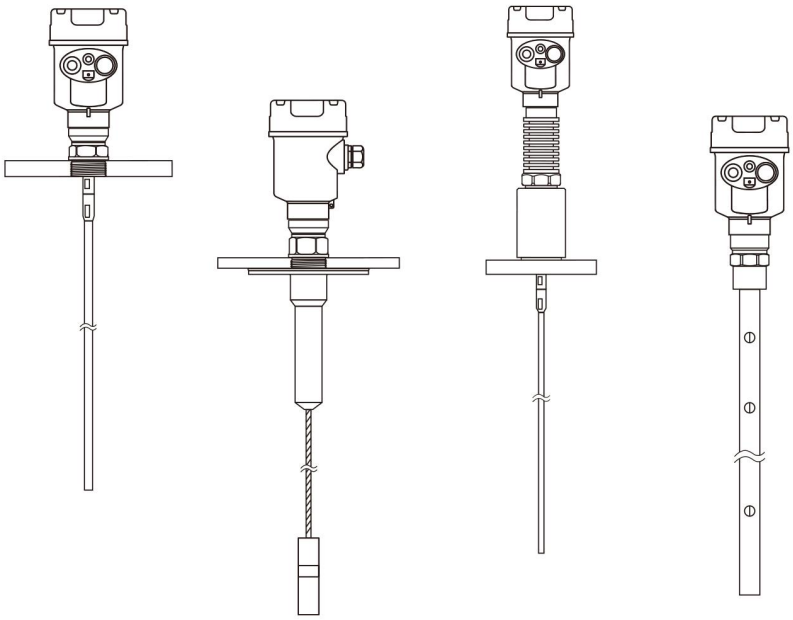
Guided-Wave Radar Level Transmitter



Contents

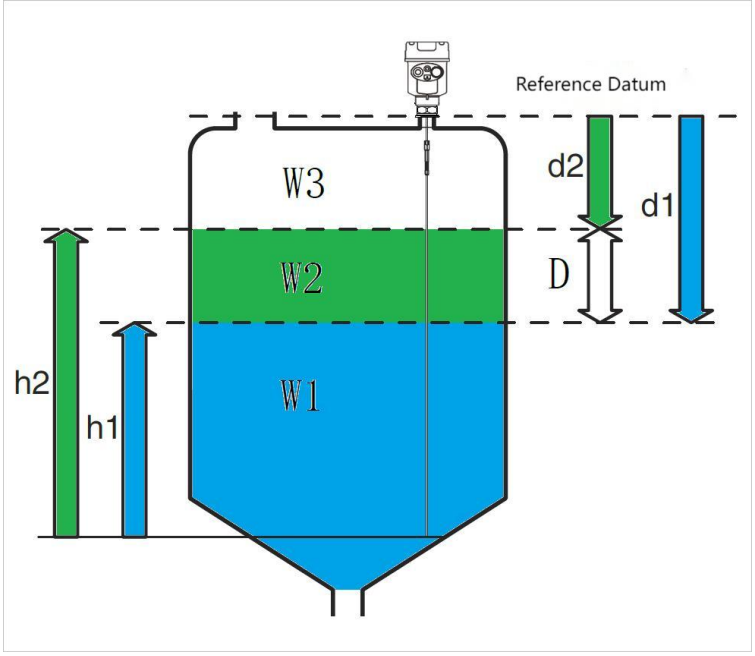
Guided Wave Radar Level Transmitter

1 Introduction

1.1 Principle of Measurement

High-frequency microwave pulses are fired along a steel cable or a metal rod. When it reaches the surface of the measured medium, part of the microwave pulse will be reflected by the medium surface, the other part will penetrate the upper part, and a second reflection occurs on the dividing surface of the upper and lower parts of the medium.

The guided wave radar will record the transmitting time and the time difference between the reflected signal of the two dielectric surfaces, and analyze the distance between the two media and the microwave interface to the radar. The measurement results are transmitted to the wireless AP access point through the RF wireless technology. The wireless AP access point can transmit the data of the wireless radar to the system through the (4~20) mA signal or the RS485.



And d1: the distance from the datum surface to the upper and lower medium division interface;

And d2: the distance between the datum surface and the upper medium surface;

H. 1: the height of the lower medium;

H. 2: the height of the upper medium;

D: Thickness of the upper medium;

W1: the lower medium;

W2: the upper medium;

W3: air or other gas medium.

1.2 Measurment Prerequisites

Upper medium (W2).

① The upper medium must be a non-conductive medium

② The dielectric constant of the upper medium is best known or used at the distance between the upper and lower parts of the medium interface for calibration.

③ The dielectric constant of the upper medium must be greater than 1.6.

④ The upper medium must be stable, without an alternating medium or a mixing ratio.

⑤ The minimum thickness of the upper medium is 100mm, clearly separated from the lower medium, and the emulsified thickness is less than 50mm (please consult the manufacturer for special working conditions).

⑥ The surface is as free of foam as possible

Lower medium (W1): the dielectric constant of the lower medium should be at least 20 larger than that of the upper medium, preferably a conductive medium.

Gas medium (W3): the gas medium is an air or a gas mixed medium.

Environmental conditions: the container is best to the metal material, such as non-metal material must use double rod or coaxial antenna.

1.3 Characteristic

Dual liquid level guided wave radar liquid level meter

① High sensitivity acquisition technology is adopted, which has the following advantages:

② Using high sensitivity TDR technology, the media with lower dielectric constant can be detected, which is more suitable for measuring oil media.

③ Metal cable or rod antenna, contact measurement, no electronic components in the antenna, stronger stability.

④ Use microwave pulse measurement, not affected by the temperature, pressure and steam in the tank, and be more adaptable.

⑤ Micropower emission, and no energy radiation to the environment, and will not be affected by the environment, is more suitable for complex tanks

Measurement of the internal environment.

