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"SIAM" COMPANY THANKS YOU FOR THE PURCHASING OF THE LEVEL GAUGE "SUDOS-AUTOMAT 2" AND ASKS YOU TO FOLLOW THESE BASIC REQUIREMENTS WHILE OPERATING IT:

- The level gauge is an electronic microcontroller-operated tool provided with an internal battery cell, display, keyboard, storage and other tools.

While operating it, try to avoid impacts, strong vibration, attack by acids, alkalis and strong solvents. Do not put the tool into liquid!

- Before turning on the level gauge for the first time, as well as after it's storing for a long time, firstly, charge the battery cell, and just after that, turn on the tool. It is always necessary to charge the battery cell until it is fully charged. It is not allowed to interrupt the charging process, as well as to charge the cell at ambient temperatures of below zero, because it causes the untimely failure of the tool!
- This type of level gauge can transfer information to a personal computer (PC) or a visual monitoring unit of BVK series on the base of a pocket PC. In order to avoid errors and information losses, when transferring the data to these tools, read attentively and strictly follow the operational requirements of corresponding software products and tools. Pay attention to the version of the installed software. This tool operates in combination with "DB **SIAM**" of a V2.0-version and higher ones.
- When tightening the tool on a gauge nipple of a well X-mas tree, it is necessary to use clips on the body.
- Do not rotate the gauge body and valve when the pressure in the operating body of the tool is excessive! After the level gauge has been installed, it is recommended to turn the body and valve in a comfortable position, and only then to open a X-mas tree valve. The neglect of this requirement sharply reduces the lifetime of rotating seals.
- **When using the level gauge, fulfill the requirements of Section "Maintenance" of this manual! Do not allow internal parts of the tool especially the acoustic transducer, valve and jointing taper thread to become too dirty, because it causes the worsening of the tool's operation and reduction of its lifetime.**
- **The level gauge can be repaired only by a service department of the "SIAM" company or by certified specialists. Unsanctioned break-down of the tool and violation of operating rules cause the forfeiture of warranty responsibility!**

1. GENERAL DATA ON THE TOOL

The "SUDOS-automat 2" level gauge (further called "level gauge") is intended for prompt monitoring of the fluid level in oil producing wells. The level gauge provides the monitoring of a static and dynamic level, recording of fluid level decline and level recovery curves as well as automatic recording of gas pressure in the annulus at the wellhead. The level gauge can be used to observe the fluid level while operating wells, as well as while putting them into operation after their workover or shutdown.

2. BASIC TECHNICAL CHARACTERISTICS

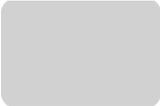
1. Range of monitored levels	65-9800 (19 685)* f t / 20-6000 m
- monitoring resolution	3.2 ft / 1 m
2. Range of monitored pressures	(0-1422) psi / (0-100) bar
- monitoring resolution	1psi / 0.1 bar
3. Maximum pressure of electromagnetic valve activation, not more than	725 psi / 50 bar
4. Off-line storage capacity	
- for symbol reports	3008
- for graphs	310
5. Time of continuous operation under normal conditions and after the battery cell has been fully charged, not less than	7 hours
6. Number of measurements with electromagnetic valve after the battery cell has been fully charged under normal conditions	250
7. Time of charging of a discharged battery cell	10 hours
8. Operating range of temperature	-40 F to + 122 F / -40°C to +50°C
9. Service life	5 years
10. Weight, not more than	15.41 lb / 7 kg

*-Option



3. COMPONENTS AND DELIVERY SET

Please refer to the list of components of a delivery set in certificate supplied with every tool (It can vary depending on the purchase order).



4. SAFE OPERATION INSTRUCTIONS

4.1. GENERAL PROVISIONS (NORMATIVE CODES)

- The construction of the wellhead equipment should correspond to the scheme approved by the State municipal engineering supervision bodies¹.
- Preparation of a well for tests and carrying out of the tests should be performed in accordance with the requirements of the Instruction and internal well servicing and tests instructions approved by the head of your company.
- Test equipment should be operated according to the operating manual delivered with the equipment by the manufacturing company.
- Safety measures are regulated by instructions of labor protection for appropriate types of work, approved by the labor protection department of the enterprise and by "Safety regulations for the oil and gas industry" approved by the State municipal engineering supervision body of Russia¹.

4.2. REQUIREMENTS TO THE PERSONNEL

- Only people who are 18 years and older, who have a secondary or higher education and are in health conditions allowing them to work in this area are permitted to carry out well test.
- The personnel should be professionally trained, examined and have a special permission to conduct the works according to the job specifications.
- The personnel should be trained to operate on the test equipment. The training is performed by personnel of the manufacturing company directly or by authorized representative of **SIAM** Company directly on the working place.

4.3. TEST OBJECT

Such tests as pressure measuring and fluid level monitoring are carried out on oil and gas producing wells of different operation types (flowing, gas-lift, artificial lift and other), as well as on injection, water-intake, monitor and other wells.

¹ Only in The Russian Federation

4.3.1. Requirements to the test object

- Construction and operation of a well should be performed in accordance with "Safety rules in the oil and gas industry".
- All Tested well, irrespective of its application and operation mode, should have a technological tap equipped with a valve and a wave metering tool seating nipple. A fluid level determination is possible only in that space of the well (tubular, tubular annulus, hole annulus, string annulus) which connects with the operating technological tap. While carrying out the measurements, there should not be any neckings (connections, dosimeters and similar tools) in the tap. The nipple of the technological tap should have the pipe taper thread of 60, 2" size, "male" or "female" type. The nipple of the technological tap should be placed at the height of 3.3 - 5.9 ft above the ground. When the nipple is at the height of more than 5.9 ft above the ground, it is necessary to use stationary or portable platforms if they are appropriate to the "Safety regulations for the oil and gas industry". The nipple which is not being used at the moment should be blanked off.
- In the way of an acoustic pulse, not more than two bends of the tubing at the angle of 90° and at the distance of 65.6 ft away from the nipple are admissible.

4.4. EQUIPMENT ASSEMBLY AND DISASSEMBLY SEQUENCE

ATTENTION! It is prohibited to stay opposite the direction of the annular space output while preparing tests, gauge operation, assembling/disassembling and adjustment of the tool.

4.4.1. Surface equipment preparation

- Make sure that the valve of the technological tap and a pressure gauge are in running order.
- Check that the pressure in the well tested annulus is in the range of maximum permissible pressure of the tool.
- Remove the end cap from the technological nipple. Clean the taper thread from sludge, oil, sand and etc. Check the compliance of the thread with the requirements mentioned above. In cases when a thread type does not comply with the requirements, as well as if there is an undue wear, massive corrosion or damages of the nipple's thread, carrying out tests is prohibited.
- Clean the inner space of the nipple from paraffin, hydrates, ice and other.
- If the nipple of the technological tap is "male" type assembles the level gauge directly. If nipple is a "female" type use adapting pipe for assembly.

4.4.2. The level gauge assembly sequence

- Clean the thread part of a coupling of the level gauge from sludge and check it. If there is an undue wear, massive corrosion or damages of the thread, the assembly of the level gauge is not permitted.

- Open the valve in the technological tap for a while (for 1-2 sec.) in order to blow it through (to clean it from condensate, ice, sludge and other plugs). Close the valve.
- Install the level gauge screwing it on as far as it will go on the nipple and turn it tight in order to avoid a displacement of the level gauge when it is under pressure. A tightening torque should be not less than 285 ± 43 psi. To tighten the thread, use the clips on the thread coupling of the level gauge and a wrench for adapting pipe from a tool set.

·ATTENTION! When tightening, it is prohibited to use impact tools and the rotating body of the level gauge as a lever.

- Turn the outlet valve of the gauge in such a way that the gas escape hole is not towards you.
- Check whether the nut of the level gauge's outlet valve is tightened well, if not, turn it tight.
- Turn the tool's body with the display and keyboard in a position comfortable for access and observation.

·ATTENTION! It is allowed to rotate the rotating body and valve only if there is no pressure in the working body of the level gauge.

- Lift off the front panel cover and set up the tool in a pressure monitoring mode.
- Gradually, not causing a pneumatic or hydraulic impact, open a gate valve until gas starts entering the level gauge. Stop the gate valve opening for a while in order to smooth the pressure in the well and in the tool's working body, and, then, open the gate valve completely. A pressure smoothing process should be controlled with the tool's display in pressure monitoring mode.
- In order to avoid a thread joint gas leakage, use thread sealing lubrication or a sealing tape.

4.4.3. Level gauge disassembly

- Turn off the tool.
- Close the gate valve of the technological tap.
- Open an outlet valve of the tool and let the excessive pressure out of the working body.
- Screw out the level gauge and take it off the nipple. Drain the working body of the condensate, clean a thread part and house the tool in its bag.
- Place the end cap on the nipple.

