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# Rolling element bearing diagnostics

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## Why do you need bearing diagnostics?

Bearings technical condition to a large extent determines availability and life of the rotary machinery. Therefore, particular attention should be paid to the evaluation and the fault diagnosis of rolling bearing condition.

Vibration-based analysis techniques came into common use in equipment diagnostics, as they provide the maximum diagnosis information. Now the vibration-based techniques are well developed enough to evaluate not only a general condition of the bearing, but also to monitor a condition of all its components, detect the particular fault and estimate the remaining lifetime.

Based on the above, specialists of the Research and Production Enterprise "TIK" have developed the SVK-A test rig for rolling bearing vibration monitoring, which is user-friendly and reliable diagnosis tool to monitor bearing condition. Since 1998 the rig production saw three generation changes and the last generation adopted all the comments and suggestions received by the designers from operators feedback.

The SVK-A test rig enables diagnosis of both new and previously used bearings. Being applied for an incoming inspection of bought-out bearings, this rig can considerably reduce the quantity of defective and low-quality bearings. As experience shows, if the incoming inspection is not practiced in the production the volume of low-quality bearings among all supplies can achieve 90%! With SVK-A test rigs implemented in many industrial plants this volume was reduced to nearly zero resulting thereby in a significant reduction in failure rate of the major equipment.

SVK-A test rig usage allows for major improve in reliability and durability of rotary machines and reduce costs arising from emergency shutdown and repairs. This rig being applied for used bearings permits to better assess their condition during scheduled maintenance and reuse them in case of positive evaluation.

## Rolling bearing diagnostic services

Research and Production Enterprise "TIK" renders services on the rolling bearings quality diagnosis to assess their condition. Such diagnosis is performed using SVK-A test rig in a qualified laboratory on TIK premises. After tests customer receives the test certificate for each bearing including a description of measured parameters, detected faults and expert's decision. The bearing assessment is performed by skilled diagnosticians.

This service is intended for companies and individuals, bearing suppliers and operators not having their own laboratory so that they can obtain objective information on the quality of bearings they possess.





## SVK-A test rig for vibration monitoring of rolling bearings

### Bearing operational position simulation

The bearing is clamped in the high-precision collet holder enabling simulation of its operational position. Removing tools are not required

