DYNAMOGRAPH «SIDDOS-automat 3M»

OPERATION MANUAL

Russia
2019

CONTENTS

1. OVERVIEW

Dynamograph “SIDDOS-automat 3M” is a complex of electronic devices and application software that provides automation of the dynamogram control process, primary study processing and database maintenance.

Testing process is conducted in an automatic mode. All the research types require no more than one operator (two operators at use of the gauge without the lifting mechanism). Graphs and numeric data of the studies are visualized using an external terminal (smartphone/tablet/well pad data collection modem).

The devices are explosion-proof designed (type of protection - intrinsically safe circuit) in accordance with the requirements of GOST 31610.0-2014 (IEC 60079-0:2011), GOST 31610.11-2014 (IEC 60079-11.), GOST 31610:2011), and have **1Ex ib IIB T3 Gb X** explosion proof mark. The devices are intended for indoor and outdoor installation in potentially explosive gas atmosphere where atmospheric explosives of IIA, IIB categories and T1, T2, T3 groups can form according to GOST R IEC 60079-20-1-2011 in the operating temperature range from -40 ºC to +50 ºC. The device design is comply with the assigned explosion proof mark, with the requirements of GOST IEC 60079-14-2013 and other regulatory documents governing the use of electrical equipment in hazardous areas.

The recommended interval between device calibration test is 1 year. To check the device transmission characteristics for compliance with the requirements of technical specification and to reduce the device to the technical specification the device is recommended to be calibrated at the dynamograph control stand after the calibration period has expired.

2. BASIC SPECIFICATIONS

Parameter name	Norm on specifications
Explosion proof mark according to GOST 31610.0-2014 (IEC 60079-0:2011)	1Ex ib IIB T3 Gb X
IP degree of protection according to GOST 14254-2015	up to IP54
Load monitoring range	0 ÷ 10 000 kgf
Displacement monitoring range	0,5 ÷ 9,999 mm
Available pump speed of the sucker rod pump horsehead	1.5 ÷ 15 SPM
Load monitoring resolution	10 kgf
Displacement monitoring resolution	50 mm
Time of continuous operation (1-2 measures per 24 hours), up to	720 h.
Weight, not exceed	3,2 kg
Service life	5 years

3. COMPONENTS AND DELIVERY SET

3.1. Basic set

Item	Quantity	Note
1. SIDDOS-automat 3M gauge	1	
2. Load cell kit	1	See more variants in 3.2.
3. AC adapter	1	
4. Charge cable	1	
5. Bag for the dynamograph	1	
6. Load cell supporting plate	2	
7. «DB SIAM» and/or SiamService software	1	
8. Operating documentation:		
8.1. SIDDOS-automat 3M. Certificate	1	
8.2. SIDDOS-automat 3M. Operation manual	1	
8.3. DB SIAM/SiamService software user's guide	1	
8.4. Sucker rod pumping unit diagnostic with the use of dynamograph "SIDDOS". Dynamometry manual	1	

3.2 Load cell kit

3.2.1 Version of dynamograph with DN-10M gauge (dynamograph with built-in jacks)

Item	Quantity	Note
1. Load cell DN-10M with expanded jacks	1	
2. Ratchet handle wrench for the expanded jacks	1	
3. Spare parts and accessories		
3.1. Shim	1	
3.2. Bottom jack housing	1	
3.3. Left jack spring	1	
3.4. Right jack spring	1	

4. SAFE OPERATION GUIDELINES

4.1 General Provisions (regulatory framework)

- The design of the wellhead equipment is to be approved by the Russian Technical Surveillance Agency (RTSA).
- Preparation of the well for tests should be conducted in accordance with the requirements of the current Manual and internal guidelines for maintaining and testing wells approved by the head of the company.
- Test equipment is to be operated according to the operating instructions supplied with the equipment.
- Measures to ensure safety are regulated by labor protection instructions for respective types of work approved by the Company's Department of Labour Protection and the Safety Regulations in Oil and Gas Industry approved by the RTSA.

