Quartz pressure gauges

zPas

User Manual

zPort V1.0.0.23

2021

INTRODUCTION

In searching for new Oil & Gas sources and while developing existing fields, many upstream companies that deal with exploration and production conduct surveys in extreme conditions both for the equipment and technology.

Upstream companies currently conduct oil prospecting and surveys, at conditions deemed inoperable up till now. Current surveys are being conducted at depths where both temperature and pressure are often over the limit, and well conditions are at a critical point to maintain stability of gauges and other equipment.

Due to the aforementioned issues, zPas quartz pressure gauges devote high attention to:

1. Increased upper-limit for temperature measurement.

The Quartz Technology provides high performance results at conditions where the data quality is of utmost importance. The quartz sensor provides better long-term stability and increased resolution accuracy compared to a piezoresistive sensor.

The large memory capacity of the gauge allows storing measurement data with a high sampling rate that in turn provides rich data content, and the long battery life can acquire the highly accurate data throughout all operations on formation testing.

2. The gauge is equipped with a high-resolution pressure recording module -- 0.00002 MPa (20 Pa), which allows it to record the desired signal while conducting well testing (Build-Up/Drawdown) at various conditions. Under conditions of low permeability, low porosity and high viscosity, all receiver well responses are relatively low. By utilizing pressure gauge data, it is possible to reduce the survey duration 3-5 fold. The high gauge resolution allows for a high-quality well testing.

3. The gauge is built to be resistant to corrosion and hydrogen sulphide.

Gauge Specifications

The zPas gauge is designed for autonomous logging surveys. It is equipped with a non-volatile memory and can exchange data with a computer via a mini-USB cable.

Fig. 1 Assembled Gauge

The gauge features a cylindrical body comprising a gauge head and a cap that can be connected through a thread. A probe is located at the rear part of the gauge head along with the temperature sensor that surrounds the gauge. The pressure sensor is also mounted within the gauge head, which has a dedicated channel allowing free passage of mediums to the sensor. To protect the sensor elements, a housing is provided that has holes that allow the medium to pass through

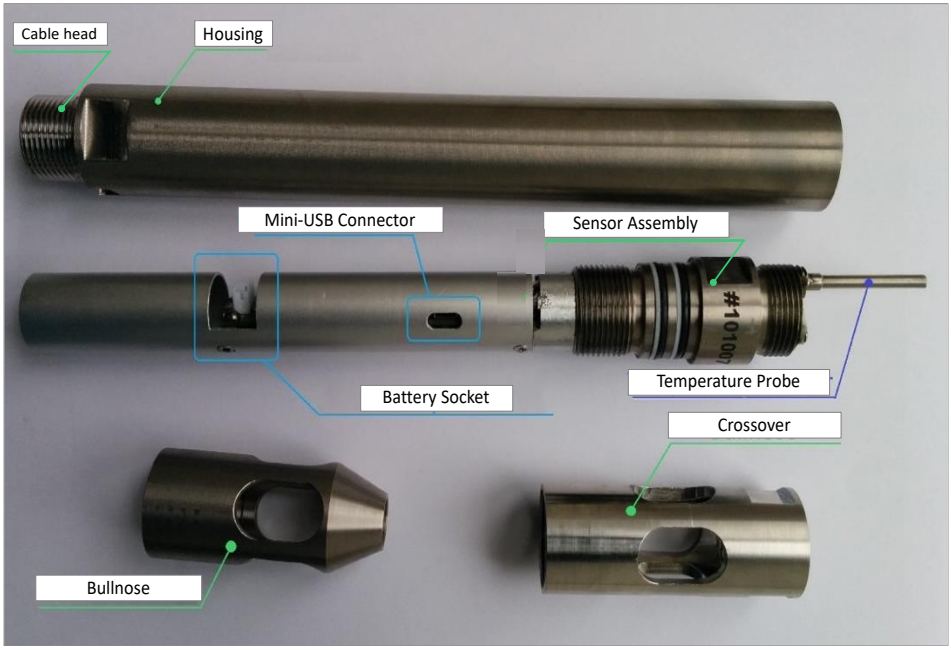

Fig. 2 Gauge Components

Both the housing and the cap are threaded and can be assembled into a logging suite.

