



LOAD SENSOR DN-130

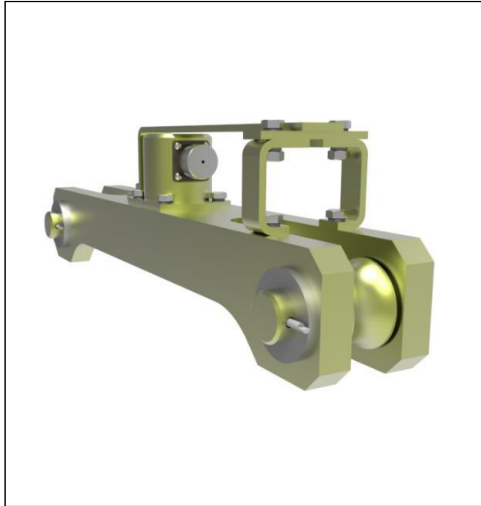
Operation Manual

PLA140.201.000.000 RE

Rev. 01

LOAD SENSOR DN-130

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This Manual provides information for service personnel how to perform installation, commissioning and maintenance of the Load Sensor DN-130 and its modifications (hereinafter referred to as the DN-130).

The DN-130 exploitation is allowed to be used by personnel who has studied this manual, set of exploitation documentation and passed safety training.

The DN-130 is intended to measure the tension force (load force) in the deadline rope (cable) for HOOK LOAD and WOB as well as other derived drilling parameters calculation or to measure the load force in the rope during make-up procedures for TONG LINEPULL or TONGS TORQUE parameters calculation. The sensor is made as part of the DEL-150 Drilling and Well Workover Monitoring System (hereinafter referred to as the DEL-150).

The DN-130 has the following modifications:

- DN-130 with the Modbus/RS-485 output;
- DN-130(A) with both Modbus/RS-485 and analogue outputs;
- DN-130(R) is the wireless configuration.

Scope of application is explosive zones of premises and outdoor facilities according to Ex-marking. The DN-130 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 DN-130 sensor consists of a housing with an integrated strain gauge bridge and an electronic circuit that includes filters, analog-to-digital converter, microprocessor, non-volatile memory for recording and storing calibration data,

power supply voltage stabilization circuit, intrinsically safe unit at the power input. Housing is a flexible metal frame with an arc-shaped cradle in the middle and rollers at the ends. A rope passes through the rollers and the cradle. A cylindrical metal cup with a connector is attached to the housing (see Fig. 1).

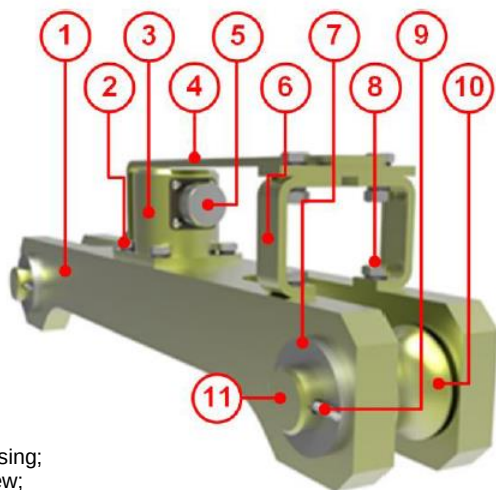
The DN-130(A) modification includes second connector for the analogue output (see Fig. 2).

The DN-130(R) modification includes cylindrical metal cup closed with a threaded cover that houses the radio module PCB and the battery power supply unit. A cylindrical antenna of the radio module, made of radio-transparent material, is attached to the sensor's housing. The antenna is protected from mechanical damage by a special metal bracket (see Fig. 3).

