PetroLine'A ООО НПП «ПЕТРОЛАЙН А» 2024

LEVEL GAUGE U-150

Operation Manual
PLA150.208.018.000 RE

This Manual provides information for service personnel how to perform installation, commissioning and maintenance of the radar Level Gauge U-150 (hereinafter referred to as the U-150).

The U-150 exploitation is allowed to be used by personnel who has studied this manual, set of exploitation documentation and passed safety training.

The U-150 Level Gauge is required for level measurement of different types of fluids. The Level Gauge is used as part of the DEL-150 Drilling and Well Workover Monitoring System (hereinafter referred to as the DEL-150).

Scope of application is explosive zones of premises and outdoor facilities according to Ex-marking. The U-150 is manufactured in accordance with the requirements of ISO 9001:2015.

In order to exclude the possibility of mechanical damage, violation of electroplating and paint coatings, the rules of storage and transportation of the device should be observed. When studying the rules of operation, it is also necessary to be guided by the technical description and operating instructions of the DEL-150 System.

The U-150 Level Gauge is made in a cylindrical enclosure with a protection degree from external influences at least IP67. The enclosure consists of a base box and a cover, fastened with three screws. Inside the enclosure there is an electronics unit, which is a printed circuit board with electronic components located on them. External connections are made using a connector located on the side surface of the enclosure.

1. Technical Characteristics

Name of parameter	Value
Level measurement range, mm	300…3000
Accuracy, %FS	±1.0
Accuracy caused by a change in ambient temperature for every 10 °C from normal conditions, %FS	±0.75
Output signal	Digital
Communication protocol	Modbus
Power supply range, VDC	7.5…28
Power consumption, max., Wt	1.6
Ex marking, ATEX	II2GExibIIAT3Gb
Ex marking, EAC	1ExibIIBT5GbX
Ingress protection	IP67
Operating conditions: • Ambient temperature range, °C • Relative humidity, max., % • Atmospheric pressure range, kPa	 -40…+50 90 96…104
Dimensions, mm	Ø95 x 205
Weight, max., kg	1.5
Service life, min., years	10

2. Explosion Safety During Operation

Explosion protection is provided by an intrinsically safe electrical circuit (“i” type of explosion protection).

3. Requirements for Keeping Equipment Specifications that Cause its Explosion Safety

During operation, it is forbidden to break the seals and open the U-150 enclosure.

When the MU-150 / MU-150E / MK-140 unit of the DEL-150 System is switched on, it is forbidden to connect and disconnect cables, power cable and grounding conductors. In case of malfunctions, it is necessary to turn off the MU-150 / MU-150E / MK-140 unit and disconnect the power cable from the power source. Then replace the faulty U-150 with a serviceable one by connecting it according to the documentation (operation manual for the DEL-150).

During operation, check the condition of communication cables periodically. If a violation of the protective layer on the cable lines is detected, replace the damaged cable immediately.

Do not allow sealing violations. If a damage is detected, replace the faulty equipment.

Ensuring explosion safety during operation is according to the safety regulations, applicable to the equipment with which (or as part of which) the equipment is used.

ATTENTION!!! During operation, it is necessary to monitor the equipment status and its cables. In case of any mechanical damage of the equipment or any of the cables connected, further operation is strictly prohibited!

4. Operating Principle

The U-150 Level Gauges are designed on the basis of radio wave (radar) technology.

The Level Gauge is installed at the top of the tank and emits short microwave pulses towards the product surface in the tank. When the pulse reaches the surface, part of the energy is reflected back into the signal transducer, where it is processed by the electronic unit of the Level Gauge. The time difference between the emitted and reflected pulse is determined by the microprocessor and converted into the distance on the basis of which the level is calculated.

The minimum measurement reference point is 0.3 m from the radiator membrane (see Fig. 1). It is called "dead zone" of the Level Gauge, when the reflected signal arrives to the sensor so soon that the Level Gauge does not have time to adjust from transmission to reception and the surface cannot be detected.

5. Installation

NOTIFICATION. Installation and further commissioning of the equipment should be carried out only by qualified specialists.

Before installing the U-150, it is necessary to make sure that:

- Basic dimensions at the processing facilities correspond to the dimensions of the U-150 (see Fig. 1);
- Fixing bolts and screws are present;
- There is no damage of the connector insulation;
- There is no external damage of the components;
- There is no damage of the insulation of the signal cable.

Disregard of this instruction may lead to a serious failure of the U-150.

Installation requirements

Proper installation of the Level Gauge is necessary for reliable operation of the radio wave level measurement system. The Level Gauge with a stand is designed to be installed on the top of the tank using bolts and nuts. Guide slots in the Level Gauge and guide screws in the support help to attach it and a support quickly. (see Fig. 2).

