TECHNICAL OFFER

For The Ultrasonic Double Rail Testing System
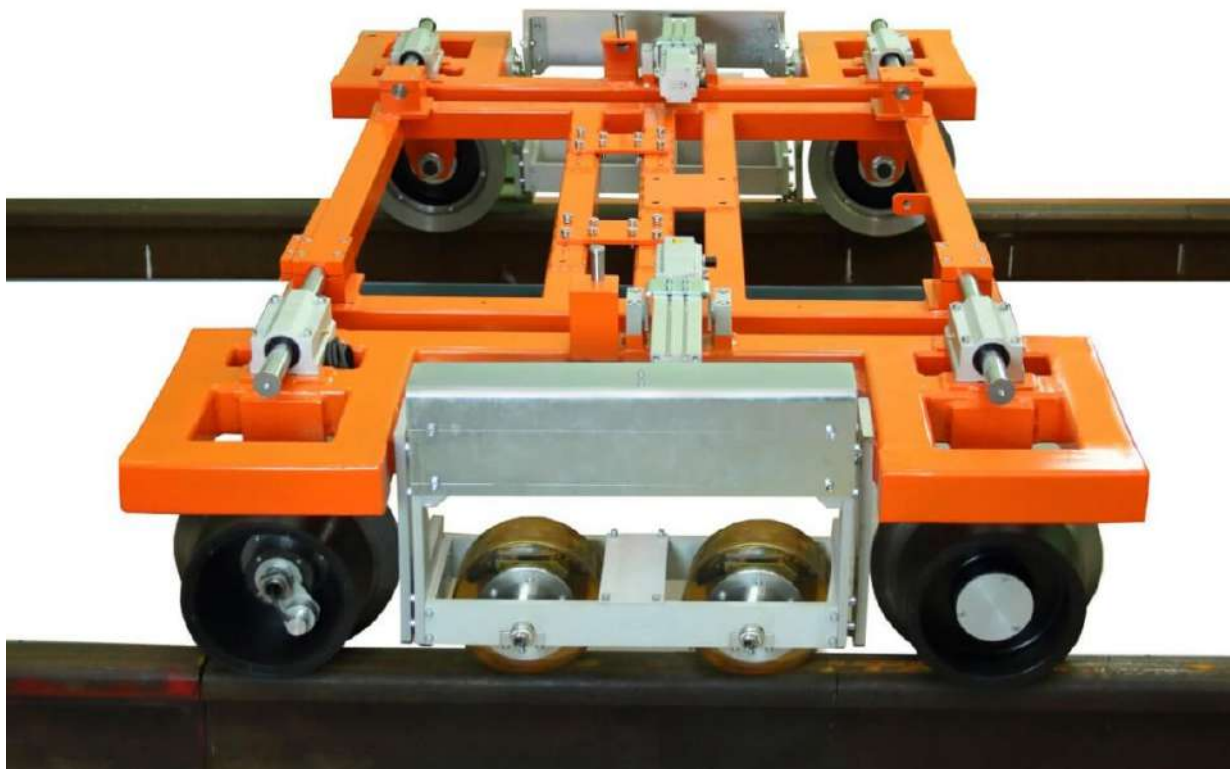
OKOSCAN UT73HS

1.   Introduction

Ultrasonic Rails Testing System **OKOSCAN UT73HS** is intended for:
- continuous ultrasonic testing (UT) of dual-line track throughout the length and cross-section at a speed of up to 40 km/h;
- measurement of the defects parameters and saving of the test results in a database.

2. Scope of supply

No.	Item description	Quantity
Mechanical Units And Components		
1	Wheels-based trolley with the track width-adjusting positioning system	1 pc.
2	Fitting system for the immersion probe units	2 pcs.
3	Tilting and position system of the fitting device for the immersion probe units	2 pcs.
4	Couplant tank with pump, level detectors, piping and valves	1 pc.
5	Encoder	1 pc.
6	Box for electronic equipments	1 pc.
Ultrasonic Unit		
	Electronic unit (EU)	1
9	Ultrasonic Module (MUX)	24-32 pcs
10	Immersion probe unit (IPU/Wheel) with integrated probes (probe set stated for one wheel):	4 pcs.
10.1	Probe 0^0 4 MHz	1 pc.
10.2	Probe 45^0 2.5 MHz	1 pc.
10.3	Probe 70^0 2.5 MHz	3 pcs.
10.4	Probe 40 2.5 MHz (Side Looking)	1 pc.
10.5	Probe 58x34 2.5 MHz	2 pcs.*
11	Connecting cable (US Module-EU)	2 pcs.
13	Battery	1 pc.

14	Power unit supply	1 pc.
16	GPS-module	1 pc.
Software		
17	Specialized SW for testing and settings	1 cop.
18	Specialized SW for review and analysis of the test results	1 cop.
Set of Spare Parts		
19	US module (MUX) — 1 pc.;	1 set.
20	Cable (US module(MUX)-Switch) — 1 pc.;	
21	Tyre for IPU — 1 pc.	

* - optional. Supplied for extra cost

3. Design and Technical Parameters

3.1 Ultrasonic rail testing System **OKOSCAN UT73HS** (the System) meant to the rails testing at a speed of up to 40 km/h and all types defects detection in accordance with the UIC 712 R listing.

3.2 The following UT methods are implemented in the System: echo technique, echo-shadow method, and pitch-catch technique of the testing according to TS EN 16729-1 "Railway applications - Infrastructure - NDT on rails in track - Part 1: Requirements for ultrasonic inspection and evaluation principles" and other European regulatory documents.

3.3 By its structure, the System consists of the following main blocks and units:

- − trolley;
- − immersion probe units;
- − Ultrasonic modules (MUX);
- − Electronic Unit of Flaw Detector;
- − Additional equipment (power supply system, water supply and distribution system).

