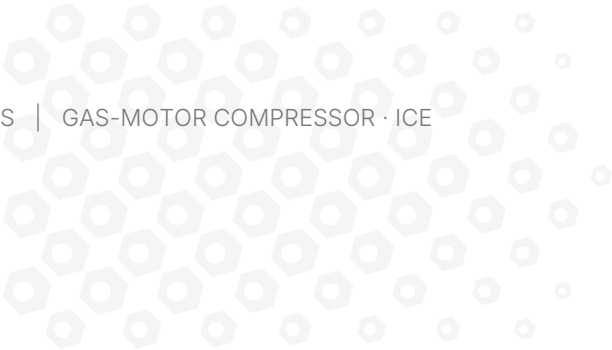




PJSC UKRNAFTA TEST REPORT · 2400 ENGINE HOURS

Gas-motor compressor 10GKNA: cylinders and compression restored without teardown

PJSC Ukrnafta, Kachanivka Gas Processing Plant, Hlynsko-Rozbyshivske gas and condensate treatment unit · commission of 8 specialists chaired by the chief engineer of the KGPP; approved by the director of the oil and gas refining department
Kachanivka GPP, Ukraine · tests 21.10.2014 — 19.03.2015 · report approved 09.06.2015

PRODUCT	TEST OBJECT	DOCUMENT TYPE
XADO revitalizant XADO revitalizant gel (industrial) · XADO VITAFLUSH oil system cleaner	Gas-motor compressor 10GKNA two-stroke engine, 10 power cylinders · serial no. 705, inventory no. 411335	Test report under a program approved by the customer

COMPONENT	CONDITION AT START OF TESTS	WHAT WAS MEASURED
Engine, 10 power cylinders	In service, cylinder-to-cylinder compression spread 2 bar (12–14 bar)	Compression and combustion pressure in all cylinders
Control cylinders No. 6 and No. 9	Accumulated wear, scuff marks and scratches; cylinder 9 has a longitudinal score over 0.5 mm deep	Diameters in two sections along two axes
Engine block and frame	Continuously operating unit, not taken out for repair	Vibration at 26 control points, three directions

Measurements were taken three times: before treatment, at 425 and at 2400 engine hours of operation. Treatment was performed without stopping or disassembling the unit.

Key results

↑ **3.6-20.8 %**

compression across cylinders, 12-14 → 14.2-15 bar

↓ **0.12-0.22 mm**

control cylinder diameter, 355.14-355.29 → 355.01-355.10 mm

↓ **14-38 %**

vibration displacement of block and frame,
20.5-88.1 → 9.3-67.4 μm

Compression in all ten power cylinders

CYLINDER	BEFORE TREATMENT, bar	2400 ENGINE HOURS, bar	CHANGE
I	14	15	+7.1 %
II	12	14.5	+20.8 %
III	13	14.5	+11.5 %
IV	13	14.5	+11.5 %
V	14	15	+7.1 %
VI	13	14.2	+9.2 %
VII	13.5	14.5	+7.4 %
VIII	13	15	+15.4 %
IX	14	14.5	+3.6 %
X	14	15	+7.1 %

Measured at 295-310 rpm, the same operating mode in all three measurements. Compression rose in all ten cylinders, the spread between them 2 → 0.8 bar.

Diameters of the working part of the control cylinders

CYLINDER	SECTION / AXIS	BEFORE TREATMENT, mm	2400 ENGINE HOURS, mm	CHANGE, mm
No. 6	50 mm, axis A	355.18	355.01	-0.17
No. 6	50 mm, axis B	355.15	355.03	-0.12

CYLINDER	SECTION / AXIS	BEFORE TREATMENT, mm	2400 ENGINE HOURS, mm	CHANGE, mm
No. 6	250 mm, axis A	355.14	355.02	-0.12
No. 6	250 mm, axis B	355.14	355.02	-0.12
No. 9	50 mm, axis A	355.27	355.07	-0.20
No. 9	50 mm, axis B	355.29	355.07	-0.22
No. 9	250 mm, axis A	355.24	355.04	-0.20
No. 9	250 mm, axis B	355.28	355.10	-0.18

The diameter decreased because a metal-ceramic layer built up on the worn surface — this is exactly what caused the compression to rise.

Longitudinal score on the working surface of cylinder 9

SCORE DIMENSION	BEFORE TREATMENT	2400 ENGINE HOURS
Depth	over 0.5 mm	no more than 0.3 mm
Width	up to 2.5 mm	up to 1.0 mm
Length	up to 120 mm	no more than 90 mm

In the middle part of the score, over a length of up to 7 mm, it has been completely eliminated by the metal-ceramic layer. The dimensions were recorded by the commission during inspection.

Vibration displacement of the engine block and frame, μm

MEASUREMENT POINT	LEFT, BEFORE	LEFT, 2400 H	RIGHT, BEFORE	RIGHT, 2400 H
1 · vertical, rear side of the block	48.5	18.1	24.1	31.5
2 · horizontal, rear side of the block	64.7	56.2	64.7	47.5
3 · axial, rear side of the block	42.2	18.0	37.3	25.6
4 · vertical, rear side of the frame	20.5	13.3	33.3	9.26
5 · horizontal, rear side of the frame	28.6	26.8	32.4	27.9

MEASUREMENT POINT	LEFT, BEFORE	LEFT, 2400 H	RIGHT, BEFORE	RIGHT, 2400 H
6 · axial, rear side of the frame	33.2	28.6	35.2	29.0
7 · vertical, front side of the block	87.5	64.6	69.5	61.1
8 · horizontal, front side of the block	88.1	62.2	76.1	67.4
9 · axial, front side of the block	63.6	20.0	49.3	31.2
10 · vertical, front side of the frame	44.6	20.2	34.8	21.6
11 · horizontal, front side of the frame	56	30.9	36.4	28.5
12 · axial, front side of the frame	33.4	28.5	34.5	24.3
13 · vertical, rear central side of the block	46	41.0	—	—
14 · axial, rear central side of the block	46.2	31.8	—	—

26 control points in three directions, the same points and the same operating mode before treatment and after 2400 engine hours of operation.

Commission conclusion

The commission of PJSC Ukrnafta recorded: the diameters of the working parts of the control cylinders (6 and 9) after a total operating time of **2400 hours** decreased by **0.12-0.22 mm** owing to the formation of a metal-ceramic coating, which practically completely eliminated the accumulated mechanical wear; the working part of the cylinders has the appearance of a smooth polished surface, through which traces of the former scuffs and scratches are visible but cannot be felt by touch. Eliminating the accumulated cylinder wear with XADO compounds makes it possible to extend the residual service life without shutting down the gas-motor compressor and disassembling it for repair. The vibration level at the control points decreased by **22-53 %**, and at individual points of the engine block the vibration displacement — by **1.2-3.2×**. Compression readings in all cylinders increased by **6 to 16 %** and stabilized: the compression spread decreased **2.5×**, from **2 to 0.8 bar**. An increase in compression contributes to higher engine power, while a smaller compression spread across the cylinders reduces crankshaft imbalance.

XADO

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The results apply to the two-stroke engine of a 10GKNA gas-motor compressor under industrial operating conditions at a gas processing plant; on other units and in other operating modes the figures may differ. The original PJSC Ukrnafta report with the commission signatures is provided in full.