1. Technical Characteristics

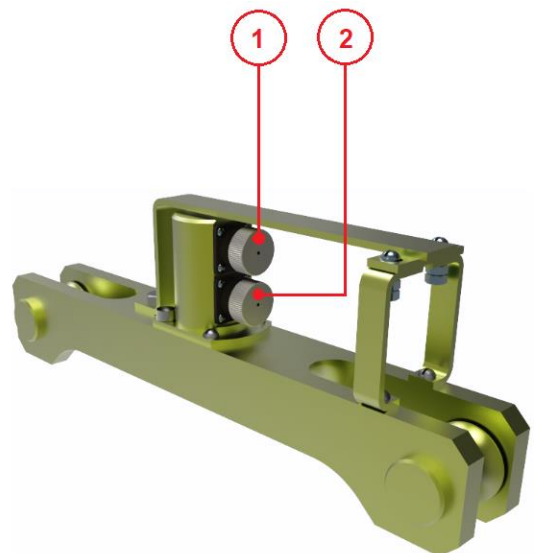
Name of parameter	Value
Rope OD range, mm	16...38
Minimum measurement limit, kN	5
Maximum measurement limit, kN	400
Accuracy, %FS	±3.0
A scale division value issued in a digital code to indicate the value of load, kN	1
Output signal	Digital
Output signal (optional)	Analogue 4...20 mA
Communication protocol	Modbus
Power supply range (digital circuit of the DN-130, DN-130(A)), VDC	12...18
Power supply range (analogue circuit of the DN-130(A)), VDC	12...24
Power consumption, max., Wt	0.75
Power supply from the battery (DN-130(R)), VDC	3.6
Battery lifespan, months	12
Ex marking, TR CU 012/2011	1ExibIIBT4Gb
Ex marking, ATEX	II2GExibIAT3Gb
Ingress protection	IP66
Ambient temperature range, °C	-45...+65
Dimensions (DN-130) depending on the rope OD, mm:	
➤ Ø 16, 18 mm	310 x 70 x 111
➤ Ø 22, 25 mm	420 x 83 x 124
➤ Ø 28, 32 mm	500 x 88 x 127
➤ Ø 35, 38 mm	540 x 100 x 140

Name of parameter	Value
Dimensions (DN-130(A)) depending on the rope OD, mm: ➤ Ø 16, 18 mm ➤ Ø 22, 25 mm ➤ Ø 28, 32 mm ➤ Ø 35, 38 mm	310 x 70 x 132 420 x 83 x 146 500 x 88 x 147 540 x 100 x 160
Dimensions (DN-130(R)) depending on the rope OD, mm: ➤ Ø 16, 18 mm ➤ Ø 22, 25 mm ➤ Ø 28, 32 mm ➤ Ø 35, 38 mm	312 x 70 x 133 420 x 78 x 146 500 x 90 x 148 540 x 103 x 161
Weight (DN-130) depending on the rope OD, kg: ➤ Ø 16, 18 mm ➤ Ø 22, 25 mm ➤ Ø 28, 32 mm ➤ Ø 35, 38 mm	5 8 11 15.5
Weight (DN-130(A)) depending on the rope OD, kg: ➤ Ø 16, 18 mm ➤ Ø 22, 25 mm ➤ Ø 28, 32 mm ➤ Ø 35, 38 mm	5.5 8.5 11.5 16.0
Weight (DN-130(R)) depending on the rope OD, kg: ➤ Ø 16, 18 mm ➤ Ø 22, 25 mm ➤ Ø 28, 32 mm ➤ Ø 35, 38 mm	5.5 8.5 11.5 16.0
Service life, min., years	10
Recommended calibration interval, months	12



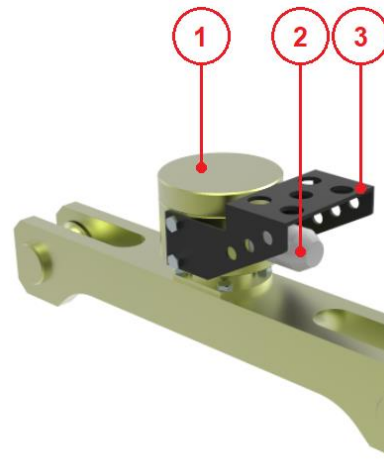
1. Housing;
2. Screw;
3. Cup;
4. Handle;
5. Connector;
6. Bracket;
7. Washer;
8. Screw;
9. Cotter;
10. Roller;
11. Axis pin

Figure 1. The DN-130 components



1. Connector for analogue 4...20 mA output;
2. Connector for Modbus/RS-485 output

Figure 2. The DN-130(A) components



1. Threaded cover of cup;
2. Antenna;
3. Bracket

Figure 3. The DN-130(R) components

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 DN-130 housing.

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 DN-130 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. Installation



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

Before installing the DN-130, it is necessary to make sure that:

- Basic dimensions at the processing facilities correspond to the dimensions of the DN-130;
- 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 insulation of the signal cable.

Disregard of this instruction may lead to a serious failure of the DN-130.