The gauge can be controlled via an external PC using a dedicated software. In accordance with the Logging Tool security standards, the software ensures a high level of security.

The software is split into Software Unit and Gauge Unit.

1. Software Unit - **zPort**, allows to configure gauge settings, read and save gauge data. When the reading process is complete, it is possible to view the acquired data on a graph and verify its integrity.

2. Gauge Unit - is responsible for logging and saving data to non-volatile memory as well as for all communications with remote PCs. Gauge Unit software has two states: Work, Ready

During the "**Work**" state, the gauge performs logging using a preset flow pattern and saves the data to a non- volatile memory. The gauge maintains logging until either the memory or power runs out.

At the end of the logging, or after the data has been transferred, the gauge switches back to "**Ready**" state.

When the gauge is connected to a PC while in the "**Work**" state, the current logging will continue. At his point it is also possible to examine gauge status and to make sure that it is in the "**Work**" state.

Ready state is used to configure gauge for start-up and to retrieve the data from the non-volatile memory. During this state, if the gauge is disconnected from the PC - it proceeds into sleep mode. It is possible can wake it up by reconnecting it to a PC.

When the gauge is reconfigured for the start-up, the gauge will power up. All data within the non-volatile memory will be wiped out, the program recording will be initiated, and the gauge will switch to the Work state.

A program resembles a table with time intervals and a set of possible actions. Each time interval contains the state and sampling interval. If the state was set to "off", the sampling will be suspended during this interval.

Otherwise, the sampling will be performed according to the specified time interval. In total, a program may contain up to 16 entries.

The program is worked out according to the current logging survey. Utilizing the program will increase the gauge flexibility and responsiveness.

Gauge Assembly Guide

Step 1. Applying a protective lubricant

All fluids inside a well are located within a harsh environment, therefore prior to any operations with the zPas gauge, it is essential to apply a protective lubricant (“Lithium lubricant" or similar in properties) to both the pressure unit and the lubricant cup. In case the protective lubricant was already applied it must be replaced.

1.1 Before replacing the lubricant, make sure that the gauge cap is tightly screwed on to the gauge head (Fig. 3).

Fig. 3 LubricantCup

1.2 Remove the housing from the gauge head.

1.3 Remove the stop fitting from the pressure unit (this will require removing 2 mounting screws) (Fig. 4).

Fig. 4 Stop fitting with mounting screws

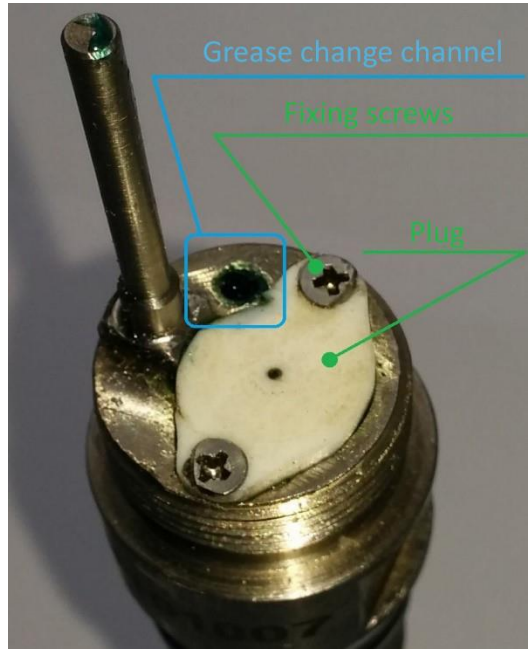

Fig. 5 Rear view of the gauge head and sensors

1.4 When filling the lubricant cup, be careful not to damage the temperature probe.

1.5 Fill the lubricant through the intake. Stop filling when "fresh" lubricant flows out from the pressure receiver.

Fig. 6 Pressure receiver with stop fitting removed fully filled with lubricant

Fig. 7 Greasing Procedure

1.6 Install the stop fitting using the mounting screws. Apply greasing once again through the intake of the lubricant cup, until it flows out from the stop fitting. The last procedure should be carried out gently to avoid damaging the stop fitting.

