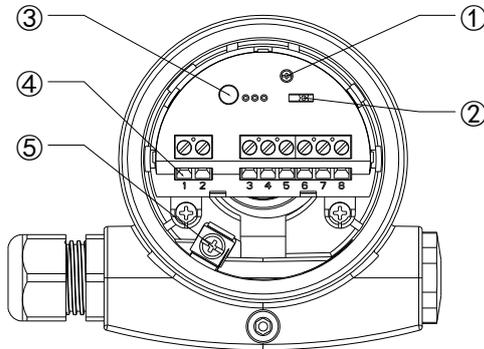


Fig. 9 Relay output

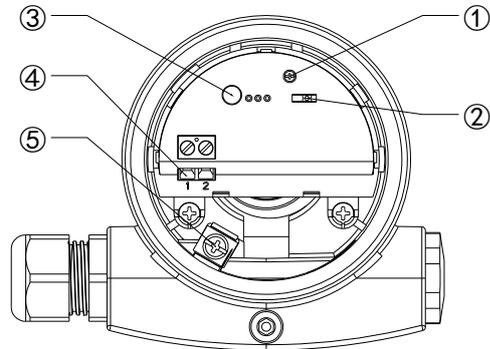


Fig. 10 Two-wire output

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 Tube-11 makes it better to adapt to the measured medium. As default setting, the potentiometer is set to the right end position, the medium with density of  $\geq 0.05\text{g/cm}^3$  can be detected. For light-weight medium, the potentiometer should turn to the left end position (the lowest measurable density is  $0.02\text{g/cm}^3$ ), 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  $\geq 0.05\text{g/cm}^3$ ; 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 a 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 switch

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

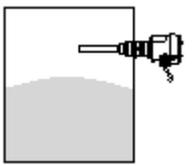
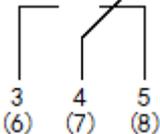
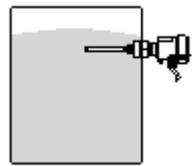
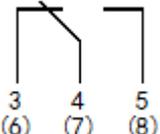
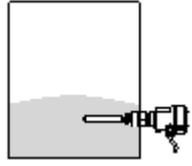
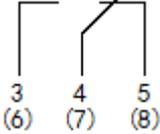
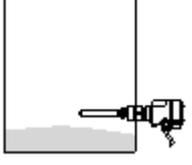
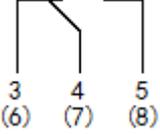
Signal lamp for indication of the switching status:

- Green = normal
- Red = alarm
- Red (flashing) = fault

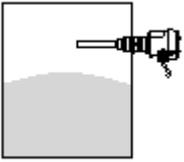
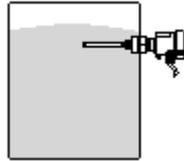
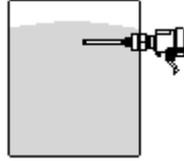
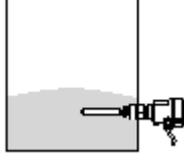
## 5.5 Signal function table

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	Switching 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	Sensor Current	Control 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 Tube-11, do NOT hold the rod body by hands, it may damage to the sensor, even distort the rod body.

## 6 Fault analysis and maintenance

### 6.1 Fault analysis

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

Tube-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 rod

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.

**Table 3 Fault analysis**

<b>Fault type</b>	<b>Fault analysis</b>	<b>Fault rectification</b>
Tube-11 signals Error reporting when 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 probe 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 the instrument then does not change the mode, the electronics module may be defective, Exchanging the electronics module.
	Unfavorable installation location	Mount the instrument at a location in the vessel where no dead zones or mounds can form.
	Buildup on the probe	Check the probe if there is buildup and remove it.
	Wrong mode selected	Reset the correct mode on the mode switch (overfill protection, dry run protection).
Signal lamp flashes red	Damage on the probe	Check if the probe is damaged or extremely corroded.
	Electronics defective	Exchanging the electronics module
	Damage to other parts of the instrument	Exchange the instrument or send it in for 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

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 Tube-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 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: +86-0755-28407683, you can find the relevant services on our website “[www.jiweimeter.cn](http://www.jiweimeter.cn)”.

