



# **SP SERIES MAGNETOSTRICTIVE PROBE**

## **User Manual**

**Zhengzhou Windbell Measurement and Control Technology Co., Ltd**

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**Safety Notes**

The ATG system is installed in gas station and oil depot, please read safety instructions for explosion protection.

No power during installation.

The cable from probe must be connected to Windbell GSB03 safety barrier.

The products are prohibited to be installed in explosion proof area over its own Ex level.

The console and printer must be installed in safe area, such as office.

**Safety warning**

The tank must have earth busbar, the earth must be safe and reliable.

ATG system must share the same earthing with tank.

**Unpack and check**

Please check all the materials according to the list. If anything missed, please contact the local representative or distributor directly. You can also find the contact information of Windbell in this manual.

**Quality Track Card**

After installation, please post the Quality Track Card to Service Department of Windbell for fast and right service. Thank you very much!

## 1. Introduction

Windbell SP series magnetostrictive probe take advantages of Wiedemann effect, Villari effect and ultrasonic effect of intelligence material, convert displacement information to time value which most easily to be measured with high-precision, so achieve high accuracy measuring for liquid level. Because of few mechanical parts, magnetostrictive probe have distinct features as high reliability, easy installation and wide application, etc. Digital signal transmit have remarkable highlights than traditional analog signals, especially on high anti-interruption ability, enhance long distance communication as 500m, and higher security.

The circuit design is intrinsically safe type.

### 1.1 Two types magnetostrictive probe

- SP magnetostrictive probe
- SP magnetostrictive density probe

### 1.2 Product features

- Transmit probe data to console in real time(ms speed), including liquid product level, product density, water level and temperature.
- 5 points temperature sensor offers precision measurement.
- Digital signal transmit ensure the safety and reliable performance.
- High accuracy.

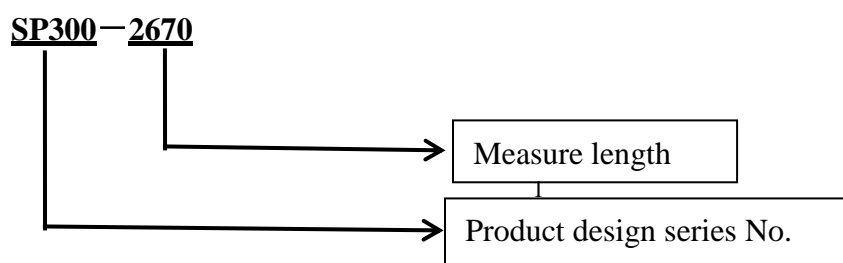
### 1.3 Main uses

The SP300 magnetostrictive probe is used to measure liquid product level, product density, water level, and temperature inside underground tank or aboveground tanks, and transmit the data to upper processing console or back-office management software through RS485 communication.

### 1.4 Application

SP300 magnetostrictive probe can be applied in all the approved light petroleum products and chemical products.

### 1.5 Model meaning



## 2. Operating Principles

Magnetostrictive probe is mainly consists of 2 floats that moves up and down a rod. The float contains a permanent magnet, and the stem houses a wire waveguide through which an electrical pulse is sent, the float position is measured as the sensor sends an electrical pulse, called an interrogation pulse, down the stem through the wire waveguide made of ferromagnetic material. When the electrical interrogation pulse reaches the float, the two magnetic fields caused by the electricity in the wire and the magnet in the float produce a vibration in the wire waveguide. This vibration, called a strain pulse, travels back to the sensor at a known speed.

By measuring the time delay between the electrical interrogation pulse and resulting strain pulse, the distance to the float can be determined with a high degree of accuracy.

This provides a form of continuous level measurement as the sensor sends a pulse down the waveguide several times a second. Dual level measurement is also an option, where the location of two floats is determined. This is especially useful when measuring the interface between two liquids such as oil and water.

Magnetostrictive level sensors provide a high degree of repeatability, and are our most accurate liquid level measurement solution, resolution of about 0.01 mm.

## 3. Structural Characteristics

### 3.1 Appearance

**Magnetostrictive probe:**



**Density probe:**



### 3.2 Components

Magnetostrictive probe is mainly composed of probe head, temperature sensors, protection steel pipe, magnetostrictive waveguide wire and floaters with magnet inside. Install probe into the riser pipe of oil tank, insert protection steel rod into liquid in

underground tank, floaters float on the liquid surface, and slides up and down on rod according to the changes of liquid level. Processing measured data of product level, water level and average temperature of five-points, then transmit these data to smart console by digital communication port.