⑥ Wireless transmission of measurement data, eliminating tedious traditional wiring, and single point-to-point or multi-point to multi-point data transmission

2 Product Profile

Application	Media with layered properties such as oil and water
Explosion-proof Certification	Exia ⅡC T6 Ga / Exd ⅡC T6 Gb
Measurement Range	Cable type: 0 - 30m / Rod type: 0 - 6m
Frequency Range	500MHz - 1.8GHz
Antenna	Single cable or single rod antenna
Measurement Accuracy	± 5mm
Process Temperature	Standard type: -40 ~ 120℃High
Temperature Type	-40 ~ 200℃
Custom-made Type:	-40 ~ 280℃
Process Pressure	(-0.1 ~ 4) MPa
Signal Output	(4 ~ 20) mA HART / Modbus - RS485
Field Display	Four-digit LCD programmable
Power Supply	Two-wire (DC24V) / Four-wire (DC 24V / AC220V)

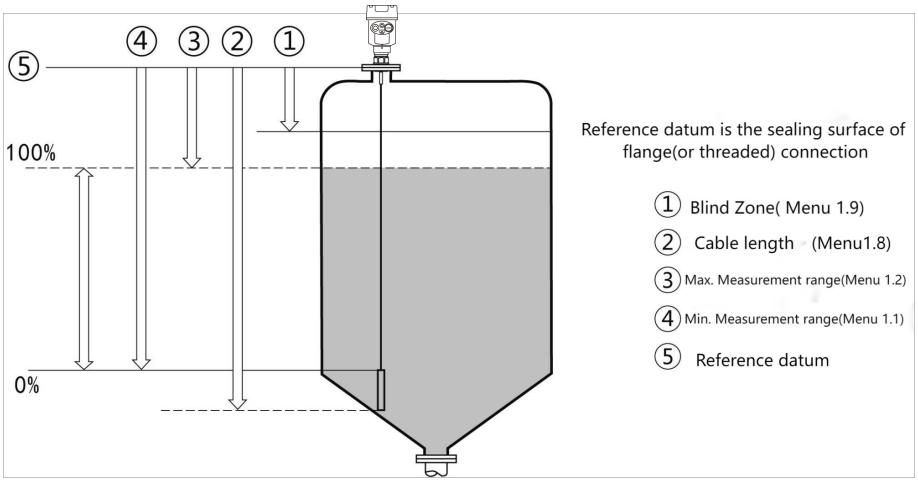
3 Installation

3.1 Installation Guide

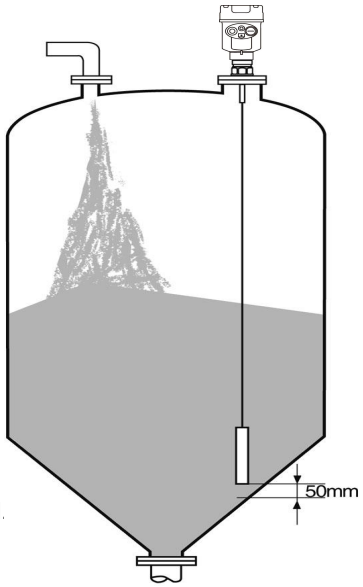
Determine that the cable or rod should not touch the internal obstacles, so the facilities in the tank should be avoided as far as possible, such as human ladder, limit switch, heating equipment, bracket, etc. In addition, it should be noted that the cable or rod shall not intersect with the feed flow.

3.2 Installation Considerations:

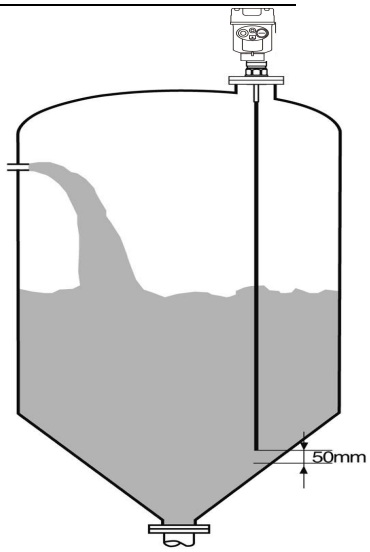
The highest material level shall not enter the measuring blind area; the instrument must be kept a certain distance from the tank wall; the installation of the direction of the cable or rod to the surface of the measured medium. The instruments installed in the explosion-proof area must comply with the installation regulations of the national explosion-proof danger zone. The shell of the original safety type adopts the aluminum shell. This safety type instrument can be installed in the explosion-proof requirements, the instrument must be connected to the earth.



3.3 Installation Site:

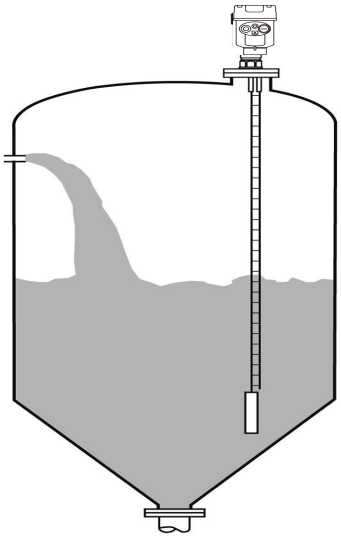


- Keep away from the outlet and feed ports.
- The metal tank does not touch the tank wall and the tank bottom in the whole measuring range.
- It is recommended to install at 1 / 4 or 1 / 6 of the bin diameter, with The minimum distance of the tank wall is 1 / 10 of the measurement range.
- The minimum distance from the cable or rod probe is 300mm.
- The bottom of the probe is 30mm away from the tank bottom.
- The minimum distance of the probe from the obstacle in the tank is 200mm.
- If the bottom of the container is tapered, the center of the tank top can be installed



3.4 Measurement Characteristics of Rod Radar Bit Meter:

- Can measure a permittivity of 1.8 for any medium.
- It is generally used to measure the viscosity of 500 cst and it is not easy Media that produces adhesion.
- The rod radar can reach a maximum range of 6 meters, mainly For the measurement of the liquid liquid levels.
- Have strong penetration to steam and foam, measured actorish.
- For the liquid measurement environment with large foam, a single rod shall be selected Type 1 guided wave radar bit meter measurement.



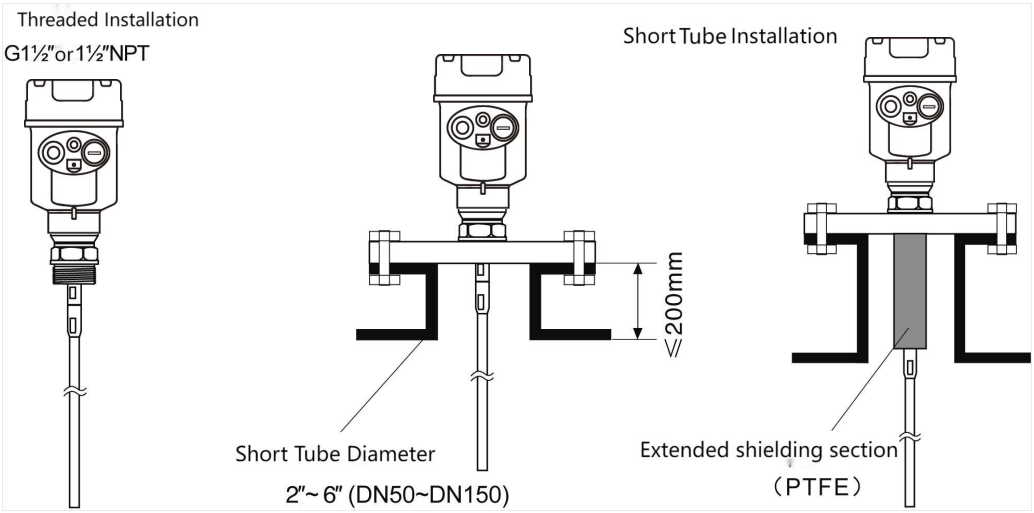
3.5 Measurement Characteristics of Dual-Cable Radar Bit Meter:

- For liquids with relatively small dielectric constant and light solids The powder can be used by double cable guide wave radar bit meter, To ensure a good and accurate measurement.
- Can measure the permittivity of 1.6 for any medium.
- It is generally used to measure the viscosity of 500 cst and it is not easy Media that produces adhesion.
- The dual cable radar bit meter can reach 30 meters.

