

# USO-1TM

## SCANNING DEVICE

for ultrasonic testing  
axles of wheelsets of freight and passenger cars



## MANUAL

VLNG 135-01 RE

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The **USO-1TM** scanning device has two versions:

- **USO-1TM** – for control of axes of RU-1 and RU-1SH types
- **USO-1TM (RV2SH)** – for control of axles of type RV2SH

When **USO-1TM** operates in conjunction with an ultrasonic flaw detector **TOMOGRAPHIC 5M**, all inspection zones are passed in one revolution of the wheelset, with the construction of tomography of the controlled axis and determination of coordinates (x, y) of defective areas.

When **USO-1TM** operates in conjunction with other standard ultrasonic flaw detectors, the control zones are switched manually; to control each zone, it is required to switch the switch to the position corresponding to the controlled control zone, load the flaw detector setting and perform one pass of the device along the axis. Due to the lack of the possibility of connecting a coordinate device, the construction of tomography is impossible.

# 1 MANUAL

## 1.1 Introduction

**1.1.1** This operation manual contains operational information and basic technical characteristics of the **USO-1TM** scanning device for ultrasonic testing of wheelset axles of freight and passenger cars and is intended as a guideline for workers and engineers who carry out ultrasonic testing at railroad car enterprises.

**1.1.2** The developer and manufacturer of **USO-1TM SPC «NPK» TECHNOVOTUM» Ltd**, Moscow.

**1.1.3** When performing ultrasonic testing, along with this operation manual, the following regulatory and technological documents should be used:

- operating manual for the used flaw detector;
- STO RZD 1.11.002-2008 «Non-destructive testing. Elements of wagon wheelsets. Technical requirements for ultrasonic testing»;
- STO FPK 1.11.001-2011 «Non-destructive testing system at JSC FPK. Elements of wheelsets of 1520 mm gauge passenger cars. Requirements for ultrasonic testing»;
- PR NK V.2 - 2013 «Rules for non-destructive testing of parts and components of wheelsets of cars during repair. Special Requirements»;
- technological instructions and operational (technological) charts regulating the preparation and ultrasonic testing of wheelset axles.

## 1.2 Purpose

**1.2.1** The scanning device **USO-1TM** (hereinafter referred to as the device or **USO-1TM**) is a component of the ultrasonic inspection system designed for ultrasonic testing of wheelset axles of freight and passenger cars using the ultrasonic flaw detector **TOMOGRAPHIC 5M** or others standard ultrasonic flaw detectors.

There are two modes of operation:

- multichannel operation mode (for **TOMOGRAPHIC 5M** flaw detectors),
- single-channel operation mode (for other standard ultrasonic flaw detectors).

**1.2.2** The device can be used for ultrasonic testing of new and used wheelset axles.

**1.2.3** The device provides installation of piezoelectric transducers (PEP) on the pre-approach part of the cylindrical surface of the axis with a fixed distance between them and a fixed angle to the axis.

**1.2.4** Climatic version of the device - UHL 4.2 (GOST 15150-69).

**1.2.5** An example of recording a device when ordering it: Scanning device **USO-1TM (RV2SH)** TU 4276-008-37084240-10.

## 1.3 Technical data

**1.3.1** The control object is the axles of the wheelsets of freight and passenger cars. Axle type - RU-1, RU-1Sh (RU-1 version), RV2Sh (RV2Sh version). The monitored zones, variants of the ultrasonic inspection method of the axles of wheel pairs and the used transducers from the kit are presented in **Table 1**.

Table 1

Controlled areas and method options	Type of probe used	Defects detected
BR1 - zone of fillet transition of the neck to the pre-apical part of the axis	2 P121-5,0-65°, working on separate scheme	type 423 (crack in the fillets of the necks and the pre-axle parts of the axle);
BR2 - the area of the neck between the rings p/w	P121-2,5-43°	type 422 (crack in the necks and pre-accessible parts of the axle);
BR3 - outer edge of the wheel hub	P121-2,5-19°	type 421 (crack in the axle bearing)
BR4 - inner edge of the wheel hub	P121-2,5-55°	

**1.3.2** Probe parameters – according to TU 4276-001-29313470-06

**1.3.3** Overall dimensions of the device, mm, no more

length x width x height, mm	457 x 395 x 140
working part radius	
- version RU-1, mm	83
- version PB2W, mm	93

**1.3.4** Weight, kg, no more .....2,6

**1.3.5** Installed trouble-free operating time, h, not less.....1600

**1.3.6** Average service life, years, not less.....5

#### 1.4 Product composition and includes

The completeness of the device is determined by **Table 2**.