Control board of probe is composed of CPU, instrumentation amplifier circuit and communication circuit. CPU adopts high-frequency processor, to ensure the instantaneity and reliability of data sampling. High-accuracy instrumentation amplifier circuit guarantee the authenticity of sampled data waveform. And digital communication guarantee the reliability and anti-jamming of data remote transmission.

#### 4. Main Technical Parameters

<b>Power supply</b>	DC12V, 50mA
<b>Precision</b>	±0.5mm;
<b>Repeatability</b>	±0.2mm
<b>Resolution of product level</b>	0.01mm
<b>Resolution of temperature</b>	0.0625℃
<b>Resolution of water level</b>	0.01mm
<b>Operating temperature range</b>	−40℃~60℃ (-40 to 140°F)
<b>Points of temperature measured</b>	5
<b>Maximum communication distance</b>	500m
<b>Communication mode</b>	RS485
<b>Intrinsic safety parameter</b>	Power port: $U_i = 15V, I_i = 400mA, P_i = 1.2W, C_i = 4.85\mu F, L_i = 0;$
	Signal port: $U_i = 7.14V, I_i = 147mA, P_i = 0.26W, C_i = 0, L_i = 0;$
<b>Mark of explosion proof</b>	Ex ia A T4
<b>Protection grade</b>	IP67
<b>Associated apparatus</b>	Windbell GSB03 safety barrier
<b>Definition of power cable</b>	BLUE – POWER+ BROWN – RS-485A WHITE – RS-485B BLACK – POWER-
<b>Applicable medium</b>	Gasoline, kerosene, diesel, light oil, heavy oil ,alcohol mixture,
<b>Communication address</b>	6 digits, please see “Manufacturing Code ” on nameplate of probe = Probe ID

## 5. Overall Dimensions, Weight and Material

- Overall dimensions: diameter 2"
- Floater kits: 2"
- Height: customization
- Weight: depends on height
- Material: Mainly SS316

## 6. Use and Alignment

The installation quality of ATG system and its accessories have a close bearing on safety, service quality, measuring accuracy and lifetime.

In order to operate safely, please comply with this manual. If it is out of accord with local regulation, please install and operate according to local regulation.

### 6.1 Attention and requirement during installation

The probe should keep away from the delivery pipe and suction pipe at least 1 meter. Otherwise, the oil flow will have an influence on the probe performance, even bend and damage the probe.

During the installation, the outlet direction of delivery pipe should be opposite the probe. Riser pipe must be welded vertically (vertical to horizontal line not the manhole cover), insert into manhole cover but not more than 100mm. Inner wall of riser pipe must be smooth and no welding slag. Correct installation please see Fig. 1 as below.

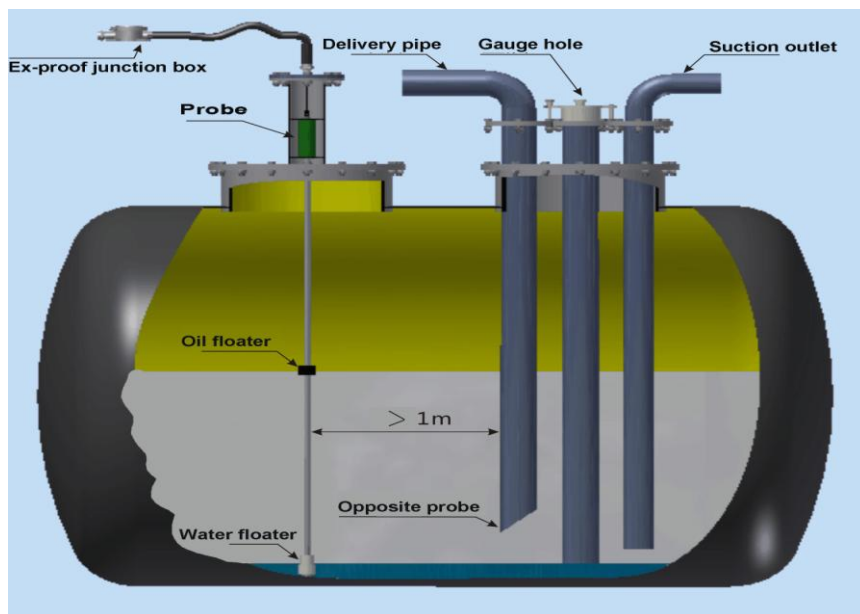


Fig. 1

### 6.2 Installation of riser pipe and its flange

For Windbell probe, inner diameter of riser pipe is 100mm (4"). Length of the riser pipe should be more or equal to 350mm, design please refer to Fig. 2.