1.7 Remove excess lubricant using a piece of cloth

1.8 Place the housing on the gauge head

Step 2. Installation and replacement of power component (hereinafter referred to as "battery").

Replace a new battery for every survey.

2.1 Assemble a new battery by soldering (or "welding") it to the connector

2.2 Put the housing on the gauge head (if it is not already on). This will prevent damaging the thermal probe.

Fig. 8 A battery with a soldered connector.

2.3 Remove the gauge cover from the gauge head.

2.4 The battery compartment is located at the rear of the gauge head. At the front there is a connector for the battery.

2.5 Disconnect the old battery from the battery connector.

2.6 Remove the locking ring (fig. 9) with the pliers (fig.10). Do this gently, or you may lose the locking ring.

Fig. 9 Locking ring pliers

Fig. 10 Plastic cap and locking ring

2.7 Remove the battery and plastic cap (by removing the locking ring):

The plastic cap goes on the positive contact of the battery. While keeping the same battery alignment install it into the battery compartment. Make sure that the battery connector sticks out from the opening next to the power connector.

Next, place the plastic cap on the negative contact of the battery. Using the locking ring pliers, install the locking ring into the slot.

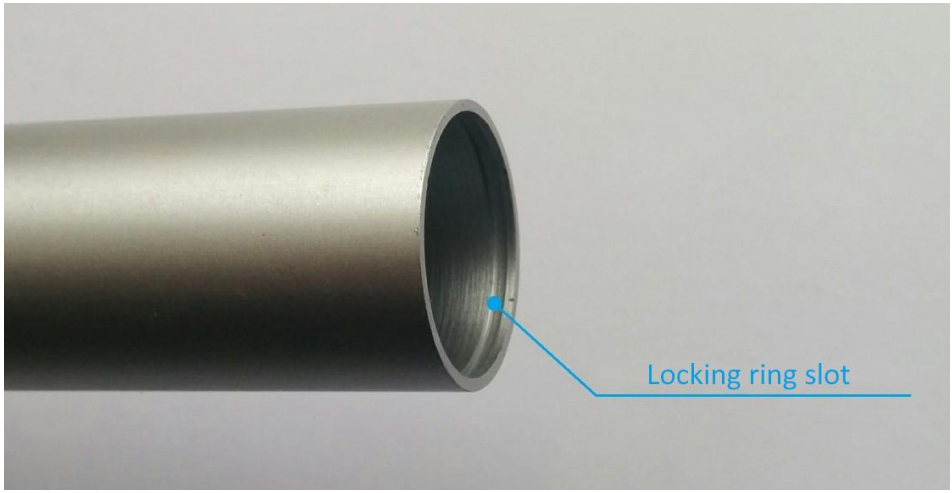

Fig. 11 Locking ring slot

2.8 Power the gauge by inserting the battery connector into the power connector.

2.9 Secure the battery connector into the opening of the power connector (this will prevent short-circuiting when placing the gauge cover).

Step 3. Powering the gauge

3.1 Connect the gauge to a PC using a mini-USB cable.

3.2 Wait 3-5 seconds for the gauge drivers to load. After the drivers have been loaded, the gauge will be displayed in the Device Manager as a virtual com port (STMicroelectronics Virtual Port (COM))

3.3 In order launch **zPort** software, click on its shortcut or go to the start menu in the software

3.4 The software automatically detects all connected gauges. To select a particular gauge, select it with a mouse and the selected gauge will be highlighted in blue.