Table 2

Document designation	Name and symbol	Quantity, pc
VLNG 135 - 01	Scanning device USO-1TM	1
(are part of VLNG 135-01)	P121-5,0-65-USO	2
	P121-2,5-43-USO	1
	P121-2,5-19-USO	1
	P121-2,5-55-USO	1
-	Connecting cables (set)	1
VLNG 135.06/08	Spring	1
VLNG 135 - 01 RE	Manual	1 pc
Package		1

#### 1.5 Device and principle of operation

General view of **USO-1TM** is shown in **Fig. 1**. The names of the main elements of the device are presented in **Table 3**.

In the cage (position 11) there are transducers (position 12), fixed in the sockets of the cage. The clip is marked with numbers. Each type of probe is installed in the corresponding socket. The meanings of the marking signs are presented in **Table 4**.

The position of the probe in the holder can be adjusted. All probes are spring-loaded for uniform clamping to the axle surface. The handles (positions 1 and 2) are intended for setting the **USO-1TM** in the working position and holding it in this position during control.

A spring-loaded mounting lever (position 9) is attached to the cage, fixing the **USO-1TM** on the axis. When mounted on an axle, the set lever is retracted with a handle (position 2).

The path sensor (position 10) is designed to determine the position of the device on the axis.

The operating mode switch (position 26) is designed to select between multi-channel or single-channel control schemes.

The **USO-1TM** electrical connection diagram is presented in **APPENDIX 1**.

The path sensor and the probe are connected to the channel multiplexer (item 8) by means of cables with connectors (item 4), the connectors on the multiplexer cover are marked. The designation of the connectors is shown in **Table 4**.

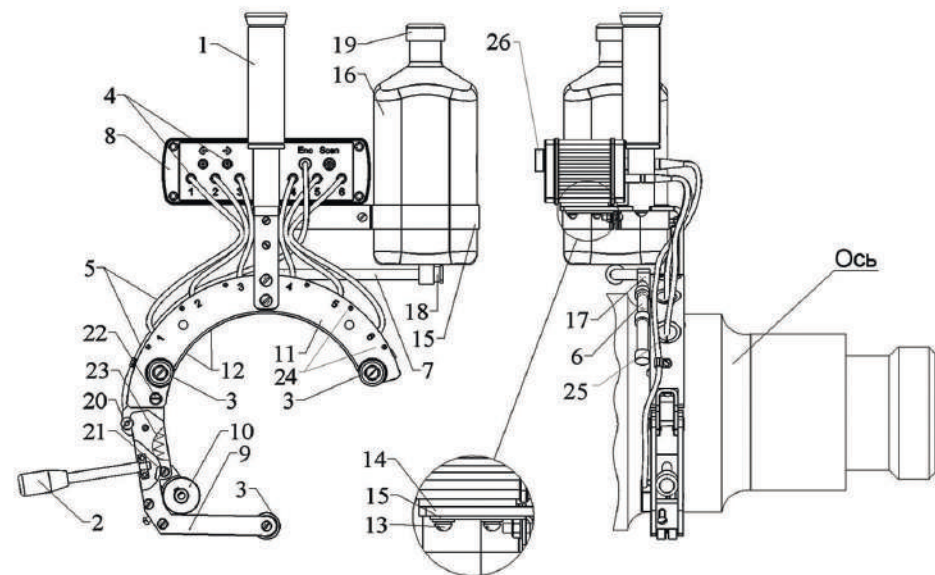


Fig. 1

**Note:** the image of the axis in the figure (Fig. 1) is shown conditionally.

Table 3

Name	Position	Name	Position
Handle	1	Screws	13
Handle	2	Staple	14
Support rollers	3	Clamp	15
Connectors	4	Tank	16
Electric cables	5	Accumulator	17
Distribution pipes	6	Faucet	18
		Bung	19
Inlet pipe	7	Detent	20
Multiplexer	8	Axle	21,22
Positioning lever	9	Setting arm spring	23
Distance sensor	10	Locking screws	24
Holder	11	Bung	25
PEP	12	Gallet switch for operating modes	26