### Condition monitoring of all bearing components

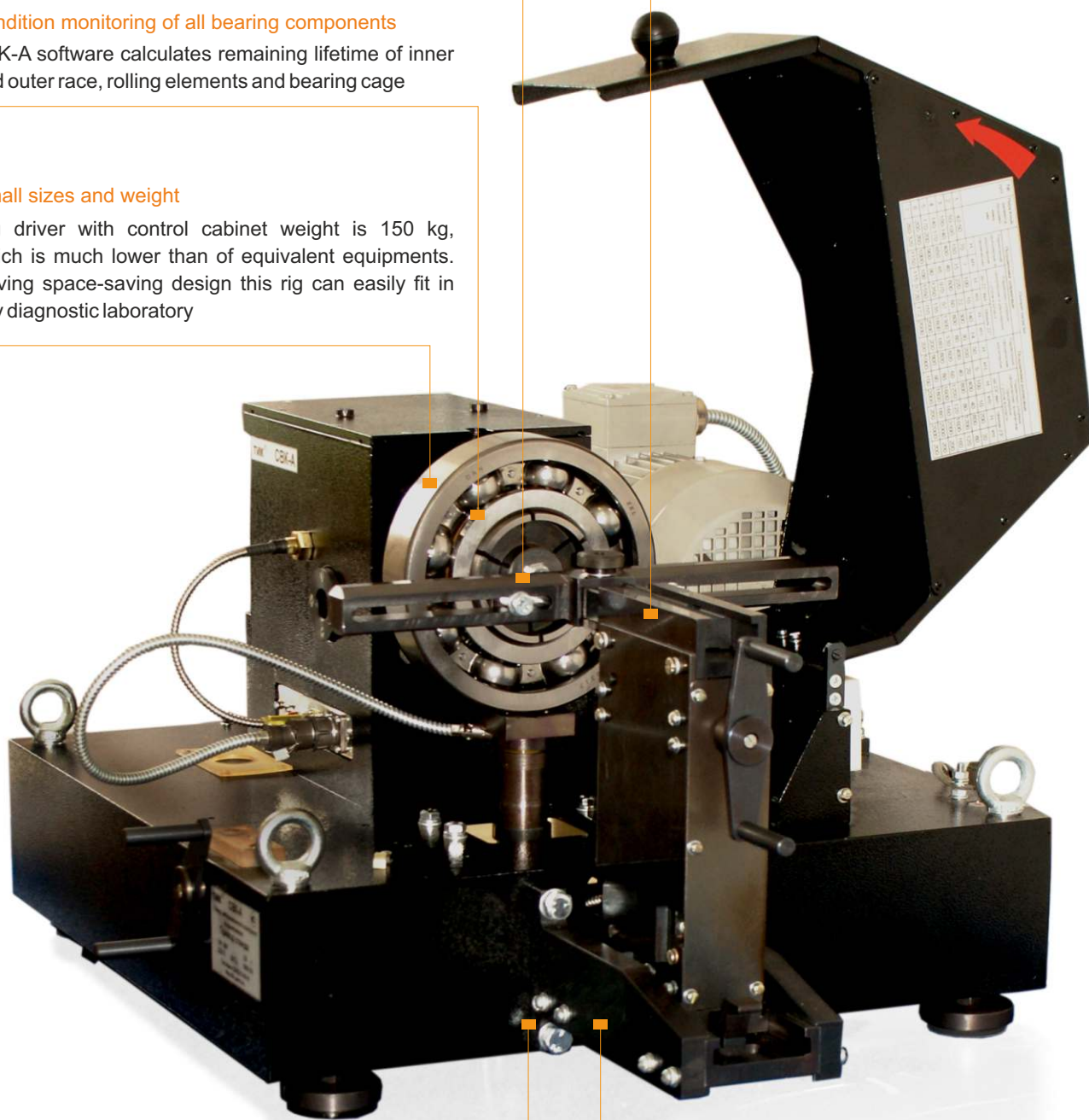
SVK-A software calculates remaining lifetime of inner and outer race, rolling elements and bearing cage

### Small sizes and weight

Rig driver with control cabinet weight is 150 kg, which is much lower than of equivalent equipments. Having space-saving design this rig can easily fit in any diagnostic laboratory

### Four methods of bearing diagnosis

Rig software provides three test methods: evaluation of vibration levels in frequency bands, evaluation of vibration acceleration signal kurtosis, and spectrum analysis of vibration acceleration signal envelope. SVK-A can be optionally equipped with the radial clearance measurement device



### Ease of operation

The bearing rig testing does not require highly qualified personnel. It is enough to complete two-day training at TIK on rules and methods of maintenance and work with SVK-A test rig

### Complies with applicable regulations

SVK-A test rig is certified and registered in the National Register of Measuring Instruments, and software and procedure guidelines were developed in accordance with GOST R 52545.1-2006, measurement procedure guideline RD VNIPP.038-08

## SVK-A test rig for vibration monitoring of rolling bearings



### Specifications

#### Main parameters

Inner bore of the bearing under test, mm .....35-150  
20-180\*

\*Customized

Outer diameter of the bearing under test, mm .....42-320

Bearing width, mm .....7-106

Axial load range, N .....0-2000

Radial load range, N .....0-2000

Frequency range of applicable  
vibration transducers, Hz .....20-10 000

Rotational speed of the monitored  
bearing inner ring, RPM .....900/1800

Monitoring error of the spindle shaft speed, % .....± 0.5

Test time, sec\*\* .....30

\*\*Without taking into account the time of dismantling, heating  
and dismantling of the bearing

#### Interface

Power supply voltage .....~ 220 B, 50

Power consumption, kW, no more than .....1.6

Computer connection via .....USB

#### Design parameters

Overall dimensions:

- rig driver, mm .....830x620x560

- control cabinet, mm .....300x450x240

Rig weight (excl. computer), kg:

- rig driver with sensors .....120

- control cabinet .....30

Weight of standard set of collets and accessories, kg\*\*\* .....50

\*\*\*Scope of supply is to be specified when drawing up a contract

#### Performance

During measurements the following environmental conditions  
shall be met:

- ambient temperature, °C .....+5 ...+40

- relative humidity (without condensation of moisture), % .....95

- atmospheric pressure, kPa .....90-105

#### Manufacturer's warranties

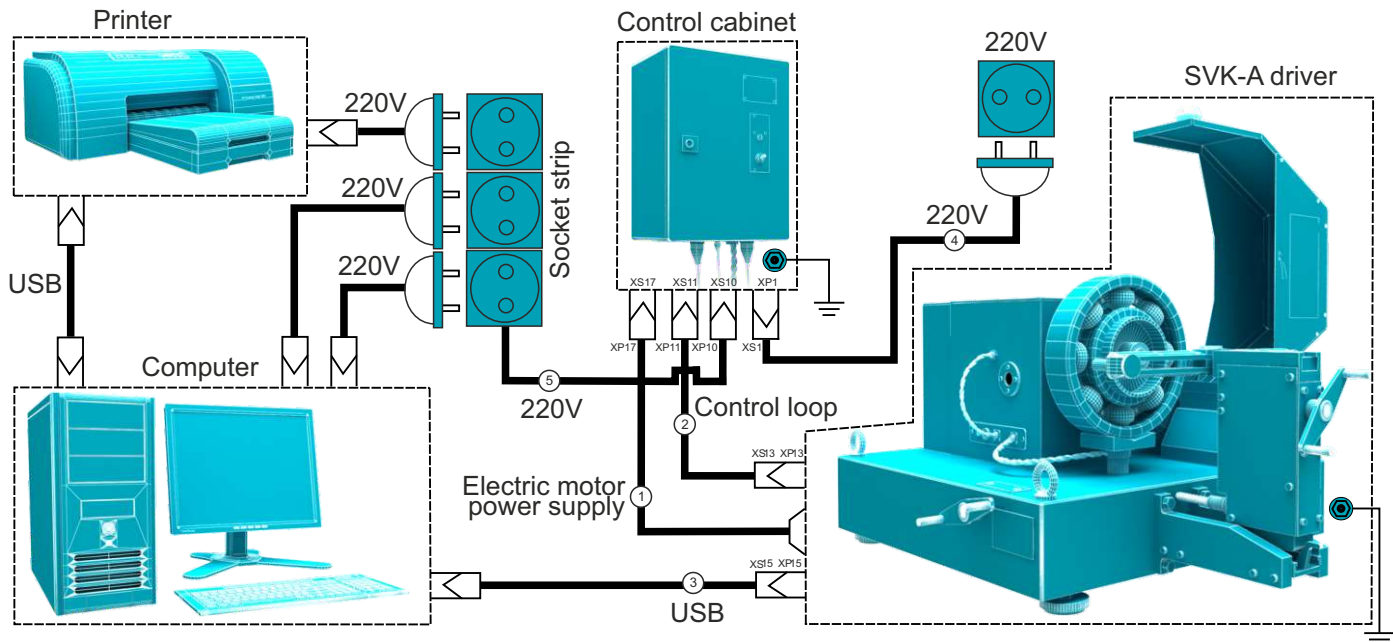
Warranty period, month .....24

Service life, year .....10

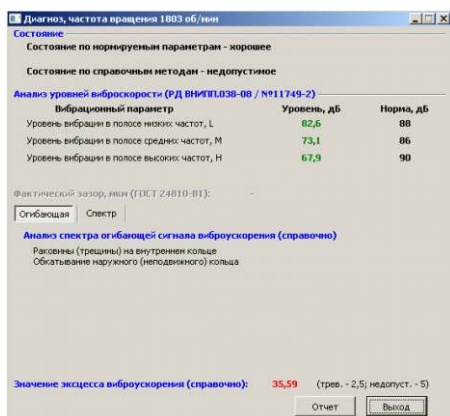
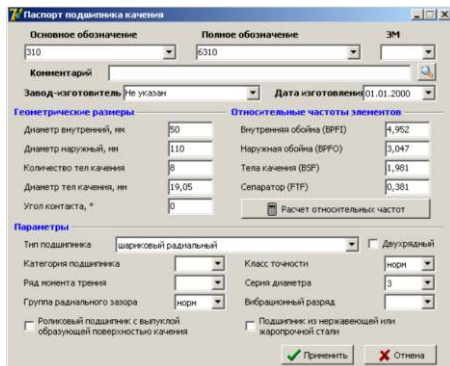
Calibration interval, years .....2



