




Railway infrastructure diagnostics  
for safety and comfort



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HAND-HELD AND PORTABLE  
DIAGNOSTIC TOOLS, ROAD-RAIL  
TRACK MAINTENANCE VEHICLES



President  
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**AO «Firma TVEMA», a private company, founded in 1989, is the world leader in the development, production and support of the systems for the railway infrastructure diagnostics. The company is the only manufacturer in the world that has in its product range all types of tools for the track superstructure and overhead line diagnostics. It performs the full scope of work on the design, production and maintenance of these tools.**

## COMPANY ACTIVITIES

The company's headquarters, production, maintenance and training centers are located in Moscow, the branch offices operate in Fryazino and Irkutsk, and the regional offices are opened in Ukraine, China and India.

The company has more than 300 employees, almost half are engineers of various profiles. The production and maintenance center with an area of more than 8 thousand square meters includes access tracks, repair and maintenance shops, office and laboratory facilities, indoor and outdoor sites. The center fully meets the requirements of international quality management systems — the general ISO 9001 and the industry-specific IRIS.

Nowadays, dozens of railway companies and subways worldwide operate approximately 390 mobile and over 4,000 hand-held and portable diagnostic tools manufactured by TVEMA. Our innovative products and technologies successfully operate in more than 30 world countries on 5 continents. The company's products can be found on the railways of Russia and Germany, Czech Republic and France, USA and Brazil, Canada and Slovakia, Finland and Bulgaria, Romania and Serbia, Israel and Hungary, Turkey and Mongolia, China and India, Guinea and Libya, Ukraine and Belarus, Kazakhstan and Kyrgyzstan, Turkmenistan and Armenia, Latvia and Estonia. Our products are used in Moscow, St. Petersburg, Novosibirsk, Nizhny Novgorod, Minsk, Almaty, Baku and Beijing subways, at industrial enterprises of large Russian companies: Gazprom Neft, LUKOIL, Severstal, Coal Company Severny Kuzbass, Metalloinvest Holding. Among our clients are the Baikonur

and Plesetsk spaceports and even the children's railway in the city of Novosibirsk.

For about three decades, TVEMA has cooperated with Russian Railways. At the same time, the company made many of its developments in close cooperation with Russian Railways, and on the basis of its decisions made by the order of the Russian government. Products of the TVEMA brand make up three quarters of the all-Russian fleet of mobile diagnostic tools and more than 50% for the CIS countries. Non-production activities worth special noting. For example, a certified "Center for Training of Specialists in Technical Diagnostics" is operating in Moscow. Since 2009, over 7,000 representatives of railways and subways of Russia and foreign countries have been trained here. The developed technical support service and its own personnel training center allow the company to ensure not only the quick commissioning of even the most sophisticated equipment, but also its further trouble-free operation.

*By deciding to cooperate with us, you can be sure that the operation of your railway infrastructure facilities will become safer and more efficient.*



# HAND-HELD AND PORTABLE DIAGNOSTIC TOOLS, ROAD-RAIL TRACK MAINTENANCE VEHICLES

*No matter how long the railway track is — thousands or dozens of kilometers — it must be equally safe for travel, and therefore it is equally in need of constant and high-quality inspection and diagnostics. While on long routes, the use of expensive mobile tools and diagnostic devices for such inspection is economically justified, their use in small, low-density and station sections of the track is not always advisable and almost always economically inefficient. TVEMA specialists solved this problem by mastering the production of a whole line of diagnostic tools designed to monitor the railway infrastructure of low-density railway sections, yard, access and repair tracks of stations and industrial enterprises.*

*These are, above all, portable diagnostic trolleys and hand-held diagnostic tools. They are used both for continuous and local inspection following the mobile diagnostic tool inspections. In the segment of portable rail diagnostic tools, TVEMA offers the customer a complete series of devices allowing to solve the whole range of the railway track operator tasks.*

*To fulfill the tasks of inspection of low-density and yard sections of railways, subway infrastructure and urban rail transport, TVEMA specialists mastered the production of a whole segment of specialized road-rail self-propelled rolling stock based on off-road and all-terrain vehicles. These vehicles allow to carry out low-speed diagnostics and lubrication of low-density and yard sections of the track, perform shunting operations and deliver repair crews to the detected fault location. Due to the road-rail system, they can move both on the motorways and on the railway track.*

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## SPRUT-2 FLAW DETECTION TROLLEYS

*The SPRUT-2 ultrasonic dual rail flaw detector is a perfect tool for the efficient rail testing.*

### PRODUCT PURPOSE AND COMPOSITION

SPRUT-2 is designed for continuous and local inspection of rails, welded joints and turnout elements and for the flaw depth detection. The flaw detector uses innovative ultrasonic rail testing technologies with an adaptive threshold for automatic channel sensitivity adjustment and inspection result evaluation. In its operation, the flaw detector implements an echo-pulse, echo-shadow and echo-mirror measuring methods.

The flaw detector has a built-in geolocation and cellular communication module (LTE/GPS/GLONASS/BEIDOU) for transmitting data to the diagnostic center and a color Touchscreen display with 16,000,000 colors. The product has optimal mass-dimensional characteristics and the trolley design, ensuring an unobstructed passage of any turnouts.