3.6 Method of Installation

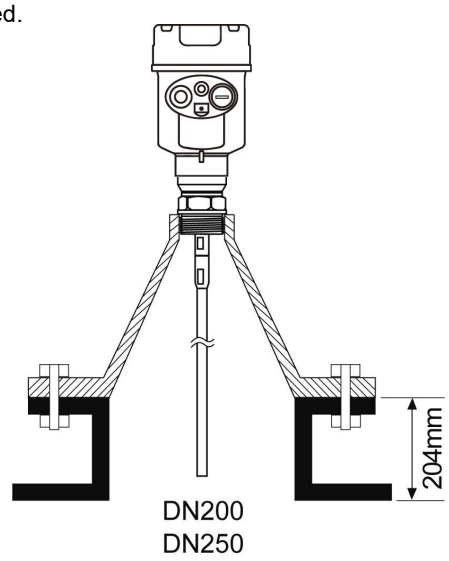
- **Reasonable Installation Shall Ensure the Long-Term, Reliable and Accurate Measurement of the Instrument:**

The guide wave radar position meter is connected by thread and flange, and can be installed on the short pipe. The smaller the installation pipe diameter is, the shorter the pipe length shall be, and the more stable the measurement is. When the diameter of the short pipe is 2 ″ to 6 ″, the height of the short pipe should be 200mm. If the short pipe is installed, it is best to truncate the short pipe or lengthen the shielding section of the sensor.



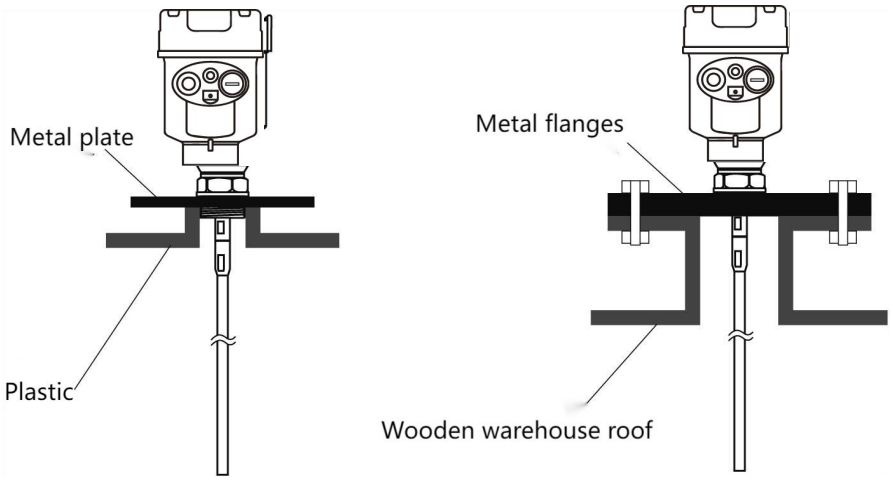
➢ **DN200 or DN250:**

When the guided wave radar needs to be installed on a short tube with a diameter greater than 200mm, the inner wall of the short tube produces echo, which will cause measurement error in the case of the dielectric constant of the medium is low. Therefore, for a short tube of 200mm or 250mm in diameter, a special flange with a "horn interface" is required.



➢ **Installation on Plastic Tank:**

Whether cable type or rod type, if the guide wave radar works normally, the process connection surface is generally metal. When the guide wave radar is installed on the plastic tank, if the top of the tank is also plastic or other non-conductive material, the instrument should be equipped with metal flange, if the threaded connection, with a metal plate.



3.7 Installation Instructions

✧ The rod probe can be up to 6 meters, for the measuring distance of more than 6 meters, the cable probe can be selected.

✧ If there are more obstacles in the tank or too close to the probe sensor, the guide tube can be installed for measurement.

➢ **Pull down of the cable**

When feeding and discharging, the medium produces a pull force on the cable probe, and the size of the pull force depends on the following factors:

A. Length of cable B. Density of material C. diameter of storage bin D. Diameter of cable

- **Optimization of interference**
  - ✧ Interference echo suppression: the programming and debugging software can suppress the interference echo to achieve the ideal measurement effect.
  - ✧ For media viscosity not greater than 500 cst (liquid only), a bypass tube or guide tube can be used to avoid interference.
- **Installation of a low-dielectric constant liquid**

For media with dielectric permittivity greater than 1.3, viscosity 500 cst and no adhesion, a guide tube can be installed for measurement, achieving the following effects:

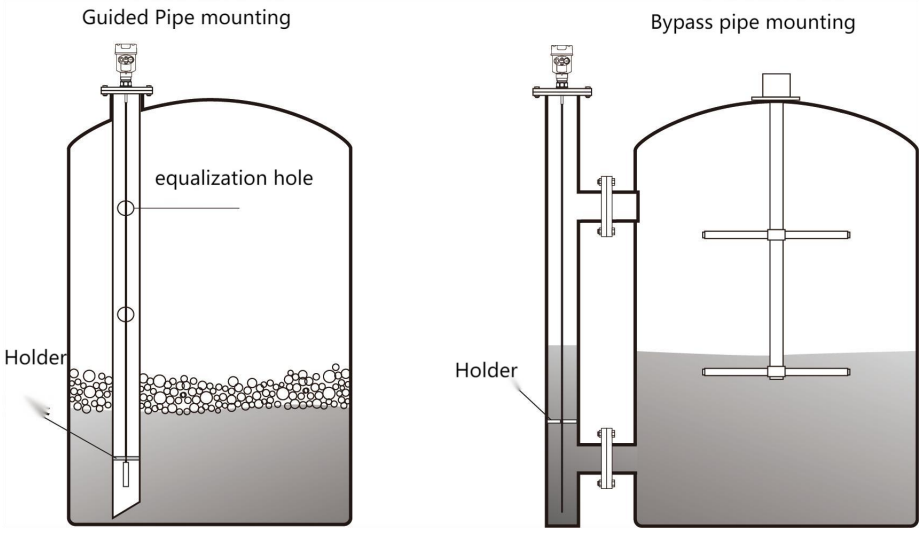
- ✧ Excellent reliability, high precision
- ✧ Can be used for any medium with a dielectric constant of 1.3 and is measured independent of the conductivity of the medium
- ✧ The obstacle and short pipe size in the tank do not affect the measurement