Open a cable hole on the center of blind flange, fix G1/2 screw for cable pass and seal. Flange design please refer to Fig. 3.

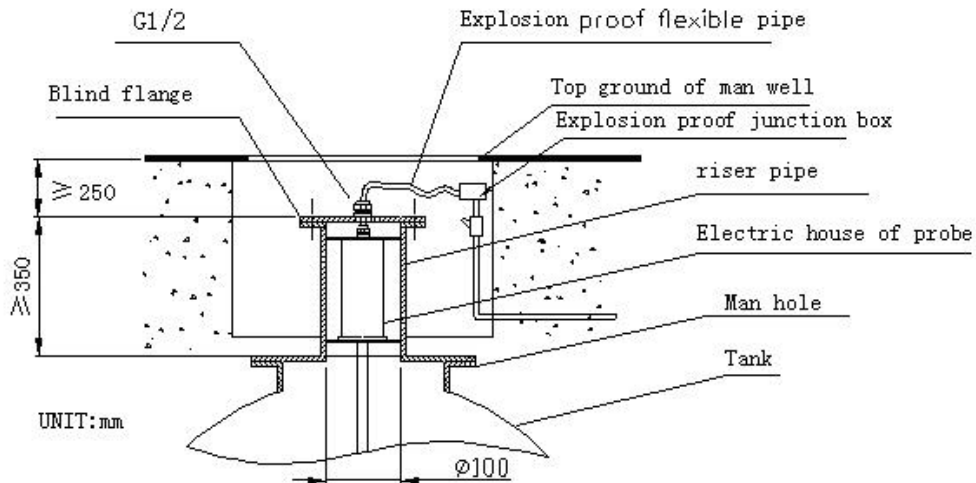


Fig. 2

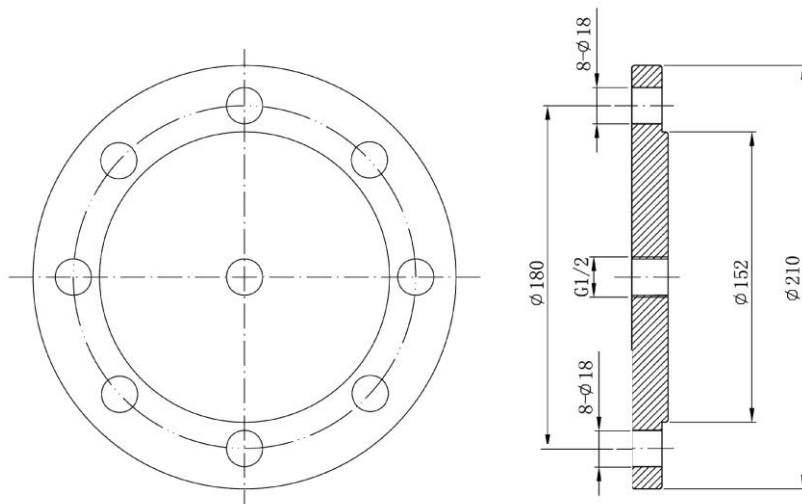


Fig. 3



### 6.3 Construction requirements of manhole

- Man-well opening should be larger than 800×800mm, convenient for construction and equipment installation.
- Man-well opening must have a enclosing wall higher than 300mm, to avoid outside water penetrating into man-well. Man-well also has cover above.
- The distance between man well opening and blind flange of riser pipe should be more than 250mm, for the installation of explosion proof flexible pipe.
- There must be asbestos pad between riser pipe flange and blind flange, and do not forget to joint the two flanges with sheet copper.
- Grounding sheet iron must be reliable connected to the earth system of underground tanks, earth resistance should less than 1Ω.
- Earth wire should be larger than 6 mm<sup>2</sup>, and connect to grounding iron reliably.