5. ARRANGEMENT AND OPERATION OF THE TOOL

5.1. GENERAL INFORMATION

The SUDOS-automat 2 level gauge is a compact electronic mono-unit tool. It is a completely independent tool and provides all functional abilities of a well level gauge. The tool is capable to display all basic monitoring parameters and results immediately.

The level gauge maintains the data export to a PC or viewing unit of BVK series. An applied software DB "SIAM" included in the delivery set, makes it possible to create and add computer data bases, to process and analyze measurement results in more detail.

5.2. ARRANGEMENT, APPLICATION AND OPERATION OF COMPONENTS

5.2.1. SUDOS- automat 2 level gauge

The level gauge is intended to generate acoustic pulses in the annulus, to receive and convert an acoustic response (an acoustic signal), as well as to determine the fluid level and to monitor pressure at the well head. The tool operates according to its internal program controlled with a built-in microprocessor controller which synchronizes the operation of all the components, processes the data transferred from primary transducers, performs a level calculation, displays the operation modes and monitoring results on a digital display, as well as it registers measurement parameters and results in its fixed storage, and ensures a communication with external devices (a computer and a visual monitoring unit).

When using the exhaust receiver from the level gauge kit, it is required to take into consideration that the working pressure of the receiver must not exceed the maximum operating pressure of the electromagnetic valve shut.

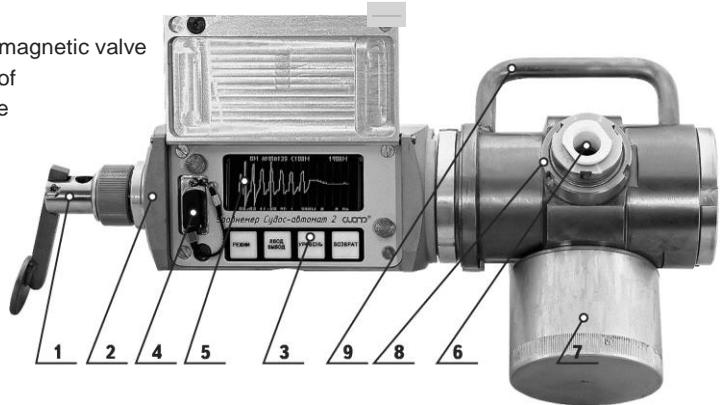
When annulus pressure is around 20 atm. and more, it is required to screw the exhaust receiver, equipped with sealing ring, into the nozzle in order to guarantee the shut of electromagnetic valve.

In order to monitor the level of liquid, the level gauge has to be set up directly on the control socket of the fountain armature and doesn't require any control wires.

Control unit and indicator, along with electromagnet, the control unit of electromagnetic valve and the mounting clip are set on the rotary body. The body can rotate around its long axis within the 270 degrees angle relatively to the screw connecting muff. Manual valve can rotate around its long axis with no limits.

Attention! Make sure that there is no pressure in the level gauge operating capacity before to set the receiver up or rotate the tool body or manual valve.

- 1 – the rotary removable manual valve
- 2 – body of tool
- 3 - keyboard
- 4 - connector for external devices (network adapter, wire to charge the tool from the car on-board electrical network, computer, BVK)
- 5 - OLED display
- 6 – nozzle of electromagnetic valve
- 7 – the control unit of electromagnetic valve
- 8 – screw nut to fix the rotary nozzle
- 9 - mounting clip



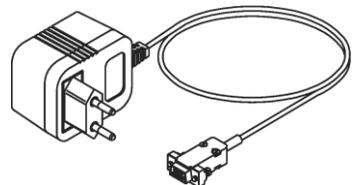
The level gauge operates on a built-in battery cell with a life resource of not less than 1000 "charge-discharge" cycles. To charge the cell, in the level gauge there is a built-in programm controlled charging device allowing to service the battery cell correctly.

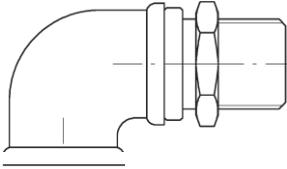
When monitoring the fluid level, the level gauge is installed directly on a gauge nipple of the well Christmas tree, and measuring cables are not required. The control and display units are placed on the rotating body and have a protective cover. The body with the valve and control and display units can be positioned conveniently by rotating it about its longitudinal axis in any direction and at any angle (up to 360°). The outlet valve can also be rotated freely about its longitudinal axis in order to fix an outlet hole in a position not towards an operator.

ATTENTION! It is allowed to rotate the body and the outlet valve only if there is no excessive pressure in the working body of the level gauge.

5.2.2. Power adapter

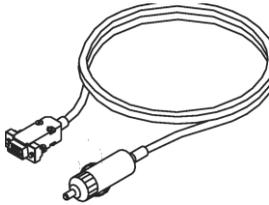
The power adapter is intended to power a charging device built in the level gauge. When charging a battery cell, the power adapter is connected to an industrial supply line of 220V/50Herz, and its plug is plugged in the auxiliary slot of the level gauge. The adapter ensures appropriate parameters of charging when the line voltage is from 190V up to 240V. At the current load of not less than 300 mA., its outlet d.c. voltage is 12V with spikes of not higher than 1V.





5.2.3. Rotating nozzle

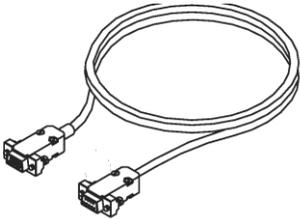
The rotating nozzle is intended to turn gas outlet during electromagnetic valve activation to the safe side from the operator. The rotating nozzle is twisted in the electromagnetic valve nozzle and fixed by the screw nut in selected direction.



5.2.4. Car cable

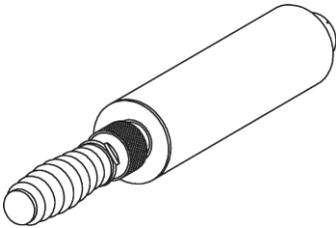
A cable makes it possible to charge the level gauge with a fixed voltage of 12V up to 27V from the car power supply under the field conditions.

ATTENTION! The battery cell's temperature should be in the range of + 30 F up to +86 F.



5.2.5. Interface cable

The interface cable IBM PC is intended to connect the level gauge to a computer and to transfer data from the tool to a computer data base.



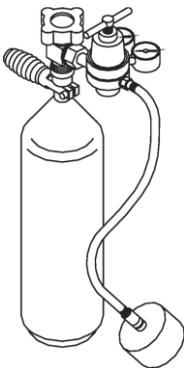
5.2.6. Additional accessories

Acoustic pulse generator GAI-01

The acoustic pulses generator GAI-01 is used to generate the acoustic effect when there is no excessive pressure in the well's annulus. The GAI-01 may also be used to monitor the fluid level down up to 5905 - 8202 ft. when the annular pressure is rather low. The GAI-01 has a reservoir for accumulating the excessive air pressure (a receiver), a hand pump, a transportation lock and a valve for quick draining off which are integrated into one body. Spare rings for the GAI-01 are placed into unscrewed handle of GAI-01.

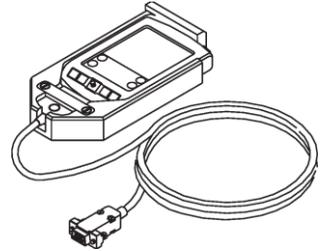
- GB0-01 Gas Cylinder Set

GB0-01 Gas Cylinder Set is used primarily for recording of a level recovery curve (or when well is starting up) in the automatic curve without operator's involvement in case there is no or very low (up to 29-43.5 psi) annular gas pressure. GB0-01 Gas Cylinder Set includes: a cylinder with nitrogen (2134 psi), a reducer which allows to regulate output pressure up to 217 .5 psi, a connection hose with quick-release coupling and a receiver which is installed on the level gauge outlet hole.



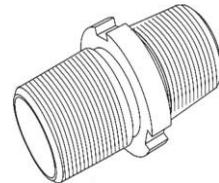
- Visual monitoring unit BVK

The BVK is used to visually monitor measurement results in tabular as well as in graphic form, to determine the level more accurately using acoustic signals graphs, to record these data in its storage and then to transfer them to the computer database. While doing so it is still possible to collect measurement results in the level gauge itself and then to transfer them to the computer. The BVK is manufactured on the base of an up-to-date Palm PC and is housed in an impact-resistant body. The BVK is connected to the level gauge by means of cable. The acoustic signal graph is displayed exactly at the moment of carrying out the measurement.



, Adapting pipe

Adapting pipe is used to connect the nipple of the technological tap of "female" type with the level gauge of "female" type.



Exhaust receiver

Exhaust receiver is intended to guarantee the electromagnetic valve shut when the annulus pressure is around 20 atm. and more. Receiver has to be set up on the outlet nozzle of the electromagnetic valve (threaded coupling) and during the exhaust the annulus gas leaves the well through the constantly open outlet hole of receiver (by analogy with silencer).