4.1.1 Requirements to Personnel

- Well tests are to be carried out by individuals above 18 who have secondary education and who are medically cleared for work.
- Qualification requirements to the personnel:
  - not below category 5 for oil and gas production operators;
  - not below category 4 for well test operators.
- The personnel must attend professional training in accordance with the requirements of local instructions on well operation, organization and study conduction. The professional stuff must also study Safety rules in the oil and gas industry (by Federal Environmental, Industrial and Nuclear Supervision Service of Russia, - Federal Rules and Regulations (FNP) №101); Operational Code for Electrical Installations (PUE), Chap. 7.3 "Electric installations in hazardous areas"; Regulations for Technical Maintenance (PTE) and safety regulations PTB, Chap. 3.2.

"Electrical installations in hazardous areas". The personnel is required to pass the relevant examinations.

- Personnel must participate in on-the-job training session on research equipment operation. The training session is given by the manufacturing company.
- The personnel quantity to operate the dynamograph is about 1-2 people.

4.1.2 Requirements to the test object

- Researches are carried out on producing wells equipped with bottomhole rod pumps of any type and any design with drive from a sucker rod pumping unit of SKN series according to GOST 5866-56, SK according to GOST 5866-76, SKD according to OST 26-16-08-87 of all standard sizes, and similar foreign production.

- Column of rods of any length and configuration should end with polished rod with diameter 19 - 36 mm.

- Packing of the polished rod should be made by sealing SUS1 or SUS2.

- The connection between the rod and the sucker rod pumping unit should be made by polished rod carrier bar of a PCSH-type wellhead rod. When using a DN-10 load cell, the limits of the suspension configuration are shown in Figure 1.

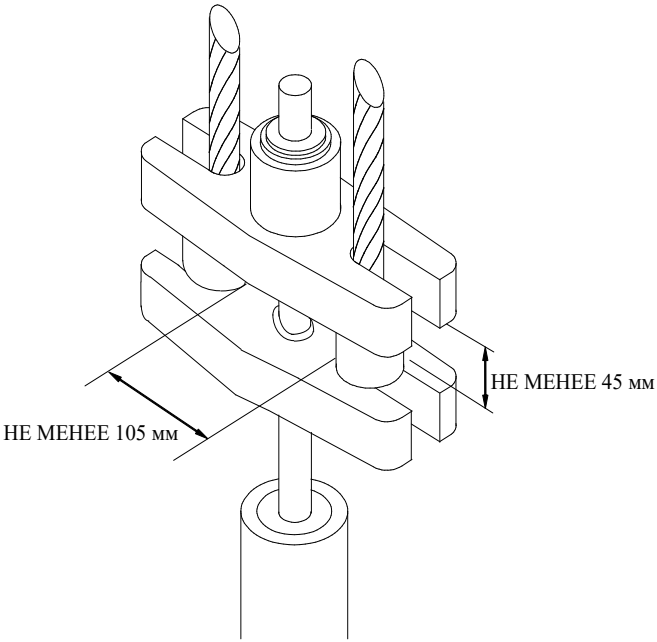


Figure 1. Carrier bar of wellhead polished rod

- Installation and operation of the sucker rod pumping unit and its electrical equipment shall be carried out in accordance with the "Regulations on Labor Safety in Oil and Gas Industry".

- The control station of the sucker rod pumping unit must have a mode switch for manual operation.

- Moving parts of the sucker rod pumping unit (crank-connecting rod mechanism, multiple V-belt drive) should have a proper standard fence.

- The SC gearbox must have a proper hand brake.

- The wellhead shall be equipped with a service platform for the wellhead polished rod packing so that the upper end of the packing is not more than 1 meter above the site, and the cable hanger cross-beams in the extreme lower position of the horsehead are not more than 1.5 meters. The distance between the lower hanger cross-beam and the cap of the head of the wellhead should be at least 20 cm. (Figure 2).

