XADO

IE S012 | INDUSTRIAL CASE | MECHANICAL ENGINEERING | METAL-CUTTING MACHINE TOOLS

REVITALIZATION CYCLE · JULY 2012 — NOVEMBER 2013

16K20, TV-320, 3B151 machines: higher spindle accuracy, drive draws less power

SE “KhMZ “FED”, machine shops and shop No. 16 · measurements: planned-maintenance bureau, shop mechanical and power engineers, XADO LLC engineers · approved by the chief engineer and the chief mechanical engineer of the plant

Kharkiv, Ukraine · treatment 18.07–18.09.2012 and 24.07–07.11.2013 · reports 22.11.2012 and 11.11.2013

PRODUCT

XADO revitalizant compounds

treatment without disassembly of the units, the machines stayed in shop production

TEST OBJECT

Metal-cutting machine tools, 5 units

screw-cutting lathes 16K20 with CNC, IZh 1I611PF-1, TV-320 · cylindrical grinders 3B151, inv. No. 16000 and No. 16004

DOCUMENT TYPE

Summary report of 2012 and two technical reports of 2013

MACHINE	OPERATING TIME	WHAT WAS MEASURED	REPORT DATE
16K20 with CNC, inv. No. 10411	836 h	Spindle run-out and play, drive power, vibration, gear tooth thickness	22.11.2012
IZh 1I611PF-1, inv. No. 10366	198 h	Spindle run-out and play, drive power, vibration, ovality, gear tooth thickness	22.11.2012
TV-320, inv. No. 10707	154 h	Spindle run-out, drive power, vibration	22.11.2012
3B151, inv. No. 16000, shop No. 16	512 h	Power and current per phase, vibration at 10 points, workpiece ovality	11.11.2013
3B151, inv. No. 16004, shop No. 16	495 h	Power and current per phase, vibration at 10 points, workpiece ovality	11.11.2013

Operating time is the machine running hours after treatment up to the control measurement. The spindle bearings were treated; on the lathes also the gearbox and the feed box, on the 3B151 — the spindle headstock lubrication system.

What repeated on all five machines

↓ 0.02-0.05 mm

spindle radial run-out, 0.04-0.1 → 0.02-0.05 mm

↑ 0.05-0.1 mm

gearbox gear tooth thickness over the constant chord

↓ 7-13 %

drive power under load, 1.05-3.46 → 0.95-3.0 kW

↓ 2-6×

ovality of the control workpiece, 0.006-0.018 → 0.003 mm

Spindle unit geometry — screw-cutting lathes

MACHINE	PARAMETER	BEFORE	AFTER
16K20 with CNC, inv. No. 10411	Radial run-out of the spindle seat	**0.04 mm**	**0.02 mm**
16K20 with CNC, inv. No. 10411	Face run-out of the spindle seat	**0.03 mm**	**0.02 mm**
16K20 with CNC, inv. No. 10411	Spindle axial play	**0.06 mm**	**0.04 mm**
16K20 with CNC, inv. No. 10411	Spindle radial play	**0.03 mm**	**0.02 mm**
TV-320, inv. No. 10707	Radial run-out of the front spindle bearing	**0.1 mm**	**0.05 mm**
IZh 1I611PF-1, inv. No. 10366	Face run-out of the spindle seat	**0.01 mm**	**0.007 mm**
IZh 1I611PF-1, inv. No. 10366	Spindle axial play	**0.04 mm**	**0.03 mm**

The gearbox gear tooth thickness on the 16K20 and the IZh 1I611PF-1 grew by **0.05-0.1 mm**, and the backlash in the mesh became smaller.