While the level gauge is operating, the outlet hole of exhaust receiver is constantly open. The screwing of receiver into the nozzle has to be done manually up to the stop, with no usage of instruments. It is required to make sure that there is no pressure in the receiver before dismantling it. If during the dismantling process, the big efforts have to be applied, it is possible to use wrenches, which fit to the sides of the connecting pipe (from the nozzle side).

Attention! Before to set the receiver up - make sure there are no foreign objects inside it. In case of scurf -clean the inner surface of the tool with little amount of diesel fuel or kerosene and dry the receiver.

Recorded results, including full echograms of signal, can be transferred to the Block of visual control (BVK) or to the computer database.

5.3. LEVEL GAUGE OPERATION

5.3.1. Function

When monitoring the fluid level, a wave metering method is used. The operation process is rendered automatically. An operator takes part only in acoustic pulse generation with the help of either the outlet valve of the level gauge or additional devices (such as GAI-01).

An acoustic pulse passes through the well annulus from the level gauge to the fluid level and back with a velocity depending on the physical and chemical conditions of gas. The tool monitors an acoustic signal during 20 seconds, amplifies it and records it in its storage. Simultaneously the gas pressure in the annulus is also determined and recorded in the storage. While analyzing and processing the recorded data, the fluid level in the well is determined, then shown on the display, and automatically stored in a nonvolatile memory of the tool as a symbol report. Recorded results including a complete echo gram of the acoustic signal can be transferred to a visual monitoring unit or a computer database.

When calculating the fluid level, the tool automatically selects an acoustic pulse velocity according to one of the sound velocity tables recorded in it. The number of the correction table is selected by the operator. In addition to it, it is possible not to use the tables, but to set a sound velocity (irrespective of pressure and level) manually using the keyboard.

According to our experience, the sound velocity in wells can greatly vary even within one and the same field. Therefore, it is highly recommended to use your (applied for your region) correction table for an individual field or a group of wells within the field. In any case, the tool will display a level based only on the sound velocity that has been set in it! (For more details please see Supplement 2).

The tool analyses the level of all signals including noise signals, as well as it evaluates a degree of an interference effect, and, when it is necessary, automatically activates (or deactivates) a program filter of interference suppression.

5.3.2. Control and display units

The control and display units are the following: a symbol display of operation modes, parameters and measurement results and a four-key keyboard.

The display is used to show the tool's operation modes, to control the input of initial parameters (reference data) of a test, to monitor the test in progress and to display basic numerical results of the test.

The four-key keyboard provides an input (a change) of necessary parameters, input of operator's commands, control of all the operation modes including both a mode of the

independent operation of the tool and a mode of its communication with peripherals. A general view, layout and notation of the keyboard's keys are shown in the picture.

The functional duties of the keys are described in more detail in the next section.

5.3.3. Basic functions of the keys



B MODE key makes it possible to
 Turn on the tool.
 Consecutively look through (in a closed cycle) the operation modes.
 Consecutively look through a number of flashing (changeable) digit place position on the digital display when entering (or changing) parameters.



INPUT/OUTPUT key makes it possible to
 Turn on the tool.
 Change a value of a set parameter step-by-step (cycling) looking through the provided alternatives. The set parameter (being changed) is displayed as a flashing sign. This means that a parameter may be entered.



LEVEL key makes it possible to
 Turn on the tool.
 Starts a fluid level measuring process.
 Change any tool mode from back to the initial one by consecutive pressing the LEVEL and MODE keys (move back/ reset).
 Turn the tool off by consecutively pressing the LEVEL and INPUT/OUTPUT keys.



BACK This special service key is used as a prefix key. It changes direction of the operation of the MODE and INPUT/OUTPUT keys (only if the BACK key is pressed at that moment). The BACK key significantly simplifies the procedures of selection of a required digit when setting a well and a well cluster number and other parameters, as well as it makes it possible to correct a mistaken keystroke.

5.3.4. Operation modes of the tool

GENERAL NOTES

- In this section the operation modes and their symbol display are described. They are presented in the same order as they are initiated when pressing the MODE key several times.
- All parameters mentioned in this section (a number of well and well cluster, test parameters) can be set in any order irrespective of each other and they are stored in the tool's storage automatically (even if the tool is turned off) until they are changed.
- Word records made to the set parameters are automatically recorded in a symbol report of each measurement and, then, they can be read in all records (including when transferring data to a stationary computer, etc.).
- In order to save time when carrying out the work directly on a well, it is recommended to set necessary parameters beforehand.

MODES DESCRIPTION

1. The measurement of the pressure and the battery voltage.

Indication of time and date

The device starts operating in this mode immediately after switching on. Example:

BATT. VOLT. 7.52 V
PRESSURE 10.6 BAR
12:20:26
24/09/09

1. Battery voltage - 7.52 volts
2. Pressure - 10.6 Bar
3. Current time - 12 h. 20 min. 26 sec.
4. Current date - 24 September 2009

2. Indication and setting up the number of well, cluster and field

In order to change the number press <<INPUT /OUTPUT>> button – the six bits of the well number start flashing. Using <<MODE>> button, choose what to correct: the well number, the well cluster number or the field number. Then press «INPUT/OUTPUT» button. The high-order digit starts flashing. Correct the necessary value by the consecutively pressing of <<INPUT/OUTPUT >> button.

Pressing <<MODE>> button you can choose next digit or digits of number of the well/cluster to correct. All correction is stored into the tool memory automatically.



There is a possibility to put the (this letters will be in English Sudos?) letters from the Cyrillic alphabet as the last two bits (may be "digit" will be more appropriate word?) in the number of well and the well cluster. The maximum quantity of places for the well number is 6 bits, for the well cluster number - 5 bits, for the field number - 3 bits. Example:

WELL	4 3 2 1 0 4
CLUSTER	5 2 8 1 4
FIELD	0 0 3

1. Number of well-432104
2. Number of cluster – 52814
3. Number of field -003

3. Type of survey. Automatic valve. The period of impulse.

This mode makes it possible to indicate and choose the type of survey. In the tool the following conditional abbreviations of the types of survey are taken:

- (measuring or detection) of static level (STAT.)
- determination of dynamic level (DYN.)
- recording of the curve of the level build-up (BU.)
- recording of the curve of the level decreasing (DD.)
- automatic registration of the gas pressure (GPC.)

In order to choose the type of survey press <<INPUT/OUTPUT>> button consecutively. In the example the determination of dynamic level is chosen and the automatic valve mode is set off.

SYRVEY	DYN
AUTOMAT	NO

In order to switch the automatic valve mode on, press "MODE" button to have the flashing "NO" in the line "AUTOMAT". Then press "INPUT/OUTPUT" button to select "YES". The window of survey will be as follows:

SYRVEY	DYN
AUTOMAT	YES
DURATION	0.20

The period of impulse (0.05 or 0.20 sec.), generated by electromagnetic valve, is to be set in the line "Period". In the example, period of impulse 0.20 seconds is set.

4. Period and quantity of surveys.

This mode is active for the automatic registration of pressure (GPC) only. In the window of tool it is possible to initiate and set up the time intervals (in minutes) for the tool's operation when automatically recording annulus pressure.

The possible alternatives are: 1, 2, 3, 4, 5, 7, 10, 15, 20, 30, 40, 60, 90, 120, 180, 240, 300, 420, 600, 720. Time interval is selected by consecutive pressing of «INPUT/OUTPUT» key. In the same window it is possible to initiate and set up the quantity of measurements. The possible alternatives are: "-", 1, 2, 3, 4, 5, 7, 10, 15, 20, 30, 40, 50, 70, 100, 150, 200, 300, 400, 500, 600, 700, 800, 900. Symbol "-" displays the infinitive quantity of measurements. In this case the level gauge operates in the automatic mode until the operator switches the tool to the Mode STAT. or DYN. or until the battery cell is discharged. Example:

```

SURVEY.  GPC
PERIOD    720
MES.Q-TY. 900
    
```

1. Type of survey -GPC
2. Time interval-720 min.
3. Quantity of measurements -900

5. Time interval. (The mode is active for BU and DD surveys only.) In the window of the type of survey it is possible to initiate and set up the number of the corrected interval, period and quantity of measurements for the BU and DD modes. Maximum quantity of intervals to correct – 5. Possible variants for the time period and quantity of measurements are the same as for the GPC mode and are described in item 4 "Period and Quantity of surveys", (except the 1 min. tool's operation interval), and also it is allowed to set "O" for the quantity of measurements (except the first interval). If the quantity of measurements is set as "O" - the current and the all next intervals will not be processed.

```

SURVEY.  GPC
AUTO     YES
DURATION
0.2
    
```

1. Type of survey -GPC
2. Automatic valve -yes
3. Automatic valve operation interval- 0.2 sec.
4. Number of corrected interval -1
4. Operation interval-10 min.
5. Quantity of measurements –20

6. Jump to GPC. Data Transfer. (Mode is active for BU and DD modes only and when the automatic valve mode is on). Window of this mode appears after the window of type of survey in the case "MODE" key is pressed. Jump to GPC – it is a mode to automatically change the operation mode from BU or DD to the mode of the automatic pressure registration (GPC) in the case the liquid level is lower than 50 meters and the quantity of reflections is more than 8. If "YES" is set – change of the type of survey is allowed, if "NO" is set – the change is forbidden.