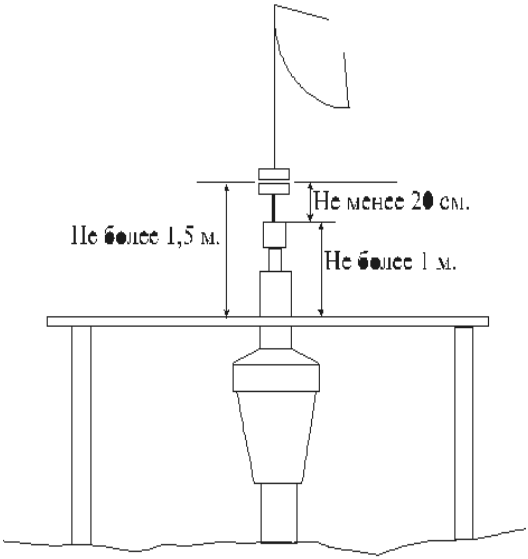


Figure 2. Wellhead equipment

- The service site must meet the requirements of the "Oil and Gas Industry Safety Regulations". The diagram of the site is shown in the picture.

- If the height of the wellhead rod packing is low (up to 2 m above the ground), portable sites may be used provided that they meet the above requirements.

4.2 Safety measures during the operation

4.2.1 Basic requirements

When preparing, conducting research, assembling and disassembling the equipment the personnel should be guided by the “Safety rules in the oil and gas industry”, Operational Code for Electrical Installations (PUE), Chap. 7.3 “Electric installations in hazardous areas”; Regulations for Technical Maintenance (PTE) and safety regulations (PTB), Chap. 3.2. "Electrical installations in hazardous areas”.

The following is prohibited:

-operation of a sucker rod pumping unit without a crank-

connecting rod mechanism and a V-belt drive;

- operating without stopping the sucker rod pumping unit;
- locating people under the sucker rod pump and its horsehead;
- turning the pulleys manually and braking them with non-standard devices (pipes, scrap, etc.);
- using of non-standard means of switching the motor on and off;
-carrying out testing on a defective handbrake of a sucker rod pumping unit;
- open fire using, smoke, use of non-explosive safety devices and equipment.

Installation of the dynamograph should be performed only from the sites intended for work with wellhead equipment.

Handle careful of all instruments of the complex. Carry and transport the parts of the complex packed in standard cases. Avoid shock loads on sensors.

Do not allow the presence of unauthorized persons at the site of the investigated well during installation of the dynamograph and measurements. It is prohibited to use non-standard installation tools and technologies.

Before mounting the dynamograph, make sure that there are no mechanical damages and make a total dynamograph function check.

If the space between cross-beams or the gauge is soiled, remove the dirt with a rag.

The attachment of the cable to the wellhead assembly must ensure that it does not collapse during start-up and operation of the sucker rod pumping unit. When dismounting, the cable is removed from the mount and, when stretched, is fed smoothly into the dynamograph reeling.

Start and stop of the sucker rod pumping unit is performed according to the operating instructions of the sucker rod pumping unit.

During assembly, disassembly and operation, do not stand in front of the dynamometer or place vehicles or other equipment in the danger area. Operators and equipment must be located sideways on the windward side

of the well.

4.2.2 Preparation of surface facilities

Check the availability and serviceability of the handbrake, horsehead holder, protective fences and service platform.

If the sucker rod pumping unit is operated in remote control mode or in automatic mode, switch the control to manual according to the instructions.

Hang up a sign on the starter: “Do not switch on, the operation is under way”.

Make sure that the wellhead packing has no fluid passes at any rod position.