- **Corrosive media measurement**

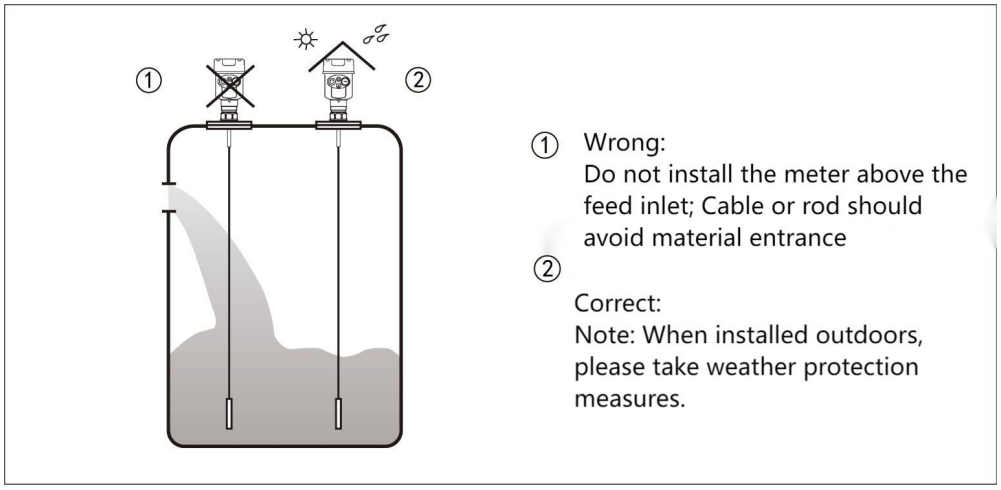
If measuring corrosive media, the rod or cable probe sleeve PTFE and PFA sleeve can be used for measurement

3.8 Special Instructions and Precautions in the Installation:

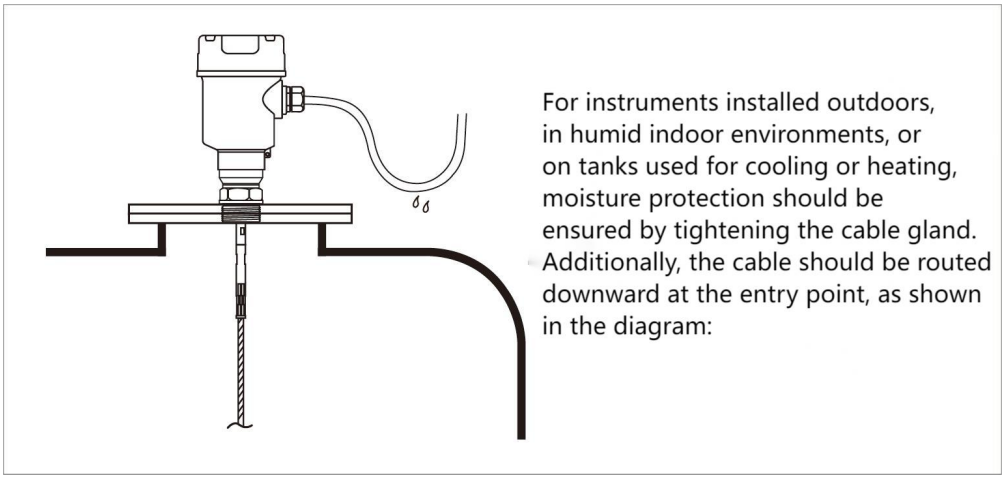
- For the long guide wave radar of the middle cable used on the site, it is necessary to intercept the excess cable to ensure the correct measurement. The cable cannot be knotted, wound or attached to other objects.
- When cutting the cable, the power supply of the instrument should be cut off, the cable should be removed, the screws on the heavy hammer should be removed from the bottom of the cable, and the heavy hammer should be installed. After the instrument is installed, the power supply should be connected and the parameters should be reset.
- For the cable guided wave radar with casing, when the cable is too long, it shall not be intercepted by itself, and shall be returned to the original factory for interception.
- For the instrument installed in the guide tube, the insulation bracket is used to fix the radar probe to ensure that the radar probe (rod / cable) is concentric with the guide tube, otherwise the measurement will be affected due to shock or false echo.



- **Install the Right and Wrong:**



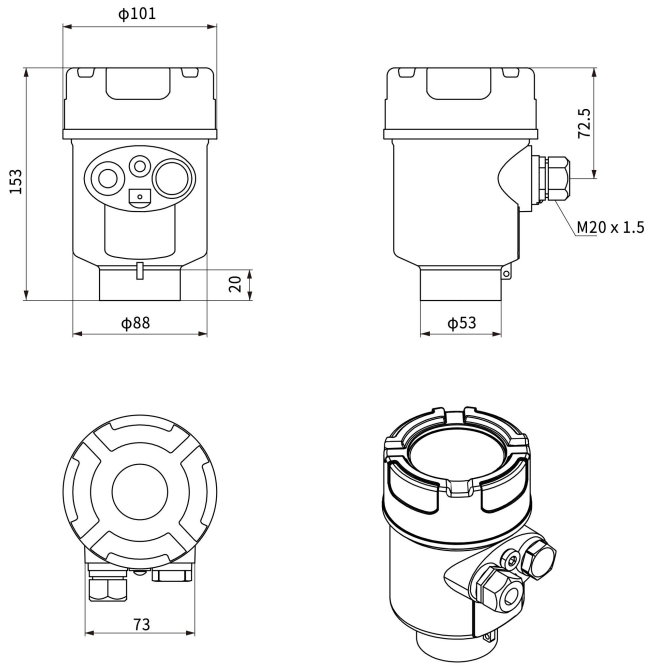
- **Dampproof:**



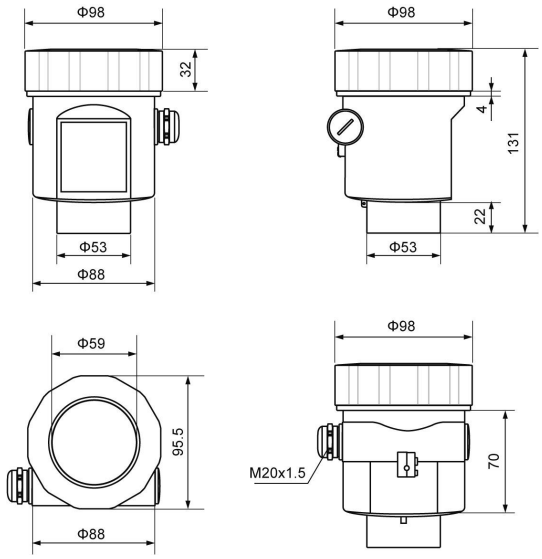
4 Structure Size (in mm)