If the "Transfer of data" mode is on – it is allowed to transfer to the computer the data on the measurements, after operation in the BU or DD modes.

In the example – "Jump to GPC" is set on and the transfer of the data is set off.

GPC MODE WHEN

LEVEL < SO M	YES
TRANSFER	NO

7. Indication and setting up the number of the table of corrections and sonic velocity

This mode makes it possible to indicate and choose the number of the working table for the sonic velocity. The factory basic version contains three alternatives.

0 – there is no table at all (sonic velocity has to be set manually)

1 – there is a table appropriate for Siberian region (Supplement 3)

2 – there is a table appropriate for Tatarstan region (Supplement 3)

In addition to it, using computer and database «SIAM»>, it is possible to create and install to device any of four user tables (for details see Supplement 2). The user table (from the already installed in the tool), is selected by pressing "INPUT/OUTPUT" button consecutively.

Example: the operating table №1 is chosen.

ACOUSTIC SPEED

TABLE	1
-------	---

When the mode 0 is chosen, the manual input of the sonic velocity is activated. Indicator shows the previously set velocity of sound (in m/s). Setting up of the required velocity is to be done in the same way as in the case with setting up the number of well or well cluster. The velocity range, available for manual input, is from 200 to 499 m/s.

Example: the sonic velocity is 330 m/s

ACOUSTIC SPEED

TABLE FIXED	330 M/S
-------------	---------

8. Gas outlet and additional gain

This mode makes it possible to change the level determination program in the case of the gas outlet from well (working with outlet valve) "GAS OUTLET YES" or the gas inlet into the well (working with GAI) "GAS OUTLET NO". To work on the wells where there is no pressure at all (working with GAI), use the "INPUT" button to set the mode "GAS OUTLET NO". When setting on the new well or on the new well cluster, the mode "GAS OUTLET YES" is automatically set ON. Also in this window the additional gain is shown. The additional gain is used if reflection of the acoustic signal is low. To switch the additional gain on, press "Input" button when parameters "ADD. GAIN" is active to set it YES. When setting on the new well or on the new well cluster, the mode "ADD. GAIN NO" is automatically set on. In the example the gas outlet mode is set on and additional gain is off.

GAS OUTLET	YES
ADD.GAIN	NO

9. Storage capacity and storage cleaning

The vacant storage capacity left to record the measurements results is indicated on two counters. The first counter shows free storage for the symbol reports (RECORD №) (numerical parameters and the level control results), and keeps decrementing by one with every new measurement. The second counter shows free storage for the graphs of measurements (ECHOGRAM №) and also keeps decrementing by one with every new measurement. Example: memory is enough to record 3008 symbol reports and 310 graphs.

RECORD	3008
ECHOGRAM	310
CLEAR MEMORY	NO

The total capacity of the storage is adequate for 3008 symbol reports and 310 graphs. Counters return to the initial storage capacity when they are initialized or data are transferred to computer.

The storage cleaning and the time and date setting modes are described in Supplement 8.

10. Indication and setting up the operator number, workshop number, the pressure sensor cleaning, the correction of seconds.

In order to examine and to set number of operator -press "MODE" button several times to jump to the window of the operator and workshop number.

OPERATOR	1 04
WORKSHOP	5 28
Z.PRES.	-10.6 A
	1 2:20:26

In the example: operator number 104 and workshop number 528 have been recorded. In order to change a number - press "INPUT/OUTPUT" button. Three digits of the operator number start flashing. Using "MODE" button choose what to correct: the number of operator or the number of workshop. Then press "INPUT/OUTPUT" button. High-order digit starts flashing. Correct it to the required value by the consecutive pressing of "INPUT/OUTPUT" button.

In order to zero seconds - keep pressing of "MODE" button until the digits of seconds start flashing. Then press "INPUT/OUTPUT" button – seconds drop to zero. It is required to zero seconds if you want to synchronize tool with external devices such as computer or the Block of visual control (BVK).

This mode makes it possible to correct the deviation from zero of the pressure gauge and is designed to compensate a possible temporary fluctuation from zero. It is also intended to adapt the pressure gauge to different temperature conditions. In this mode a correction, taking into account when a deviation from zero occurs, is recorded in the tool's storage. The correction automatically allows the determination of the actual pressure value when further measurements are carried out.

Setting the pressure gauge at zero can only be conducted under the influence of atmospheric pressure (zero excessive pressure) on the level gauge. If the level gauge has already been installed at the well head, the annular gate valve should be closed. The outlet valve should be open when setting the pressure gauge's level at zero.

Turn on the tool to set the pressure gauge at zero. Then, activate additional modes (as described above).

The last digit places show the correction value taken into account (in this case, added) if any measurement for the determination of the actual pressure value is conducted.

In the example the correction equals 125 psi. Press the INPUT/OUTPUT key. In this case, a new deviation correction will be saved in the tool's storage, and the pressure readings will be set at zero in the pressure monitoring mode.

The saved correction is stored in the tool's storage (even when initialization is carried out) until another deviation correction is saved during the next zero correction.

The first digit places show the zero deviation correction of the amplitude of an echogram. In the example the correction equals 7 units. The correction is calculated automatically according to the echogram of the previous level determination.

11. Battery cell

This mode makes it possible to indicate outer power, the battery cell's voltage and time of its discharging in a previous cycle of its charging.

EXT.POWER NO
DISCH.TIME 12:43
BATT.VOLT 7.5V

For charging battery just connect power adapter to device and 220 v. Charging starts automatically. For best using of the battery before charging battery will discharging. Af ter 3 second of start process discharging-charging display will turn of f.

When you turn on deviceyou will see follow:

DISCHARGE
REMAIN TIME 12:43
BATT.VOLT 7.5 V
EXT VOLTAGE 15.0 V

Af ter discharging automatically will start charging:

CHARGE
REMAIN TIME 9:43
BATT.VOLT 7.5 V
EXT VOLTAGE 15.0 V

In the example the voltage 7.5 Volts and the time of discharge 12 hours 43 minutes are indicated. Display will turn of f after 3 second. If "Mode" button will be pressed then display will turn on and information about progress of charging will shows. If "Mode" button will be pressed one more time then shows next message:

STOP CHARGING
PROCESS ?
NO

If you press "Input" button NOwillchanges to YES andcharging willstopped.

You could use outer power for device for long time working. In this case you should change parameter "**EXT.POWER NO**" to "**YES**". In this case when power adapter will connected, You will see:

FOR B A T . C H A R G E
P R E S S I N P U T
B A T T . V O L T 7.5 V
E X T V O L T A G E 15.0 V

If you want start charging –press INPUTelse device will uses external power working.

12. List of measurements

In this mode up to the three measurements for the current date and well number can be shown in the title. In each line of measurements the time of measurement, quantity of reflections and the measured level of liquid are indicated. Pressing "INPUT/OUTPUT" button - jump to the next measurement. Pressing BACK and "INPUT/OUTPUT" button simultaneously - jump to the previous measurement. Symbol > indicates the cursor. Pressing "MODE" button activates the graph of measurement, marked with cursor.

```

26 / 09 WELL 678943
 16 : 51 L 2 1027 F
> 16 : 53 L 2 1030 F

```

In the example the measurements are shown for date the 26th of September and number of well 678943. The measurement, marked with cursor, has been carried out at 16:53, the measured fluid level was 1030 meters and 2 reflections have been determined. The previous measurement had been carried out at 16:51, the fluid level was 1027 meters and 2 reflections had been determined.

13. The echogram visualization. Work in this mode is described in Supplement 7.

On the indicator the digit position of the right symbol depends on the level of acoustic noise: then the level of noise is higher then more to the right the symbol is shifted. While pause, on indicator there is a line "Analyze of the noise amplitude". As soon as two symbols (/) appear on the screen - push to the end the handle of the manual valve in order to generate acoustic impulse.

In the 5 seconds time the level gauge will switch off and will start operating in automatic mode, switching on in the period of time, previously set for the first interval. After the level gauge carries out the quantity of measurements, set for the first interval, the tool starts switching on with the time period, set for the second interval and so on until the fifth period is completed or quantity of measurements is 0.