3.3.1 Measuring trolley

Trolley is basic structure made of the aluminum profile with wheels, tilting system of the fitting device for the immersion probe units, and water supply system for the immersion probe units. Total Weight of trolley without couplant – no more 90 kg
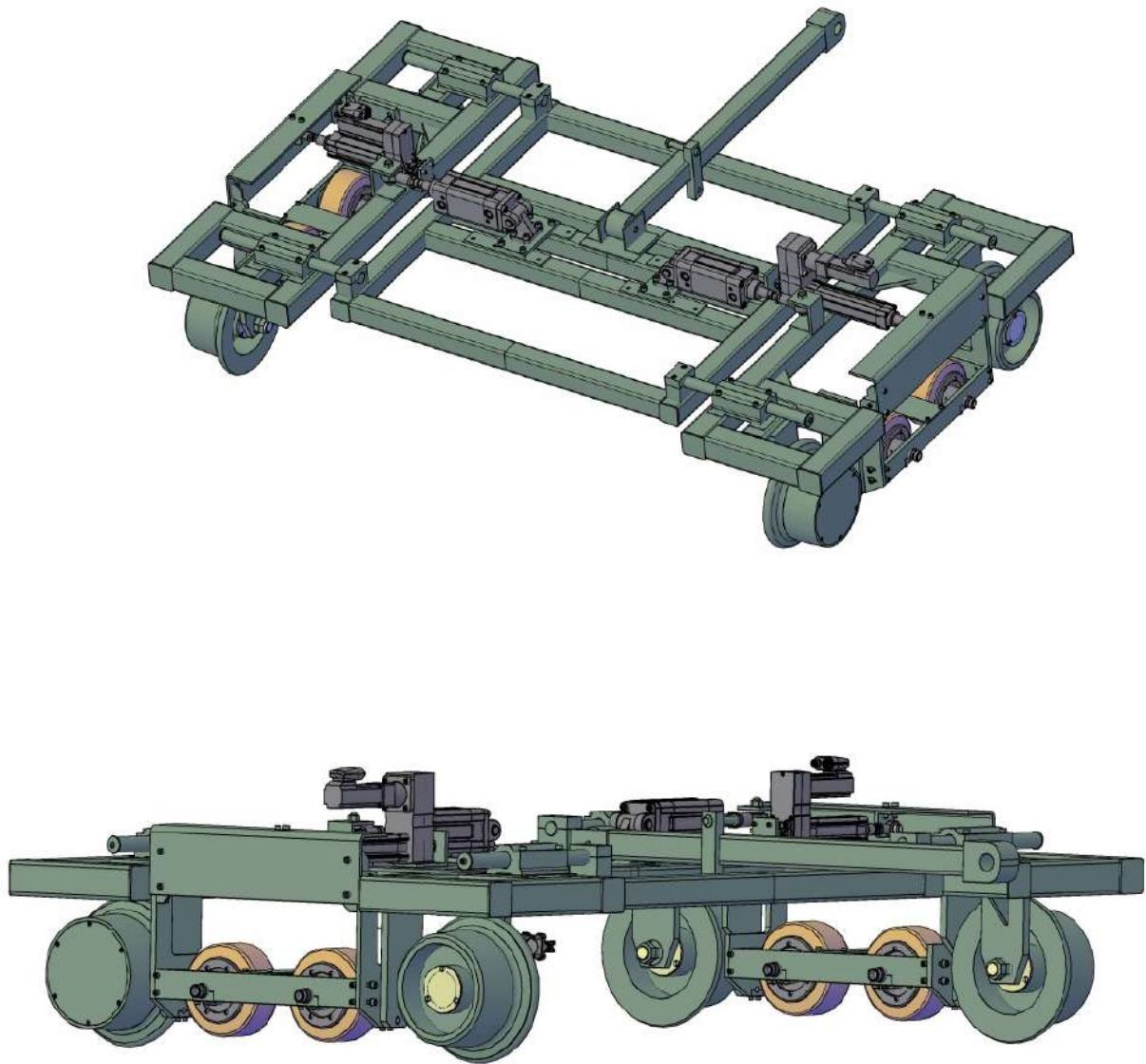
Figure 2 – Measuring trolley

3.3.2 Immersion probe unit (IPU)

IPU is a wheel with the soft polyurethane tyre, integrated probes, filled with liquid (ethylene-glycol). IPU is mounted onto the measuring trolley with aid of the fitting system.

IPU is composed of the following components:
- axis;
- bearings;
- Probe fixing bracket;
- cable connectors;
- ultrasonic transducers 6-8 pcs.;
- polyurethane tyre;
- inflow valve for the couplant;
- air valve (nipple).

The System **OKOSCAN UT73HS** includes four (4) immersion units - two IPUs per rail:

- Left forward IPU (L-FWD),
- Left-backward IPU (L-BWD),
- Right-forward IPU (R-FWD),
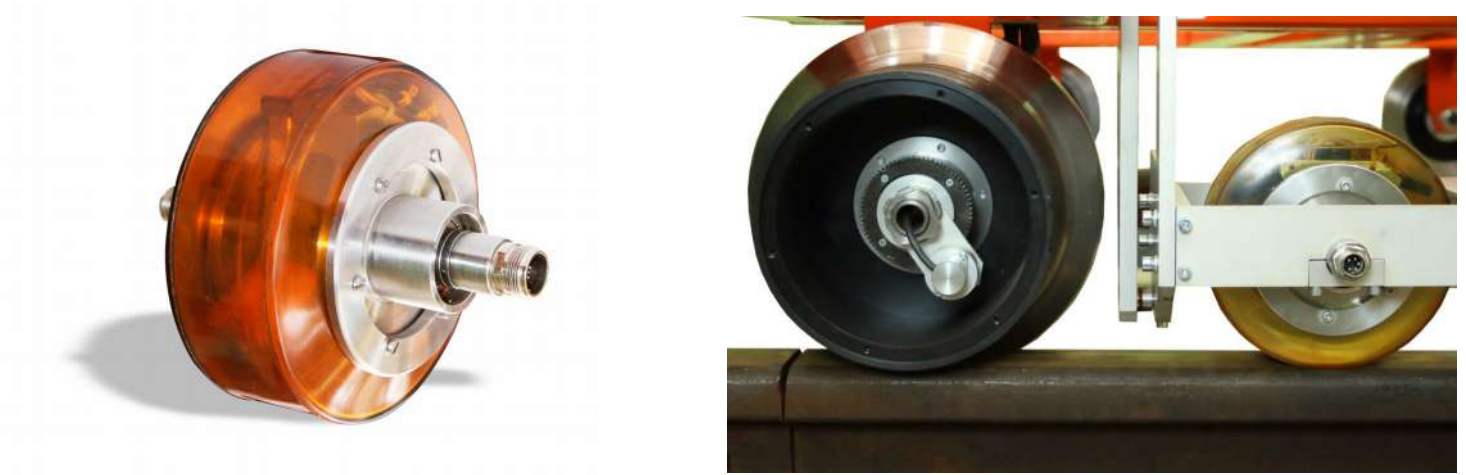- Right-backward IPU (R-BWD).
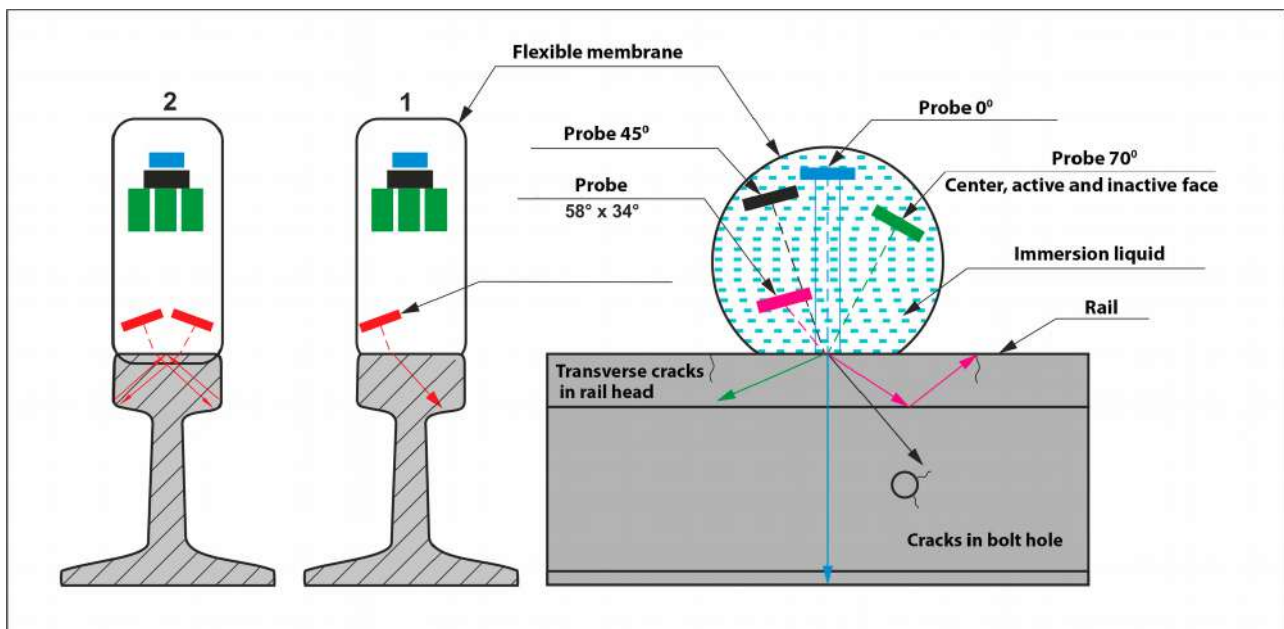

Figure 3 – Immersion probe unit (IPU)

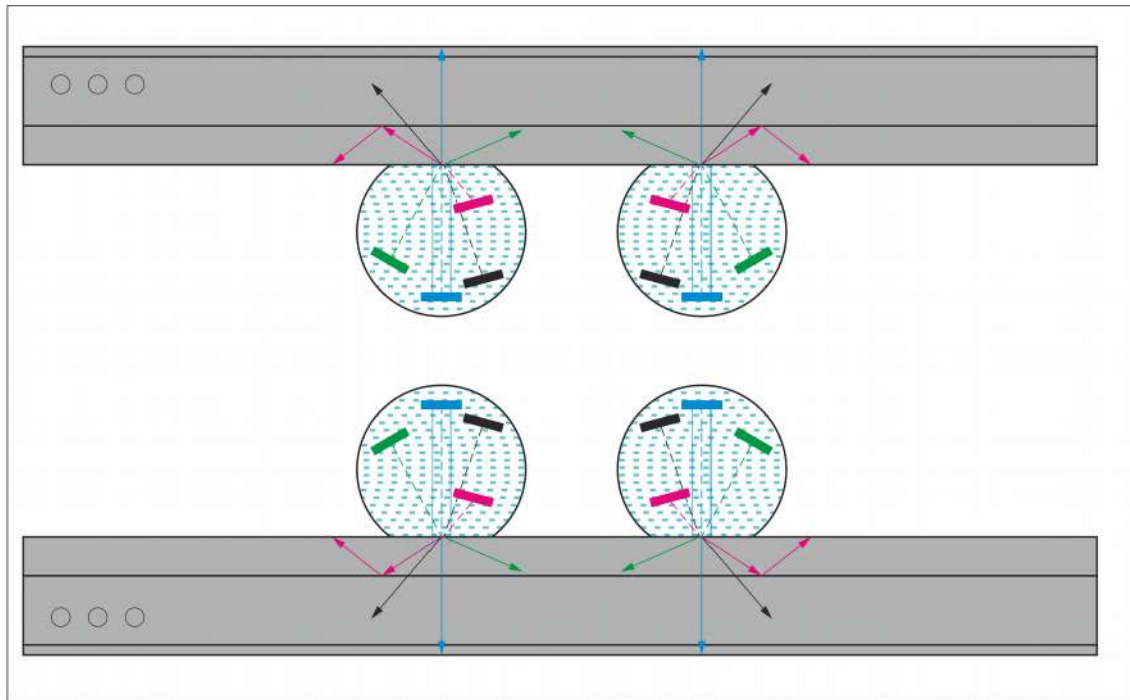**Figure 4 –** IPU ultrasonic test scheme of a rail

Figure 5 - IPU positioning on the rails

The following probes are used in the IPU:

- **3 (Three) 70⁰ probes (ref. Fig. 4, 5)** are used for testing of the central and side (active and inactive) faces of the rail head for the presence of transverse cracks. The probes scan rail head in two directions, along the path and back. This allows to detect transverse cracks of different orientation relative to the vertical plane, including the ones developing beneath the horizontal delaminations at a distance not more than 50 mm from the beginning of delamination in the sounding test direction of the PET.