## SVK-A test rig connection diagram



## SVK-A test rig software



The SVK-A test rig software provides three test methods. One of them, evaluation of vibration levels in frequency bands, is implemented according to the requirements of regulations. The other two methods, the evaluation of vibration acceleration signal kurtosis and spectrum analysis of vibration acceleration signal envelope, are advisory and based on the gained long-term statistical data in vibration diagnostics and mathematic simulation. Bearing being diagnosed only by vibration level in three frequency bands often results in skipping of faults that, if being incipient, do not affect so much on the vibration level. On the contrary, the evaluation of bearing quality using spectrum analysis and acceleration signal kurtosis makes it possible to detect incipient faults and, despite the absence of applicable laws, gives ground to a user to doubt in adequate quality of the bearing.

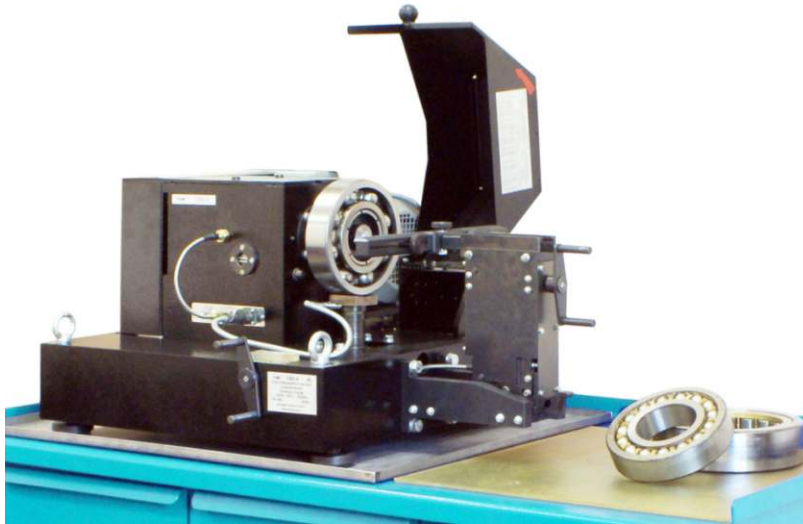
The software provides options to choose from available database the appropriate bearing or add new one, having specified bearing geometry, type, radial clearance, and other parameters.

Prior to starting the work, the software automatically sets required rotational speed, axial and radial loads for chosen type of bearing. These values are displayed in the start menu and monitored through appropriate checkboxes. With a help of special levers the required axial and radial loads are applied. Upon achievement of specified values the checkboxes turn to green. The rotational speed is set automatically at the driver start. All that is left to do is to press "START" button and follow up a measurement process.

After saving the measurements done the measured signals are being analyzed, and a report on the bearing condition is made up automatically. Meanwhile the diagnostician has a possibility to look through spectra for independent evaluation. In the result of the study report is printed, which can be used as the document certifying the diagnosis results. To do is to press "START" button and follow up a measurement process.

The SVK-A test rig is certified and registered in the **National Register** of measuring instruments, and software and procedure guidelines for diagnosis and evaluation of technical condition were developed in full compliance with the requirements of reference documents in effect: **GOST R 52545.1-2006 (ISO 15242-1:2004)**, guideline **RD VNIPP.038-08** (vibration standards).

## TIK-SVK rolling bearing diagnostic laboratory



RPE "TIK" can help industrial enterprises with the organization of the bearing diagnostics laboratory from scratch.