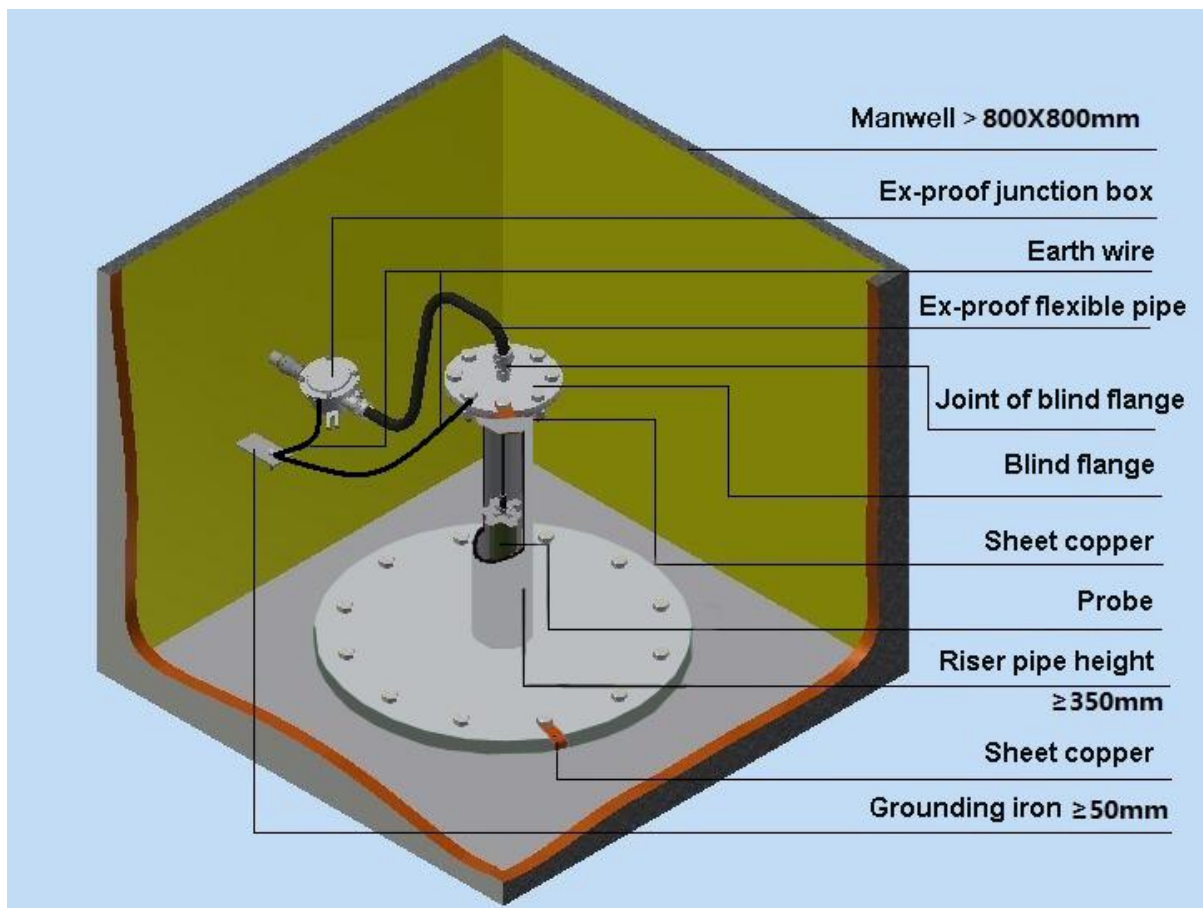


Fig 4.

#### 6.4 Layout of protection steel pipe and communication cable

Please see Fig. 5 as below.

- All communication cables must go through protection steel pipe.
- When lying, protection steel pipe must be put under ground at least 300mm depth. Spacing distance between pipes must be at least 200mm.
- Corner of protection steel pipe must be one-round turn for cable to through easily.
- Each cable of probe must be put in separate pipe.
- The cable from smart console to probe must be complete one, shouldn't have any joint.
- For safety, we recommend use RVVP4×0.5 (or larger) shield cable and must accord with the requirement of capacitance per foot not more than 100pF, length of cable should be less than 300m. Shielding layer of cable from probe must be coupled with PE port of console, the shielding layer of cable in explosion proof junction box should be wrap up well by insulating tape,
- There should be a grounding terminal on the protection steel pipe, and must reliably connect with the earth system of gas station.
- The end of pipe which inside control room must be injected into explosion proof sealant, to ensure reliable sealing and avoid vapor going into room.