4.3 Safe assembly for the dynamograph

- Stop and brake the sucker rod pumping unit at the lower position of the rod.
- Align the gauge jacks so that they can fit freely between the cross-beams.
- Place the gauge in the cross-beam space with the jack screws towards the balancer. Fasten the gauge with a safety chain to the cable hanger elements. The jack's lower supports should rest on the lower cross-beam in the entire plane. If the beam has an uneven surface, a steel gasket of appropriate thickness and configuration must be used.
- Align the gauge with the cross-beam and polished rod in two directions:
  - the pier axis of the jack must match the longitudinal axis of the top beam;
  - the polished rod should be positioned symmetrically with respect to the jacks.
  - Using the jacks, with the handle wrench, lift the top beam over the thrust sleeve, successively twisting one or the other jack

until the wedges are completely brought together. As a result, the upper crosshead should rise above the hanger thrust sleeve and transfer the entire load to the gauge prism. It must be ensured that the upper beam only transfers the load to the gauge prisms and does not come into contact with the jack housing. A gap of at least 2 mm between the beam and the jack housing should remain.

4.4 The procedure of safe disassembly of the dynamograph

- Stop the sucker rod pumping unit in the lower position.
- Switch off the device if it is on.
- Release the dynamo by successively loosening the jacks.
- Unscrew the safety chain, remove the dynamo from the cross-beam space, clean the dirt and place the device in the transport box.

4.5. Scheduled maintenance and repair work

In case of malfunctions, please contact the manufacturer of the complex or specialized organizations that have a certificate for repair work from the manufacturer. Disassembly of the dynamograph and other products of the complex leads to the loss of warranty.

- It is forbidden to disassemble the dynamograph and other elements of the complex and perform repair work on the well.

- It is prohibited to charge the dynamograph batteries with a non-standard charger. Charge the batteries in accordance with the operating instructions of the complex with careful following its requirements.

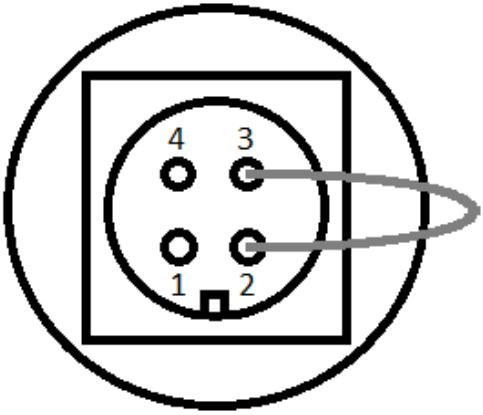
- The charger is powered by AC 220V, 50Hz industrial AC power, so take general precautions: do not plug the charger into faulty electrical outlets, do not use extension cords, and do not leave turned on devices unattended.

- Do not heavily pollute the gauges, especially the jacks and measurement pyramids built into them. Remove the dirt with a rag. Gasoline may be used with subsequent lubrication of coupling screws.

- Check the condition of the fastening screws of the dynamograph at regular intervals. When loosening, tighten them and secure with paint.

- Do not allow dirt or sand to enter the connectors of the dynamogaph. If dirty, flush the connectors with ethyl alcohol or alcohol-gasoline mixture (9 parts alcohol, 1 part gasoline) using a brush. Alcohol consumption - 100g per month of operation. After washing it is recommended to apply a small amount of CYATIM GOST6267-80 grease to the connectors surface.

- At critical hang-up of the device and absence of any reaction from it the device could be restarted forcibly by closing 2 and 3 contacts of the connector with a metal object (a paper clip/piece of a wire) as shown in the figure:



Front view of the connector. Short circuit 2 and 3 for the forced restart.

4.6. Storage and transportation

Please store the tool in its standard bag in dry heated rooms with the – 10°C to + 40°C temperature range and moisture content of 80% and below. While storing the tool, check the battery voltage every 2 months (Section 6.13).

The tool can be transported using any type of transport at the – 40°C to + 50°C temperature range.