### The Turn-Key project of diagnostic laboratory includes:

- laboratory project development;
- customer site localization;
- packing a set of appropriate equipment;
- technical assistance;
- consulting and personnel training;
- assistance in development of internal techniques, regulations and supplier contracts.

## Full configuration of bearing diagnostic laboratory

- unpacking-packing table (2 pcs.);
- demagnetizing and pre-check table;
- set of auxiliary tools (caliper, electro-spark marker, loupe on tripod with illumination, device for fixation of roller without side roller bearings, device for measuring radial clearance);
- table with a tub of disassembly (2 pcs.);
- workbench for SVK-A stand;
- diagnostic station (personal computer, printer);
- table for the diagnostic station;
- table with a bath for washing and preservation (3 pcs.);
- rack for bearing storage (2 pcs.);
- climate control system.

## Laboratory for incoming inspection of rolling bearings



*unpacking-packing table, 2 pcs.*



*demagnetizing and pre-check table with tools*



*table with a tub of disassembly, 2 pcs.*



*table with a bath for washing and preservation, 3 pcs.*



*table with diagnostic station (personal computer, printer)*



*workbench and SVK-A stand*



*rack for bearing storage, 2 pcs.*

## Test fixture for roller and cage-free roller bearings

Designed for testing of roller rollerless anti-friction bearings by means of the SVK-A vibration control bench.

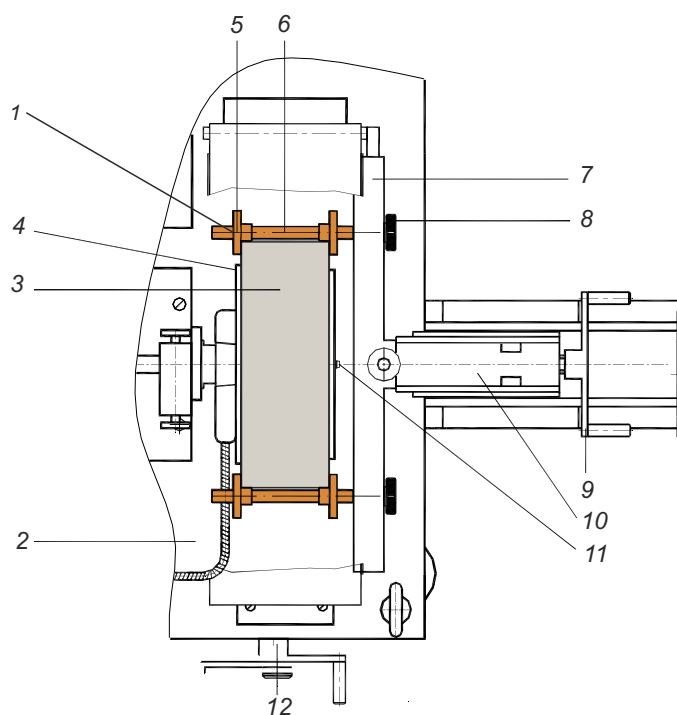


Figure 1. Schematic mounting diagram of flangeless roller bearing holding fixture (top view)

- |                                |                                  |
|--------------------------------|----------------------------------|
| 1. Bearing test device         | 8. Retaining nut for holder rod  |
| 2. SVK-A test rig              | 9. Axial loading machine wheel   |
| 3. Bearing under test          | 10. Axial loading machine        |
| 4. Collet                      | 11. Collet bolt                  |
| 5. Movable stop                | 12. Radial loading machine wheel |
| 6. Holder rod                  |                                  |
| 7. Axial loading machine plate |                                  |



This fixture consists of two holders for outer race with each having movable stop and holder rod.