Probe features:
- Probe type – single element;
- Wave type — transverse;
- Probe frequency — 2.0 - 2.5 MHz;
- Probe angle — 70°±1°;
- Testing range – rail head height (extension of the testing range is possible, up to the half the height of the rail).

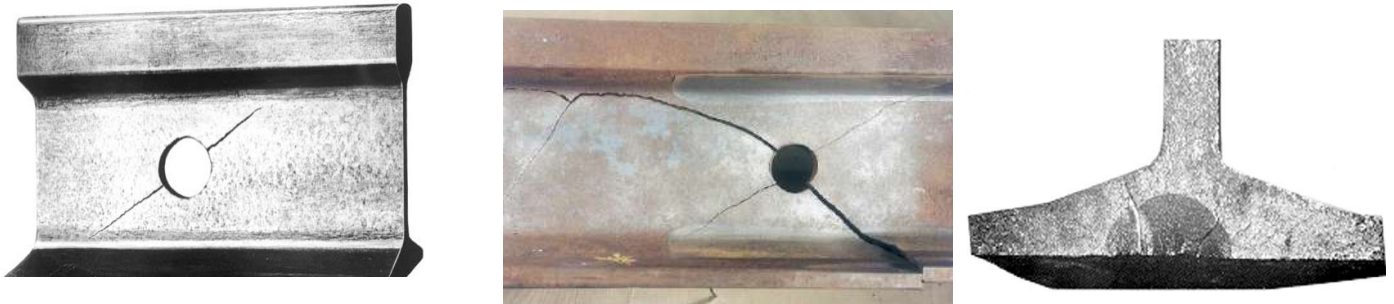The images of the defects detected by three 70⁰ probes

- **45⁰ probe (ref. Fig. 4, 5)** are used for testing of the whole cross-section of the rail in the rail web projection including the bolt holes. The testing is performed by the echo technique. Sonic test of the rail is done in two directions – along the path and back.

Probe features:
- Probe type – single element;
- Wave type — transverse;
- Probe frequency — 2.0 - 2.5 MHz;
- Probe angle — $45^0 \pm 2^0$;
- Testing range – all the rail height.

The images of the defects detected by 45^0 probe

- **0^0 probe (ref. Fig. 4, 5)** are used for testing of the whole cross-section of the rail in the rail web projection by the echo technique and the echo-shadow method. Echo-shadow technique is used for the defects detection according to the back wall signal attenuation, and allows to detect the flaws which are not detected by the echo technique, and the cracks in the bolt holes. Echo-shadow technique also allows to control the acoustic contact fault, and centering of the search system.

Probe features:
- Probe type – single element immersion;
- Wave type — longitudinal;
- Probe frequency — 4 MHz;
- Testing range — all the rail height.

The images of the defects detected by 0^0 probe
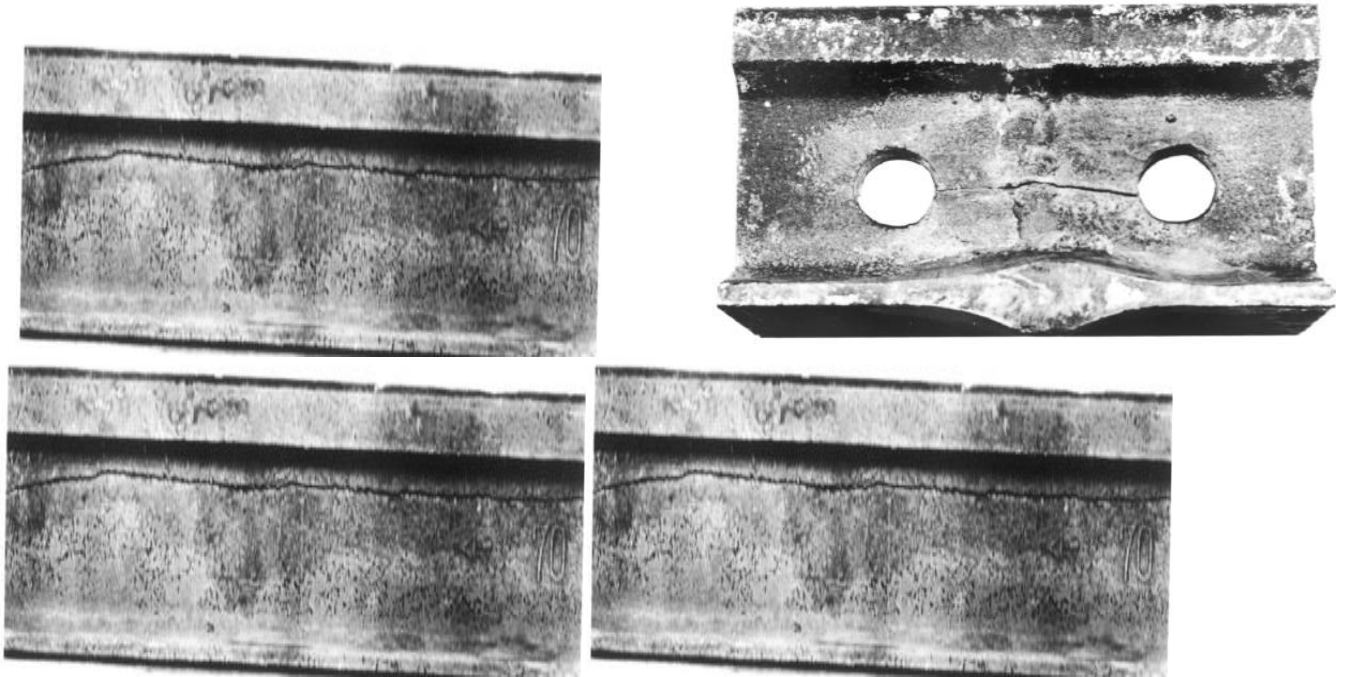
- **40⁰ probe «Side looking» probes** are used for testing of the active and inactive faces of the rail head for the presence of longitudinal vertical cracks. Rail head testing is done by the echo-technique, the probes are turned for 90^0 relative to the longitudinal rail axis and perform the testing of the head edge of both active and inactive faces.