The flaw detector has the following functions:

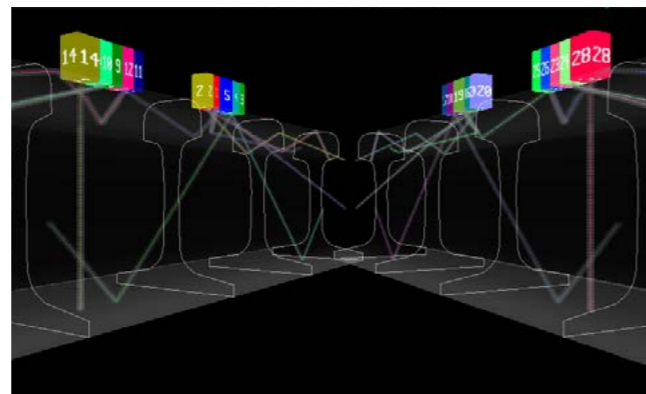
- manual coordinate adjustment by kilometers and railway milestones;
- data visualization in various forms — A-scan and B-scan;
- data rewind during the inspection with the scaling function;
- data presentation in the form of ultrasonic beam travel inside a three-dimensional rail model;



— sound alarms when the permissible inspection speed is exceeded, the acoustic contact is absent, etc.

— ability to remotely monitor the operator work in real time with the screenshot receipt at the controlling party initiative.

The SPRUT-2 flaw detection trolley should be serviced by an operator who has undergone special training to work with it. When working on the line, the operator should be accompanied by track supervisor or track foreman.



### SOFTWARE

The software contains various modules, including a module for automated configuration and a web service in the form of an encrypted cloud server, accessible to authorized users from anywhere in the world. With it, the inspection of the current flaw detector positions and routes on the map, express evaluation of data and download of session files are carried out.

### SCOPE OF APPLICATION

The network of railways, subways, urban transport and industrial enterprises.

### ADVANTAGES

- Use of advanced probe configuration.
- Presence of a control panel with the output of information about the current operation modes.
- Sound and light indication.
- Use of the global positioning system GLONASS/GPS.
- Use of color display.
- Data transfer with USB flash drive and via wireless mobile Internet.

## SKAT-2 AND SOM SINGLE-RAIL FLAW DETECTORS

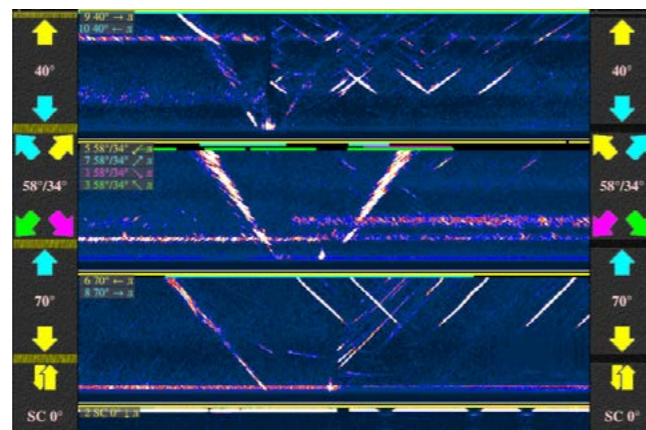
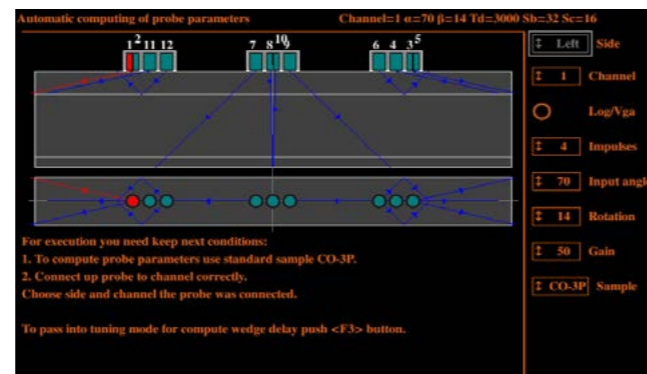
*New single-rail flaw detectors SKAT-2 and SOM developed by TVEMA differ in their functional and operational parameters from similar products of other manufacturers and have a number of advantages.*



## PRODUCT PURPOSE AND COMPOSITION

The single-rail flaw detectors are designed for detection, recording and evaluation of signals from flaws in rails of the sections where testing is difficult or unsafe if conducted on two rails simultaneously (rails located in tunnels, on bridges, near passenger platforms and in places with intensive train traffic). SKAT and SOM allow to perform inspection using the echo-pulse and echo-shadow methods both with transducer blocks and separate manual transducers. The flaw detectors have 14 acoustic channels for continuous inspection and 2 channels for local (manual) inspection, including low-frequency channels. The use of innovative ultrasonic rail testing technology with an adaptive threshold for automatic flaw detector channel sensitivity adjustment and automated inspection result evaluation eliminates the "human factor" influence on the inspection accuracy and results.

The flaw detectors have a built-in geolocation and cellular communication module (LTE/GPS/GLONASS/BEIDOU) for transmitting data to the diagnostic center and a color Touch-screen display with 16,000,000 colors. The products operate without occupying the haul. The products can be carried manually by one person.