- **Table Shell Size**

✧ **Casting aluminum case**

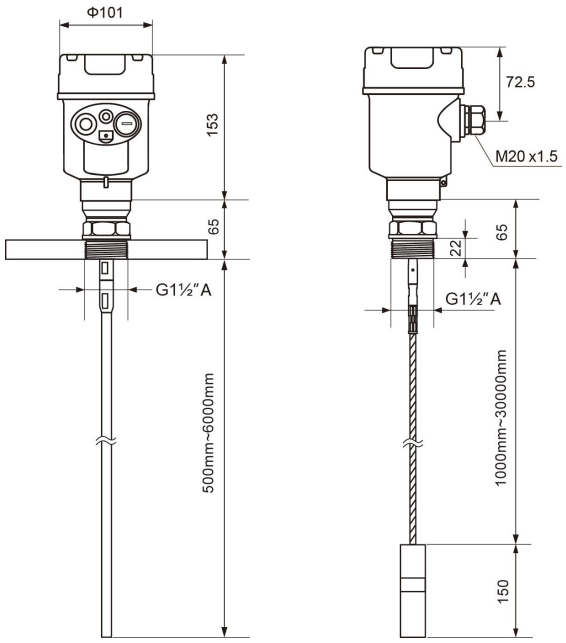


✧ **Plastic case**

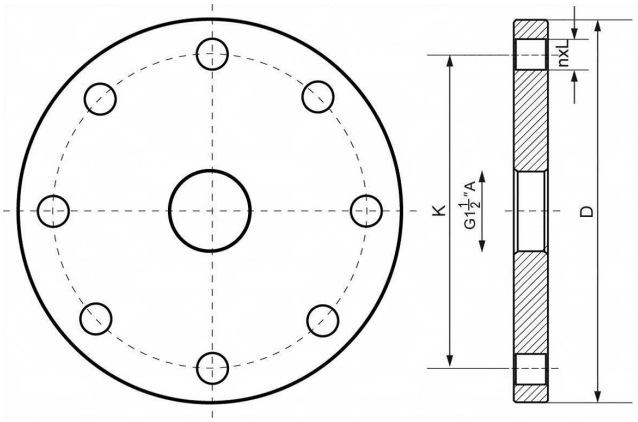


Product Size

✧ **701**



✧ **Flange Selection**



Flange: HG/T20592-2009 PN16 RF

Flange Datasheet

Model	(FOD)D	(BCD)K	(No.) N	Diameter
DN50	Φ165	Φ125	4	18
DN80	Φ200	Φ160	8	18
DN100	Φ220	Φ180	8	18
DN125	Φ250	Φ210	8	18
DN150	Φ285	Φ240	8	22
DN200	Φ340	Φ295	12	22
DN250	Φ405	Φ355	12	26

5 Electrical Connection

- **Power Supply Voltage**

Note:

FOD means Flange outer diameter

BCD: Bolt circle diameter

No: the number of bolts

Diameter: Bolt circle diameter

(4~20) mA / HART (two-wire system) The power supply and the output current signal share a two-core shielded cable. See the technical data for the specific power supply voltage range. For the local safety type, add a safety grille between the power supply and the instrument.

(4~20) mA / HART (four-wire) power supply and current signal are separated, each using a two-core shielded cable. See the technical data for the specific power supply voltage range.

Modbus-RS485 (four-wire system) The power supply line and the Modbus signal line shall use a two-core shielded cable separately. See the technical data for the specific power supply voltage range.

- **Installation of the Connecting Cables**

General introduction The power supply cable can be ordinary two-core cable, the outer diameter of the cable shall be (6~12) mm,

To ensure the seal of the cable inlet. If electromagnetic interference exists, shielding is recommended cable.

(4~20) mA / HART (two-wire system) power supply cable can use ordinary two-core cable.

(4~20) The mA / HART (four-wire) power supply cables shall be wired with dedicated earth wires.

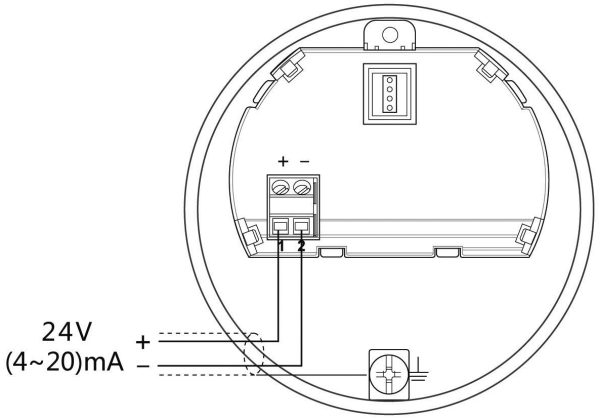
Modbus-RS485 (four-wire system) Power supply cables shall be shielded cables.

Shield and wiring of the cables Both ends of the shielding cable shall be grounded. Inside the sensor, the shield must be connected Internal ground terminal. The external ground terminal on the enclosure must connect to the earth.

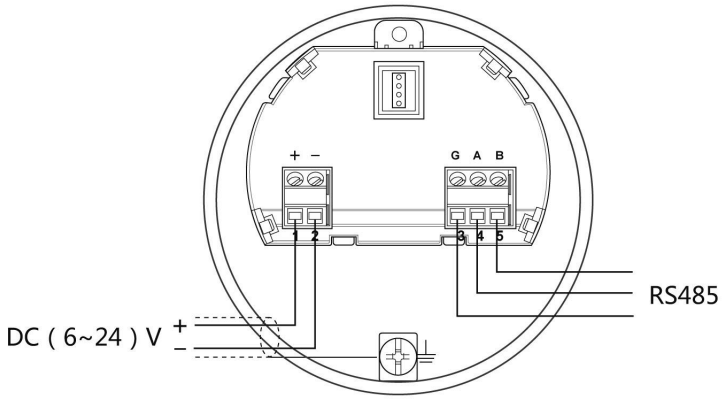
If there is ground current, the shielding cable passes away from the side of the instrument A ceramic capacitor (e. g. 1 nF / 1500V) is grounded to connect The role of the road high-frequency interference signal.