Probe features:
- Probe type – single element immersion;
- Wave type – transverse;
- Probe frequency — 2.0 - 2.5 MHz
- Probe angle — $40^0 \pm 1^0$
- Testing range — side faces of the rail head.

The images of the defects detected by 40^0 probe (side looking)
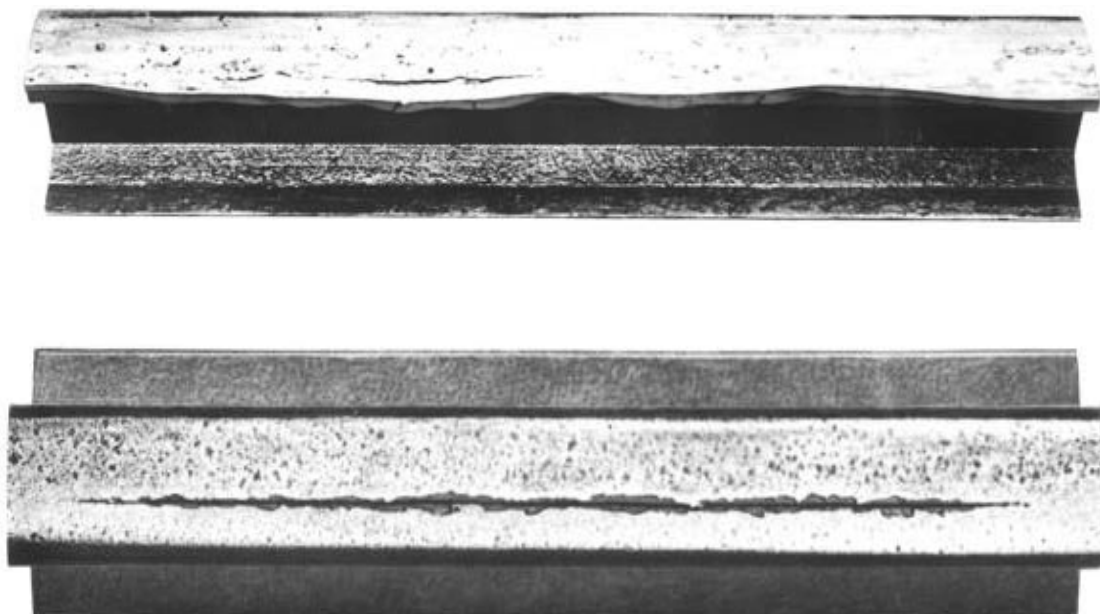
- **2 (Two) 58^0x34^0 probes (ref. Fig. 4, 5)** are used for testing of the active, inactive rail faces, and its central part. The rail testing is performed by the echo-technique with a straight once reflected beam, and by the echo-shadow method («diamond» scheme), with the radiation direction along the path and back. For that, the single element immersion angle-beam of (55 ÷ 60)° (turned for (32 ÷ 36)° relative to the longitudinal axis in the active and inactive faces PETs are used, Figure 4). This enables to detect transverse defects of different orientation relative to the vertical plane.

 - Probe type – single element immersion;
- Wave type – transverse;
- Probe frequency — 2.0 — 2.5 MHz
- Probe angle — 58^0 ±1^0
- Testing range — side faces of the rail head, rail head running surface.
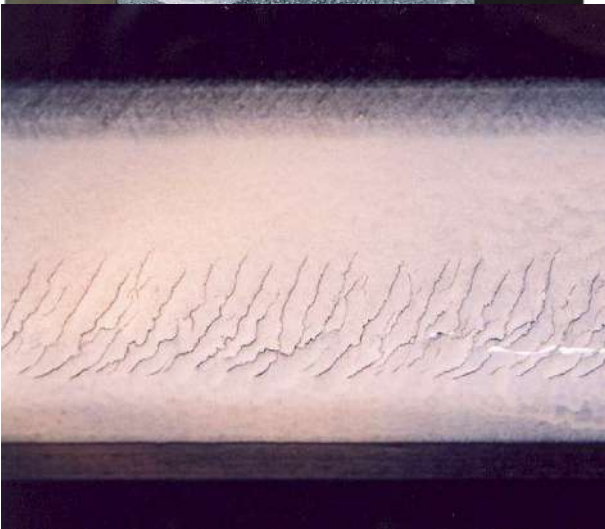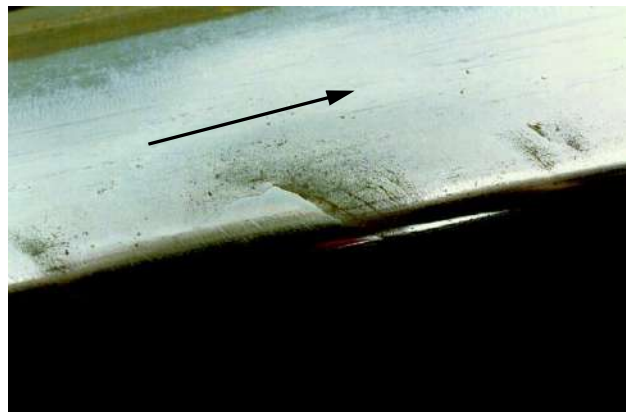
3.3.4 Ultrasonic module OKO-22 UT (MUX)

Ultrasonic module (MUX) (ref. Fig. 6) is intended for: management of the scanning pulse transmissions, acoustic signals receipt and processing, and for their transfer to the PC.

front panel

rear panel

Figure 6 – Appearance of the ultrasonic module OKO-22 UT (MUX)

Figure 7 – Appearance of the electronic unit of the ultrasonic flaw detector

3.4 Main technical characteristics of the System

3.4.1 Parameters of the detection efficiency

No.	Item	Value
1	"Dead zone"	0^0 Probe: 8 mm; 45^0 Probe: 5 mm; 70^0 Probe: 3 mm; 58^0 Probe: 5 mm;*
2	Test area	0^0 Probe: all the rail height; 45^0 Probe: all the rail height; 70^0 Probe: rail head; 58^0 Probe: rail head;*
3	Resolution with respect to coordinates: - Longitudinal coordinate; - Depth; - Rail height.	 1.0 mm; 0.1 mm; 0.1 mm.
4	Positional accuracy: - Longitudinal coordinate;	 ± 3 m/km;

		- Depth; - Rail height.	± 0.5 mm; ± 0.5 mm.
5		GPS	Global coordinate record in the test file with further possibility to review on the PC
6		Minimum detected defects (in a sonic test step of 2 mm)	Cylindrical hole with 2 mm diameter in the rail head 5 mm depth and 1.5 mm width groove in the active face of the rail head (or 5 mm diameter flat-bottom hole in the active face), transverse crack simulation. 5 mm depth, 2 mm width groove in the rail base, corrosion simulation.