5. ENSURING EXPLOSION-PROOFNESS OF THE PRODUCT.

5.1. Explosion-proofness of the product

Explosion-proofness of the device is provided by the type of protection "intrinsically safe electric circuit" “ib” level, according to the requirements of GOST 31610.11-2014 (IEC 60079-11:2011), which is achieved by the following:

Basic circuit diagram includes the protective component “Fib”. The protective component “Fib” is an intact spark protection unit with the short-circuit current limitation at 0.07 A (maximum), using current limiting resistors and semiconductor fuses in series. Double redundancy is used in the “Fib” protective component to ensure greater reliability. The “Fib” component is integrated into the battery compartment of the device. The design of the protective component “Fib” is met with the requirements of GOST 31610.11-2014 (IEC 60079-11:2011), including leakages and clearances. The minimum width of conductors on the PCB is 0.2 mm, copper thickness is not less than 18 μm. Thus, the electrical circuit coming out of the battery compartment of the device is intrinsically safe.

The electrical circuit principal and applied third party components provide maximum power consumption not more than 1.5 W from the internal battery with maximum possible voltage on it 7.2 V. The total maximum capacity of the electrical circuit is 20 μF, maximum inductance is not more than 200 μGn. The maximum current in the circuit during normal operation is not more than 200 mA.

The battery has special made contacts which exclude the possibility of its incorrect switching on (polarity reversal) and is located in the internal battery compartment of the device. The design of the battery compartment ensures that the battery does not fall out of the device. Do not replace the battery and do not charge it in the hazardous area. For this reason, in order to inform the user about special conditions of use of the device, the identification plate of the device is marked with an "X" sign indicating special conditions of safe operation.

The maximum temperature of overheating of components and connections in the circuit diagram during normal operation is 15 °C max. Thus, the surface temperature of conductors and elements during operation and at maximum operating temperature plus 50 ° C is not more than 65 ° C. Device enclosures are made with the degree of protection against external influences not lower than IP54 according to GOST 14254-2015.

5.2. Measures to ensure and keep the device explosion-proofness during the assembly, disassembly and repair of the dynamograph.

5.2.1 Measures to ensure explosion-proofness before the production process:

- The elements used in the protective component of “Fib” are subjected to an acceptance test:
  - resistors are tested for their nominal resistance;
  - the fuses are checked against the short-circuit current limit;
- Materials used for casting the protective component “Fib” are subjected to an acceptance test according to the certificates presented.

5.2.2 Measures to ensure explosion-proofness during production:

- The protective component “Fib” with the installed battery is subjected to an outgoing inspection:
  - the short-circuit current and open circuit voltage at the output of the protective component are checked;
  - visual inspection of the filling location is carried out in order to confirm the absence of any foreign inclusions, bubbles, cracks or stratification.

5.2.3 Measures to ensure explosion-proofness during operation:

- Check that the cover of the battery compartment and the compartment itself (including the threaded connection) are free from mechanical damage and corrosion. In case of corrosion or mechanical damage, do not operate the device;

- meet the requirements specified by the "X" sign in the explosion proof mark (see item 1.3.2 of TU 4273-004-20690774-2018).

5.2.4 Measures to ensure explosion-proofness during repair:

- the device must be repaired only by the employees of the manufacturer.

Repair by third parties or individuals is prohibited.

- the protective component “Fib” is not to be repaired. It is made intact and must be replaced in case of failure. Repair of the “Fib” component is not permitted.

- after repair, the device must be tested according to the test procedure, with the “Fib” component tested for short-circuit current and open-circuit voltage (together with the battery installed).

6. GENERAL INFORMATION ON THE TOOL

6.1 Design and use of dynamograph components

Dynamograph "SIDDOS-automat 3" (hereinafter a dynamograph) designed for integrated control of sucker rod pumping units (SGNU). It provides automatic control of dynamograms such as "load - position of the rod" in operating condition and when the well is start up, as well as valves test in static condition. The special feature is the monoblock design of the dynamograph. The design allows to exclude the connecting cable, which increases the efficiency and safety of the test.