After the level of liquid is determined, the tool shows the level and quantity of measurements during 3 seconds, and then switches off.

In order to save the storage capacity and the battery cell energy, it is recommended to set interval for the tool's operation from 30 to 90 mins., quantity of measurements 9, 15.

In order to save the battery cell energy and the recourse of valve, for operation in BU and DD modes it is recommended to set up the intervals as follows:

First interval - interval for the tool's operation 5 mins., quantity of measurements 10.

Second interval - interval for the tool's operation 10 mins., quantity of measurements 20.

Third interval - interval for the tool's operation 30 mins., quantity of measurements 20.

Fourth interval - interval for the tool's operation 60 mins., quantity of measurements 20.

Fifth interval - interval for the tool's operation 180 mins., quantity of measurements 7.

If the "Jump to GPC" is allowed, tool automatically changes the operation mode from BU or DD to the mode of the automatic pressure registration (GPC) in the case the level of liquid is lower than 50 meters and the quantity of reflections is more than 8.

If the battery cell is deeply discharged, the tool automatically changes operation mode to mode of the automatic pressure registration (GPC).

After the jump to GPC mode, the tool uses the settings for GPC mode in order to select the interval for tool's operation and quantity of measurements.

14. Cancel of the GPC, BU and DD modes

In the GPC, BU, DD modes it's possible to switch the level gauge on, to look through operating modes of the tool, to carry out the control measurement of level by means of electromagnetic valve, to transfer data to computer and BVK. To do any of those things – press "MODE" key to switch level gauge on. On the indicator there will appear name of automatic mode: GPC, DD, or BU. For example

BU 4:51

Here: 4:51 (min:sec) - time, left for the automatic valve shut. If then, during 3 seconds any key is not pressed or the "ENTER" key is pressed – level gauge switches off and keeps operating in the automatic mode. If then the "MODE" key is pressed – level gauge goes to the mode of the annulus pressure measurement. After the tuning is over – level gauge can be switched off in the usual way or it switches off automatically in 100 seconds after the pressing of any key. Then level gauge keeps operating in automatic mode. While tool is operating in automatic mode, the measurement, planned to be carried out in the exactly set time, has the higher priority for execution. So, 2 minutes before the automatic measurement, (in the case "LEVEL" key is pressed), on the indicator there will appear the following line:

BU 0:51

Here: 0:51 – time, left for the automatic valve shut. While the tool is operating in automatic mode, time from 75 to 0 seconds, left for the automatic valve shut, is not shown, in order to save the cell energy. Symbol "0" appears on the screen approximately 3 seconds before the shut.

In order to cancel automatic mode – select DYN or STAT modes of survey.

In addition to the general tables, up to 4 user tables, containing data on the certain wells, fields and so on, can be recorded in the memory of the tool. Numbers of the user tables can range from 10 to 63. User tables can be recorded to the memory of tool while the tool is connected to the computer and data on measurements are transferred to the database.

Work with database, including the matters how to create and use the user tables, is described in the manual "SUDOS BD-Graf" the measurements and echograms database. User Guide", which is included in the tool kit. In the user tables the velocity of sound can range from 250 to 505 m/s.

5.3.5. Turning the tool on and turning it off

ATTENTION! Before turning on the tool for the first time after it has been stored for a long time or transported, it is necessary to fully charge the battery cell. Only after having charged the battery the tool may be turned on. Otherwise, the tool cannot be switched on or it can switch off immediately after having been turned on. But this does not mean that the tool has any default.

SWITCHING ON

Pressing one of the three keys turns on the tool: MODE, INPUT/OUTPUT, LEVEL. After being turned on the tool remains in the same operation mode as it was in before turning off, if none of the keys are pressed within a period of longer than 100sec.

SWITCHING OFF

The tool can be turned off from any operation mode by pressing consecutively the keys LEVEL and INPUT/OUTPUT. To turn the tool off from the annulus pressure monitoring mode, press the key INPUT/OUTPUT.

The tool goes off automatically:

- If none of the keys are pressed within a period of longer than 100 sec.;
- If any malfunctions accompanied with displayed notes like ERROR occur (in this case the tool goes off within a 20-second period);
- If the battery cell's voltage decreases down to 6.5V.

In the latter case all the information stored in the tool are saved, but in order to prevent a full discharge of the battery cell, it is necessary to charge it (see Supplement 4).

& PREPARING FOR WELL TEST

ATTENTION! When preparing tests, assembling and disassembling equipment, please strictly follow the requirements of the Safe Operating Instruction (Section 4).

Preparation sequence for tests are given below with references to the appropriate sections of this manual:

1. Preparation of the tool for service – see Section 6.1
2. Checking of the surface equipment to be available for service (preparation for service) – see Section 4.4.1.
3. The level gauge assembly – see Section 4.4.2.
4. Setting of test parameters – see Section 5.3.4:
 - Setting of well cluster and well number, field number and test type, required parameters of the test.

6.1. PREPARATION OF THE TOOL FOR SERVICE

The procedure of preparation of the tool for service is rather simple and it involves the following operations:

1. Turn on the tool (see Section 5.3.5).
2. Check voltage of the cell and, when necessary, charge it.
4. Check current time and, when necessary, correct it.
5. Check the vacant storage capacity. If there is not enough room for results of forthcoming work and data stored in the storage are still important, it is necessary to save them by transferring them to a computer (Supplement 4) or to a visual monitoring unit (Supplement 5).
6. Turn off the tool.

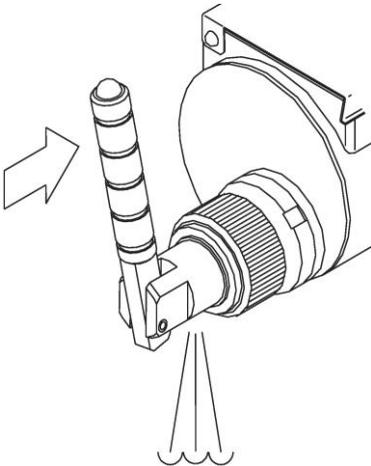
The steps mentioned above take minimal time and it is recommended to carry them out every day (every shift) before a working shift. It is highly recommended to check the battery cell's voltage beforehand in order to have time to charge it if necessary.

7. MEASURING

ATTENTION! While performing work on a well, strictly follow the requirements and provisions of the Safe operating Instruction (Section 4).

7.1. FLUID LEVEL MONITORING

Install the tool on the nipple of the technological tap (see Section 4.4.2). If the nipple of the technological tap is "male" type assemble the level gauge directly. If nipple is a "female" type use adapting pipe for assembly. After having placed the tool in a position comfortable for access to the keys and observation of the display, turn it on and set (if they have not been set beforehand) a number of a well and a well cluster, a test type and other necessary parameters.



ATTENTION!

It is prohibited to stay opposite the direction of the annular space output while preparing tests, gauge operation, assembling/ disassembling and adjustment of the tool.

When using acoustic pulse generator GAI-01, change over the level monitoring program in a position of gas inlet into the well (Mode 5).

Press the LEVEL key and wait for about one second until the stable I symbol appears on the display. It means that the tool is ready for level measuring. During this one-second pause the level gauge measures a noise level in the well and automatically determines a necessary operation threshold.

The digit place in which the I symbol is displayed depends on the noise level: the higher the noise, the more right the I symbol appears.

Generate an acoustic pulse by pushing to the limit on the handle of the tool's outlet valve. The next 20 seconds after an acoustic pulse has been generated the tool detects and records acoustic data from the well. Acoustic data detection can be observed on the display showing the signal peak level in 50 gradations (the more right the symbol moves the higher the noise level is).

For each calculation the calculated value of the fluid level, the number of reflections, test parameters and a graph are automatically recorded into the tool's storage for symbol reports

and into the 5storage for echo-gram5 combined with 5ymbol report5. Hence, 5ymbol report5 are recorded into the echogram5 5storage and are duplicated in the 5storage for 5ymbol report5.

To make the monitoring re5ult5 more reliable, it i5 highly recommended to repeat the level mea5urement. If the mea5urement re5ult5 5ignificantly differ from each other, it te5tifie5 that the tool cannot determine the fluid level automatically. Thi5 can becau5ed by different rea5OП15 (5ome of them are con5idered in Supplement 1). In thi5 and a5 well a5 in other doubtful and nece55ary ca5e5, it i5 recommended to determine the fluid level according to an acou5tic 5ignal graph. One can get an acou5tic 5ignal graph when tran5ferring mea5urement data to per5onal computer or vi5ual monitoring unit.

7.2.AUTOMATIC RECORDING OF GAS PRESSURE IN THE WELL HEAD ANNULUS

In5all the level gauge on the nipple of the technological tap (5ee Section 4.4.2).