Install the Level Gauge vertically for a sufficient level of reflected echo/signal from the surface of the liquid and the greatest amplitude of the echo/signal captured.

Obstacles to the "beam" propagation lead to strong false echoes/signals, so install the Level Gauge so as to avoid false reflections.

It is recommended to install the U-150 Level Gauge at a distance of at least 0.5 m from the walls of the tank in order to avoid weakening or loss of the echo/signal (see Fig. 2).

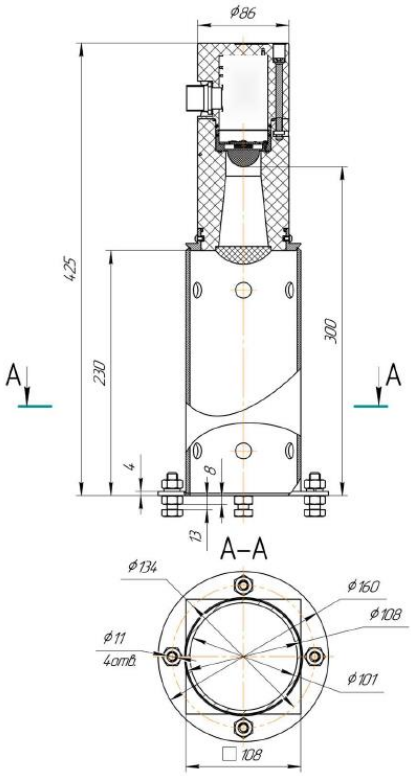

Figure 1. Overall dimensions of the U-150 Level Gauge with stand

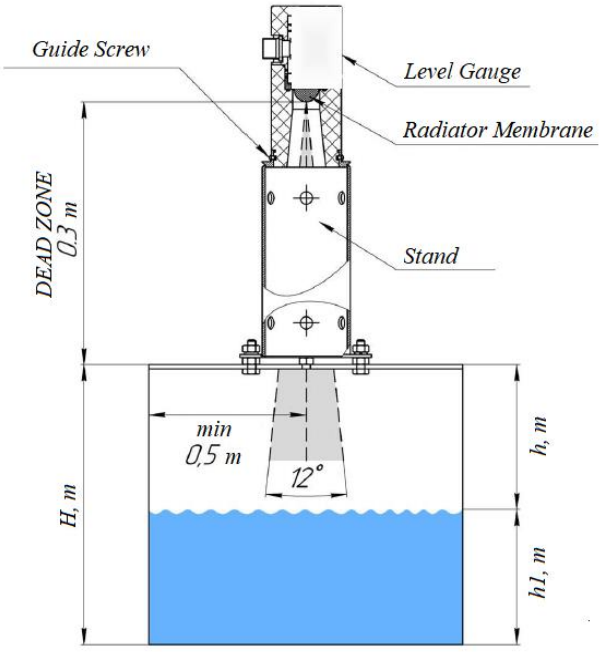

Figure 2. Installation Requirements

In the absence of agitators, the Level Gauge should be installed in the center of the tank (installation the Level Gauge in the center of the tank reduces the dependence of the mud level readings on the inclination of the tank).

Fluid surface effect

Foaming liquids can weaken the echo/signal level, because foam is a poor signal reflector. If the foam is conductive and thick, the Level Gauge can measure its surface. If the foam

has low electrical conductivity, microwaves can penetrate the foam and measure the surface of the liquid. Therefore, it is advisable to install the Level Gauge in a place where the surface of the liquid will always be clean. Do not install the U-150 Level Gauge directly above the liquid flow into the tank.

Tank design effect
If there are agitators in the tank, install the Level Gauge away from the swirl center created by the agitator.

To install the Level Gauge, it is necessary to:

- Determine the installation location of the Level Gauge;
- Cut a hole of 108 x 108 mm on the top of the tank and drill holes (4 pcs.) for mounting the support (see Fig.1);
- Install a Level Gauge.

NOTIFICATION. The stability of the readings and the accuracy of the level measurements depend on the correct installation of the Level Gauge

6. External Electrical Connections Installation

Connecting the U-150 to the MU-150 / MU-150E / MK-140 unit of the DEL-150 System, use the SHR20/SHR20 universal commutation cable from the supplied package (see Fig. 3).

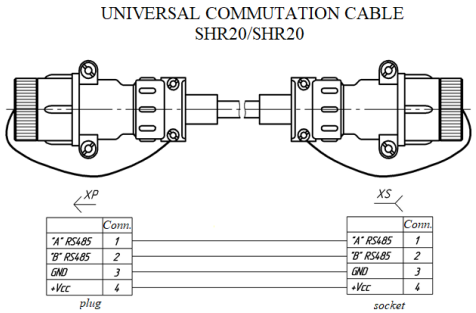

Figure 3. SHR20/SHR20 universal commutation cable

The cable from the U-150 is connected to any of the connectors of the MU-150 / MU-150E / MK-140 unit marked “RS-485” / “Sensor” (see Fig. 4).