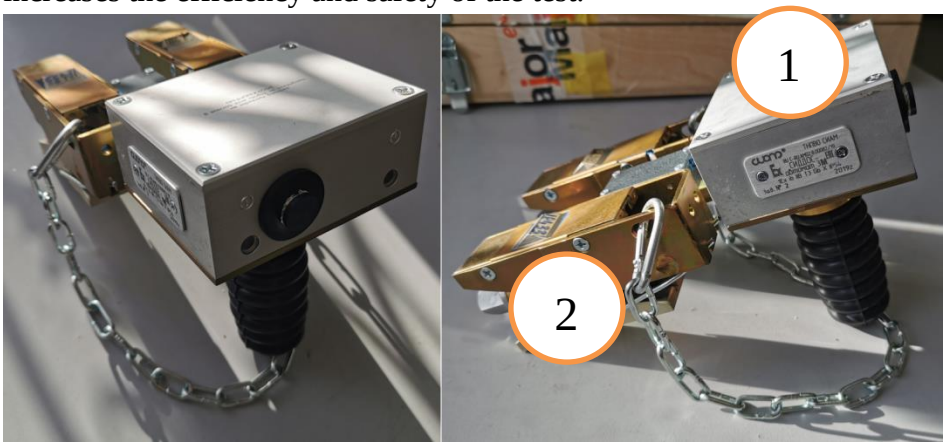


Figure 3 - Appearance of the gauge

The dinamograph consists of two modules: an electronic unit and a load cell. The electronic block (1) is a microprocessor-based controller that sets the algorithm of the complex, receives and processes data from the displacement cell and load cell (2), and provides communication with external devices wirelessly. The electronic block is connected to the cross-beam load cell.

6.2 Dynamograph operating principle

The dynamograph operating principle is to simultaneously record the change in time of load on the polished rod and its displacement at different operating modes of the rocking machine.

In the dynamograph the type of test "DYNAMOGRAM" is implemented - recording the dependence of load-position of the rod.

All the tests are conducted in automatic mode. The research parameters are set by the operator. They can be changed at any time using the external terminal software depending on the purpose of the test. The last parameter setting is saved each time, thus simplifying the algorithm of operating strictly on the well as much as possible.

All test results are memorized in the terminal software. They can be viewed and transferred to a PC at any time.

Batteries are used as power cells to ensure long operating time. The dynamograph monitors their status and is equipped with an integrated charging controller.

7. DYNAMOGRAPH OPERATION DESCRIPTION

The dinamograph is equipped with two indicators. The indicator "Charging" shows the status of the device battery: battery is charged (green), battery is empty (red), battery is charging (orange).

The "Power" indicator shows the status of the device: the device is in operating mode (green), measurement is performed (flashing or burning red), measurement error (flashing red after finishing deleting the dynamograph).

A connector on the front panel is provided for charging the device battery.

7.1 Switching on and switching off

The dynamograph is switched on remotely by detecting the device via Bluetooth channel and connecting to it.

The device is switched off automatically after 3 minutes of inactivity.

Automatic shutdown also occurs when the battery voltage drops to 3.2 volts.

7.2 Work with the gauges in the "SIAM Service" applied software.

Before starting work on the terminal, the software must be installed. The installation method is specified in p.3 of the software user's manual

You need to enable the Bluetooth communication module on the terminal according to the instruction on specific device (phone/tablet).

Gauges with the installed Bluetooth 4 module are constantly in low-power mode and are activated remotely when the operator is connected.

The operation process of the Bluetooth 4 gauge is the same as that of a conventional gauge, except for the absence of a power-off button on the case and the associated functionality.

The sensor connection process is described in Section 4 of the "SiamService" User Manual.