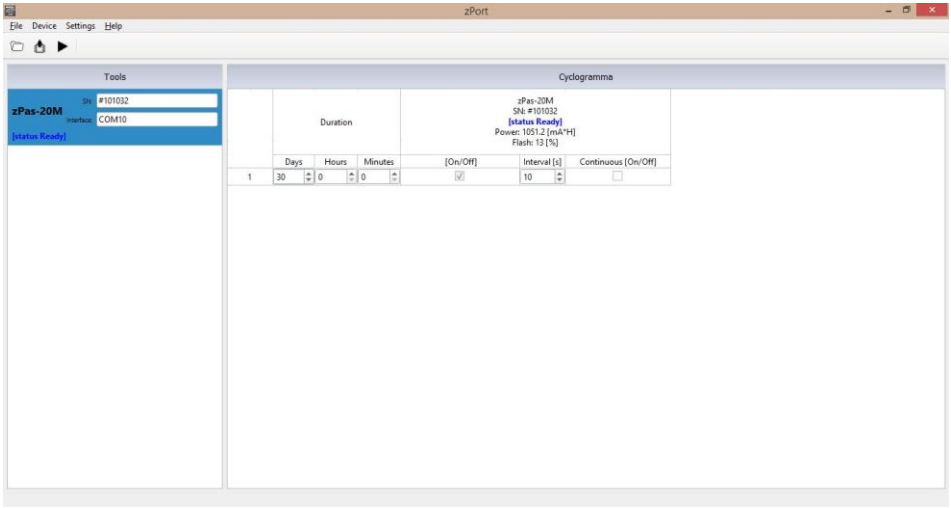

Fig. 12 Overview of the zPort software with the zPas gauge

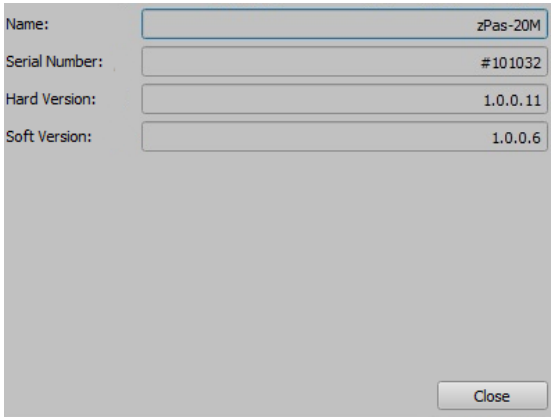

Fig. 13 The Gauge Tab/ Gauge Info

Step 4. Setting up the program.

4.1 After connecting the gauge, read the current program using the zPort software and display it in the form of a table (Fig. 14).

Each table row is used to determine the duration of the time interval during which the following specified parameters are valid: sampling status and interval, activation of continuous logging mode. The gauge processes the program from top to bottom. After switching to a new interval, it uses its parameters to control the selection. After reaching the end of the program, the gauge shuts down. The logging continues until either the memory is full or the battery power runs out. The total amount of energy and memory needed to perform a given program is visible on the screen, and it is necessary to take this into account when working out a survey. **Please note that the actual battery capacity depends on the temperature, storage conditions, De-passivation parameters, and battery release date.**