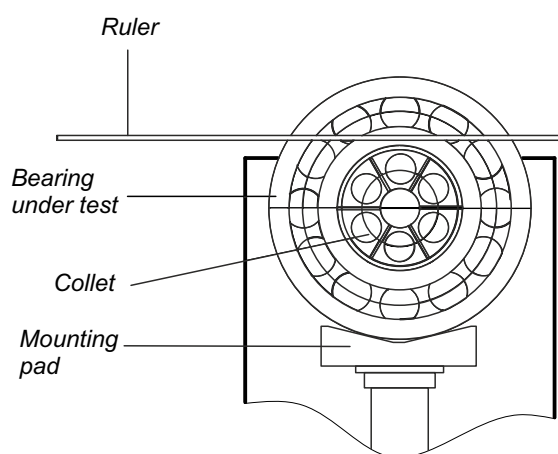


Figure 2. Installation diagram for the test device of roller flangeless bearings (side view)

Before diagnosing bearings when installing the device, align the outer and inner ring of the bearing to be inspected using a metal ruler, setting it in accordance with figure 2.

## Specification

### Main parameters

Minimum outer diameter of the bearing under test, mm	80
Maximum outer of the bearing under test, mm	320
Maximum bearing width, mm	90

### Performance

Operating temperature range, °C	20 ± 15
Relative humidity (at 25°C), %	95

### Design parameters

Dimensions, mm	160
Weight, g	440

### Manufacturer's warranties

Warranty period, month	18
Service life, years	10

## Device for measurement of the radial clearance of the bearings

The thermal (radial) clearance of the bearing is the most important parameter that must be controlled. Failure to comply with this parameter can lead to overheating and seizure of the bearing. And this, in its turn, leads to the need to restore the shaft and/or the hole in the housing, or to even more complex and expensive equipment maintenance. Often such situations end with a **stop of the technological process** or even a fire.

Research and Production Enterprise "TIK" has developed an **inexpensive, simple and effective device** that allows you to make sure that the radial clearance of the bearing complies with the standard and to protect industrial machines from breakage or fire.



*Design of the device with replaceable clamps*



*Types of sizes of the replaceable clamps*

The device contains a **steel base** with **support ribs** on which, with the help of a **replaceable clamp** and a **bolt**, the tested bearing is fixed. The radial clearance is measured using an **indicator** (a clock or digital type) located on a **movable holder**.

During the measurement of the radial clearance, the tip of the indicator is brought to the outer surface of the bearing outer ring. By shifting the outer bearing cage in the direction of the axis of the indicator in the forward and reverse direction, the maximum and minimum readings are determined. The radial clearance is defined as the difference between the maximum and minimum readings of the indicator.

In order to compensate possible non-roundness of bearing outer and inner rings, the procedure is repeated several times in different angular positions.

The radial clearance is measured by method "A" in accordance with **GOST 520-2011**.

### Features

- a set of three replaceable clamps for bearings of various sizes;
- two highly accurate indicators as an option (clock type or digital);
- simplicity and convenience in operation;
- small overall dimensions and weight.

## Technical characteristics

### Basic parameters

Bearing inner seat diameter, mm	35-150
Bearing outer diameter, mm	55-320
Bearing width, mm	10-106
Indicator division value, mm	0.01 / 0.001

### Package content

Device, pcs	1
Indicator (clock / digital), pcs	1
Set of clamps for installation of bearings, pcs	1

### Operation parameters

Range of operating temperatures, °C	20±15
Relative humidity, at 25 °C, %	80

### Design parameters

Dimensions, mm	450x330x100
Weight, without a bearing, kg	14

### Manufacturer's reliability and warranty parameters

Guarantee service life, months	18
Service life, years	10





## Customer feedback on the implementation of the SVK-A stand

### “Energo-Gas-Noyabrsk”, OJSC

“...The rig integration has significantly improved machinery performance in the whole. There are no any more equipment failures because of faulty bearings. The time between repairs of the equipment with bearings accepted for use “without limitations” has increased. The number of purchase bearings has reduced...”

*V.A. Olkhov, Chief Engineer*

### “Electrotyazhmash-Privod”, LLC, Lysva

“...suppliers change bearings that were rejected during incoming inspection...SVK-A implementation made it possible when inspecting to detect bearings nonconforming to standards and technical documentation (GOST, TU) by clearance or having unwanted sounds...”

*P.G. Shuklin, Deputy Quality Assurance Director*

### “Volgogradneftemash”, OJSC

“Shift to foreign-made bearings has decreased a rejection rate to almost zero. The excessive vibrations source has been eliminated during our assemblies testing... We use the rig to check bearings which are parts of the equipment we produce, as well as to check bearings used in the plant energy services...”