In the "Device search" menu there is a "Bluetooth" icon (see Fig.4), by pressing it the process of Bluetooth 4 device search is started.

In the list you should find "SIDDOS-automat 3M" device.

When you press on the found device the connection is set (see Fig.5), and if the connection is successful the device appears in the "Available devices" menu.

When clicking on the device in the list "Available devices" it should appear in the "Control panel" tab.

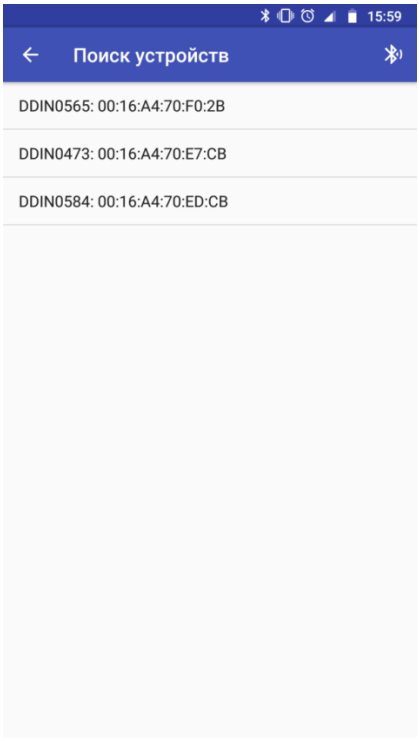


Figure 4

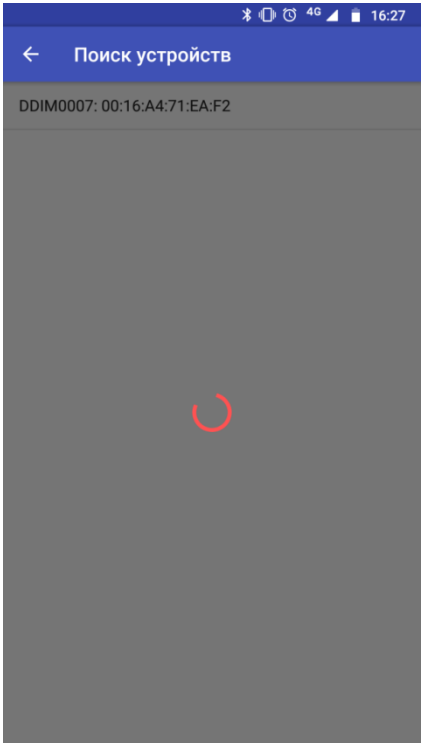


Figure 5

Go to the “Control panel” tab, in wich the connected sensor is to be displayed. The sensor window should show the data being updated, indicating that the sensor has been successfully connected to the terminal (see Figure 6).

(see Figure 6).

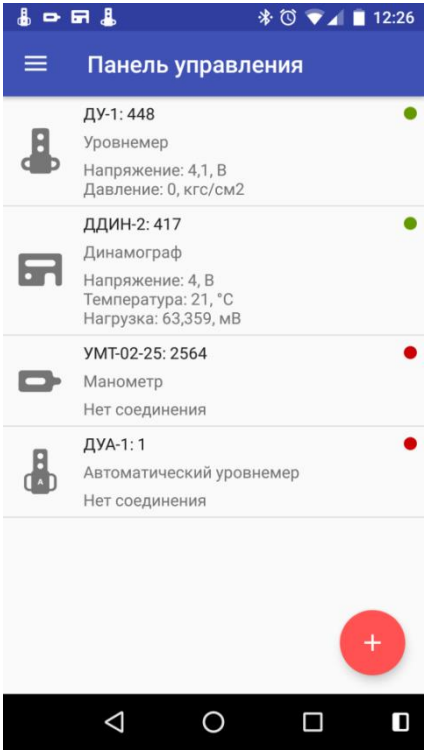


Figure 6. Gauge list

In the “Help” tab check the availability of information about the field to be measured. If the information about the field is absent, enter it manually.