## SOFTWARE

The software has an intuitive menu, user-friendly interface and extended functionality. The software has an encrypted cloud server on the Internet, accessible to authorized users from everywhere. With it, the inspection of the current flaw detector positions and routes on the map, express evaluation of data and download of session files are carried out.

## SCOPE OF APPLICATION

The network of railways, subways, urban transport and industrial enterprises.

## ADVANTAGES

- Mobility.
- Sound and light indication.
- Automated piezoelectric transducer parameter setting.
- Prompt inspection data transmission via the Internet.
- Use of the global positioning system GLONASS/GPS.
- Use of color display.
- Display of the rail inspection results on the 3D model.
- Data transfer with USB flash drive and via wireless mobile Internet.

## PT-10 TRACK MEASURING TROLLEYS

*PT-10 trolleys have proven to be reliable assistants to middle-level railway specialists, established a certain standard for the same segment products from other manufacturers and became a basis for development of a number of prospecting systems for railway track inspection and diagnostics.*

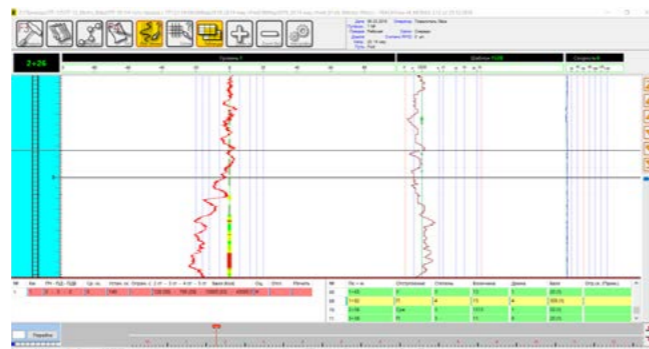
### PRODUCT PURPOSE AND COMPOSITION

Computerized track measuring trolleys of PT series are designed for inspection, recording and digital indication of the current track coordinate values, track gauge width and the crosslevel during the track infrastructure construction, operation and repairs. The trolleys measure the track geometry parameters and process the information in the same format as the track measuring cars, they also allow to perform a full-scale analysis of the current track condition and predict its future condition and possible deterioration. Due to the exhaustive hardware and flexible software, reliable and simple design, allowing to operate them in any climatic conditions, these trolleys are in high demand among railway workers. PT-10 trolleys are produced with a modified touchscreen display and a microprocessor, which uses modern innovative technologies that provide more comfortable working conditions for the operator. The trolleys can be used at the railway sections both with and without automatic block signal system.

The PT-10 track measuring trolleys should be serviced by an operator who has undergone special training to work with it. When working on the line, the operator should be accompa-



nied by track supervisor or track foreman. The product operates without occupying the haul. The product is carried manually by one person.



### SOFTWARE

The software allows data processing to identify the measured parameter deviation from the maintenance standards, received data storing with a qualitative assessment of the track facility condition, forming and exporting the output report forms to the analytical center or service units.

### SCOPE OF APPLICATION

The network of railways, subways, urban transport and industrial enterprises. Computerized track measuring trolleys of the PT series are one of the most popular and high-demand TVEMA products.

### ADVANTAGES

- Simple and original design.
- Mobility.
- Modular design.
- Unique mass-dimensional characteristics.
- Export of received data to operational units.
- Use of the global positioning system GLONASS/GPS.
- Use of color display.
- Operation in a wide range of temperatures.

## PT-12M AND PT-12-01 DIAGNOSTIC TROLLEYS

The diagnostic trolleys PT-12M and PT-12-01 have the extended range of the measured railway track geometrical parameters. PT-12 track measurement trolleys provide the accurate detection of track geometry problems. The trolleys are compliant to actual European, American, Indian and Chinese standards, as well as the standards of CIS countries.

### PRODUCT PURPOSE AND COMPOSITION

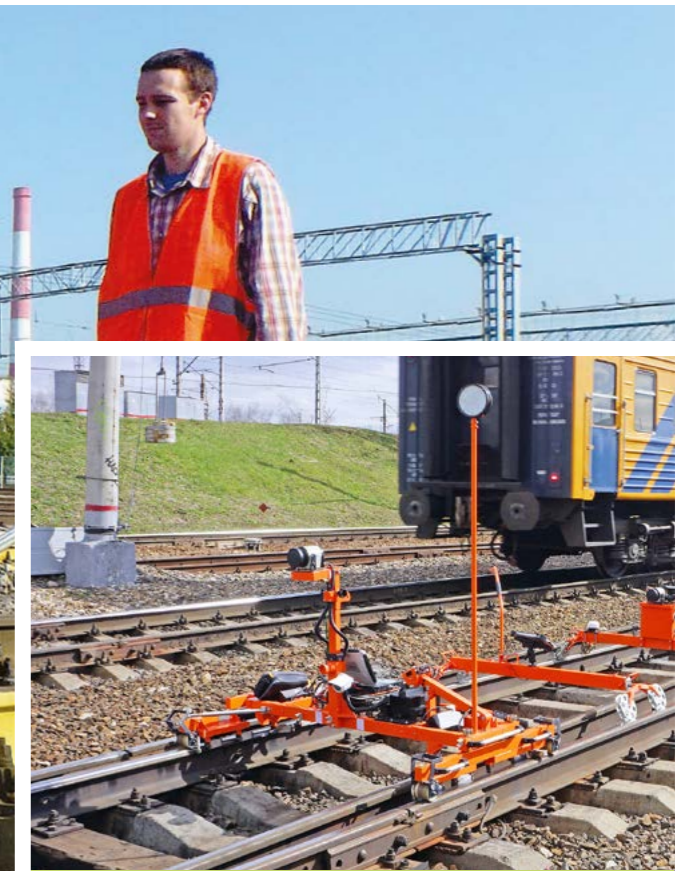
PT-12 delivers all track geometry parameters, including:

- gauge;
- superelevation;
- horizontal and vertical alignment;
- track profile;
- twist.