Af ter having placed the tool in a po5ition comfortable for acce55 to the key5 and ob5ervation of the di5play, turn it on and 5et (if they have not been 5et beforehand) a number of a well and a well clu5ter, an automatic ga5 pre55ure recording te5t type (**GPC** mode) (Mode 3) and an interval of the tool'5 operation. Pre55 the LEVEL key. The di5play will 5how **START GPC**.

The level gauge 5tart5 it5 operation in 5 5econd5 and it will automatically *come on* in a 5et time period, operate during 0.2 5ec. (it mea5ure5 the pre55ure and record5 the mea5urement re5ult in the 5storage), automatically go off, and 50 on. It i5 recommended to 5elect 5uch a period of mea5urement5 50 that within a total operation period the tool make5 not more than 3008 mea5urement5.

To interrupt the **GPC** mode, 5elect the mode5 of STAT or DYN te5t type.



8. MAINTENANCE

8.1. SCHEDULE OF MAINTENANCE

The tool's maintenance (M) is subdivided into 4 groups depending on an operation interval and is presented in the table below.

Work type	M 1 Once a week	M 2 Once a month	M 3 Once in 6 months	M 4 Once in 12 months
Cleaning of the taper joining thread, the acoustic transducer, the pressure gauge, the face panel and the body	+	+	+	+
Maintenance of the outlet valve	-	+	+	+
Cleaning of the auxiliary slot for connection of peripherals	-	+	+	+
Operation monitoring ¹¹	-	-	+	+
Pressure test ¹¹	-	-	+	+
Replacement of sealing rings ¹¹	-	-	-	+
Notes: 1) maintenance work is carried out by a service center of the "SIAM" company or by certified specialists of the Company.				

8.2. MAINTENANCE PROCEDURE

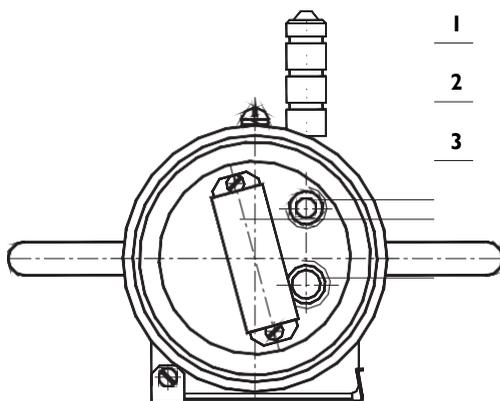
ATTENTION! When using petrol and alcohol follow the rules of fire prevention! Carry out the work only in well-ventilated rooms.

8.2.1. Cleaning of the taper joining thread, the acoustic transducer, the pressure gauge and the face panel.

When cleaning, use clean petrol, a brush and cleaning cloth. It is possible to pour out a little petrol into the inner space of the thread jointing coupling. However, do not submerge the tool body into liquid to clean it, and not allow the liquid to be spilled on the panel of the keyboard and the display, and into the auxiliary slot. When cleaning the heavily dirty thread, such metallic instruments as an awl, a screwdriver, can be used. However, while doing it, do not use force! The acoustic transducer's body is covered with protective varnish, do not damage it! It is prohibited to put any things into the hole of the pressure gauge!

After having cleaned the tool, wipe over its surface with cleaning cloth. Cleaning should result in a bright metal face panel with clean cleaning cloth slightly wetted with glass washing liquid. After that, wipe over the panel. In order to avoid scratches on the glass (the lightfilter of the display), not make great efforts while cleaning and wiping it over.

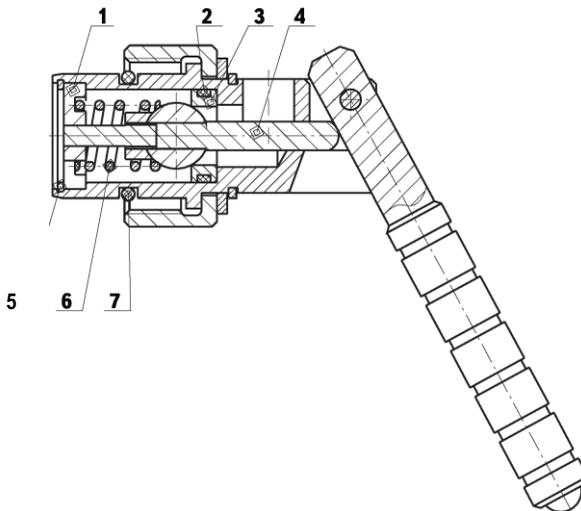
External surfaces of the tool (except of the face surface) are wiped over with clean cleaning cloth slightly wetted with petrol and then, are wiped dry.



8.2.2. Maintenance of the outlet valve

The outlet valve is cleaned with clean petrol, a brush and cleaning cloth. Before cleaning, remove the valve from the level gauge, place it into a clean reservoir and pour out a little petrol. Not taking the valve out of the reservoir, push the handle several times. Clean the external surfaces with a brush. Do not leave the valve into petrol for a long time. After washing the valve, wipe it dry with clean cleaning cloth. Before placing the valve back into the level gauge,

lubricate slightly the surface of a rubber sealing ring (7) with lubrication. After the valve has been installed into the tool, assemble the latter on a level gauge tests bench GMS-1 (gauge monitoring stand) and blow through the valve with clean air at the pressure of 71...114 psi. Test the valve for leak-proofness with soap lotion/dilution. Slight leaks indicated by formation of small air bubbles around the outlet hole is permissible. If the valve leaks more than permissible, rewash it. In case if the leak is not stopped even after the rewashing, replace the valve couple (valve tappet with ball (4) and the valve seat (3)). To do this, carefully compress the retaining ring (5) and pull it out of the valve body. Draw a guide bushing (1), a spring (6) and the valve tappet with a ball (4) out from the valve body. Take the seat (3) and the sealing ring (2) out from the valve body too.



Replace the valve couple and reassemble the valve in reverse order; while reassembling, lubricate slightly the surface of the rubber sealing ring (7) with the lubrication.

The seat has a face (bevel edge) on the outer diameter. The face is of small dimensions and, therefore, before assembling, it is necessary to determine accurately whether it is at its place. The seat should be installed in such a position that the face "looks" inside the body.

8.2.3. Cleaning of the auxiliary slot for connection of peripherals

To clean the auxiliary slot, pure ethyl alcohol or alcohol. Alcohol consumption is 30 gr. per month of operation. After cleaning, lubricate slightly the surface of the auxiliary slot with the lubrication.

8.2.4. Operation monitoring

Monitoring of basic operational parameters of the level gauge is performed only by engineers of **SIAM** Company or by its authorized representative.



9. STORING AND TRANSPORTATION OF THE TOOL

It is necessary to store the level gauge in a special package in dry heated rooms; the ambient temperature should be in the range from 14 F up to 104 F and their humidity content should be not more than 80 %.

It is permitted to transport the tool in a special package with any type of transportation when the ambient temperature is in less than -40 F or more than 122 F.

While transportation, avoid strong vibration and impacts.

When storing the tool, it is necessary to inspect the voltage of the built-in battery cell once per month and, if necessary, to charge it.

The cell charging is allowed only when the ambient temperature is above zero!

SUPPLEMENTS

SUPPLEMENT 1. LEVEL MONITORING UNDER COMPLICATED CONDITIONS

In some situations it is difficult to detect an acoustic signal reflected from the fluid level accurately and, consequently, it is difficult for the tool to render automatic determination of the fluid level reliably. Some reasons for this, recommended measurement techniques and modes and methods of result analysis are described in the given supplement.

RECOMMENDATIONS ON MEASUREMENTS UNDER COMPLICATED CONDITIONS

Factors making automatic determination of a level to be more difficult are as follows:

<p>1. A high fluid level (not deeper than 98 ft) from the wellhead makes a period of acoustic transient signal response to be shorter than the duration of the signal itself</p>	<p>A response arrives on the initial signal background, and, therefore, it is difficult to detect it.</p>
<p>2. In the well annulus there is great interference caused by too strong vibration of the tubing and casing string, vibration of an electrical submersible pump (EPS), leaks from valves and other reasons.</p>	<p>The returning acoustic signal has a lower amplitude than that of the noise level.</p>
<p>3. There is much foam in the annulus.</p>	<p>The foam absorbs the acoustic transient signal, and, therefore, it arrives at the wellhead significantly alleviated/ at a significantly lower level.</p>
<p>4. Either the valve is not open completely, or the space between the tubing string and the casing string is too narrow because of hydrate and paraffin plugs</p>	<p>The response acoustic transient signal is scattered in multiple changes of gaps.</p>
<p>5. There is a very low (less than 7 psi) or a zero excessive pressure in the annulus whereas the fluid level is at a great depth (deeper than 3281 ft)</p>	<p>The acoustic transient signal that is generated and returns is of very low amplitude.</p>

A low fluid level. It is recommended to generate an acoustic pulse of a **shorter** duration.