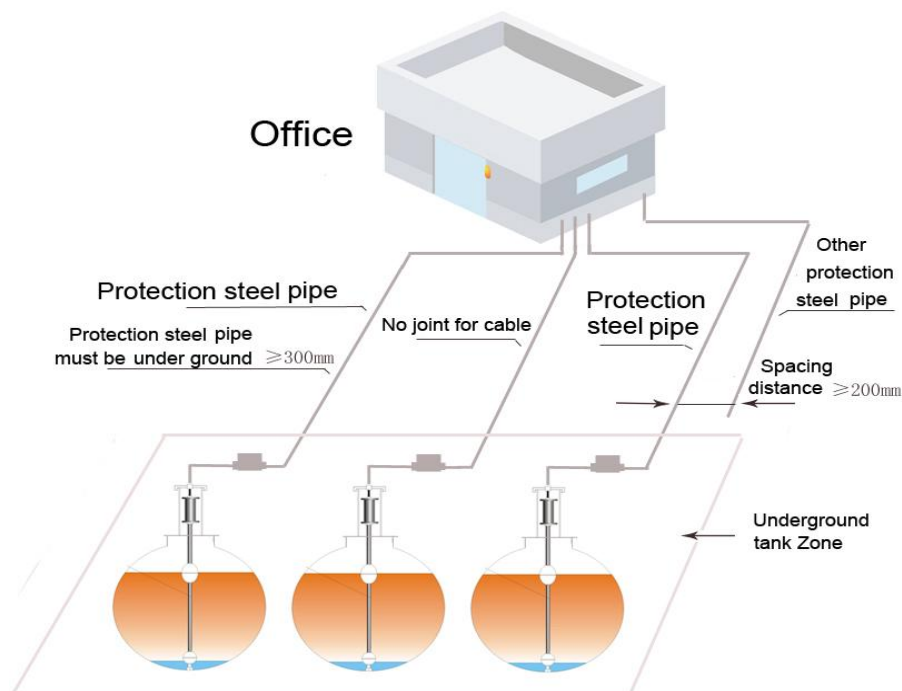


Fig 5.



### Safety warning

To ensure the safety of gas station and guarantee the normal work of the system, the anti-lightning system of gas station should be able to protect the whole ATG system, and should reserve earth port for the anti-lightning system.

## 6.5 Installation of probe

### Notice

1. For probe is high-precision product, please handle gently during move and installation.
2. During installation, please keep vertical of probe, otherwise will affect the accuracy of measurement.
3. Don't draw-off communication cable of probe when installation.

- Take probe out of package box.
- Record "Manufacturing Code" on nameplate of probe, later communication setting will use it.
- Remove foam package of probe.
- Install fixed plate at both ends of electric house.
- Plug communication cable into the socket at top of electric house and screw it tightly.
- Carefully put oil floater and water floater at the bottom of probe.
- Put probe into oil tank carefully by two hands, then hold fixed plate and adjust probe to be vertical, installation position please see Fig.6.

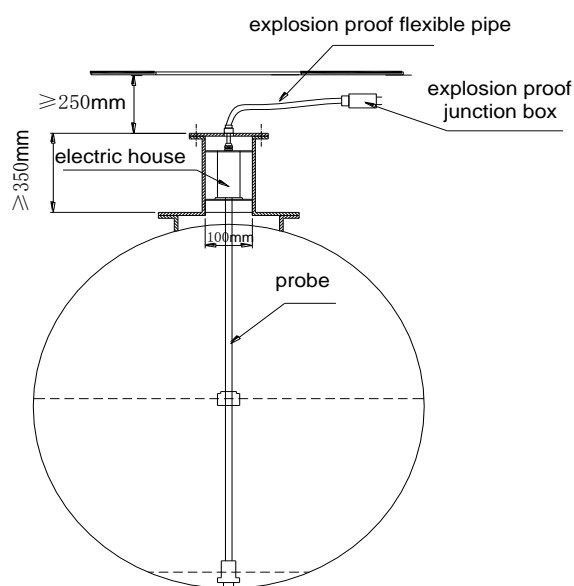


Fig. 6

**Safety warning**

When installation, must use anti-static tools, like copper spanner, screwdriver etc.

**6.6 Installation of explosion proof flexible pipe and explosion proof junction box**

Details please see Fig. 7 below.

**Safety warning**

1. Every accessory must be installed in order and the order cannot be reversed.
2. Explosion-proof isolation sealed tube joint must be full filled with explosion proof daub, to prevent oil gas enters into control house through protection steel pipe.
3. Cables must be tightly compressed by sealing element, to prevent the infiltration of oil and gas.
4. All accessories must be screwed tightly.