Additional modules can be installed to provide more functionality:

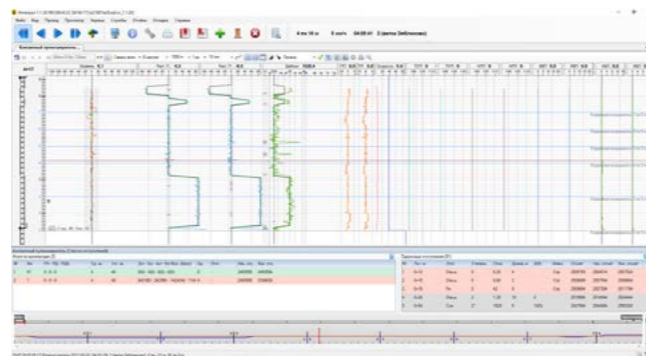
- perform a three-dimensional scanning of the railway infrastructure facilities (bridges, tunnels, platforms, etc.);\*
- perform an automated assessment of the contact rail geometric position (vertical and horizontal)\*;
- perform integrated video surveillance of the track condition\*;
- monitor lateral and vertical wear, canting, inclination of the rolling surface\*;
- perform binding to the track coordinates by kilometer and/or milestones\*.

\* these functions are implemented only in the PT-12M unit.



Product components:

- trolley frame;
- data acquisition and preprocessing system;
- software and hardware;
- workstation with application software;
- power module and charger.



### SOFTWARE

The software collects and processes track geometry data to identify deviations from the maintenance standards with their quantitative and qualitative assessment, stores the received data, generates and exports the output report forms to the analytical center or service units.

### SCOPE OF APPLICATION

The network of railways, subways, urban transport and industrial enterprises.

### ADVANTAGES

- Wide range of monitored parameters.
- Simple design.
- Mobility.
- Long operating life of the measuring equipment.
- Data export to the analytical center and service units.
- Use of the global positioning system GLONASS/GPS.
- Operation in a wide range of temperatures.

## SHEP DIGITAL TRACK GAUGE

*Digital technologies are being increasingly introduced on the railways. In particular, the common track gauge, a tool for measuring the track geometry and turnout parameters, has changed dramatically.*



### PRODUCT PURPOSE AND COMPOSITION

Digital track gauges SHEP are designed to measure, visualize and transmit data for further processing of the railway track and turnout geometrical parameters, as well as to verify and calibrate the measuring channels of mobile track-measuring infrastructure diagnostic tools.

The product is used on the tracks and turnouts of all classes, both in operation and under construction.

Product components:

- rod made of aluminum or modern composite materials, equipped with a handle to carry and abut, as well as to ensure perpendicularity when installing the gauge on the rails;
- sensors for track geometry parameters measuring;
- temperature sensors;
- electronic unit with non-volatile memory and an interface for data managing, visualizing, storing, processing and transmitting. To determine the measurement location, the electronic unit is equipped with the GLONASS/GPS system.

If it is necessary to transfer the measurement results to a remote computer, the SHEP can be supplemented with a smartphone.

The product operates without occupying the haul. The product is carried manually by one person.



### SOFTWARE

The SHEP software consists of two parts: one is installed as a firmware on the electronic unit, the second is installed on a mobile phone/smartphone.

The first, installed directly on the gauge tool, receives, pre-processes and visualizes the data from the electronic unit. The second, installed on the smartphone, ensures the data reception from the tool's electronic unit, their primary processing and storage, visualization, initial filling of the established document forms, as well as the Internet transmission of results to the railway infrastructure management system.

### SCOPE OF APPLICATION

The network of railways, subways, urban transport and industrial enterprises.

### ADVANTAGES

- Wide range of monitored parameters of the turnouts and track sections.
- Simple design.
- Simple interface.
- Mobility.
- Small weight.
- Ability to perform diagnostics of the track with different track gauge width.