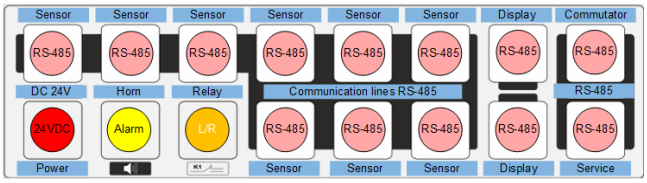

Figure 4. The MU-150 / MU-150E / MK-140 unit’s connectors “RS-485” / “Sensor” for the U-150 connection

7. The U-150 Functional Test

For functional test of the U-150 Level Gauge it is necessary to connect the Level Gauge to MU-150 / MU-150E / MK-140 unit, to turn power on and to make sure that the parameter MUD VOLUME is displayed on the MU-150 / MU-150E EL screen (see Fig. 5).

Figure 5. Readings on the Control Module display

8. Readings Issues

If the connection with the U-150 is lost, the symbol "-----" opposite the parameter MUD VOLUME is displayed on the MU-150 / MU-150E EL screen (see Fig. 6).

Figure 6. Readings in case of loss of communication with the U-150

In case of loss of communication with the U-150 it is necessary to carry out actions in the following order:

1. Checking of the integrity of the commutation cable;
2. Reconnection of the U-150 cable to the free connector of the MU-150 / MU-150E / MK-140 unit marked “RS-485” / “Sensor”;
3. Checking of the presence of the parameter in the related menu’s list of the Control Module;
4. Replacement of the cable;
5. Checking of the presence of the parameter in the related menu’s list of the Control Module;
6. Replacement of the U-150;
7. Checking of the presence of the parameter in the related menu’s list of the Control Module.

9. Setting of the U-150

When the Level Gauge installation is completed, it is necessary to turn on the MU-150 Control Module and to enter the setting mode using the MU-150’s keyboard (see Fig. 7).

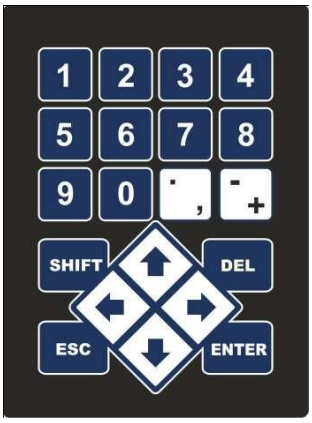

Figure 7. The MU-150 Control Module keyboard

Proceed in the following order to reach out required parameter:

1. Unblock the keyboard by pressing SHIFT + ENTER simultaneously;
2. Enter OPERATING PARAMETERS menu by pressing SHIFT + 3 simultaneously;
3. Use ↓ , ↑ and ENTER to select required parameter. To return to the previous menu, use ESC.

ENTER	MUD OUTPUT MUD LEVELS + GAS + MUD DENSITY +
ENTER	MUD LEVELS MUD VOLUME1 MUD VOLUME2 MUD VOLUME3 MUD VOLUME4
Setup the required settings described below	MUD VOLUME1, m3 MAX 050.00 MIN ---- MAX 2 ---- MIN 2 ---- HORN OFF TANK TYPE RECTANG AIN SETTINGS HOLDER HEIGHT.m 0.30 TANK HEIGHT.m 02.00 TANK VOL.m3 50.00

- **MAX / MIN** – the maximum and minimum values required for activating alarm and Control Module's relay output. Alarm is activated when 95% of this value is reached. When 100% is reached, the first relay of the Control Module's blocking unit (if available) will change its state (i.e. it will close or open the electrical circuit of the actuator);
- **MAX 2 / MIN 2** – the maximum and minimum values required for activating alarm and Control Module's relay output. Alarm is activated when 95% of this value is reached. When 100% is reached, the second relay of the Control Module's blocking unit (if available) will change its state (i.e. it will close or open the electrical circuit of the actuator);
- **HORN** – turning on and off the alarm when the maximum or minimum value of mud volume is exceeded. To change the setting, use ENTER;
- **TANK TYPE** – setting the type of tank using ENTER;
- **AIN SETTING** – setting up an analog input (for using Level Gauges with an analog output);
- **HOLDER HEIGHT.m** – distance from the radiator membrane to the stand's flange (0.3 m, see Fig. 1);
- **TANK HEIGHT**.m – distance H on Fig.2;
- **TANK VOL.m3 –** actual tank capacity.

10. List of Critical Failures and Possible Issues in Maintenance Leading to Equipment Failures and Actions to Prevent these Failures (troubleshooting)

Incorrect power supply can lead to equipment failure.