## 7 Technical data

Applicable medium	Types of the medium	Granular or powdery solids ①
	Density	$\geq 0.02\text{g/cm}^3$
Probe data	Vibration frequency	$\sim 360\text{Hz}$
	Probe length	125mm
	Probe diameter	16mm
Switching Delay	When immersed	0.5s
	When laid bare	1s
Power Supply	Relay	20~253V AC/20~72V DC
	Two-wire	10~36V DC
	Max. Power consumption	8VA(AC); 1.5W(DC)
Output	Relay	DPDT, 5A/253V AC/24V DC
	Two-wire	8mA/16mA, Alarm <2.3mA
Installation conditions	Process pressure	-1~16bar
	Process temperature	Regular temperature: -50~150°C High temperature: -50~250°C Ultra-high temperature: -50~400°C
	Ambient temperature	-40~80°C
	Storage and transport temperature	-40~80°C
Cooling system data (for Ultra-high temperature only)	Air intake tube	6×4 (Outer diameter 6mm) PU tube
	Cooling air pressure	8 bar
	Min. cooling air flow rate	To be adjusted ②
Overvoltage protection	Relay	Category III, class I
	Two-wire	Category III, class II
Certificates and approvals	Ingress Protection	IP66/IP67
	Explosion-Proof	Flameproof Enclosure: Ex d IIC T6~T1 Gb, Ex tD A21 IP66 T80~440°C Intrinsic Safety: Ex ia IIC T6~T1 Ga, Ex iaD 20 T85~450°C
	CE	LVD and EMC Certificates
Materials	Housing	Aluminum alloy, stainless steel
	Ground terminal	316L
	Process connection	316L
	Probe	316L, 318 S13
	Process seal	Klingsil C-4400

**Note:** ① Maximum applicable particle size is 20mm, in this case, medium density must be lower than  $0.05\text{g/cm}^3$ .

② Cover exhaust nozzle with whistle from instrument accessories and position the whistle such that whistle's internal wall at its vent side is tightly attached to the external wall of exhaust nozzle, slowly increase the flow of cooling air until whistle blows up. This is when cooling air is at the expected minimum flow.

### Ex certificate

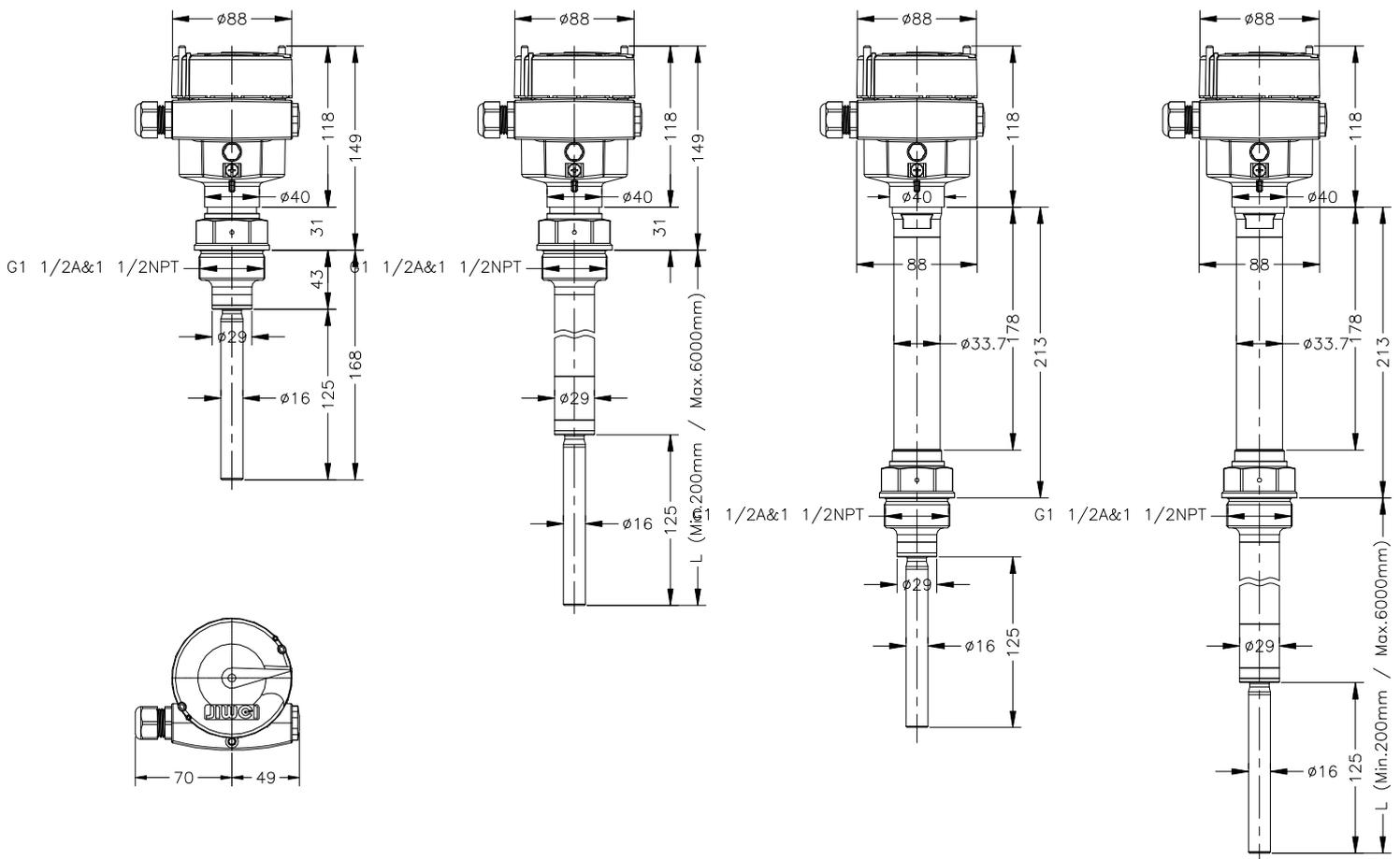
This instrument fulfills the legal requirements of the applicable Ex guidelines. You can find the Ex conformity declaration in the download area of “www.jiweimeter.cn”.