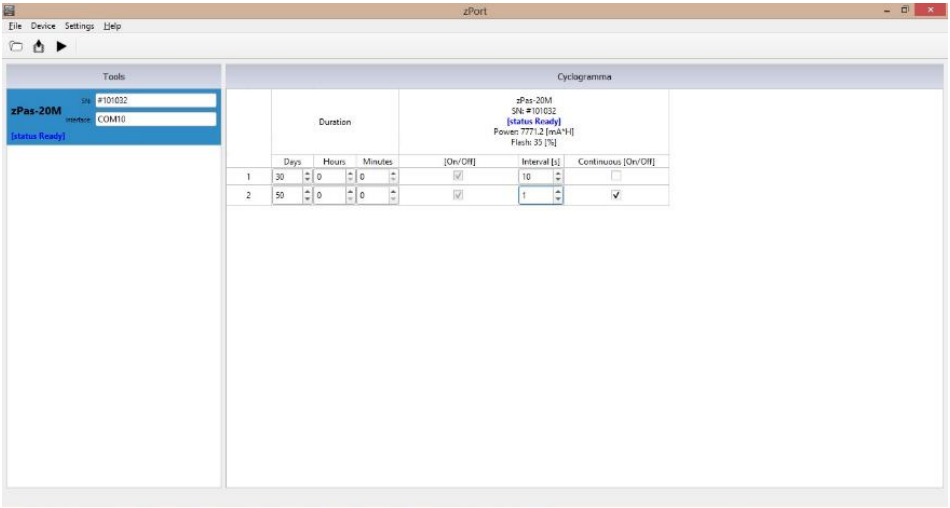

Fig. 14 The program

4.2 Specify the program according to production logging needs:

- specify the time intervals and their parameters. This can be achieved by moving the mouse cursor or touchpad and right-clicking the first column. A pop-up menu appears with all selectable actions. Select the desired action. After adding the interval, all required parameters must be filled (Figure 15).

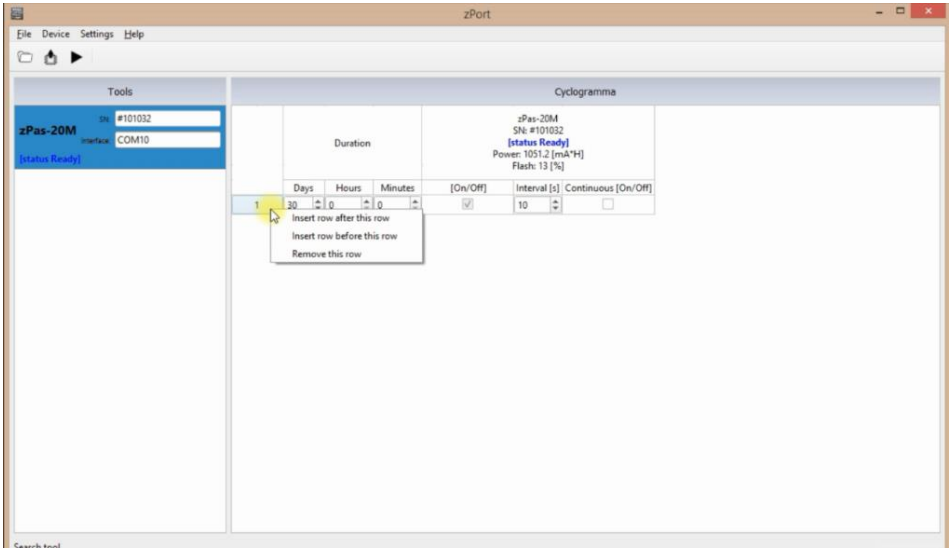

Figure 15 Context menu that allows to add additional time intervals to a program

- in the Interval column, set the durations. The sampling availability parameter is located in the On/Off column. The sampling stage in the Sampling Interval column (Fig. 15).

4.3 Load the resulting program into the gauge by clicking on the Start Gauge button. You will see a warning message stating that all the memory data will be erased (Fig. 16):

- if you select Yes, the software will wipe the memory and overwrite the program inside the gauge.

- if you select No, it would be possible to read the current data

This is a precautionary measure to avoid accidentally erasing the survey results.

Fig. 16 Alert box warning that the gauge data will be deleted

4.4 After flushing the memory the gauge can be now powered on. It is possible to monitor gauge power status, the color of the status bar in the program table should change from blue to green, and the state should switch from "Ready" to "Work".

It is also possible to start a group of selected gauges. You can select several gauges from the connected gauges list by using the Ctrl or Shift keys before selecting them with a mouse. All gauges must run the same version of firmware and the same program intervals. This means that all selected gauges must be separately started with a default Interval. Other parameters may differ and can be modified.

4.5 Disconnect the gauge from the PC.

Step 5. Check the Gauge

After the gauge has been powered on it will begin to operate autonomously (after being disconnected from the PC, for 6-10 minutes). After this time has passed, you need to recheck gauge status.

5.1 Connect the gauge to the computer.

- if the gauge status reads "Work" and is highlighted in green, then the gauge must be disconnected from the PC and the cap must be placed on top. The gauge is now ready for submersion.

- if the gauge status reads "Ready", please check the gauge battery, the gauge has a dual power supply and when connected to a PC it will be powered through USB. After that perform the startup procedure again, beginning with the program.

