

## TEST REPORT · MACHINE SHOP, ZAPOROZHSTAL OJSC

# 16K20 lathe: accuracy and surface finish restored without disassembly

Zaporozhstal OJSC, machine shop · measurements taken by a commission of plant specialists · approved by V. V. Buryak, Engineering Director

Zaporizhzhia, Ukraine · treatment 31.01-18.06.2013 · report dated 08.08.2013 · total run 1280 h

**PRODUCT**

XADO revitalizant gel  
for compressors and bearings ·  
lubrication system of the  
machine treated without  
stopping production

**TEST OBJECT**

16K20 screw-cutting lathe  
inv. No. 10512471 · spindle unit,  
gearbox, lubrication system,  
drive

**DOCUMENT TYPE**

Test report,  
Zaporozhstal OJSC  
signed by the plant commission  
and the lead engineer of XADO  
LLC

**MACHINE UNIT****CONDITION BEFORE TREATMENT****WHAT WAS MEASURED**

Spindle unit

Increased radial clearance and axial  
play of the spindle bearings

Bearing play, radial and face runout of  
the spindle seat

Gearbox

Micro-damage on the contact patches  
of the loaded gear wheels

Tooth thickness of the gearbox pinion  
and the spindle gear at the  
constant-chord height

Drive, electric motor

Machine in service in the machine  
shop

Current, voltage and power on three  
phases at idle and under load

Machine as a whole

Ovality of the turned surface 0.03  
mm, roughness Ra 7.98  $\mu\text{m}$  — class 4

Vibration at seven control points,  
ovality and Ra of the test workpiece

The lubrication system was treated twice — an initial treatment and a repeat one; the 1280 h run is counted from the start of the first treatment.

# Key results

**↑ 0.05-0.15 mm**

gearbox tooth thickness, 5.8 → 5.9 and 6.0 → 6.15 mm

**↓ 7.6 %**

power draw under load, 3.48-3.74 → 3.2-3.45 kW

**↓ 59-89 %**

vibration velocity at control points, 1.23-1.71 → 0.10-0.70 mm/s

**↓ 3.3-3.8×**

roughness of the turned surface Ra, 7.98 → 2.1-2.4 μm

## Spindle accuracy and gearbox tooth geometry

| PARAMETER                                      | BEFORE TREATMENT | AFTER 1280 H | CHANGE    |
|------------------------------------------------|------------------|--------------|-----------|
| Axial play of the spindle bearings             | 0.05 mm          | 0.02 mm      | −0.03 mm  |
| Radial play of the spindle bearings            | 0.03 mm          | 0.015 mm     | −0.015 mm |
| Radial runout of the spindle seat              | 0.03 mm          | 0.01 mm      | −0.02 mm  |
| Face runout of the spindle seat                | 0.01 mm          | 0.005 mm     | −0.005 mm |
| Tooth thickness of the gearbox pinion, 3 teeth | 5.8 mm           | 5.9 mm       | +0.1 mm   |
| Tooth thickness of the spindle gear, 3 teeth   | 6.0 mm           | 6.15 mm      | +0.15 mm  |

Play and runout — ICh-10 dial indicator; tooth thickness at a constant-chord height of 3.0 mm with m = 3.5 — ShZN-18 gear tooth vernier caliper.

## Power consumption of the machine drive on three phases

| MODE AND PARAMETER | PHASE A       | PHASE B        | PHASE C        |
|--------------------|---------------|----------------|----------------|
| Current under load | 9.81 → 8.9 A  | 10.1 → 9.2 A   | 9.95 → 9.0 A   |
| Power under load   | 3.48 → 3.2 kW | 3.74 → 3.45 kW | 3.52 → 3.22 kW |
| Current at idle    | 7.83 → 7.05 A | 7.65 → 7.1 A   | 7.76 → 6.98 A  |
| Power at idle      | 2.92 → 2.6 kW | 2.89 → 2.53 kW | 3.01 → 2.67 kW |

ATK2200 clamp meter. According to the conclusions of the report, in the loaded turning cycle the current fell by 9.6 % and the power by 7.6 %; at idle, by 9 % and 11 %.

## Vibration at the control points of the headstock and the bed

| MEASUREMENT POINT                   | VIBRATION ACCELERATION, m/s <sup>2</sup> | VIBRATION VELOCITY, mm/s | VIBRATION DISPLACEMENT, μm |
|-------------------------------------|------------------------------------------|--------------------------|----------------------------|
| Front bearing, vertical             | 3.56 → 3.49                              | 1.28 → 0.19              | 4.84 → 1.62                |
| Front bearing, horizontal           | 8.8 → 3.69                               | 1.53 → 0.7               | 4.25 → 3.22                |
| Rear bearing, vertical              | 5.59 → 2.44                              | 1.39 → 0.21              | 3.99 → 2.12                |
| Bed at the rear bearing, horizontal | 9.93 → 5.24                              | 1.71 → 0.7               | 18.9 → 4.0                 |
| Bed at the rear bearing, axial      | 7.46 → 4.8                               | 1.32 → 0.17              | 4.18 → 1.72                |
| Bed, left support, horizontal       | 4.08 → 2.12                              | 1.26 → 0.1               | 4.4 → 1.54                 |
| Bed, right support, horizontal      | 3.49 → 2.33                              | 1.23 → 0.14              | 3.99 → 2.48                |

SENDIG 911 vibration meter, seven control points; the reduction was recorded at every point and for all three vibration quantities.

## Test workpiece turned on the machine

| PARAMETER OF THE TURNED SURFACE | BEFORE TREATMENT  | AFTER 1280 H         |
|---------------------------------|-------------------|----------------------|
| Ovality of the turned surface   | 0.03 mm           | 0.01 mm              |
| Surface roughness Ra            | 7.98 μm — class 4 | 2.1-2.4 μm — class 6 |

The workpiece was turned under identical conditions each time: 800 rpm, feed 0.15 mm/rev, depth of cut 1.0 mm.

# Conclusions of the plant commission

The commission of specialists of Zaporozhstal OJSC, by final measurements after a total run of **1280 h**, established that: in the loaded turning cycle at fixed cutting conditions the current draw decreased by **9.6 %** and the power draw by **7.6 %**; the radial runout of the spindle decreased from **0.03 mm** to **0.01 mm**, and the axial play of the bearings from **0.05 mm** to **0.02 mm**; the vibration level "decreased at all control points by at least **56 %**, and at individual points of the spindle bearings the vibration parameters decreased by more than 2×"; the thickness of the control teeth on the gearbox gears increased by **0.05-0.15 mm**, and the contact patches of the loaded gear wheels "visually became smoother, without the micro-damage that was visible before the start of the treatment"; the roughness of the turned surface improved by 2 classes — from Ra **7.98 µm** to Ra **2.1-2.4 µm**. The treatment of the lubrication system with XADO revitalizant compounds was carried out without stopping the machine and without disassembling its units; in the assessment of the commission, the geometric parameters of the machine and the vibration level of the spindle bearings correspond to the accuracy parameters of a machine after a major overhaul.



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The results apply to the 16K20 screw-cutting lathe (inv. No. 10512471) of the machine shop of Zaporozhstal OJSC under the stated measurement conditions; on other equipment and under other conditions the figures may differ. The original report dated 08.08.2013 is published in full and available for download.