- **Attended Mode**

➢ The 24V two-wire system wiring diagram is as follows:



➢ The 6-24 V Modbus-RS485 wiring diagram is as follows:

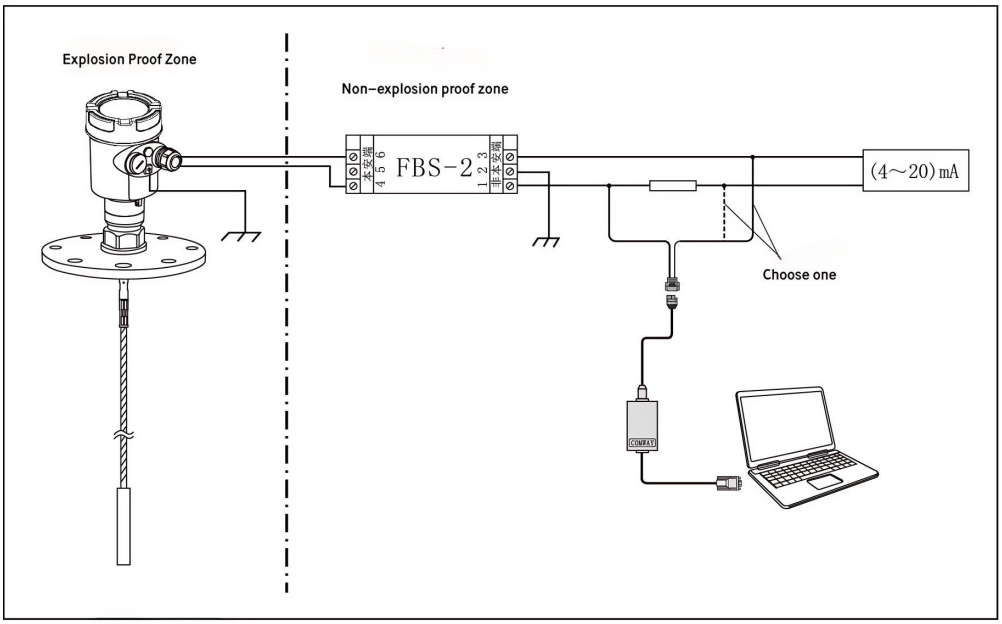


- **Explosion-Proof Connection**

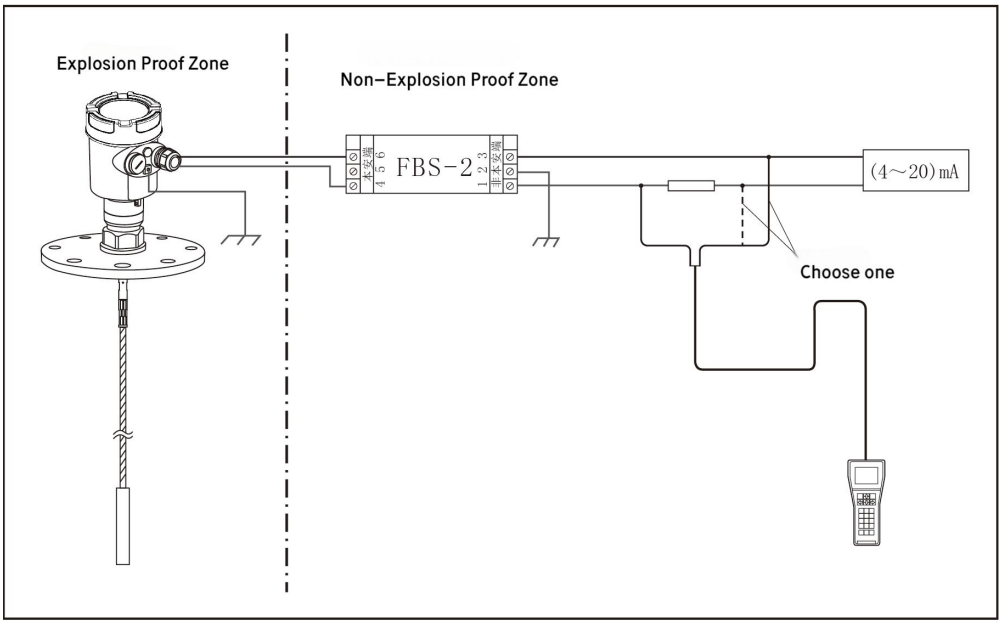
The explosion-proof form of this product is the intrinsically safe type. Explosion-proof sign: Exia ⅡC T6. This safety current guide radar bit meter is made of die-cast aluminum shell material, and the electronic parts adopt rubber sealing structure to ensure that the spark generated by partial circuit failure does not discharge. This product is suitable for the continuous position measurement of combustible medium below Exia ⅡC T6 explosion-proof grade.

This product shall be powered by a safety gate when used. The FBS-2 safety grid is the associated equipment of this product, and the explosion-proof form is intrinsically safe. Explosion-proof mark: [Exia] C, power supply voltage (21.6~26.4) VDC, short circuit current is 135 mA, working current (4~20) mA.

All cables shall be shielded flexible cable, and the maximum length from meter to safety grid is 500m. The distributed capacitor is 0.1 μ F / km and the distributed inductance is 1 mH / km. The instrument must be connected to the earth when installation. Other associated equipment without explosion-proof inspection shall not be used.



Commission with Software



Commissio with Hart Handled Programm

- **Safety Guidance**

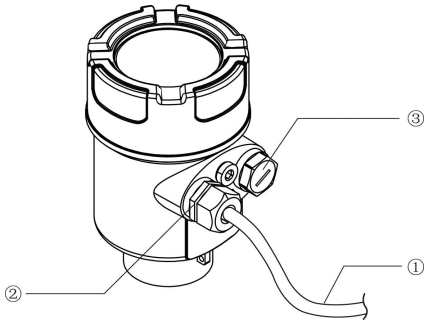
Please follow the local electrical installation regulations!

Please follow the local regulatory requirements for personnel health and safety. All operation of instrument electrical components must be performed by properly trained professionals.

Please check the nameplate of the instrument to ensure that the product specifications meet your requirements. Please ensure that the power supply voltage is consistent with the requirements on the instrument nameplate.

- **Levels of Protection**

This instrument fully meets the requirements of the protection grade IP66 / 67, please ensure the water resistance of the cable sealing head.as illustrated in following figure:



How to ensure that the installation meets the IP67 requirements:

Please ensure that the seal head is not damaged.

Please ensure that the cable is not damaged.

Ensure that the cables used meet the electrical connection specifications.

Before entering the electrical interface, bend the cable down to ensure that the water does not flow into the housing, see ①

Tighten the cable seal head, see ②

Please plug the unused electrical interface with blind blocking, see ③

6 Instrument Debugging

- **Three debugging methods:**

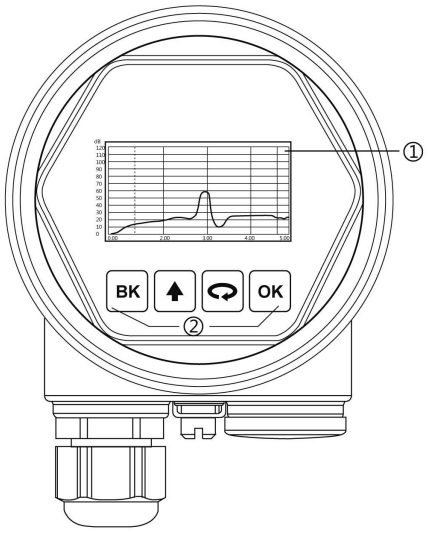
① Display/ button (if the split is displayed, make debugging on the split, see the attached connection diagram)
② Upper machine debugging
③ The HART handheld programmer

- **Display / button**

Debug the meter by using the four buttons on the display screen. The language of the debug menu is optional. After debugging, it is generally only used for display, and the measurement value can be read out very clearly through the glass window.