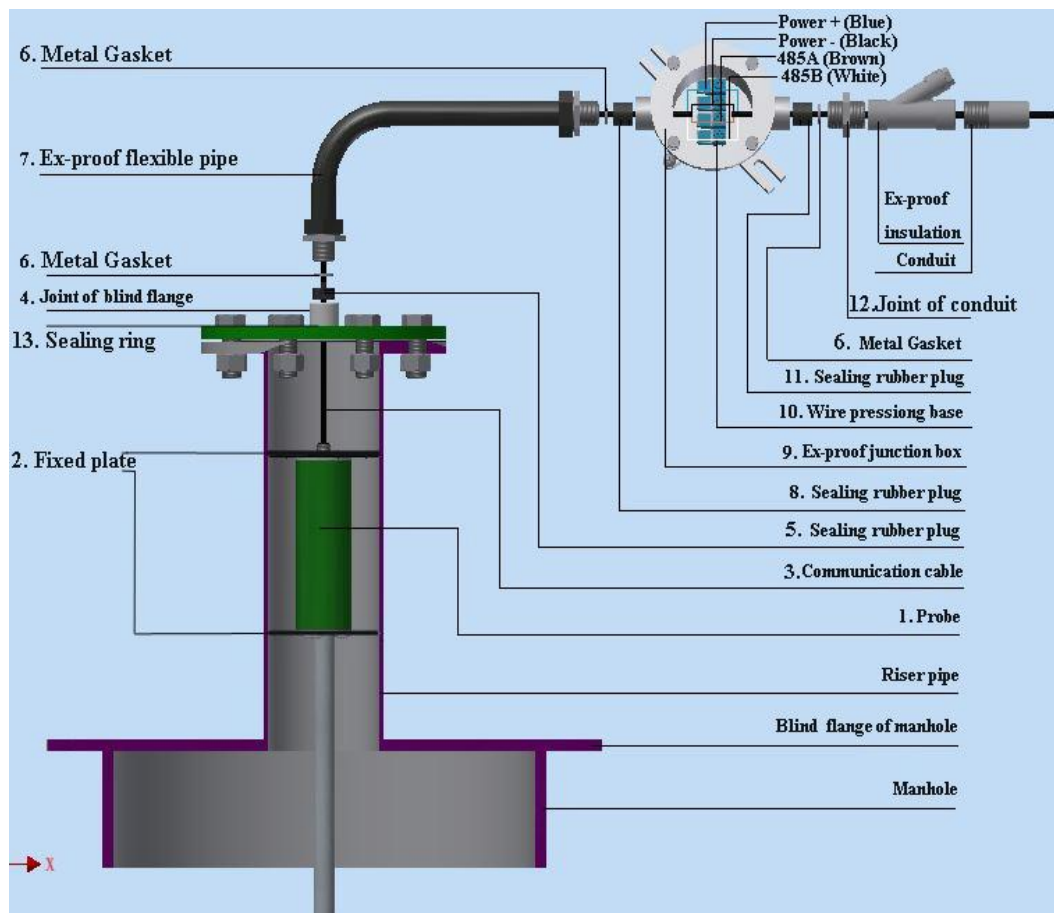
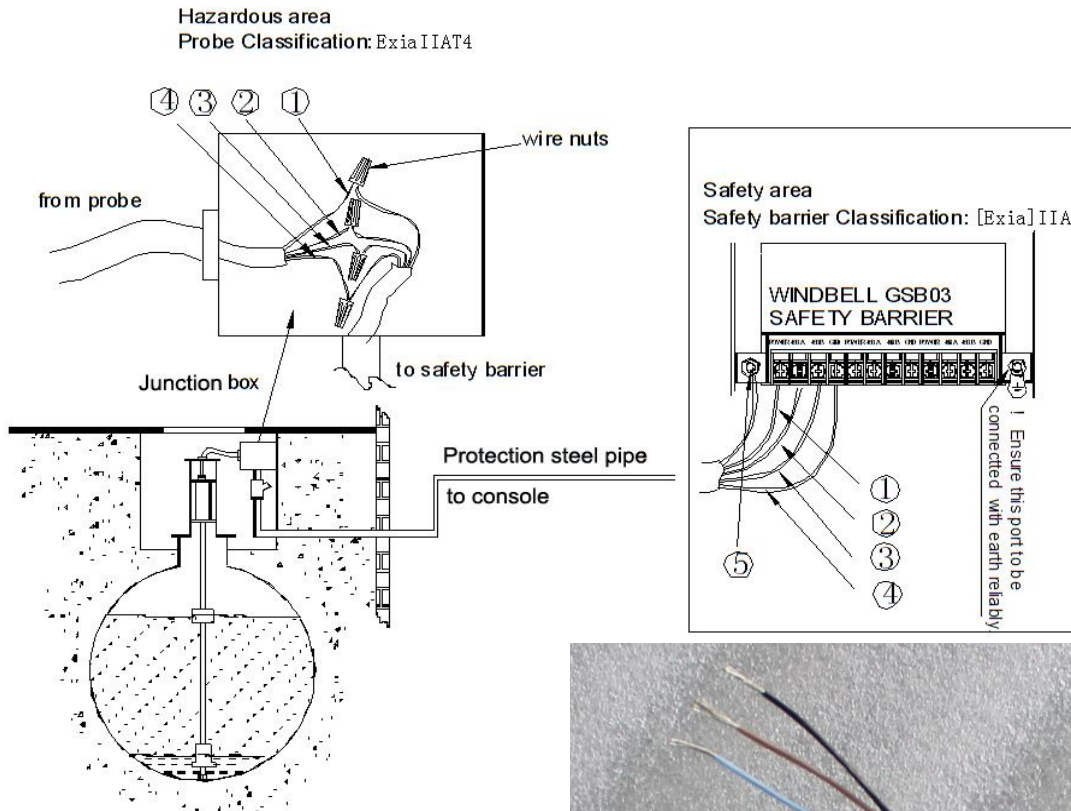