Step 6. Reading the data.

Warning! The gauge stops automatically when the data is read, the program will halt, the status of the gauge will be switched to "Ready".

The data can be read only when the gauge is connected.

6.1 To begin reading the data click on the button - Read Data. After a button has been clicked, a dialog box will appear where you can select the folder where the data will be saved. Select the folder where you want to save the data and click "Select Folder". The data reading process will begin.

It is also possible to group selected gauges and save the data to a specified shared folder. You can select several gauges from the connected gauges list by using the Ctrl or Shift keys before selecting them with a mouse. If one of the selected gauges is empty, the command will not be able to fully complete.

6.2 When the reading is complete, the software will open a window where the data will be displayed in the form of a graph (Fig. 17). Please verify the data integrity.

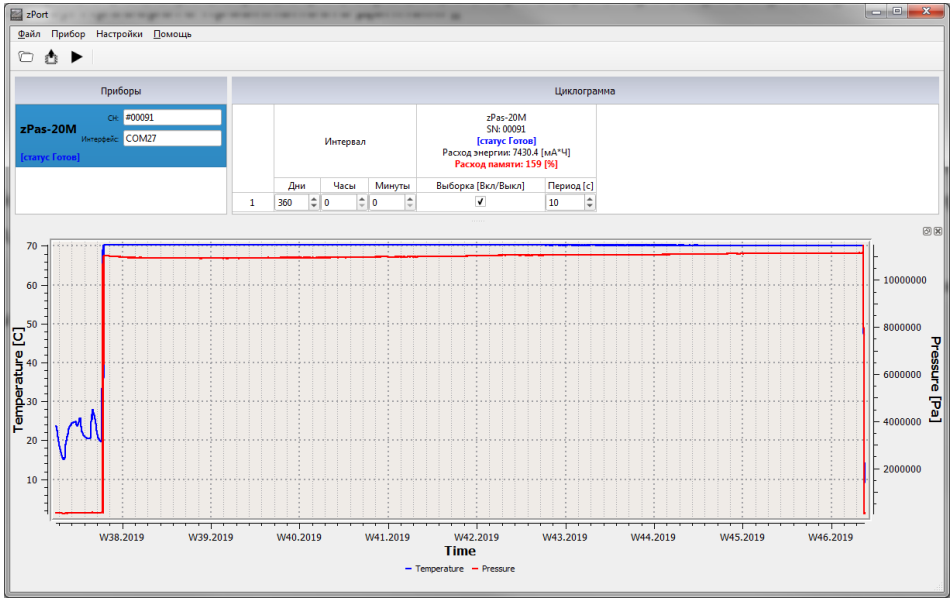

Fig. 17 Verifying the data

If the gauge cannot read the data, you must restart the gauge. (Restart is performed by disconnecting the gauge from the computer and reconnecting it with the battery disconnected from the gauge.). The data is not readable if the gauge memory has been flushed, alerting that "The gauge is empty" in the lower left corner of the window. This might be due to errors in step 5.1.

6.3 The data can be converted and stored in las format. This will require selecting File ->Save as LAS file (Fig. 18).

6.4 If the gauge has been calibrated for special purposes on an absolute pressure scale, the data can be converted to a pressure measurement scale relative to atmospheric pressure by selecting the "Null calibration" check box.