* - optional. Supplied for extra cost

3.4.2 Ultrasonic unit parameters

No.	Item	Parameters
1	System configuration	Each channel of (MUX) is capable to process the signals from 1 up to 8 Probes. Quantity of probes and system configuration depend on the customer's requirements.
2	Testing methods	Echo-technique, echo-shadow method, pitch-catch technique
3	Quantity of channels per rail in the OKOSCAN UDS2-73HS system	12 – 14 channels per rail (two immersion probe units): 0^0 Probe: 2 pcs.; 45^0 Probe: 2 pcs.; 70^0 Probe: 6 pcs.; 40^0 Probe (Side Looking): 2 pcs. $58^0 \text{x} 34^0$ Probe: 2 pcs. *;
4	Sonic test step	from 1 mm to 10 mm
5	Testing speed	Up to 40 km/h in a sonic test step of 2 mm.
6	Tested rails types	UIC60, S49, E60, etc
7	Test results output	A-Scan, B-Scan (in all channels)

* - optional. Supplied for extra cost

3.4.3 Immersion Probes Unit

No.	Item	Value
1	Diameter	160 mm
2	Cover/Tyre	Soft polyurethane, with uprated wear resistance

3	Immersion liquid	Ethylene-glycol
4	Liquid pressure	0.3 atm
5	Weight	Up to 6 kg

4. Warranty

4.1. The Manufacturer guarantees a warranty service and repair of the equipment and its components, exclusive of the expendables and wearing parts, within 12 months from the date of the equipment delivery to the Customer.

4.2. The Manufacturer guarantees producing of the components necessary for the equipment repairs within the estimated service life, and also provides a post-warranty services.

The life cycle of the **OKOSCAN UT73HS** is 10 years

The life cycle of wheel probe tyre – 1000 km

Test results viewing mode and analysis of the testing results on PC

Test results viewing mode

The mode is intended for viewing and analyzing saved data on rail inspection immediately in the instrument. This mode has all tools necessary for viewing, measuring and analyzing test results.

The implemented functional capabilities of Viewing mode is described below:

Data View menu is represented by a table containing the general test results which have been previously saved – see Figure 1. This menu also has a general functional interface («Delete», «Copy», «Delete all», «Copy all»).

N	DATE	START	RAIL	OPERATOR	SECTION	DIR.	INITAL		FINAL		
1	01.80.59939	0h 0m	TWO RAIL	м		(nı	0km	0m			
2	22.03.2017	11h 37m	RIGHT	oper1	sect1	Up	5km	0m	5Km	0m	433mm
3	22.03.2017	11h 37m	RIGHT	oper1	sect1	Up	5km	0m			
4	22.03.2017	11h 37m	RIGHT	oper1	sect1	Up	5km	0m			
5	22.03.2017	11h 37m	RIGHT	oper1	sect1	Up	5km	0m			
6	22.03.2017	11h 37m	RIGHT	oper1	sect1	Up	5km	0m			
7	16.03.2017	14h 40m	RIGHT	oper1	sect1	Up	3km	0m	2Km	998m	724mm
8	16.03.2017	13h 42m	RIGHT	мищенко	Section	Up	1km	0m	1Km	1m	467mm

F1 Delete	F2 Delete all	F3 Copy	F4 Copy all				

Figure 1 — Test results viewing mode

To view a certain test result, users should select it from the list and press "Enter" button, which will take them directly to Viewing Mode – see Figure 2.
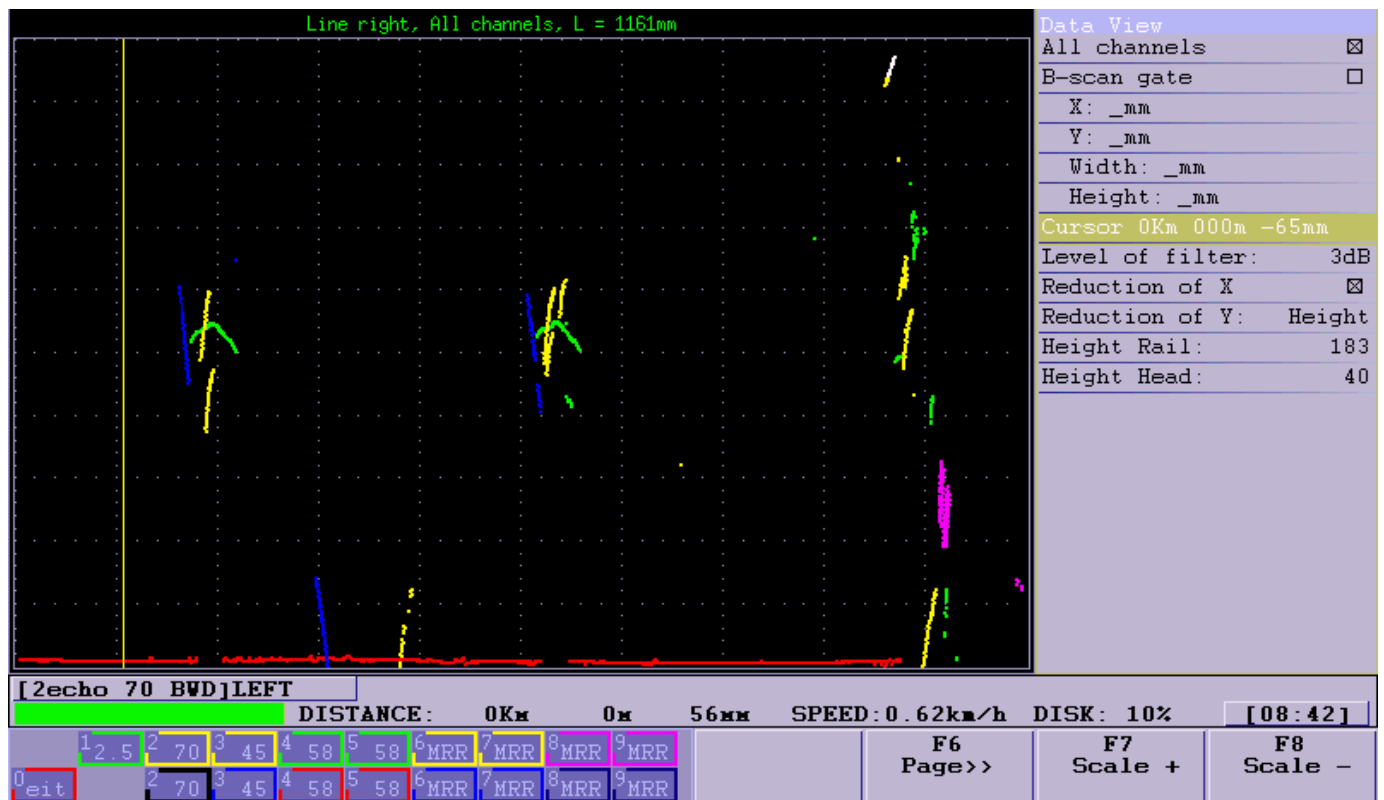
Figure 2 – Viewing mode