Fig. 7

### 6.7 ATG system electrical wiring diagram (Fig.8)

The cable from probe must correctly connect to relevant safety barrier inside console. The shielding layer of cable must connect to PE of safety barrier. The safety barrier also must connect to earth reliably. As Fig.8 shown.



**Cable Connection Table**

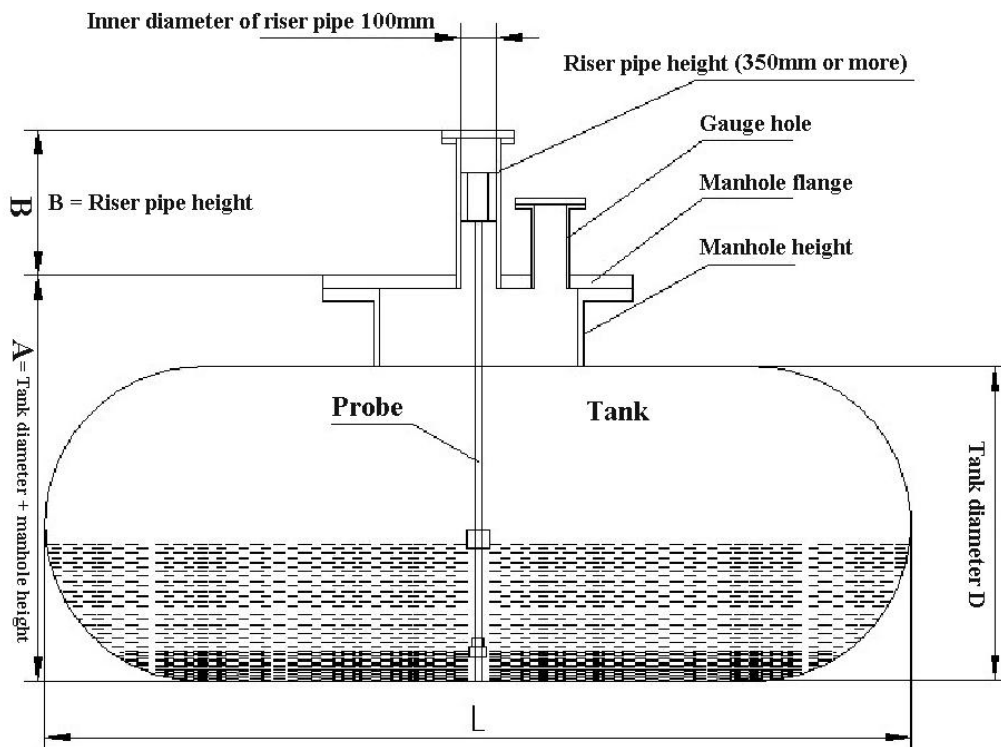
No.	Power wires	Port of safety barrier
	Blue wire	Power (Power +)
	Brown wire	485A
	White wire	485B
	Black wire	GND (Power-)
	Shielded wire	

**Safety warning**

- Earth terminal of safety barrier should reliable connect to ground by more than 6 mm<sup>2</sup> multi-core copper cable.
- No power before right wiring.
- ATG system must share the same earthing with tank.

### 6.8 Probe specification

For SP300 probe, different lengths mean different specification. For example SP300-2870, which means the model is SP300, length of probe rod (below probe head) is 2870mm. The selection of probe length is as below, Probe length =  $A + 100\text{mm}$   
 $A = \text{Tank diameter (height)} + \text{manhole height}$ , so it is the height from manhole cover to tank bottom.