## GABARIT-S AUTOMATED SYSTEM FOR STRUCTURAL CLEARANCE INSPECTION

*GABARIT-S was designed specifically for diagnostics of tunnels and artificial structures on low-density yard and access sections of a railway track. At the same time, the system implements the same method of assessing the condition of these facilities, as in the vehicular inspection tools used on the main tracks of railways and subways.*



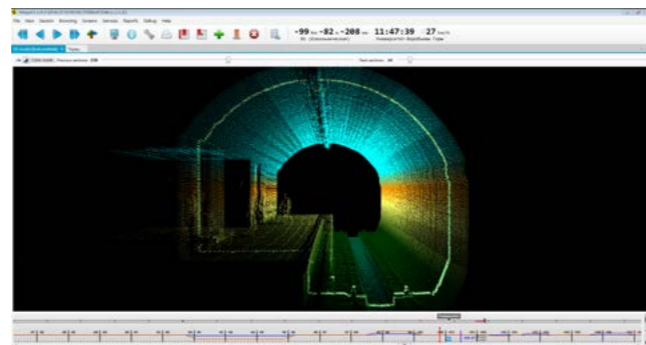
### PRODUCT PURPOSE AND COMPOSITION

The GABARIT-S system is designed for three-dimensional scanning of the surrounding space in order to determine oversized railway infrastructure facilities. The system can be used at the railway sections both with and without automatic block signal system. It has design versions for various track gauge widths and can be operated in different climatic conditions.

Product components:

- non-self-propelled track measuring trolley frame;
- sensor equipment;
- digital signal processing unit;
- video surveillance system;
- software and hardware — a laptop computer with INTEGRAL system and application software, providing the operation during the session;
- workstation with INTEGRAL application software;
- power module and charger.

A digital signal processing unit is used to decode and record the sensor equipment readings. During the operation, the unit connects to a tablet or laptop computer. Its operation is ensured by the accumulator battery. The system operates without occupying the haul. The product is carried manually by one person.



### SOFTWARE

All received information is processed by the INTEGRAL software in real time, recorded and documented for further analysis and planning of works on the routine track maintenance and repair. The program modules form analytical and reporting data on the violations of obstruction clearance, width of inter-track distances, outlines of the ballast section and the roadbed, oversized railway platforms and export the data to the analytical center and service units.

### SCOPE OF APPLICATION

The network of railways, subways, urban transport and industrial enterprises.

### ADVANTAGES

- Simple design.
- Mobility.
- Small weight.
- Ability to perform diagnostics of the track with different track gauge width.
- Manual inspection with automatic identification of the infrastructure facility parameters.
- Recorded data export to the analytical center and service units.
- Use of the global positioning system GLONASS/GPS.

## DRED SERIES SELF-PROPELLED ELECTRIC RAILWAY INSPECTION VEHICLES

*The newest product of the company, designed to monitor and diagnose the infrastructure of low-density sections of railways, subways, urban rail transport, as well as access and receiving and departure tracks of industrial enterprises.*



### PRODUCT PURPOSE AND COMPOSITION

#### Mobile infrastructure diagnostic vehicle DRED

Infrastructure diagnostic vehicle DRED allows to test the railway track sections in the range of operating speeds from 0 to 20 km/h and is a self-propelled trolley on an accumulator battery drive equipped with various inspection and diagnostic systems.

At the customer request, DRED can be equipped with diagnostic systems for:

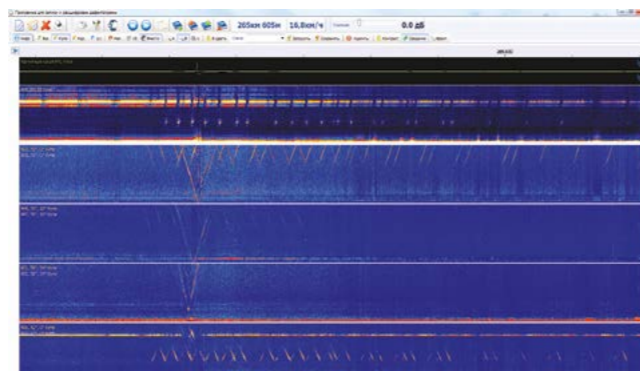
- ultrasonic rail testing;
- rail track geometry inspection;
- railway infrastructure condition visual monitoring;
- railway infrastructure facility three-dimensional scanning.

The vehicle has design versions for various track gauge widths and can be operated in a wide range of climatic conditions.

Depending on the modification, the DRED series railway inspection cars are also capable of solving the following problems:

- ballast section herbicide treatment;

— prompt delivery of track crews and necessary maintenance equipment to the scheduled and urgent work location. The railway inspection car may be additionally equipped with a trailer, almost doubling the loading capacity (up to 1000 kg in total).



### SOFTWARE

It is a smart automated system that ensures recording of primary data on detected faults, its real-time processing, long-term storage and documentation for subsequent analysis.

### SCOPE OF APPLICATION

The network of railways, subways, urban rail transport and industrial enterprise railways.

### ADVANTAGES

- Device compactness.
- Small weight.
- Versatility, depending on the tasks.
- Mobility.
- Environmentally friendly.