Table 4

Marking sign	Purpose
«1», «65»	P121-5.0-65-USO connection
«2», «43»	P121-2,5-43-USO connection
«3», «19»	P121-2,5-19-USO connection
«4», «55»	P121-2,5-55-USO connection
«5»	Reserve socket
«6», «65»	P121-5,0-65-USO connection
«Enc»	Connecting the distance sensor
«Scan»	Connection to the scanner connector of the flaw detector
«(←»	Connection to the socket of the flaw detector generator
«(→»	Connecting to the flaw detector receiver socket
«M, BR1....BR4»	Probe switching between single-channel and multichannel operation modes

## 1.6 Safety instructions

### WARNING!

**Contact with conductive liquid (for example, water) on the multiplexer connector pins (Fig. 1, position 4) is unacceptable.**

Also, beware of water getting inside the multiplexer housing (Fig. 1, position 8) when installing the tank (item 1.8.4), when the screws (Fig. 1, position 13) have been removed from the threaded sockets.

**1.6.1** Persons who are familiar with its design within the scope of this manual and have undergone practical training in control techniques with its use are allowed to work with the device.

**1.6.2** When performing control, beware of tightening clothing between the controlled wheelset and the rollers of the wheelset rotation drive. The working clothes of the operating personnel must not have hanging elements.

**1.6.3** When operating and maintaining the device, use only standard tools.

## 1.7 Preparation for work

**1.7.1** Requirements for service personnel.

**1.7.1.1** Inspection with the use of the device and its adjustment should be carried out by workers who have passed the test in the amount of knowledge of this operating manual and who have experience working with flaw detection devices of industrial installations.

**1.7.1.2** Repair and maintenance of the device must be carried out by a mechanic mechanic of at least the fourth grade.

**1.7.2** The workplace for the control must be equipped with a technical means for the installation and rotation of the controlled wheelset with a frequency of no more than 10 rpm.

**1.7.3** Preparing the device for work every shift.

**1.7.3.1** Inspect the device and make sure there is no mechanical damage.

**1.7.3.2** Check the ease of rotation of the support rollers (Fig. 1, item 8).

**1.7.3.3** Check the lever travel (position 9), as well as the free movement of the probe in the cassettes and their reliability.

**1.7.3.4** If necessary, carry out maintenance, cleaning and lubrication of the necessary components.

**1.7.3.5** Check the ease of movement of the distance sensor (item 10) and the ease of rotation of its roller.

**1.7.3.6** Check the degree of wear of the working surfaces of the probe. Replace the worn out probe if necessary.

**1.7.3.7** Check the correct connection of the probes and path sensor connectors to the channel multiplexer.

**1.7.3.8** Connect the flaw detector cables to the corresponding connectors of the channel multiplexer.

## 1.8 Operating procedure

### 1.8.1 Basic provisions

1.8.1.1 Select the operating mode by the position of the operating mode selector (Fig. 2).

There are two modes:

- multichannel operation mode (for **TOMOGRAPHIC 5M** flow detectors) - switch position «M»,
- single-channel operation mode (for standard ultrasonic flow detectors) - by the position of the switch «BR1 ... BR4».

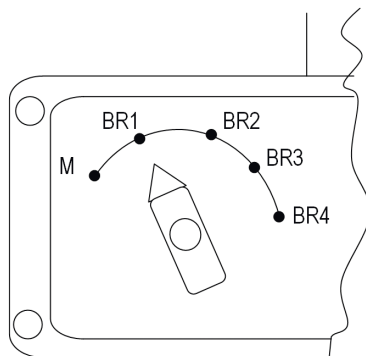


Fig. 2

1.8.1.2 In the multichannel operation mode, the **TOMOGRAPHIC 5M** flow detector in automatic mode, using a multiplexer, is connected in turn to the transducers in accordance with schemes 1 ... 4 (Fig. 3). Switching is carried out with the frequency of the operating cycle of the **TOMOGRAPHIC 5M** flow detector. In each case, the flow detector setting corresponding to the connected transducers is automatically loaded.