## 7. Handling of Typical Failures

There are only a few components and parts in this instrument and therefore the failure rate is very low during use. The frequent failures and handling methods are listed as following:

<b>Fault phenomenon</b>	<b>Cause</b>	<b>Handling measures</b>
No probe data or No Communication, oil level, water level and temperature is 0	Probe address number is blank or input address number wrongly	Check probe address and input right number
Oil level or water level stand without change	Probe is jammed	Remove obstacles around floater and probe ( or extension tube or support stand or maintenance ladder
Oil level is too low	Failure of Safety barrier	Replace safety barrier
Water level jumping again and again	Noise wave have arisen between oil pulse signal and water pulse signal	Open probe electric house, debug pulse signals again. (Please note to replace the O ring when closing to ensure seal.)
Oil level is correct, but oil volume is wrong	Tank volume table is wrong	Examine tank volume table and input correct data

## 8. Repair and Maintenance

### 8.1 Repair

- Only the repairer specially trained by the manufacturer is allowed to repair the probe.
- Cur off power supply before repair or checking for the safety issue.

### 8.2 Maintenance

- Specialized person should be designated to carry out routine maintenance on the card reader during its use.
- The maintenance and repairing personnel should carefully read this Manual and be familiarized with the circuit diagram, as well as the internal structure, external structure and circuitous philosophy of probe.



- The maintenance and repairing personnel should regularly check whether the connecting wire of probe is reliable and keep the same earth of console.

## **9. Transportation and Storage**

- The packed of probe is suitable for transportation in various ways without direct exposure to rain and snow.
- The packed of probe can be stored for more than 1 years in a well-ventilated environment with relative humidity of less than 90%.

## **10. Unpacking and Inspection**

Carry out visual check carefully before unpacking for any damage that might have happened during transportation. Inform manufacturer of any abnormality if have. Find the following accompanying documents after unpacking.

- Warranty card: 1 copy
- Manual: 1 copy
- Packing list: 1 copy
- List of accessories: 1 copy
- Probe: 1 set

## **11. Qualification Number**



## Appendix A

Table of probe installation accessories

Item	Name	Specification	Qty.	Remark
1	Fixed plate		2	For probe fixing inside riser pipe
2	Cable	RS485, 4 wires	1	Communication cable
3	Joint of blind flange	G1/2 Male – G1/2 Female	1	For cable seal and connection with blind flange
4	Sealing rubber plug	Φ18×Φ5×10	1	For Ex-proof flexible pipe and joint of blind flange connection
5	Metal gasket	Φ18×Φ10×1	3	For sealing rubber plug
6	Explosion proof flexible pipe	G1/2 ×0.7 Length about 1.5m	1	Each pipe contains one group parts ( one joint and one seal gasket)at each end
7	Sealing rubber plug	Φ18×Φ5×18	1	For connection between Ex-proof flexible pipe and junction box
8	Explosion proof junction box		1	
9	Water proof wire pressing base		4	4 pc for each probe
10	Sealing rubber plug	Φ18×Φ10×18	1	For shielding cable RVVP4x0.5
11	Joint of protection steel pipe	G1/2 Male – G3/4 Female	1	Connect between protection steel pipe and explosion proof junction box
12	Sealing ring	Φ29×Φ19×2.2	1	For joint of blind flange

## Notices:

- I. When level gauge connects to Safety barrier which obtained Explosion proof certification, and then compose a system, the system installation must comply with article 12.3 of standard GB3936.15-2000 《Electrical equipment used in Explosive gas environment 15th parts: for electronic installation in dangerous location (except coal) 》
- II. Carefully check the model and specification of Safety barrier, work pressure and polarity, avoid damage from misconnection.
- III. Disconnect safety barrier wiring before checking system circuit.
- IV. The explosion proof parameters of console safety barrier must comply with following symbol:

$$U_o \leq U_i, \quad I_o \leq I_i; \quad C_o \geq C_c + C_i; \quad L_o \geq L_c + L_i, \quad P_o \leq P_i$$

Symbol means:

$U_o$  -- Maximum output voltage;  $U_i$  -- Maximum input voltage

$I_o$  -- Maximum output current;  $I_i$  -- Maximum input current

$C_o$  -- Maximum external Cap;  $C_i$  -- Maximum internal Cap

$L_o$  -- Maximum external inductance;  $L_i$  -- Maximum internal inductance

$P_o$  -- Maximum output power;  $P_i$  -- Maximum input power

Remark: When this product used in Zone 0 of Explosive gas environment, the transformer which power to safety barrier must comply with the requirement article 8.1 in standard GB3836.4-2000.

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