## ECHO-PULSE PORTABLE ULTRASONIC FLAW DETECTORS

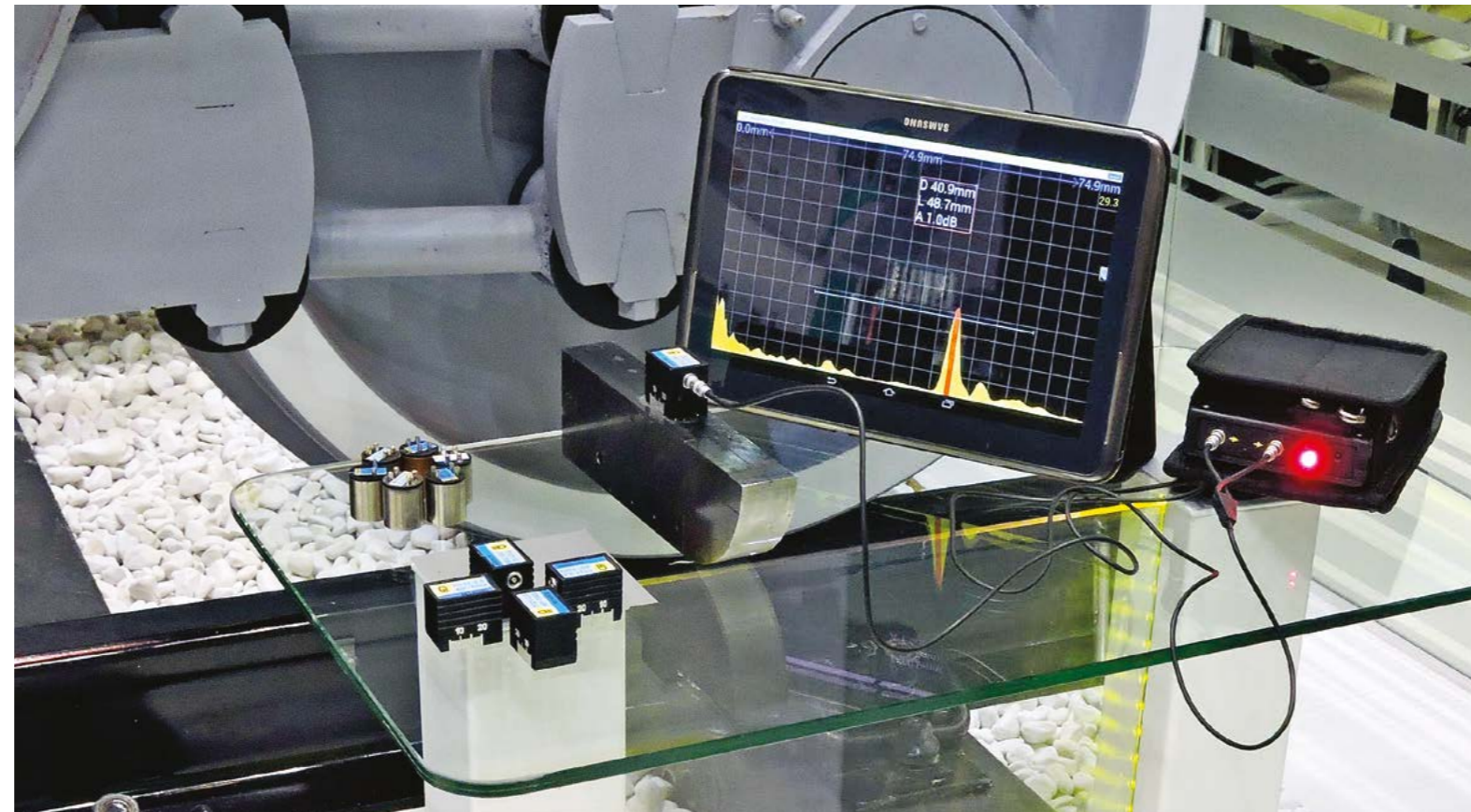
*ECHO-PULSE is a single-channel device for ultrasonic flaw testing using the contact method of introducing ultrasonic vibrations.*

### PRODUCT PURPOSE AND COMPOSITION

The multifunctional flaw detector ECHO-PULSE is designed to perform maintenance operations of the non-destructive testing of metal products, including rails of all types, nodes and parts of the railway transport rolling stock, elements of bridge structures and pipelines. It provides flaw detection in the tested facilities during their manufacture or repair, as well as their location coordinate detection.