Installation requirements for HOOK LOAD and WOB measurements

The DN-130 is mounted on the deadline rope above the deadline anchor at a distance of 0.3–1.5 m when the travelling block is empty. The recommended distance from a similar load sensor on the rope is at least 0.3 m.

For installation on ropes with OD more than 22 mm, the Installation tool for load sensor is used (see Fig. 4).

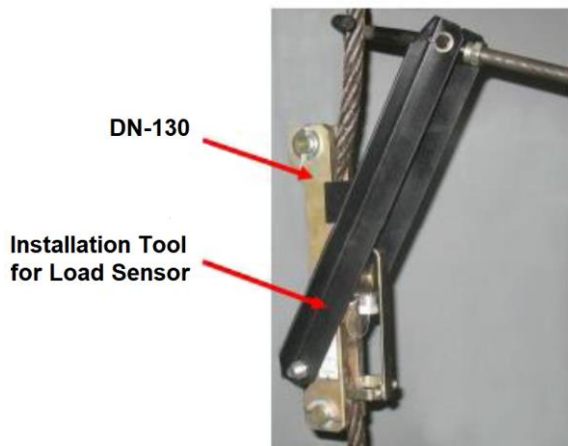


Figure 4. Installation of the DN-130 on the deadline rope

A clamp is installed right under the sensor on the rope to avoid its movement during installation or demounting.

Installation requirements for TONG LINEPULL or TONGS TORQUE measurements

The DN-130 is mounted on the working (holding) rope of the easy tong. It is necessary to maintain angle between working rope and axis of the easy tong 90° for accurate measurement (see Fig. 5). Rope must lie in a plane perpendicular to the axis of the pipes being made up. The recommended free length of the rope section for the sensor installation is at least 1 m.

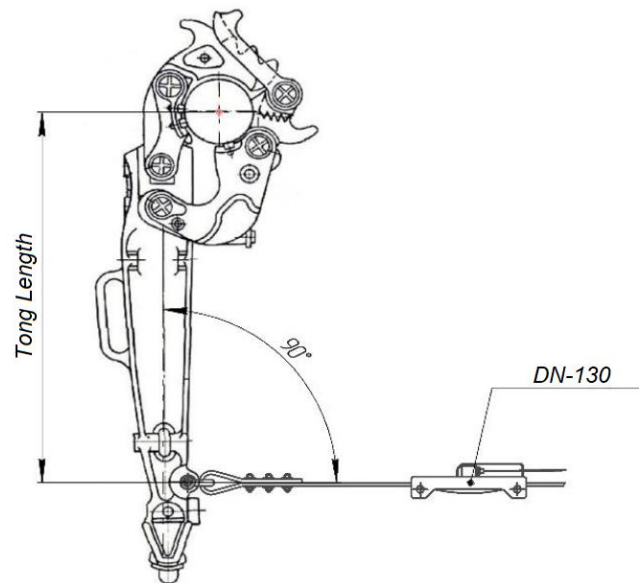


Figure 5. Installation of the DN-130 on the easy tong rope

Clamps are installed on the both sides from the sensor on the rope to avoid its movement.

The wireless modification of the DN-130(R) communicates with the MU-150 / MU-150E / MK-140 unit of the DEL-150 System via the PS-150(R1) Signal Transducer. Signal Transducer is connected by the WY20/WY20 universal commutation cable to the MU-150 / MU-150E / MK-140 unit and is installed at a distance of no more than 5 meters in line of sight from the DN-130.

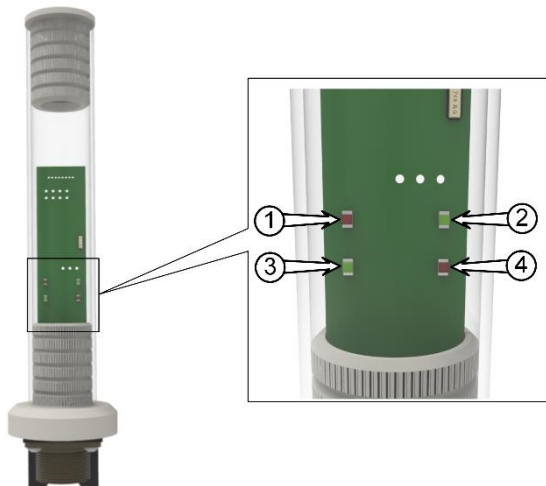
4.1. The PS-150(R1) Signal Transducer

The PS-150(R1) is made in a transparent enclosure, which allows to see LEDs located on the board when the transducer works (see Fig. 6).