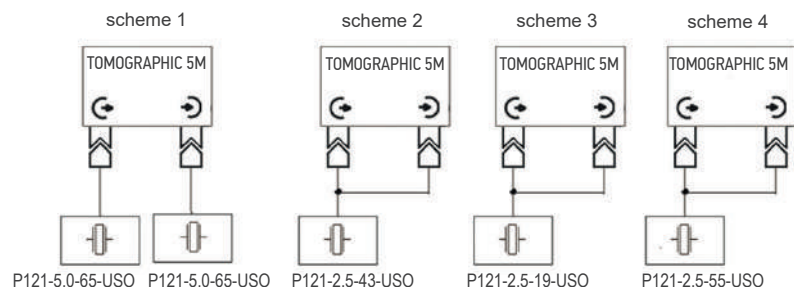


Fig. 3

1.8.1.3 In single-channel operation mode, the converters are switched manually using a switch located on the rear panel of the multiplexer (Fig. 1, item 26). In this case, the positions «BR1 ... BR4» correspond to schemes 1 ... 4. The loading of the setting corresponding to the connected converters must be carried out by the operator.

### 1.8.2 How to work

1.8.2.1 Place the wheelset on a unit that allows it to rotate.

1.8.2.2 Take the device by the handle (Fig. 1, pos. 1) and, placing it on the outer side of the wheelset, pressing the handle pos. 2 in the upper position, set on the pre-riser part of the axle.

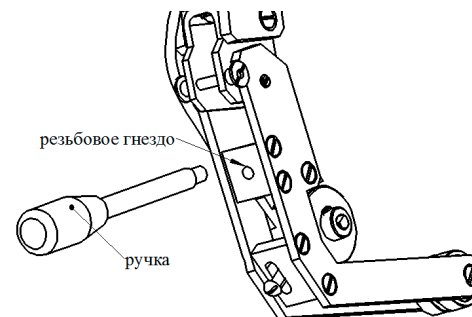


Fig. 4

**Note:**

If the handle during transportation the device has been removed, install it in the threaded socket, screwing in until it stops (Fig. 4).

1.8.2.3 Press the handle pos. 2 down, fix the device on the axle so that the spring-loaded support rollers 15 are pressed against the axle and the spring-loaded wheel pos. 14 and the roller of the path sensor pos. 10.

1.8.2.4 Make sure the transducer has an acoustic contact.

1.8.2.5 Apply the couplant with a brush along the entire path of the device. Move the device around this zone.

**Note:** if the couplant is water, follow the recommendations of paragraph 1.8.4.

1.8.2.6 Turn the wheelset so that the sensor makes a circle.

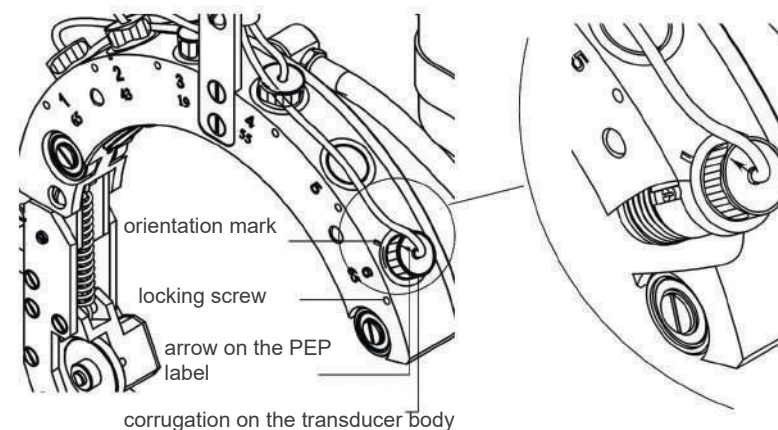


Fig. 5



**Notes:****To adjust the position of the probe:**

- loosen the locking screw,
- holding by the grooved area of the body (**Fig. 5**), turn the probe so that the arrow on the probe label is directed to the orientation mark on the holder,
- tighten the locking screw.