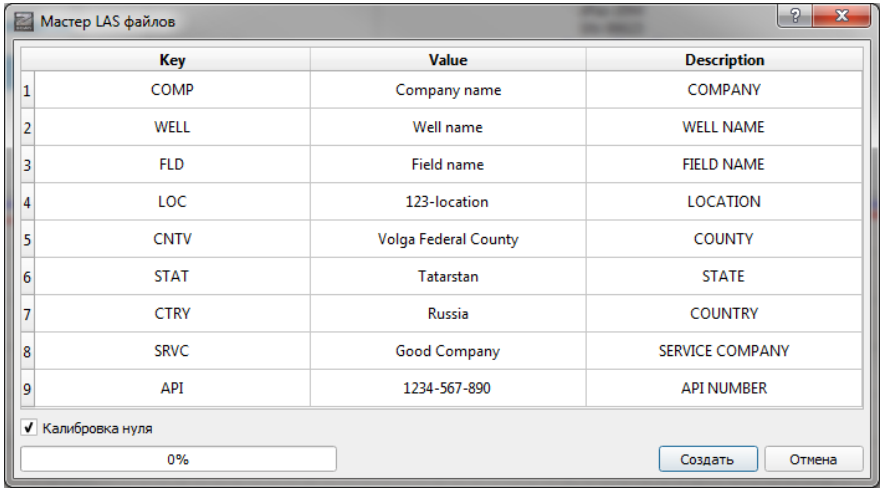

Fig. 18 LAS File Creation Wizard

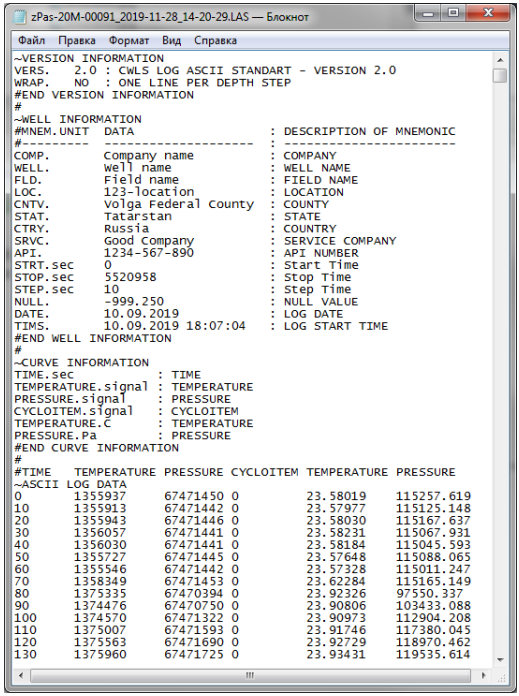

Fig.19 Las file

Security information

The gauge version and serial number can be found in the Device menu by selecting Device Information (Fig. 20).

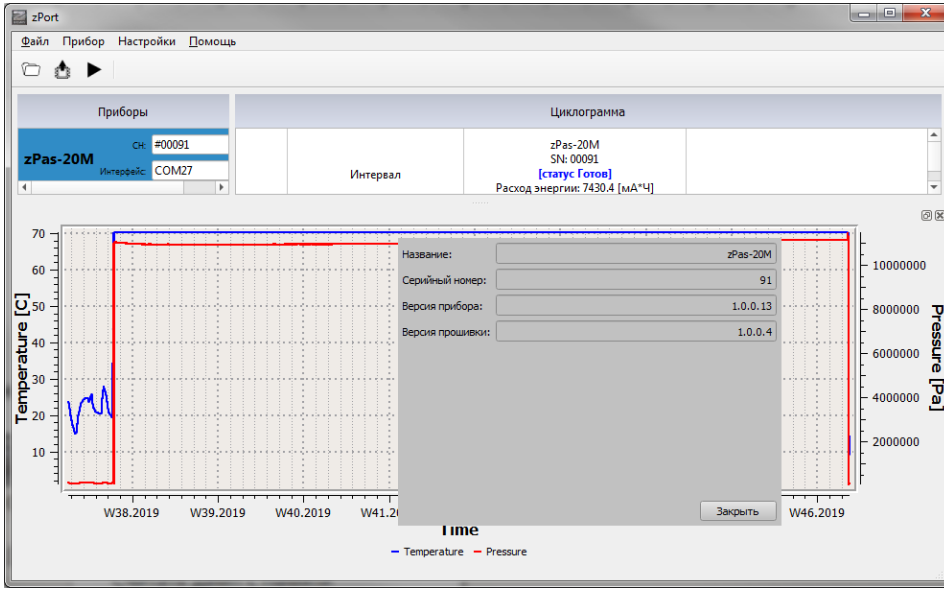

Fig. 20 Menu item displaying gauge version

Recommendations on the use of batteries.