To measure the dynamogram click to the sensor in the “Control Panel”. The window for sensor and examination parameters adjustment will be opened.

After filling all the available fields, click on the checkbox and the device will enter the measurement mode according to the set parameters.

At the end of the measurement, the “Measurement” window will open with the presentation of the dynamogram graph.

7.3 Battery charge

If the battery voltage drops to 3.2V, it must be recharged. If necessary, it can also be charged when the battery voltage exceeds 4V.

The dinamograph has a built-in battery charger, which provides optimal charging mode and prolongs the battery life. The battery is automatically fully discharged before recharging to ensure maximum battery life and eliminates the need for cycling.

Battery charging time (not including pre-discharge time) is 4 hours.

The battery should only be charged at positive temperatures. Charging of the accumulator at temperatures below 0C leads to accelerated destruction of its constituents.

To charge the battery, switch off the dynamograph and connect it to the 220V, 50Hz mains adapter or to the car's +12V on-board mains adapter. In either case, the power connection is made via the interface connector on the dynamograph.

8. DEVICE STORAGE AND TRANSPORTATION

Average service life of the device is 5 years long.

The warranty period of storage is 6 months from the date of manufacture of the device, the warranty period of operation is 12 months from the date of putting the device into operation. Storage time of the device in storage for 6 months before the start of operation, subject to storage, is not included in the warranty period.

The device should be stored in a standard bag in dry heated premises, at the temperatures from -10 to +40 °C and moisture less than 80%.

Product transportation is allowed in a standard bag by any type of transport at the temperature from -50 to +50 °C.

Severe shock and vibration are to be avoided during transportation.

When storing the device, a monthly check of installed accumulator voltage shall be done at least monthly and charged when needed. Charging shall only be done at positive temperatures!

9. CLAIM INFORMATION

If the device malfunctions during the warranty period, the consumer must draw up an act indicating the signs of faults. Act indicating the exact address of the consumer should be sent to the manufacturer.

КОМПАНИЯ СИАМ

LIMITED LIABILITY COMPANY
TOMSK SCIENTIFIC INDUSTRIAL
INTRODUCTION COMPANY SIAM

Address: 3 Belaya Str.,
Tomsk, 634003, Russian Federation;
Tel.: (3822) 65-38-80
Fax: (3822) 65-97-97
E-mail: siamoil@siamoil.ru
Web-address: http://www.siamoil.ru

For repair and maintenance of products manufactured by TSIIC "SIAM" LLC please contact the service centers of the company:

1. Service center in Neftejugansk, Tyumen region
   106 Microrayon 11B,
   Neftejugansk, 628305, Tyumen region, Russian Federation;
   tel.: (34632) 3-44-69; +7912-812-95-73.
2. Service center in Strezhevoy Office, Tomsk region
   2 Promyshlennaya Str.,
   Strezhevoy, 636785, Tomsk region, Russian Federation
   tel.: (38259) 6-34-90; +7913-829-98-46.
3. Service center in Otradny, Samara region
   36 Sovetskaya Str., office 10,
   Otradny, 446300, Samara region, Russian Federation

tel.: +7917-013-21-74.

4. Service center in Almetyevsk, Tatarstan Republic
   7a Bazovaya Str,
   Almetyevsk, 423450, Tatarstan Republic, Russian Federation;
   tel.: (3822) 65-58-80; 45-021.
5. Service center in Tomsk
   3 Belaya Str.,
   Tomsk, 634003, Russian Federation.
   tel.: (3822) 90-00-08; 20-02.

Name, date	Claim	Measures taken

REVISION RECORD SHEET

Revi-sion	Numbers of sheets (pages)				Total sheets (pages) of document	Ref # of docu-ment	Incoming # of sup-porting document	Signa-ture	Date
	Revised	Replaced	New	Annulled					