The PS-150(R1) has the following technical characteristics:

Name of parameter	Value
Frequency range, GHz	2.4
Output power, mW	15
Max. distance for stable wireless communication, m	5
Power supply range, VDC	12...18
Ex marking, TR CU 012/2011	1ExibIIBT5Gb

Name of parameter	Value
Ex marking, ATEX	II2GExib[ib]IIAT3Gb
Ingress protection	IP65
Ambient temperature range, °C	-45...+65
Dimensions, mm	Ø30 x 150
Weight, kg	0.2



1. TxD – wireless data sending to the sensor;
2. RS-485 – data exchanging by RS-485;
3. RxD – wireless data exchanging;
4. Fault – software error

Figure 6. The PS-150(R1) Signal Transducer

5. External Electrical Connections Installation

The WY20/WY20 universal commutation cable from the supplied package (see Fig. 7) is used for connection of the DN-130 or the Signal Transducer PS-150(R1) to the MU-150 / MU-150E / MK-140 unit of the DEL-150 System.



ATTENTION!!! During installation, it is strictly prohibited to fix the commutation cable to the deadline rope or to the easy tong working rope.

The cable is connected to any of the connectors of the MU-150 / MU-150E / MK-140 unit marked "RS-485" / "Sensor" (see Fig. 8).

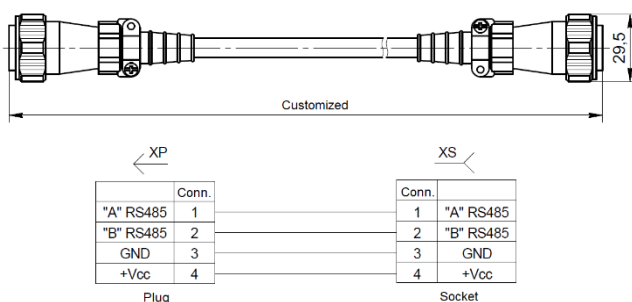


Figure 7. WY20/WY20 universal commutation cable

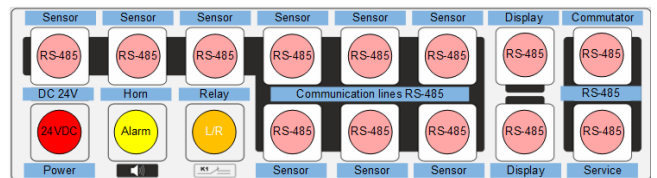
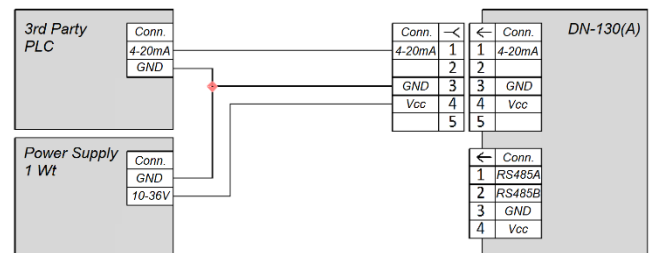


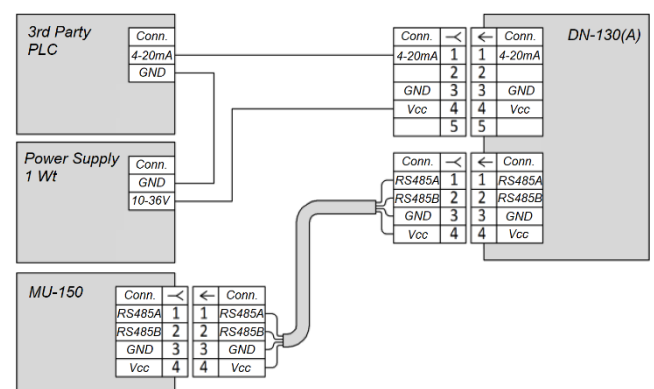
Figure 8. The MU-150 / MU-150E / MK-140 unit's connectors "RS-485" / "Sensor" for the DN-130 connection

The DN-130(A) modification allows connection of the second analogue output to the 3rd party systems according to drawings on Fig. 9.

1.



2.