To provide the gauge with autonomous power supply, lithium thionyl chloride cells are used with a nominal operating voltage of 3.6 V. Compatible battery sizes include AA, 14505, 17505 to 18505. The table below shows the capacity for several types of batteries. This table is composed according to the data from manufacturers, where the battery capacity and consumption of the gauge are given at room temperature.

The actual battery capacity depends on the operating temperature, storage conditions, de-passivation parameters and battery release date, and actual performance may vary from declared specifications.

To ensure correct gauge operation replace batteries on time.

Please choose the right battery type according to the temperature in the surveyed well and its program, the calculator is provided within the program that allows to check battery compatibility.

Interval	SL-560\S	ER14505	LS14500	ER17505	ER18505	Type
(sec.)	1700	2400	2600	3600	4000	mA * h
1	13	18	19	22	22	Number of days
2	24	33	36	43	43	
3	33	47	51	65	65	
4	42	59	64	87	87	
5	49	69	75	104	108	
6	56	79	86	118	130	
7	62	88	95	131	146	
8	67	95	103	143	159	
9	72	102	111	153	170	
10	77	109	118	163	181	
11	81	115	124	172	191	
12	85	120	130	180	200	
13	89	125	135	188	208	
14	92	130	140	194	216	
15	95	134	145	201	223	
16	98	138	149	207	230	
17	100	142	153	213	236	
18	103	145	157	218	242	
19	105	148	161	223	247	
20	107	152	164	227	253	

- The following values are highlighted when gauge runs out of memory and stops.

O-ring replacement guidelines

Fig. 21

The rings should be installed as shown in the image in Fig. 21.

The rings should be replaced depending on their condition, if they are noticeably deformed (flattened). Replace no more than once in 2 years of intensive operation at high-temperature. When installing the rings, treat them with a special lubricant.

Warning: Do not remove the fluoroplastic rings!

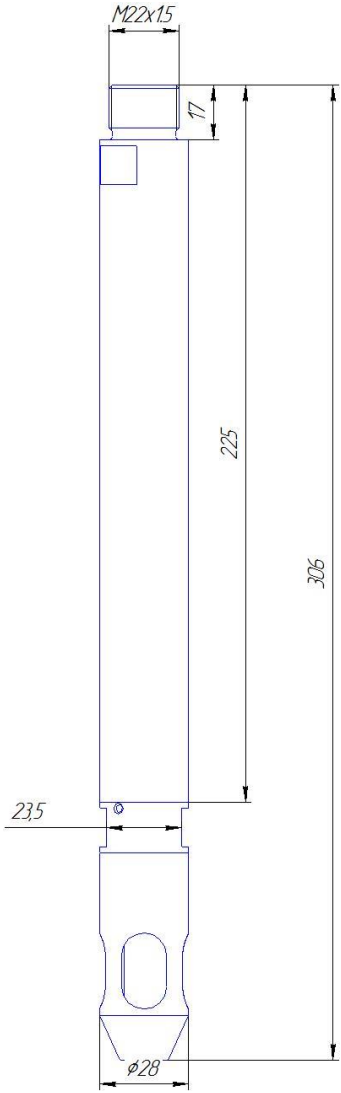

Fig. 22 Dimensions and connection dimensions zPas version I. (scale in mm)

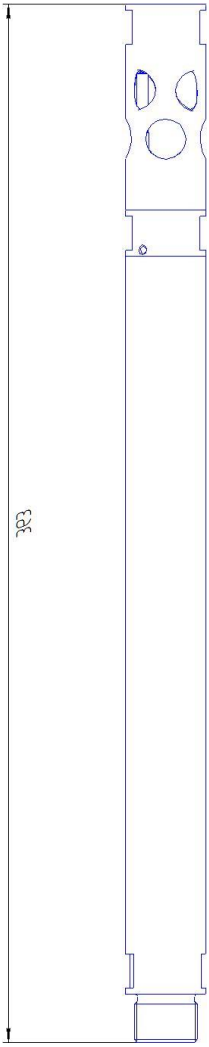

Fig. 23 Dimensions of zPas version II (scale in mm)