Display / button

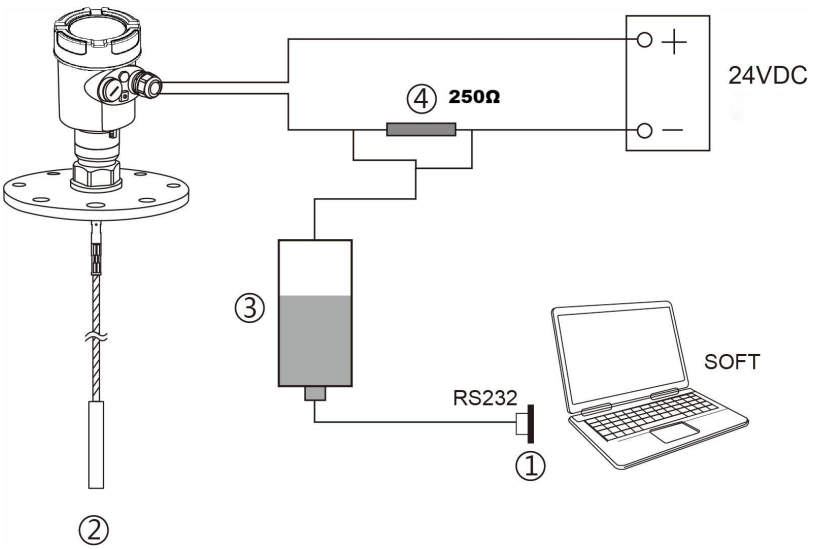
① liquid-crystal display
② key



- **Upper machine debugging**

Connected to the upper position computer
via HART

①USB joggle
② Guide wave radar bit meter
③ The HART Converter
④ 250 Ω resistance

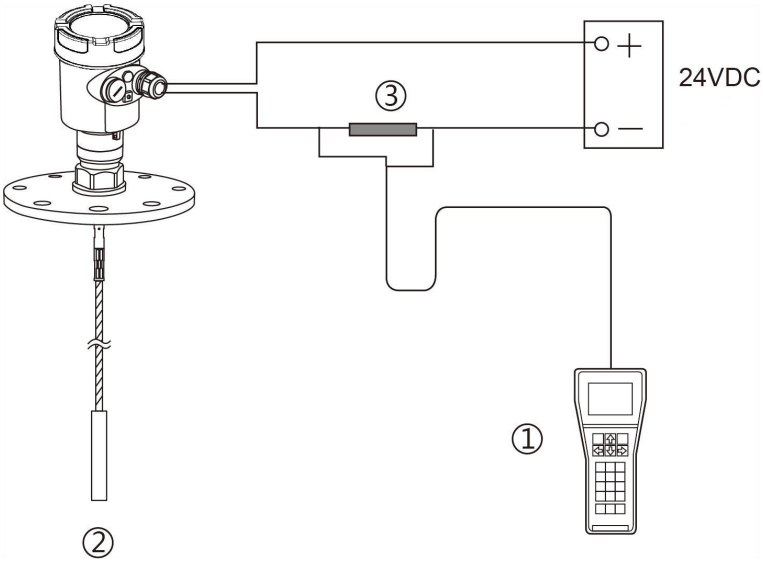


- **HART handheld programmer programming**

① The HART handheld programmer

② Guide wave radar bit meter

③ 250 Ω resistance



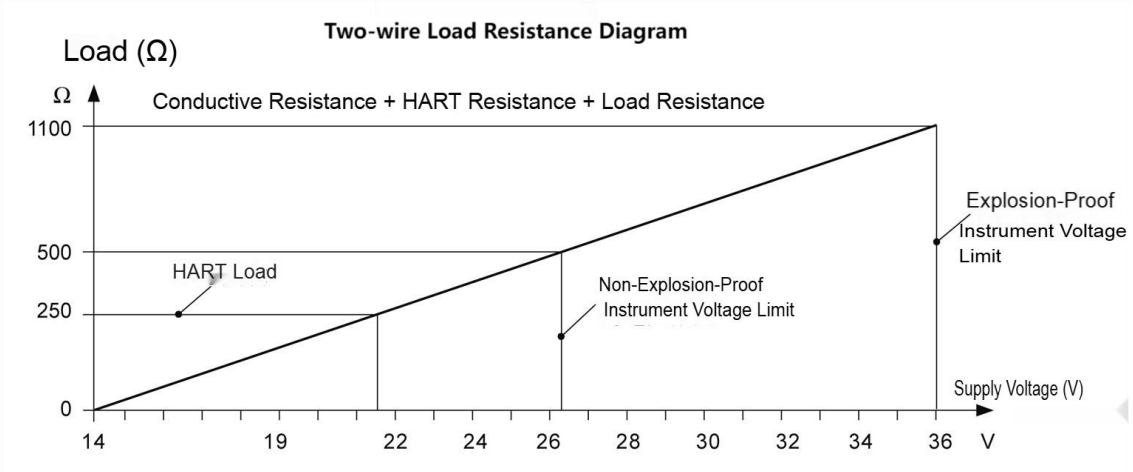
7 Technical Parameters

General Data	
Detection of component materials	
The rod type	Stainless steel 304,316L
Cable type	Stainless steel 304,316L
Procedure linkage	G1 ½ ″ A thread or 1 ½ ″ NPT thread / flange /clamp
Seal	Viton fluorine rubber, Kalrez fluorinated rubber
Hull	Cast aluminum, plastic, and stainless steel
Sealed silicone rubber between the housing and the housing cover	
Case window	Polycarbonate
Earth terminal	Stainless steel, 316L

Power Supply Voltage		
Two-wire system	24 VDC	
Four-wire system	6 ~ 24VDC （Modbus-RS485）	
	198~242VAC (double-chamber diaphragm)	
	110VAC (double-chamber diaphragm)	
Power dissipation	Max. 22.5mA	
Allow ripple	- <100Hz	Uss < lV
	- (100 ~ 100K) Hz	Uss < l0mV

Cable Parameters	
Cable inlet / plug	1 M20 l.5 cable inlet (cable diameter: 6~12mm)
	1 blind block of M20 l.5
Spring wiring terminal	For wire cross-section of 2.5mm²

Flange Outer Parameter	
Output signal	(4 ~ 20)mA HART / Modbus-RS485
Resolution ratio	1.6μA
Breakdown signal	Current output iconstant;20.5mA;22mA;3.9mA
Two-wire system load resistance	See below
Four-wire system of load resistance	Maximum 400 Ω
Integration time	(0~36) s, which is adjustable