### Protection rating

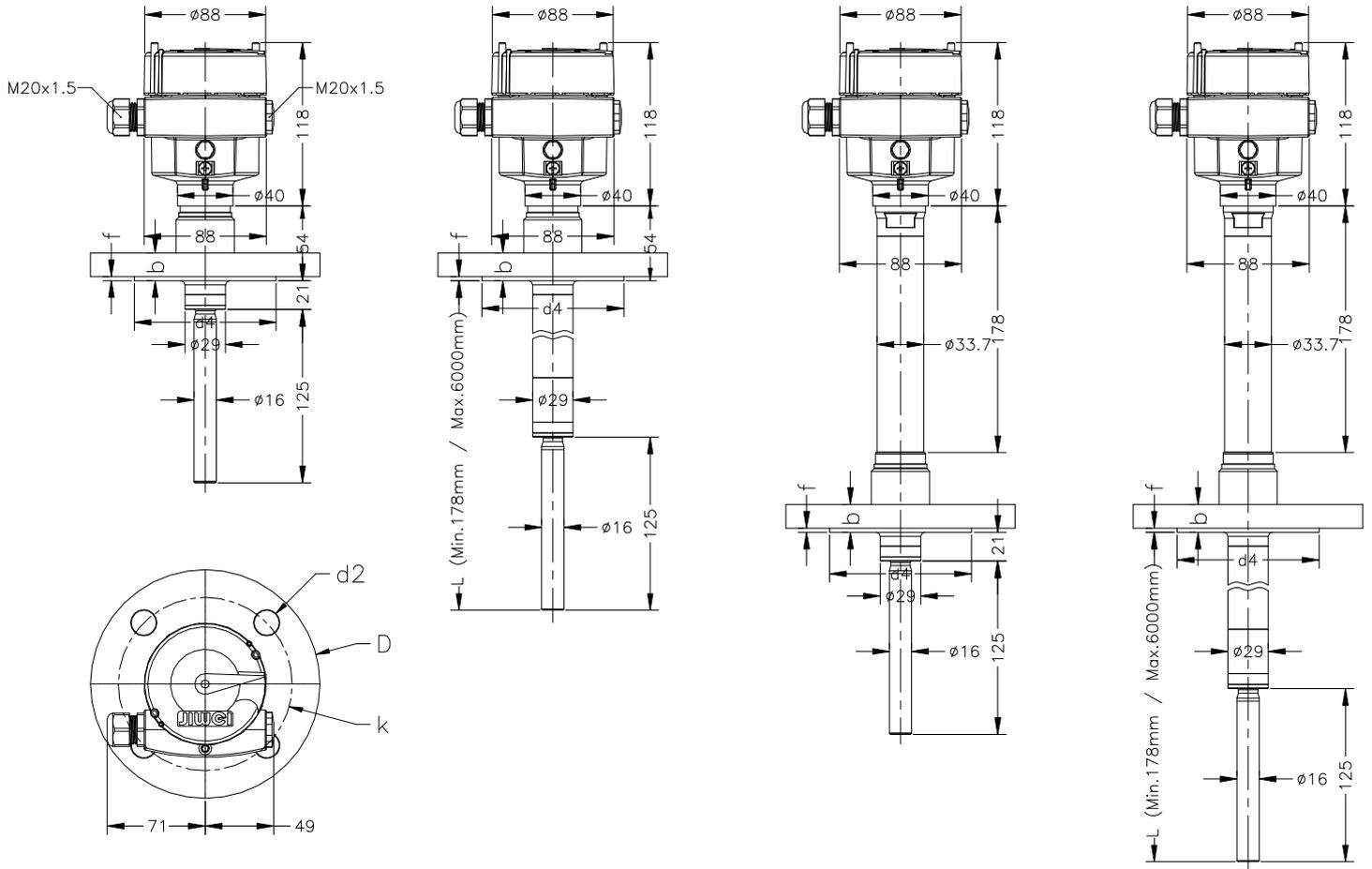
This instrument fulfills the legal requirements of the applicable GB guidelines. The housing version with protection rating IP66/67. You can find the GB conformity declaration in the download area of “www.jiweimeter.cn”.

## 8 Dimensions

Tube-11-Thread



Tube-11-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 versions, 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 in due 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