*S.I. Usachev, Chief Process Engineer*

### “Surgutneftegas”, OJSC

“...We have not faced any problems or rig failures during the period of usage. Each year TIK specialists perform full maintenance works on test rig, and it's all OK.

Experience of rig utilization allows us to say, that this equipment meets stated requirements and proves to be fully equal to imposed tasks.

The SVK-A test rig has permitted us to reduce maintenance and shutdown expenses for critical units through prompt detection of defective bearings.

We recommend using this equipment as diagnostic and quality evaluation tool for rolling bearings”.

*N.L. Zhuravsky, Chief Mechanical Engineer*

### “Inter Podshipnik Group”, CJSC

“An exclusive distributor of FBJ bearings (Japan) advices to use TIK technologies for incoming inspection of rolling bearings. SVK-A vibration diagnostic rig demonstrated its best qualities while using such technologies at incoming inspection of bearings at different companies”.

*R.K. Kazyev, General Director*

### “Concern Uralelectroremont”, OJSC, Yekaterinburg

“...Implement of test rig like SVK-A allowed for cost saving for repeated repairs of bearing assemblies due to early detection of defective bearings...”

*V.A. Lappo, Deputy General Director*

### “Kaustik”, OJSC, Sterlitamak

“Since comissioning in 2008 there were 4355 bearings tested on the rig, where 1318 pieces were found to be faulty, which translates into 30% of defective goods. Laboratory diagnostics provides full operation cycle to control rolling bearing quality, preventing thereby bearings, which are not satisfactory following the results of vibration monitoring and diagnosis, from entering into service. The rig features stable and reliable operation”.

*D.F. Akhmetshina, R.N. Kozlenkova, Inspectors, Quality Control Dept.*

*A.S. Tupikin, E.V. Vorfolomeev, E.Sh. Zubairov, Diagnostics Engineers*

### “Donetsky Electrotechnical Plant”, PJSC

“...“DETP”, PJSC has purchased SVK-A test rig for vibration monitoring of rolling bearings and put it into service.

During the period of operation we managed to:

1. Compile a list of producers and suppliers of bearings, that meet our requirements in a most appropriate way;
2. Reduce the amount of reclamations related to the bearing failures to almost zero;
3. Enhance design, process and production discipline, also the same for a company products quality degree in the whole.

These achievements are due in large part to the SVK-A Test Rig, which your team has developed. Thank you and your TIK team for the work performed. I wish you to never stop at what has been achieved and continue your fruitful activity in the domain of reliable rolling bearing diagnostics”.

*A.L. Samoilenko, Quality Assurance Director*

### Nadymkaya Power Distribution Station, Engineering and Technological Center

“For many years in our activity we use diagnostic equipment produced by your company. This equipment is notable for good quality, high performance and ease of use that enable early detection of defects in manufacturing facilities.

In this regard I would like to thank you personally and your company, and wish you success and further prosperity”.

*A.A. Stolbovoy, Head of Nadymkaya Power Distribution Station*

## Approval documents

Pattern Approval Certificate of Measuring Instruments №70743-18 for vibration control stands of rolling bearings SVK-A

Valid until 28/03/2028



Certificate of type approval of measuring instruments for vibration control stands of rolling bearings SVK-A in the Republic of Kazakhstan № 1656.

Registered in the register of the state system for ensuring the uniformity of measurements of the Republic of Kazakhstan 10.02.2023r, № KZ.02.03.08204-2023/70743-18

Valid until 28/03/2028



Certificate of type approval of measuring instruments for the vibration control stand of rolling bearings SVK-A in the Republic of Belarus № 16265.

