ТОО Жаикмунай Группа компаний Oil & Gas nostrum

ZetScan LLC

Test Certificate

on downhole memory quartz gauge zPas-20M

manufactured by ZetScan (Russia)

Kareva Str. 43/1, Uralsk city, Kazakhstan 25 July 2018

Customer: LLP Zhaikmunai (Nostrum Oil & Gas PLC)

Test Objectives:

1. Check for compliance of **zPas-20M** gauge (manufactured by **ZetScan**, Russia) with well test requirements of Zhaikmunai
2. Check **zPas-20M** reliability under a long-term downhole survey
3. Check for compliance of **zPas-20M** accuracy and resolution with zPas-20M factory specifications
4. Compare reliability, accuracy and resolution of **zPas-20M** gauges with popular market alternative, represented by **PPS-28** (manufactured by **Pioneer Petrotech Services Inc.**, Canada)

Test Location: producing wells 23 and 33, Chinarevskoye field, Zhaikmunai

Test Dates: 22.04.2018 – 07.05.2018

Test Type: long-term (16 days) pressure build-up survey

Trial Committee:

Customer representative: Talgat Nauruzov, Head of Reservoir Management & Production Engineering Department, Zhaikmunai LLP

Manufacturer representative: Anatoly Bulkin, Head of Production, ZetScan LLC

Manufacturer representative: Albert Semenov, Head of zPas Laboratory, ZetScan LLC

Test Procedure:

For the purpose of comparative side-by-side testing the **zPas-20M** gauges have been pulled down in the same tool string with **PPS-28** gauges.

The trial job has been conducted by shutting down producing well 23 of Chinarevskoye field (Zhaikmunai) for 15 days pressure build up and suspending the following downhole gauges:

- memory gauge **zPas-20M** with serial number SN101025
- memory gauge **PPS-28** with serial number SN90544

The trial job has been conducted by shutting down producing well 33 of Chinarevskoye field (Zhaikmunai) for 15 days pressure build up and suspending the following downhole gauges:

- memory gauges **zPas-20M** with serial number SN101045
- memory gauges **PPS-28** with serial number SN90444

Test results:

	Well 23	Well 33
Tool Model	zPas-20M	zPas-20M
Serial Number	SN101025	SN101045
Held up depth	4,279 m	1,300 m
Pressure-Temperature data points	164,376	164,216
Sampling rate	1 point in 10 s	1 point in 10 s
Recorded pressure range, kPa	7,123 – 13,533	18,382 – 23,259
Recorded temperature range, °C	79.32 – 90.23	87.10 – 89.58
Factory specification for pressure resolution, Pa	20 *	20 *
Pressure RMSD ** , Pa	21.2	21
Pressure discretization, Pa	19.7	19.7
Factory specification for temperature resolution,°C	0.003	0.003
Temperature RMSD *** ,°C	0.0031	0.001
Temperature discretization, °C	0.0002	0.0002

* at 10 s sampling rate
** RMSD – Root Mean Square Deviation

Comparative test results for **zPas-20M** and **PPS-28** gauges are summarized in **Application A**.

Conclusion:

1. **zPas-20M** gauges have successfully passed the trial and confirmed their reliability at long-term downhole surveys
2. The factory specifications on **zPas-20M** pressure and temperature accuracy and resolution have been confirmed by the long-term field testing
3. The long-term side-by-side comparison with market analogues (represented by **PPS-28**) has proved that **zPas-20M** has a similar reliability, accuracy and resolution in pressure and temperature readings
4. **zPas-20M** gauges can be effectively used for well testing, including static pressure surveys, pressure build up surveys, productivity index survey and cross-well pressure interference tests

Customer Representative
Talgat Nauruzov
Head of Reservoir Management & Production Engineering Department, Zhaikmunai LLP

(signature) 25.07.18

Manufacturer Representative
Anatoly Bulkin
Head of Production, ZetScan LLC

(signature)

Albert Semenov
Head of zPas Laboratory, ZetScan LLC

(signature)

Application A – Comparative test results

	Well 23		Well 33	
Tool Model	zPas-20M	PPS-28	zPas-20M	PPS-28
Serial Number	SN101025	SN90544	SN101045	SN90444
Held up depth	4,279 m		1,300 m	
Pressure-Temperature data points	164,376	124,909	164,216	60,380
Sampling rate	1 point in 10 s	1 point in 10 s	1 point in 10 s	1 point in 10 s
Recorded pressure range, kPa	7,123 – 13,533	7,090 – 13,534	18,382 – 23,259	18,376 – 23,263
Recorded temperature range, °C	79.32 – 90.23	79.77 – 89.78	87.10 – 89.58	87.20 – 89.45
Factory specification for pressure resolution, Pa	20 *	22 ***	20 *	22 ***
Pressure RMSD ** , Pa	21.2	7.2 ****	21	8 ****
Pressure discretization, Pa	19.7	6.9	19.7	6.9
Factory specification for temperature resolution,°C	0.003	0.005	0.003	0.005
Temperature RMSD *** ,°C	0.0031	0.01	0.001	0.01
Temperature discretization, °C	0.0002	0.001	0.0002	0.001

* at 10 s sampling rate

** RMSD – Root Mean Square Deviation

*** estimated from factory settings at 1 s sampling rate by dividing by $\sqrt{10} \approx 3.16$, typical for normally distributed data with 10 seconds stacking

**** 3-times improvement over factory settings most probably caused by continuous (1 s sampling rate) recording followed by 10 s data interval stacking