1. Drawing doesn't include connection to the Control Module MU-150
2. Drawing includes connection to the Control Module MU-150

Figure 9. The DN-130(A) connection

6. The DN-130 Functional Test

For functional test of the DN-130 it is necessary to connect the sensor to the MU-150 / MU-150E / MK-140 unit, to turn power on and to make sure that the parameter HOOK LOAD is displayed on the MU-150 / MU-150E EL screen (see Fig. 10).

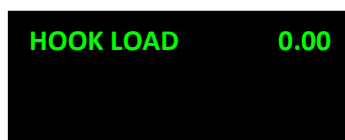


Figure 10. Readings on the Control Module display

7. Readings Issues

If connection with the DN-130 is lost, symbols "-----" are

displayed opposite HOOK LOAD parameter on the MU-150 / MU-150E EL screen (see Fig.11):

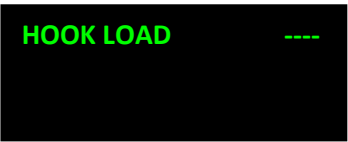


Figure 11. Readings in case of loss of communication with the DN-130

In case of loss of communication with the DN-130 it is necessary to carry out actions in the following order:

1. Checking of integrity of the commutation cable;
2. Reconnection of the DN-130 cable to free connector of the MU-150 / MU-150E / MK-140 unit marked "RS-485" / "Sensor";
3. Checking the presence of the parameter in the related menu's list of the Control Module;
4. Replacement of the cable;
5. Checking the presence of the parameter in the related menu's list of the Control Module;
6. Replacement of the DN-130;
7. Checking the presence of the parameter in the related menu's list of the Control Module.

8. Setting of the DN-130

When the sensor 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. 12).

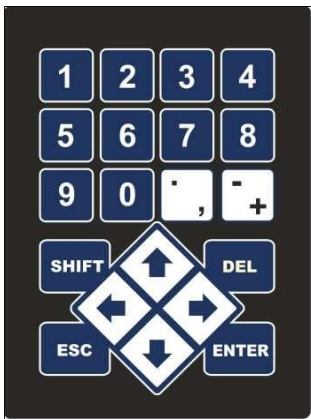


Figure 12. The MU-150 Control Module keyboard

Proceed in the following order to reach out required parameter:

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

8.1. Setting of HOOK LOAD Parameter

	HOOK LOAD WOB MUD PRESS.IN DRILLING TONGS H. TONGS
Setup of the required settings is described below	HOOK LOAD, tf MAX 100.000 FACTOR 06.00 TB WEIGHT 000.006 AIN SETTINGS AOUT SETTINGS ROPE OD SENSOR 4-20 OUT

- **MAX** – the maximum value that is required for activating alarm and relay output. Alarm is activated when 95% of this value is reached. When 100% is reached, the assigned relay of the blocking unit of the MU-150 / MU-150E / MK-140 (if available) will change its state (i.e. it will close or open the electrical circuit of the actuator);
- **FACTOR** – number of rig's Lines Strung;
- **TB WEIGHT** – difference between current value of HOOK LOAD parameter and 0 when parameter is zeroed by pressing

SHIFT + **ENTER** . Set cursor on TB WEIGHT before

it zeroing.

Zeroing is usually used to indicate net hook load value, excluding travelling block and its rope weight.

- **AIN SETTINGS** – setting up an analog input (for using 3rd party sensor with an analog output);
- **AOUT SETTINGS** – setting up an analog output when the PS-150(4K) Signal Transducer is connected;
- **ROPE OD** – is used for DN-130 with two calibration tables to choose the required one;
- **SENSOR 4-20 OUT** – configuration of the DN-130(A) modification of sensor.

8.2. Setting of TONGS TORQUE Parameter

	HOOK LOAD WOB MUD PRESS.IN DRILLING TONGS H. TONGS
--	---

	TONGS TORQUE TONG LINEPULL AKB TORQUE TONGS TORQUE2 TONGS TORQUE3
Setup of the required settings is described below	TONGS TORQUE, lbf*ft MAX 25.000 FACTOR 000.9200 SET ZERO 0.0000 UNITS lbf*ft AIN SETTINGS AOUT SETTINGS ROPE OD

- **MAX** – the maximum value that is required for activating alarm and relay output. Alarm is activated when 95% of this value is reached. When 100% is reached, the assigned relay of the blocking unit of the MU-150 / MU-150E / MK-140 (if available) will change its state (i.e. it will close or open the electrical circuit of the actuator);
- **FACTOR** – Tong Length (see Fig. 5);
- **SET ZERO** –zeroing of the parameter value by pressing



- **UNITS** – units of measurements;
- **AIN SETTINGS** – setting up an analog input (for using sensor with an analog output);
- **AOUT SETTINGS** – setting up an analog output when the PS-150(4K) Signal Transducer is connected;
- **ROPE OD** – is used for DN-130 with two calibration tables to choose the required one.