**To replace the probe:**

- disconnect the electrical connector of the transducer,
- loosen the locking screw (**Fig. 6**),
- unscrew the threaded bush with the groove by turning the grooved body of the probe counterclockwise (**Fig.6a**),
- release the threaded bushing and the spring by unscrewing the guide screw from the probe body,
- first put on the spring on the new probe, passing the cable through it, then the threaded bushing, screw the guide screw into the probe body (**Fig.6b**),
- install the probe into the corresponding socket in the cage (the spring must rest on the flange of the probe body, the guide screw on the probe body must fit into the groove of the threaded bushing – **Fig.6a**), screw in the bushing by rotating the corrugated body,
- connect the connector according to the diagram (**APPENDIX 1**).

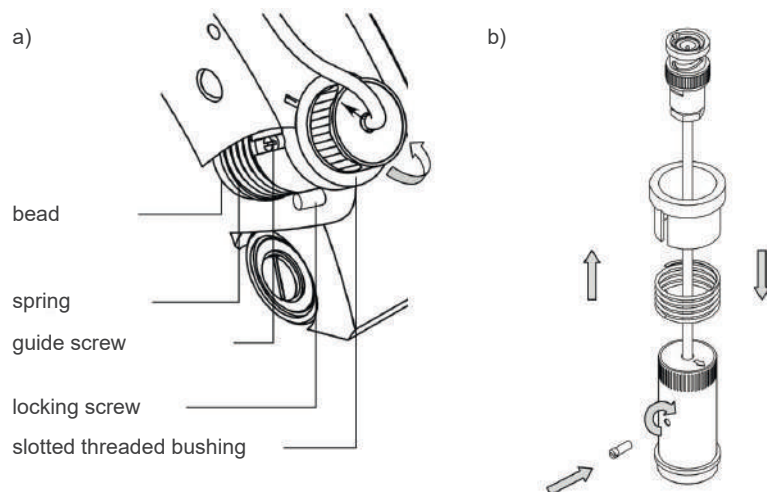


Fig. 6

**1.8.2.7** Connect the next converter and carry out the operations according to items 1.8.2.5-1.8.2.6.

**1.8.2.8** Install the device on the opposite side of the wheelset axle and perform the operations as described in items 1.8.2.4 -1.8.2.7.

**Note:**

- 1) Setting up the flaw detector and the procedure for performing testing are described in the Technological instructions for ultrasonic testing of wheelset axles of cars using the **TOMOGRAPHIC 5M** flaw detector in accordance with STO RZD 1.11.002-2008, STO FPK 1.11.001-2011 or PR NK V.2 - 2013;
- 2) When working in conjunction with the TOMOGRAPHIC 5M ultrasonic flaw detector in specialized software, the control zones are switched automatically, all zones are controlled simultaneously in one pass of the device

along the axis with the construction of tomography and obtaining the coordinates (x, y) of the defective area.

3) When working in conjunction with a standard ultrasonic flaw detector, the control zones are switched manually; to control each zone, it is necessary to load the corresponding setting and perform a passage of the device along the axis for each zone. Due to the lack of the possibility of connecting a coordinate device, the construction of tomography is impossible.

**1.8.3 Control stages**

- control from the cylindrical surface of the axis by transverse waves in the axial direction when installing the separately-aligned probe on the pre-bearing part and scanning along the perimeter of the axis in order to detect transverse cracks in the relief groove and under the inner edge of the bearing ring;
- control from the cylindrical surface of the axis by transverse waves in the axial direction when installing the probe on the pre-step part and scanning along the perimeter of the axis in order to detect transverse cracks between the bearing rings;
- control from the cylindrical surface of the axle by longitudinal waves in the axial direction when installing the probe on the pre-bearing part and scanning along the perimeter of the axle in order to detect transverse cracks in the area under the outer edge of the wheel hub;
- control from the cylindrical surface of the axle by transverse waves in the axial direction when installing the probe on the pre-bearing part and scanning along the perimeter of the axle in order to detect transverse cracks in the area under the inner edge of the wheel hub.

**1.8.4 How to work if the contact liquid is water**

**1.8.4.1** Remove the screws (**Fig. 1**, item 13) that secure the multiplexer (item 8) to the bracket (item 14).

**1.8.4.2** Without changing the position of the multiplexer, attach the clamp (position 15) with the reservoir (position 16) to the multiplexer by threading the screws through the bracket (position 14).