Strong interference. much foam. significant necking of an annulus gap. low gas pressure in the annulus. It is recommended to generate an acoustic pulse of a **longer** duration.

Very often, especially on wells equipped with an electrical submersible pump (ESP), the source of very strong interference is acoustic noise from a delivery line. In this case it is recommended to turn off the valve on the delivery side of the Christmas tree, if it does not conflict with safety requirements and the technological process of oil production. Furthermore it is necessary to place a note warning that the valve is turned off.

After measurements have been made, the valve should be turned on. It is necessary to turn on the valve in several stages in order to smooth the pressure gradually and to prevent breakdown of the pump delivery. When the valve is opened completely, take the warning note away.

Sometimes, especially on the well equipped with a back-pressure valve, the source of strong interference is acoustic noise from a back-pressure valve. In this case it is recommended to turn off the backpressure valve. After measurements have been made the valve should be turned into previous position.

SUPPLEMENT 2. SETTING OF A USER SONIC VELOCITY CORRECTION TABLE

When monitoring the fluid level, an operator can select and set a user correction table according to which the tool determines an acoustic wave velocity which is either a function of a just measured annulus pressure or a function of the pressure and the level. In addition to it, it is possible to select tables recorded in the tool's storage as well as tables transferred to the tool's storage from a computer database.

According to our data, the sound velocity in wells can greatly vary even within one and the same field. Therefore, it is highly recommended to use your (applied for your region) correction table for an individual field or a group of wells within the field. In any case, the tool will display a level basing only on the sound velocity that has been set in it!

In the fixed storage of the tool there are tables constructed according to averaged data of appropriate regions and intended for general use. They can be used only for a rough level evaluation. The tables are marked with conventional codes and titles (see Supplement 3):

Table 1 For Siberian region of Russia;

Table 2 For European region of Russia.

To evaluate tables applicability it is necessary to measure sound velocity in several active wells of the specific reservoir (at least in 3-5 % of active wells number).

Basic method of sound velocity determination in annular space is based on reference mark using. Reference mark method is realized into two steps:

- Step 1
- Step 2

Step 1. Reference mark point mounting inside the well

Reference mark - is the any kind of space heterogeneity which quite abruptly changes the annular space square area. As a rule the mandrels, protectors or some other equipment can be considered as a markers.

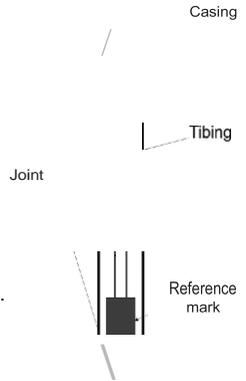


Fig. 1.Examp/e ofreference mark in we/1

Reference mark mounting can be done while tubing pullingdown. The depth of marker set must be not less than 492-656 ft below the dynamic fluid level. Some other heterogeneities in the wells can be used as additional reference marks. For example tubing diameters changes can be used as additional reference marks.

Step 2 Measurements at the wells with mounted reference marks.

Echograms processing.

Level gauge SUDOS is used to record echograms. Measured echograms processed in DB SIAM software. Main target is to identify reference marks reflections.

There two types of marker reflections are possible:

- 1) Reflection is in the same phase with the acoustic pulse and fluid level reflection. Fig.2



Fig.2. Inphase signal of ref/ection from marker.



This type of reflection can appear as a result of annular space square area reducing . For example it can happen in the following cases:

- Some thing with greater diameter than tubing diameter was used as a marker;
- Tubing diameter changes from smaller to greater size;
- Casing diameter changes from greater to smaller size;

2) Reflection is in antiphase with the acoustic pulse and fluid level reflection. Fig.3. This type of reflection can happen as a result of annular space square area increasing. As a rule it is a result of tubing diameter changing from bigger to smaller.

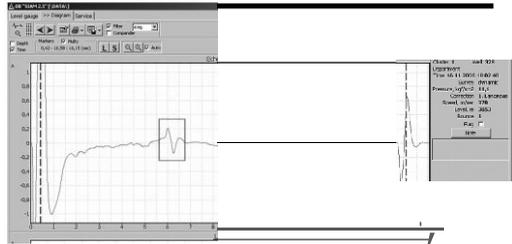


Fig.3. Reflected signal is inverted after tubing diameter changing from greater to smaller.

When echogram processed in DB SIAM v.2.5. Put left marker at the highest spike of reference mark reflection {left marker is located on the acoustic pulse spike as a default). Then please push "S" button and insert exact distance between markers (it is equal to the depth of reference mark). After this DB SIAM will automatically calculate sound velocity value and put it into exact DB field (see SIAM Database. Reference Manual version 2.5).

Results of instrumental measurements are put in a table as it is shown below.

Table1

Pressure	Sound Velocity
...	...
...	...

Pressure - Pressure in the annular space, measured by the SUDOS level gauge.
 Sound Velocity - velocity of sound.

According to the table#1 data DB SIAM generates the graph of sound velocity dependency from annular pressure. Fig.4.

It needs to plot data from table#1 and table#2 on the graph (Fig3) to estimate compliance of data from tables with the measured data.

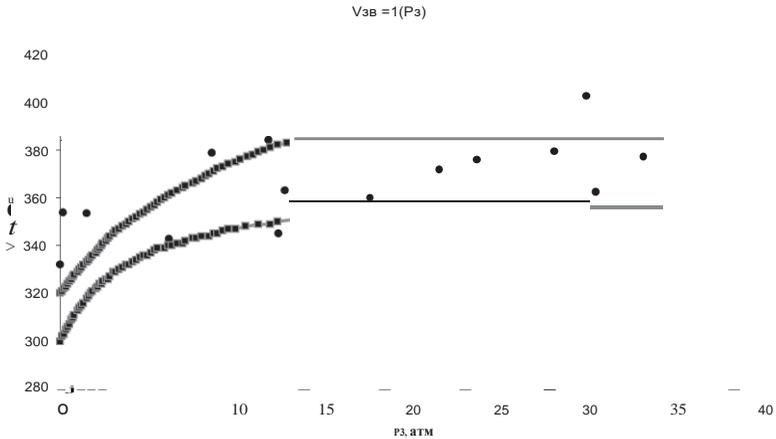


Fig. 4. Sound velocity dependency from annular space example

If differences between table data and real sound velocity values is insignificant (less than 10%), it is recommended to use the table with the nearest data to the real sound velocities values.

If both tables differs from real data (more than 10%) it needs to generate your own table of sound velocity dependency from annular space pressure.

For this, besides tables mentioned above, an on-line storage of the level gauge makes it possible to record user tables (up to 4 tables) accepted for conditions of particular oil and gas production organizations, particular oilfields, etc. A number of user tables can be from 10 to 63. User tables are recorded in the storage simultaneously with transfer of level monitoring parameters and results to a measurements and echo-grams database (the work with a database including construction and use of user tables are described in more detail in "**SIAM** Database. Reference manual version 2.5" included in the delivery set). The sound velocity in user tables can be from 820 ft/sec. up to 1657 ft/sec.

To set a user correction table, enter Mode 4 (correction (table) mode). The user table number set earlier is displayed in flashing digit places.

In order to define sound velocity correlation it is necessary to measure sound velocity at least at 50% of production oilwells of oil field at least (from the point of view of statistic reliability)

After all planned sound velocity measurements it is possible to draw the trend of nonlinear graph Fig.5.

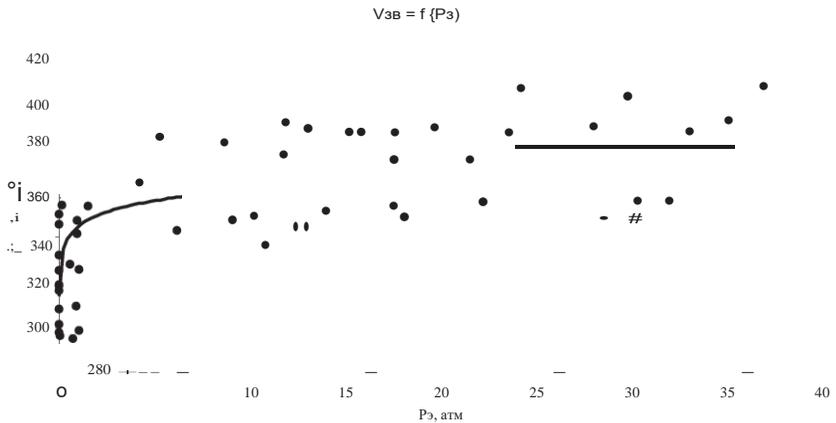


Fig. 5. Trend drawing example

According to this trend it is possible to draw the table of sound velocity correlation from annular space pressure which you can put into DB table. Fig.6. The procedure of new table transferring from DB **SIAM** to level gauges is described in "**SIAM** Database. Reference manual version 2.5".