8.3. Setting of TONG LINEPULL Parameter

	HOOK LOAD WOB MUD PRESS.IN DRILLING TONGS H. TONGS
---	---

	TONGS TORQUE TONG LINEPULL AKB TORQUE TONGS TORQUE2 TONGS TORQUE3
Setup is similar to the previous described TONGS TORQUE parameter setup	TONGS LINEPULL, tf MAX 10.000 SET ZERO 0.0000 AIN SETTINGS ROPE OD

9. Drawworks Blocking Test from the Menu



ATTENTION!!! The blocking test must be carried out only during the equipment technical inspection. An unauthorized shutdown or activation of drawworks must be excluded.

Make sure that the blocking cable is connected properly to the MU-150 / MU-150E / MK-140 unit of the DEL-150 System and perform the following procedure:

	BIND PARAMETERS OPERATING PARAM'S COPY ARCHIVE CONNECTED SENSORS SYSTEM STATUS SYSTEM SETTINGS
	SENSORS INDICATORS BLOCKERS
	BLOCKERS STATUS BLOCKER[D] [080] -- BLOCKER[R] [081] C5 BLOCKER[P] [082] --
When the blocking is triggered alarm is activated and the assigned relay of the MU-150 / MU-150E / MK-140 blocking unit	BLOCKER CHECK POLL STOPPED... BLOCKER ON

(if available) changes its state. At the same time polling of all devices is disabled during the blocking test.	
When checking is completed the polling resumes. Exit to the main menu	BLOCKER CHECK POLL STOPPED... BLOCKER ON CHECK COMPLETED

The blockers status has the following agenda:

“--” – no excess;
 “C” – alarm is activated (95% of the MAX value is reached);
 “Б” – first relay of the MU-150 / MU-150E / MK-140 blocking unit changes its state (100% of the MAX value is reached)

10. Drawworks Blocking Test on the Rig

	HOOK LOAD WOB MUD PRESS.IN DRILLING TONGS H. TONGS
Set MAX to some value that is possible to achieve during the test. Load the travelling block to exceed MAX value. Both alarm and the assigned relay of the MU-150 / MU-150E / MK-140 blocking unit (if available) must be triggered. Release load from the travelling block. Return MAX to the required value	HOOK LOAD, tf MAX 010.000 FACTOR 06.00 TB WEIGHT 000.006 AIN SETTINGS AOUT SETTINGS ROPE OD SENSOR 4-20 OUT

11. 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 may cause loss of communication with the sensor 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 sensor or Control Module, it is necessary to check the equipment technical condition according to the Clause #7 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.

12. Maintenance Procedure

Maintenance is carried out in the following order:

1. Cleaning the sensor's housing 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

13. 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.

14. Marking and Packaging

The DN-130's nameplate includes the following components (see Fig.13):

1. Trademark or name of the 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.

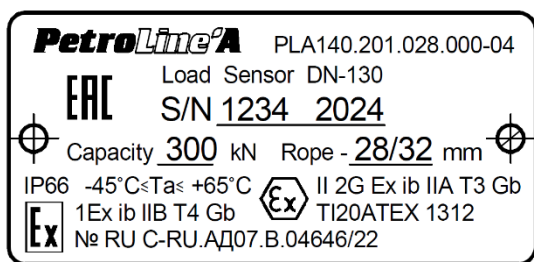


Figure 13. Example of the DN-130 marking

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 DN-130 as part of the DEL-150 System.

15. List of Components

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

16. Repair

Repair of the DN-130 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

17. Storage

The equipment requires careful handling, storage in dry, clean rooms with a constant temperature from -50°C to +65°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

18. Transportation

Transportation of the equipment is allowed by all types of closed transport. The DN-130 in a package for transportation allows the impact of transport shaking with an acceleration of 30 m/s² with a frequency of 100 beats per minute or 1500 beats with that acceleration.

19. Disposal

The DN-130 is disposed of in accordance with the requirements and norms applicable in the oil and gas industry.

20. 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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