**1.8.4.3** Connect the reservoir (item 16) to the manifold (item 17) by pushing the tube (item 8) all the way onto the manifold fitting.

**1.8.4.4** Tank (position 16), fill with water (GOST R 51232-98):

- close the tap (position 18), and unscrew the top plug (position 19) on the tank;
- fill the tank with water;
- tighten the plug.

**1.8.4.5** Mount the device on the axle, following paragraphs 1.8.2.1-1.8.2.4.

**1.8.4.6** To supply the couplant (water), open the tap (position 18) one and a half to two turns and unscrew the top cap of the tank half a turn. Water begins to flow into the control area.

**1.8.4.7** The water flow can be adjusted by unscrewing the plug more or less.

**1.9 Possible malfunctions and ways to eliminate them**

**1.9.1** Possible malfunctions of the device and methods of their elimination are presented in **Table 5**.

Table 5

Malfunction	Probable cause	Remedies
1. Decrease in the quality of acoustic contact	Contamination of the working surface of the probe	Clean the probe according to paragraph 2.1.2.3.
	Lack of contact of support rollers (Fig. 1 pos. 15) with the axle surface	Press the device against the axle, check the operation of the adjusting lever pos. 13.
2. Uneven sliding of the device along the axis	Contamination of the support rollers position 15	Clean the support rollers, lubricate
3. Path transducers does not work	The roller of the path sensor (encoder) pos. 10	Clean position sensor roller, lubricate. Check spring
4. The setting lever, pos. 9	Spring breakage	Replace the spring of the adjusting arm following point 1.9.2

**1.9.2** To replace the spring (Fig. 1, item 23), unscrew the stops (item 20), unscrew the screws securing one of the two “cheeks” of the setting arm (position 9), remove the “cheek”. Reinstall the spring:

- slide one end of the spring onto the axle (key 21),
- reinstall the removed «cheek», secure with screws;
- slide the other end of the spring onto the axle (key 22),
- tighten the stops (key 20).

**Note:** if you need to keep a diary of the movement of the product during operation, you can use the proposed form (Table 6).

## 2 TECHNICAL CERTIFICATE

### 2.1 Technical support

#### 2.1.1 General information

**2.1.1.1** Maintenance of the unit includes cleaning, inspection, adjustment and lubrication.

**2.1.1.2** Maintenance intervals - as needed.

#### 2.1.2 Cleaning

**2.1.2.1** Clean the device (except for the probe) from traces of fuel oil and other contaminants with a textile rag, then wipe it with cotton napkins GOST 11680 moistened with water at a temperature of 60 ° C with the addition of soap or synthetic detergents.

**2.1.2.2** Dry with dry cloths or compressed air.

**2.1.2.3** Clean the working surface of the probe with alcohol (GOST R 51723-2001).

### 2.2 Transportation and storage

**2.2.1** The packaged set of the device must be transported in a closed road or rail transport in accordance with storage conditions 3 in accordance with GOST 15150-69.

**2.2.2** The packaged set of the device should be stored in a dry room in accordance with storage conditions 3 in accordance with GOST 15150-69. The storage room must be free of conductive dust, acid and alkali vapors, and corrosive gases.

**2.2.3** The set of the device, received at the consumer's warehouse for storage for up to six months, can be stored in a packaged form.

### 2.3 Disposal

The device does not contain harmful substances. There are no special requirements for disposal.

### 2.4 Precious metal content

The device does not contain precious metals

### 2.5 Manufacturer's warranty

**2.5.1** The manufacturer guarantees the compliance of the device with the requirements of TU 4276-008-37084240-10, provided that the consumer observes the conditions of operation, transportation and storage.

**2.5.2** The warranty period is 6 months from the date of commissioning, but not more than 12 months from the date of receipt by the consumer. Probes and connecting cables are not covered by the warranty.

**2.5.3** The guaranteed shelf life is 18 months from the date of manufacture.





## APPENDIX 1

Diagram of electrical connections and connection of the scanning device **USO-1TM**  
(for **TOMOGRAPHIC 5 M**) (reference)