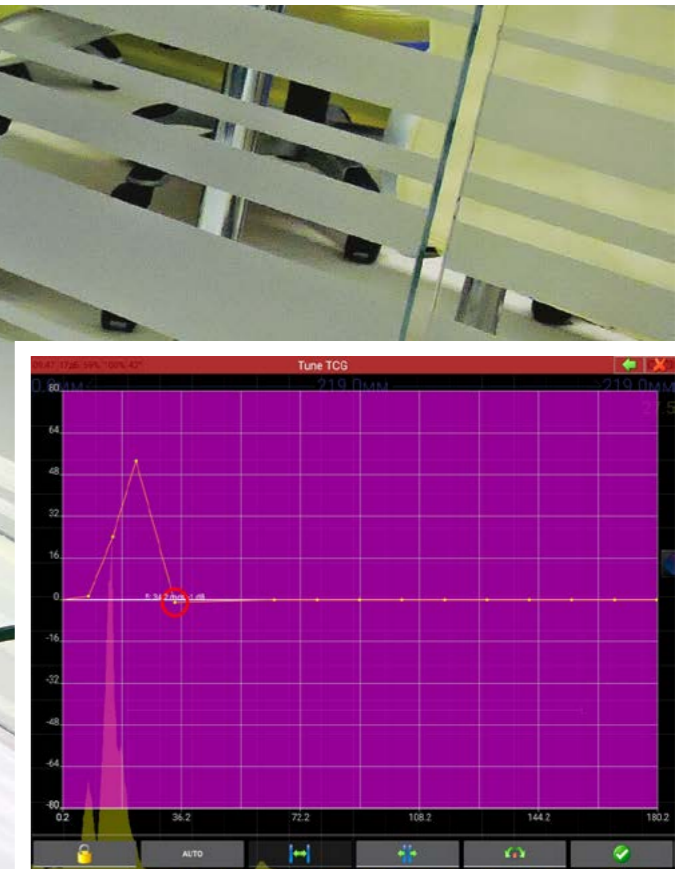
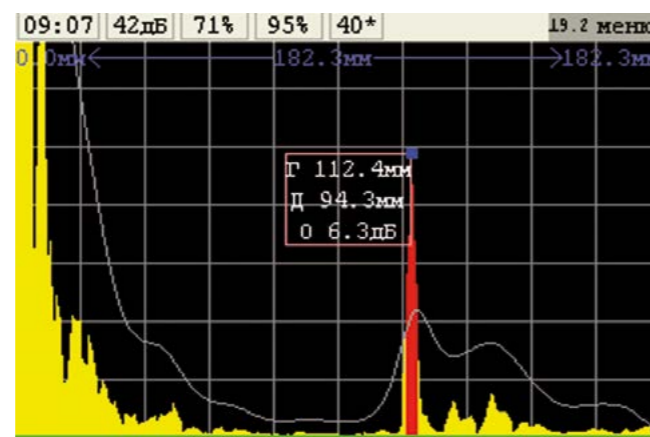
The flaw detector is designed to work in the manual version as the main (standard) ultrasonic testing tool. ECHO-PULSE consists of the flaw detector electronic unit, to which the PETs and a smartphone or tablet with pre-installed software are connected.

The flaw detector provides data display in the form of A-scan and B-scan, data saving, including to portable media, and also transfers the received and processed data via Bluetooth and Wi-Fi. An innovative development is a version of the flaw detector software that runs on Android OS-based devices. The use of such devices allows to bring the inspection quality and convenience to a new level with all associated benefits: instant sending of the inspection protocol in the form of an MMS message or via e-mail; using global positioning data (GLONASS/GPS) for display in the inspection protocol; viewing inspection



documents; viewing previously saved inspection protocols; sending video file with transducer movement record.

The ECHO-PULSE flaw detector complies with the international standard ISO 12710:2002 "Non-destructive testing. Ultrasonic inspection. Evaluating electronic characteristics of ultrasonic test instruments".



### SOFTWARE

The software controlling the flaw detector operation is combined with applications installed on the Android device. For example, it is possible to make calls over the Internet, including video and conference calls, simultaneously with inspection. It is possible to transmit via the Internet the current screen image observed by the operator. The use of a logarithmic amplifier in the device receiver significantly increases the range of displayed echo signals, and the presence of an adaptive threshold depending on the noise level significantly increases the inspection reliability, especially in case of unstable acoustic contact.

### SCOPE OF APPLICATION

The network of railways, subways, urban rail transport and industrial enterprises.

### ADVANTAGES

- Minimum mass-dimensional characteristics.
- Use of smartphone or tablet as a control device.
- Wireless data transmission to the control device.
- Function of screencast with video and sound.
- Use of the global positioning system GLONASS/GPS.
- Prompt data transfer to the operational unit.
- New inspection technology that does not require highly qualified personnel.

## MULTIFUNCTIONAL ROAD-RAIL TRACK MAINTENANCE VEHICLES

*To solve the problems of inspection and maintenance of the small railway track sections in the early 2000s, TVEMA has mastered the production of a whole series of specialized hybrid road-rail track maintenance vehicles based on off-road and all-terrain vehicles of domestic and foreign production.*



### PRODUCT PURPOSE AND COMPOSITION

These vehicles allow to perform a whole range of railway track small section inspection and diagnostics at low speeds, perform shunting work at stations and yard tracks, promptly deliver repair crews with the necessary equipment to the remedial work sites and carry out the rail lubrication procedure. The LDM diagnostic laboratories are equipped with all kinds of diagnostic systems for flaw detection, track measurement, spatial scanning, video inspection, etc. produced by TVEMA.

Due to the hybrid road-rail system, the vehicles can move both on motorways or off-road and on a railway track. All of them also have a traffic safety system and the ability to quickly move from road to rail and back. They can be operated at any time of the year and day in a wide range of temperatures. The traffic safety system allows the use of the track maintenance vehicles on the railway hauls open to traffic. The range of specialized hybrid road-rail track maintenance vehicles is constantly expanding and modifying.



### SOFTWARE

The modular INTEGRAL software collects, displays and analyzes data and forms output lists. Presence of specialized software with a high level of data processing automation increases the crew work efficiency and reduces labor costs. The reports are created automatically.

### SCOPE OF APPLICATION

The network of railways, industrial enterprises, urban rail transport and subways.

### ADVANTAGES

- Independence from the railway track load and traffic schedules due to coming to the work site and back by road.
- Traffic safety system.
- Significant reduction of operating costs.
- Possibility of using standard inspection and diagnostic systems.
- Possibility of using for work as a fully functional vehicle.
- Replacement for expensive shunting rolling stock.