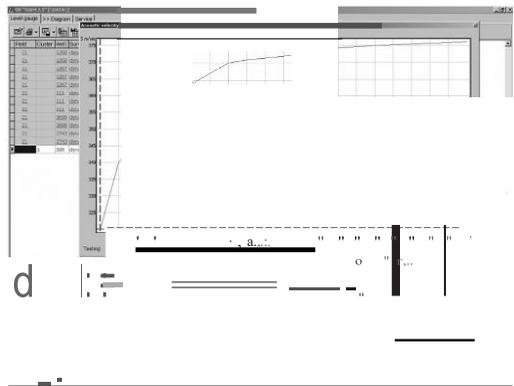


Fig. 6. Putting new data of sound velocity into DB **SIAM**

To set necessary table in the tool it needs to press the INPUT/OUTPUT key several times in the Mode 4, select a required number of the tables recorded in the tool. Then, press the MODE key, change over the tool in any operation mode required. Selected table number will remain working during all following level measurements until the next selection of a user table.

When one sets TABLE O and then presses the MODE key, the mode for manual setting of a sound velocity is activated. And the display will show a sound velocity (ft/sec.) set manually earlier.

Press the INPUT/OUTPUT key and the first digit place (hundreds) of velocity starts flashing. Change it up to the required value by pressing the INPUT/OUTPUT key several times. To pass to the next digit place of velocity, press the MODE key, and so on. After all digit places have been set, shift the tool in any operation mode required by pressing the MODE key. The velocity input is finished. The range of sound velocity set manually can vary from 600 ft/sec up to 1999 ft/sec.

The set value of a sound velocity is recorded in the tool's storage and used in all the following level measurements (irrespective of the annular pressure!) until a new sound velocity is set or another user table is selected.

**SUPPLEMENT 3. DEPENDENCE OF SOUND VELOCITY ON ANNUAL PRESSURE
(TABLES FOR GENERAL USE)**

TABLE 1

Pressure, psi	Sound velocity, ft/sec						
0	1050	29	1106	67	1161	124	1217
1	1053	30	1109	70	1165	127	1221
3	1056	31	1112	73	1168	131	1224
4	1060	33	1116	75	1171	135	1227
6	1063	34	1119	78	1175	141	1230
7	1066	37	1122	81	1178	145	1234
9	1070	38	1125	84	1181	151	1237
10	1073	40	1129	87	1184	155	1240
11	1076	43	1132	90	1188	159	1244
14	1079	44	1135	94	1190	163	1247
16	1083	47	1139	98	1194	169	1250
17	1086	50	1142	101	1198	175	1253
19	1089	53	1145	107	1201	182	1257
21	1092	56	1148	110	1204	192	1260
23	1096	58	1152	114	1207	> 208	1263
24	1099	61	1155	117	1211		
26	1102	64	1158	120	1114		

TABLE 2

Pressure, psi	Sound velocity, ft/sec	Pressure, psi	Sound velocity, ft/sec	Pressure, psi	Sound velocity, ft/sec	Pressure, psi	Sound velocity, ft/sec
0	984	29	1056	67	1102	131	1135
1	991	30	1060	70	1102	135	1139
3	994	31	1063	73	1106	141	1139
4	1001	33	1063	75	1109	149	1142
6	1004	34	1066	78	1112	159	1145
7	1007	37	1070	84	1112	169	1145
9	1014	38	1070	87	1116	175	1148
10	1017	40	1073	90	1116	192	1152
11	1020	43	1079	94	1119	199	1155
14	1027	44	1079	98	1119	213	1158
16	1030	47	1083	101	1122	242	1161
17	1034	50	1086	107	1125	285	1168
19	1037	53	1089	110	1125	370	1175
21	1043	56	1089	114	1129	484	1181
23	1047	58	1092	120	1129	683	1188
24	1050	61	1096	124	1132	853	1190
26	1053	64	1099	127	1132	1152	1194

SUPPLEMENT 4. DATA TRANSFER TO THE COMPUTER

ATTENTION! To avoid errors while transferring data to the computer, carefully read and strictly follow all the instructions given in corresponding sections of the User's Manual for the Computer Database.

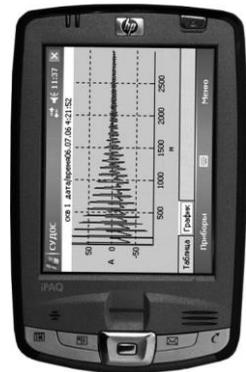
Data transfer is carried out in the following sequence of operations:

1. Turn off the level gauge (if it was on) and connect it to the computer with an interface cable.
2. Start the computer database.
3. Turn on the level gauge.
4. Start the import process to the computer database.

During the data transfer user tables are received. These tables are marked in the computer database as tables that should be exported to the tool.

SUPPLEMENT 5. VISUAL MONITORING UNIT BVK-02

The BVK (to be ordered separately) makes it possible to see measurement results in a tabular and a graphic form. The BVK can be used at the well while carrying out studies. If the BVK has been connected to the level gauge before acoustic pulse generation, the acoustic signal graph will be displayed on the screen of the visual monitoring unit immediately after measurement. The BVK also makes it possible to copy all (or selected) results of level gauge measurements into its storage. In addition to this, the BVK makes it possible to work with an acoustic signal in the mode of its magnification many times (the zoom mode) and, if necessary, the measured level value can be corrected with the help of markers.



Before using, carefully read the Operating Instructions and BVK User Manual.

SUPPLEMENT 6. THE ECHOGRAM VISUALIZATION IN THE GRAPHIC DISPLAY

- Pressing "INPUT/OUTPUT" button – jump to the previous graph.
- Pressing "BACK" and "INPUT/OUTPUT" keys together – jump to the next graph.
- Pressing "MODE" button – jump to correct the left border of the graph. With each new

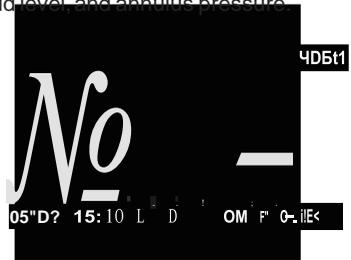
pressing of the "INPUT/OUTPUT" button, the border will be changed for approximately 150 meters (depending on the velocity of sound). Pressing "MODE" button – jump to correct the right border of the graph. Pressing "MODE" button – jump to the mode of the annulus pressure control.

While correcting, the graph borders will be displayed in numbers in the upper line. Left border – on the left side, right border – on the right side. Also in the upper line there will be shown maximum amplitude of echogram (in conventional units) and distance (in meters) between lines of the vertical grid. In the bottom line there will be shown: date of monitoring (day, month), time of monitoring (hour, minutes), quantity of reflections, liquid level, and annulus pressure.

Example:

```

OMAMPL 761 GRID 100M  657M
GRAPH
ECHOGRAM
20/03 15:36 R 27  115M D  9.5 BAR
    
```



Upper line: left border – 0 meters, maximum amplitude 761 conventional units, grid – 100 meters, right border – 657 meters.

Bottom line: date – the 20th of March, time – 15 hours 57 min., 27 reflections from the liquid level, pressure -9.5 atm.

SUPPLEMENT. SETTING OF TIME AND DATE. MEMORY INITIALIZATION

In this mode it is possible to set time, date and clean the memory of the tool.

Warning! After the memory is cleaned, it is NOT possible to recover data!

In order to save the valuable data – transfer it to the computer database before initialization of memory.

The initialization process does not change the current time and date and they can be left without correction or changed partly.

Attention! It is NOT allowed to start initialization process in the case the battery cell is discharged (indicator flashes) and also it is not allowed to turn the tool off until the initialization process is completed.

In order to clean memory – press "MODE" consequently until the window of the memory capacity and cleaning appears on the indicator. Press "INPUT/OUTPUT" button (word "NO"

starts flashing). In order to clean memory – set "YES" as it is shown in example:

RECORDS	3008
ECHOGRAMS	310
CLEAR MEMORY	YES

Then press "MODE" button. On the indicator there will appear the following window:

**FOR MEMORY ERASING
PRESS INPUT**

In order to cancel the cleaning process - press "MODE" button.

In order to clean memory -press "INPUT/OUTPUT" button. The memory cleaning process will start. After the memory is cleaned -there appears the window to correct time and date.

**1 2 : 20 : 2 6
2 4 / 0 9 / 0 8**

In order not to correct time and date -press "MODE" button. In order to correct time and date -press "INPUT/OUTPUT" button. Seconds start flashing. In order to zero seconds -press "INPUT/OUTPUT" button.

In order to correct time – press "MODE" button and then use "INPUT/OUTPUT" button to correct the flashing tens digit of hour. Then press "MODE" button to jump to the unit digit of hour and correct it in the same way. Date is changed in the same way as well.