Incorrect set maximum values for parameters can lead to incorrect operation of the external controlled equipment if the maximum level for the controlled parameter is exceeded.

A short circuit or a break circuit in the power and communication lines of the Level Gauge**,** may cause loss of communication with the Level Gauge with the following failures: lack of parameter data, symbols "????" or "----" instead of parameter data, lack of data on other parameters.

In case of failure of the Level Gauge or Control Module, it is necessary to check the equipment technical condition according to the Clause #8 of this Operation Manual. If troubleshooting did not lead to proper operation, it is necessary to stop operation and replace with obviously serviceable equipment. Defective equipment should be sent for repair to the manufacturer or to the specialized authorized service center.

In case of failures that can lead to emergency situations, it is necessary to replace the equipment that has failed. If necessary, disable additional external devices.

11. Maintenance Procedure

Maintenance is carried out in the following order:

1. Cleaning the Level Gauge's enclosure and radiator from contamination;
2. Checking the safety of seals (if available);
3. Checking the presence and strength of the mounting components;
4. Cleaning of connectors and terminals from contamination;
5. Checking for the absence of visible mechanical damages;
6. Replacement and (or) repair of damaged cable products;
7. Replacement of damaged connectors.

The contacts of the connector should be washed with an alcohol-gasoline mixture (need 3 ml.) using a soft brush. Connectors after cleaning and drying should be treated with Vaseline or similar lubricant. It is recommended to treat the threads on the connectors with graphite grease.

NOTIFICATION. Absence of maintenance records in the passport (section "Maintenance Records") ENTAILS VIOLATION OF THE OPERATION RULES, and the manufacturer has the right to withdraw from warranty obligations

12. Limit Conditions Parameters

In case of severe mechanical damage, leakproofness violations, seals violations, heating of parts to unacceptable temperatures, supply of unacceptable currents and voltages, change of calibration data, further use is unacceptable or impractical, or restoration of its serviceable or operable condition is impossible or impractical.

13. Marking and Packaging

The U-150's nameplate includes the following components (see Fig. 8):

1. Trademark or name of manufacturer;
2. Part number;
3. Name and model;
4. Serial number;
5. Manufacturing year;
6. Explosion protection marking together with certificate number;
7. Technical characteristics.

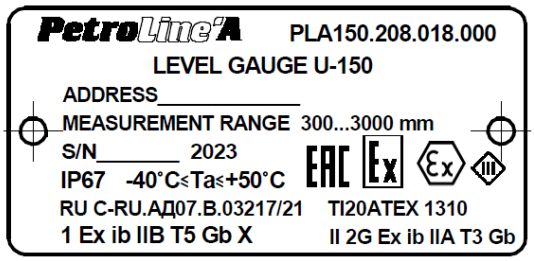

Figure 8. Example of the U-150 marking

Other data required by regulatory and technical documentation may also be reflected on the nameplate.

Boxes made of plywood with metal handles for carrying are used to transport the U-150 as part of the DEL-150 System.

14. List of Components

Full completeness is indicated in the passport for equipment released by manufacturer.

15. Repair

Repair of the U-150 is carried out at the manufacturer or at a specialized authorized service center.

NOTIFICATION. Absence of repair records in the passport (section "Repair Records") ENTAILS VIOLATION OF THE OPERATION RULES, and the manufacturer has the right to withdraw from warranty obligations

16. Storage

The equipment requires careful handling, storage in dry, clean rooms with a constant temperature from -50°C to +50°C and a relative humidity of no more than 80%.

The long-term storage requires conservation, according to the requirements of the equipment conservation instructions. The equipment arriving at the warehouses in the manufacturer's containers are not unpacked, packed on flat pallets and stacked or in the cells of the racks.

Factory-sealed devices are not allowed to be opened in warehouses.
Small devices and devices arriving in individual packaging are stored in box pallets with installation in a stack.

Devices and components without individual packaging should be stored in shelving cells no more than 3 rows in height with the use of cushioning materials between them.

Small devices and products arriving without packaging can be stored in small-cell racks and cabinets, while devices or products of the same type should be stored in one cell.

NOTIFICATION. Absence of storage records in the passport (section "Storage Records") ENTAILS VIOLATION OF THE OPERATION RULES, and the manufacturer has the right to withdraw from warranty obligations

17. Transportation

Transportation of the equipment is allowed by all types of closed transport. The U-150 in a package for transportation allows the impact of transport shaking with an acceleration of 30 m/s^2 with a frequency of 100 beats per minute or 1500 beats with that acceleration.

18. Disposal

The U-150 is disposed of in accordance with the requirements and norms applicable in the oil and gas industry.

19. Warranty Obligations

The warranty period is 12 months from the date of sale.

A full description of the warranty obligations is described in the equipment passport.

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