Type of measuring instruments approved by the State Committee for Standardization of the Republic of Belarus from 3/31/2023 № 22

Valid until 28/03/2028



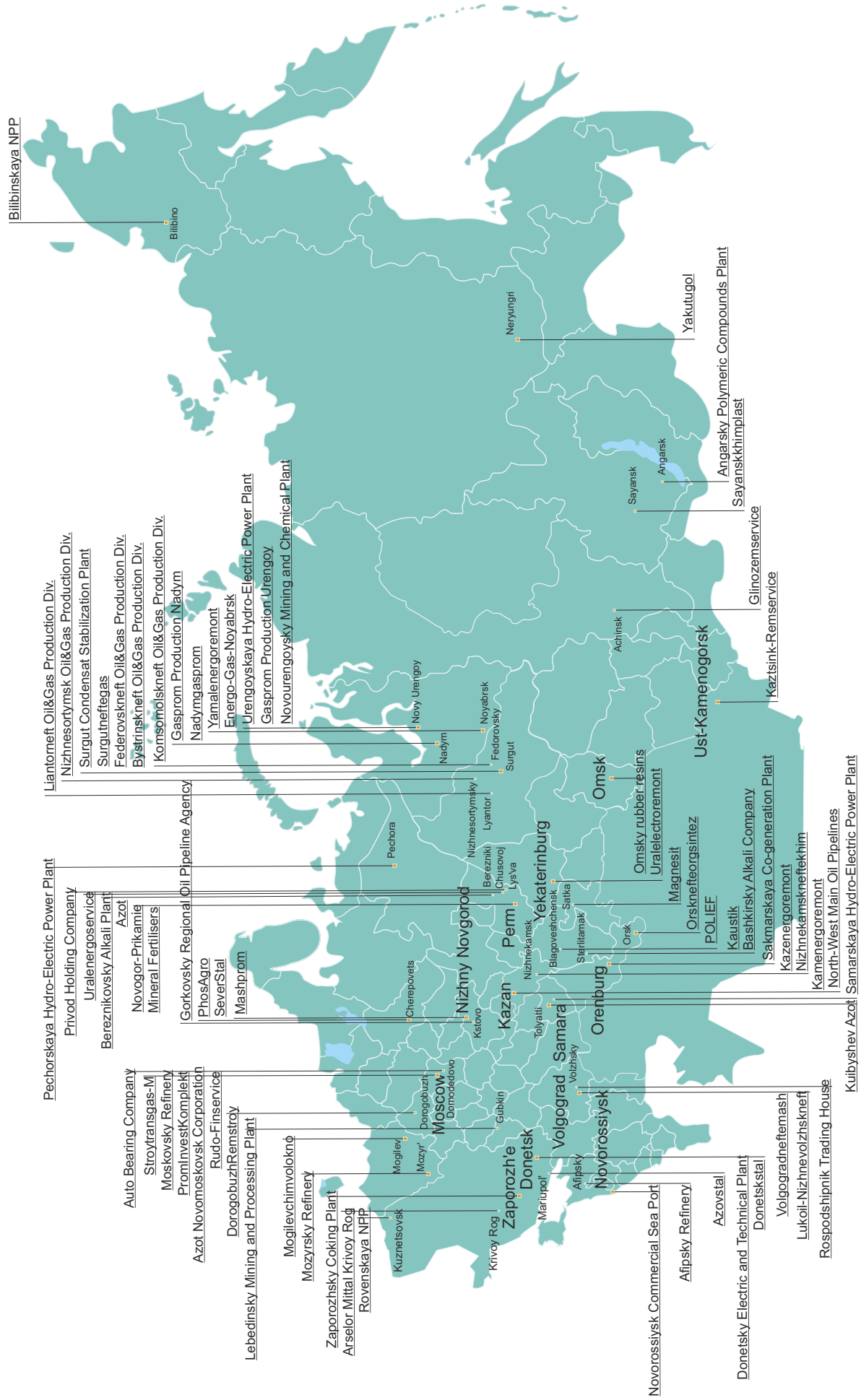
Statement of compliance EAЭC № RU Д-RU.PA05.B.45263/22 for vibration control stands of rolling bearings SVK-A.

Meets the requirements of the Technical Regulations Customs Union TR CU 020/2011 "Electromagnetic compatibility of technical means", TR CU 004/2011 "About the safety of low-voltage equipment"

Valid until 08/08/2027



# SVK-A test rig implementation geography





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