Characteristic Parameter

Maximum measurement distance 30m / 6m (cable type / rod type)

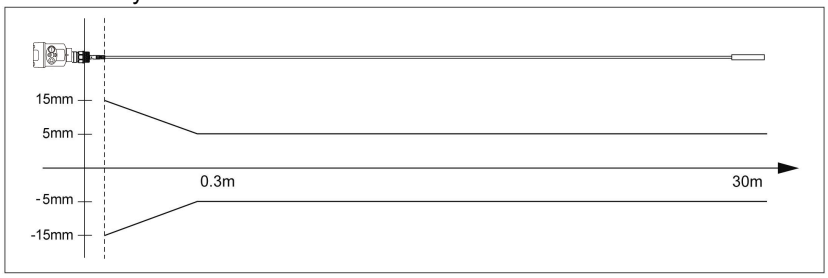
Measurement interval About 1s (depending on the parameter settings)

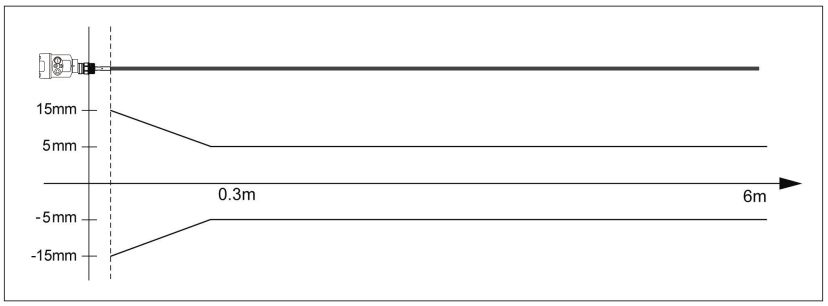
Adjust the time About 1s (depending on the parameter settings)

Resolution ratio 1mm

Accuracy: ±5mm

Schematic diagram of accuracy





Working storage and transport temperature (-40 ~ 80) ℃

Process temperature (the temperature of the antenna part) -40~120℃ (standard type) / -40~200℃ (high temperature type)

-40~280℃ (Custom Made)

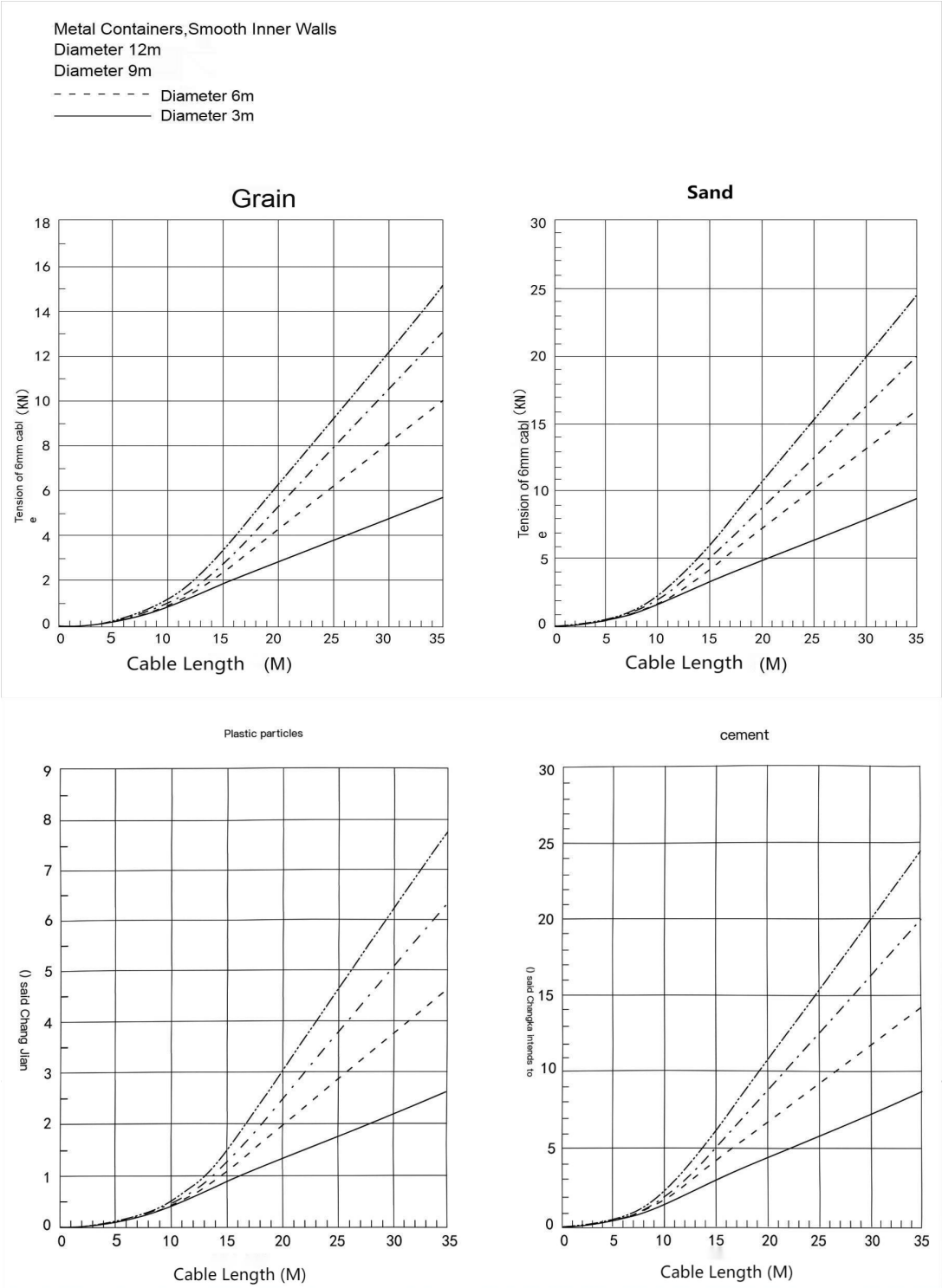
Relative Humidity < 95%

Pressure in the tank Max. 4.0MPa

Shatter-proof Vibration frequency (10~150) Hz, maximum vibration acceleration l 0 m/s²

Maximum pull See drawing force diagram

When measuring a solid medium, the pulling force depends on the vessel diameter and position, and the ones shown below are the pulling forces produced by some typical medium.



Supmea

Headquarters

5th floor, Building 4, Singapore Hangzhou Science Technology Park, No. 6 street, Hangzhou Economic Development Area, Hangzhou 310018, China

Singapore

2 Venture Drive #11-30 Vision Exchange Singapore

info@supmea.com

www.supmea.com

Supmea Automation Co.,Ltd.