## ULTRASONIC TRANSDUCERS

All ultrasonic testing tools, including those used to diagnose railway infrastructure — from portable to mobile — are based on the principle of resonant conversion of electrical oscillations into acoustic waves. Therefore, the reliability of inspection of nodes and parts of various facilities directly depends on the quality of piezoelectric transducers.

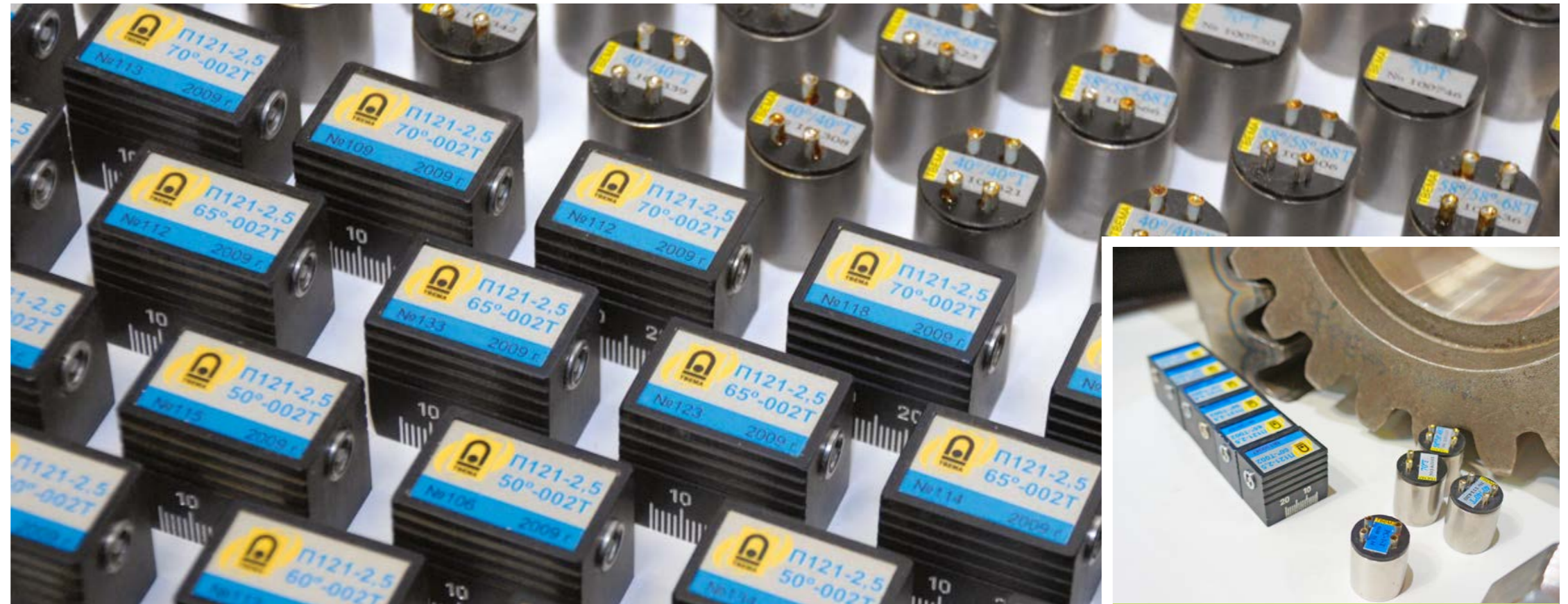
## PRODUCT PURPOSE AND COMPOSITION

Piezoelectric transducers developed and serially produced by TVEMA meet all regulatory requirements and are designed for industrial ultrasonic testing of products for various purposes, both in their manufacture and operation. They are used for both manual inspection and for application in acoustic units of mechanized and automated ultrasonic testing systems.

Depending on the purpose, the company manufactures transducers of various series:

— 001T series is designed for testing surfaces with high roughness or corrosion. The transducers have a steel case with a vertical CP50-73 (BNC) type connector and a circular piezoelectric element with a 12 mm diameter. Size of the working surface — 16x23 mm. Dimensions — 23x16x40 mm (excluding connector dimensions).

— 002T series is designed for testing small and medium thickness products. The transducers of this series have an aluminum alloy housing with a horizontal Lemo 00 type connector and a circular piezoelectric element with a 12 mm diameter. The housing material ensures uniform wear of the entire contact surface, which increases the testing reliability. Size of the working surface — 20x29 mm. Overall dimensions — 31x20x26 mm.



— 003T series. This series is designed for the same purpose as the 002T series. In this case, the transducers are with minimized beam and blind zone and with a 8x9 mm rectangular piezoelectric element. Other than that, the 003T series transducers are identical to the 002T series.



According to expert data, transducers manufactured by TVEMA are among the most reliable and cost efficient. This is not only due to the company's many years of experience in their production, but also due to the strict quality control carried out in the company's own laboratory.

## SCOPE OF APPLICATION

The network of railways, industrial enterprises, urban rail transport and subways.

## ADVANTAGES

- High sensitivity and high signal-to-noise ratio.
- Increased wear resistance.
- Low failure rate when operating in harsh climatic conditions.
- Compatibility by electroacoustic parameters and geometric dimensions with all modern tools of ultrasonic rail flaw detection: from flaw detectors and railcars to portable one- and two-way flaw detectors.