Drive power draw — all five machines

MACHINE	MEASUREMENT MODE	BEFORE	AFTER
16K20 with CNC, inv. No. 10411	Idle running, 1000 rpm	**2.7 kW**	**2.3 kW**

MACHINE	MEASUREMENT MODE	BEFORE	AFTER
16K20 with CNC, inv. No. 10411	Cutting, fixed mode	**3.46 kW**	**3.0 kW**
IZh 1I611PF-1, inv. No. 10366	Idle running, 2000 rpm	**1.3 kW**	**1.05 kW**
IZh 1I611PF-1, inv. No. 10366	Cutting, fixed mode	**1.28 kW**	**1.18 kW**
TV-320, inv. No. 10707	Idle running, 2000 rpm	**0.91 kW**	**0.8 kW**
TV-320, inv. No. 10707	Cutting, fixed mode	**1.05 kW**	**0.95 kW**
3B151, inv. No. 16000	Grinding, 250 rpm, infeed 0.25 mm, per phase	**2.2-2.68 kW**	**2.0-2.5 kW**
3B151, inv. No. 16004	Grinding, 250 rpm, infeed 0.25 mm, per phase	**2.3-3.13 kW**	**2.12-2.9 kW**

On the 3B151 machines the measurement was taken phase by phase with ATK220 clamp meters; the current under load, according to the report conclusions, dropped by **8.1** and **9.6 %**.

Machining accuracy on the control workpiece

MACHINE	PARAMETER	BEFORE	AFTER
3B151, inv. No. 16000	Ovality of the ground workpiece	**0.018 mm**	**0.003 mm**
3B151, inv. No. 16004	Ovality of the ground workpiece	**0.014 mm**	**0.003 mm**
IZh 1I611PF-1, inv. No. 10366	Ovality of the turned workpiece	**0.006 mm**	**0.003 mm**
16K20 with CNC, inv. No. 10411	Out-of-flatness of the piston blank face	**0.07 mm**	**0.04 mm**

On the lathes the workpiece was turned, on the 3B151 it was ground — the initial ovality levels are of different orders; what is comparable is the direction and the ratio of change.

Vibration of the bed and the spindle headstock

MACHINE	MEASUREMENT	REDUCTION
16K20 with CNC, inv. No. 10411	Average over the control points of the bed and the spindle headstock	**22.9 %**
IZh 1I611PF-1, inv. No. 10366	Average over the control points of the bed and the spindle headstock	**63 %**

MACHINE	MEASUREMENT	REDUCTION
TV-320, inv. No. 10707	Average over the control points of the bed and the headstock	**39.2 %**
3B151, inv. No. 16000	Vibration velocity at 10 points, **0.384-0.593 → 0.196-0.330 mm/s**	**43-56 %**
3B151, inv. No. 16004	Vibration velocity at 10 points, **0.452-0.911 → 0.200-0.628 mm/s**	**31-59 %**

On the 3B151 machines vibration was measured with a SENDIG 911 vibration meter at 10 points of the grinding headstock and the bed for three quantities; the table gives the vibration velocity.

Conclusions of the plant commissions

The reports of SE “KhMZ “FED” record: on the 16K20 “all spindle accuracy parameters of the machine improved by at least **33%** (the spindle radial run-out decreased **2×**) and came into conformity with the data sheet values”, on the TV-320 “the radial play of the front spindle bearing decreased **2×** and conforms to the permissible data sheet values”. For the 3B151 the conclusion is the same: “the reduced ovality of the control workpiece and the lower vibration parameters of the machine indicate a reduction of the radial clearances of the bearings due to the formation of a metal-ceramic layer”. Treatment of the gearbox increased the gear tooth thickness by **0.05-0.1 mm**, reducing the backlash in the mesh. The IZh 1I611PF-1 machine ran only finishing operations and was within its data sheet limits from the start — it changed less than the others: the coating builds up where there is wear. After a year of regular operation the plant confirmed in a separate report that the achieved parameters had held.

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The results apply to metal-cutting machine tools of the stated models under the conditions of the machine shops of SE “KhMZ “FED”; on other equipment and in other operating modes the figures may differ. The originals of the 2012 summary report and the 2013 technical reports, with signatures and stamp, are published in full and available for download.