In this mode, the user can perform the following operations:

1. View test results simultaneously for all channels;
2. View test results individually for each channel;
3. View test results in B-scan + Peak mode;
4. Measure signal parameters (this function is available only in one-channel mode);
5. Adjust to scale by track coordinate;
6. Filter data.

Data View menu items:

1. All channels – Intended for displaying test results for all channels or one selected channel;
2. B-scan gate – ON/OFF for measuring gate (the gate will be activated only in one-channel mode);
3. X, Y, Width, Height – parameters of measuring gate;
4. Cursor – Intended for defining track coordinate;
5. Reduction X, Reduction Y – ON/OFF for reducing by track coordinate and by depth;
6. Level of filter – Level of amplitude filtered in respect of ALARM level: +6 dB, +3 dB, 0, -3 dB, -6 dB;
7. Page >>, Page<< - Moving to another page;
8. Scale+, Scale-   - Scale increase/reduction by track coordinate.

In the test results viewing mode, the function of simultaneous data viewing for all channels is switched On by default, with reduction by track coordinate and by depth. If required (e.g. to measure defect parameters), an operator can go to one-channel mode (by unchecking «All channels» item) — see Figure 3.
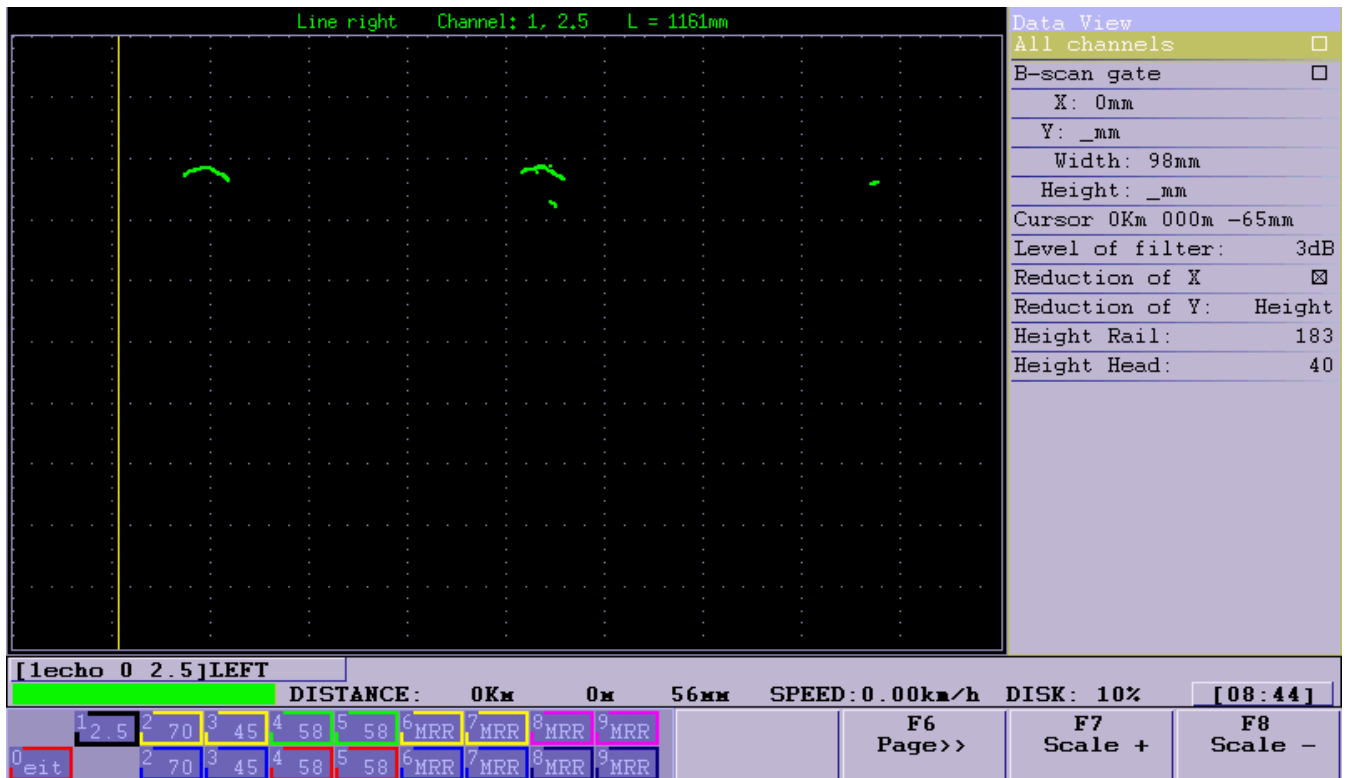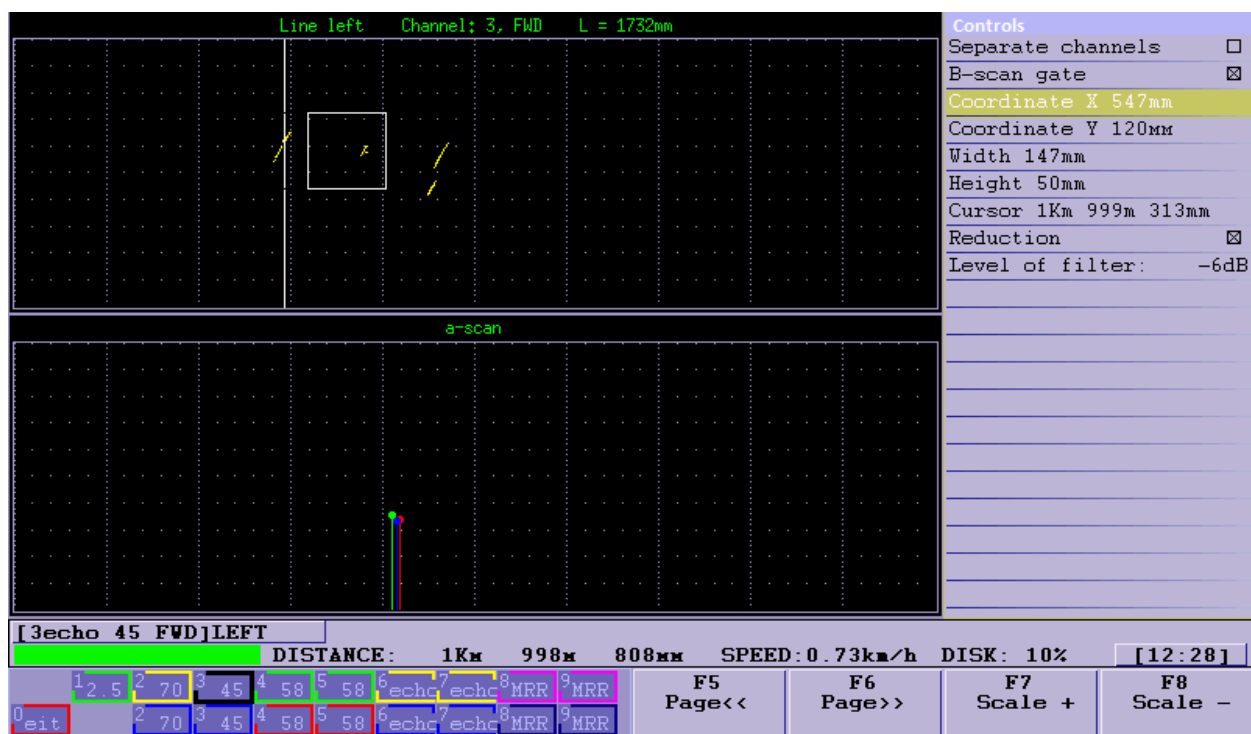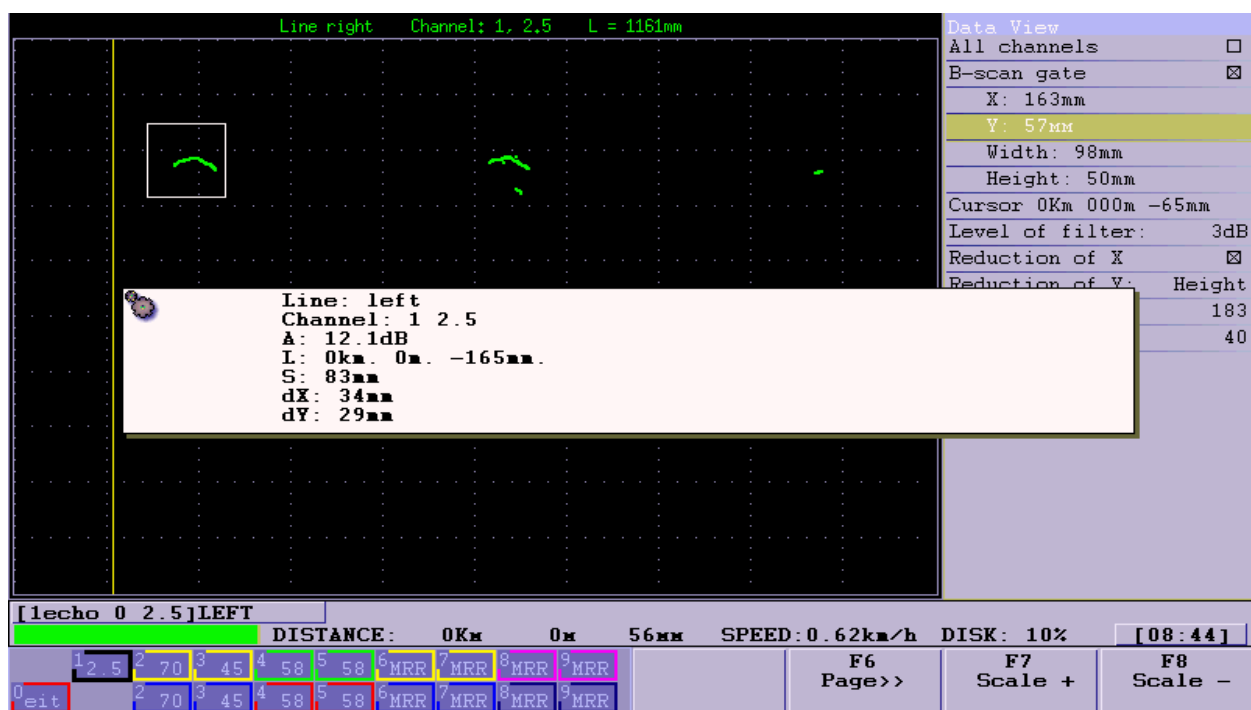
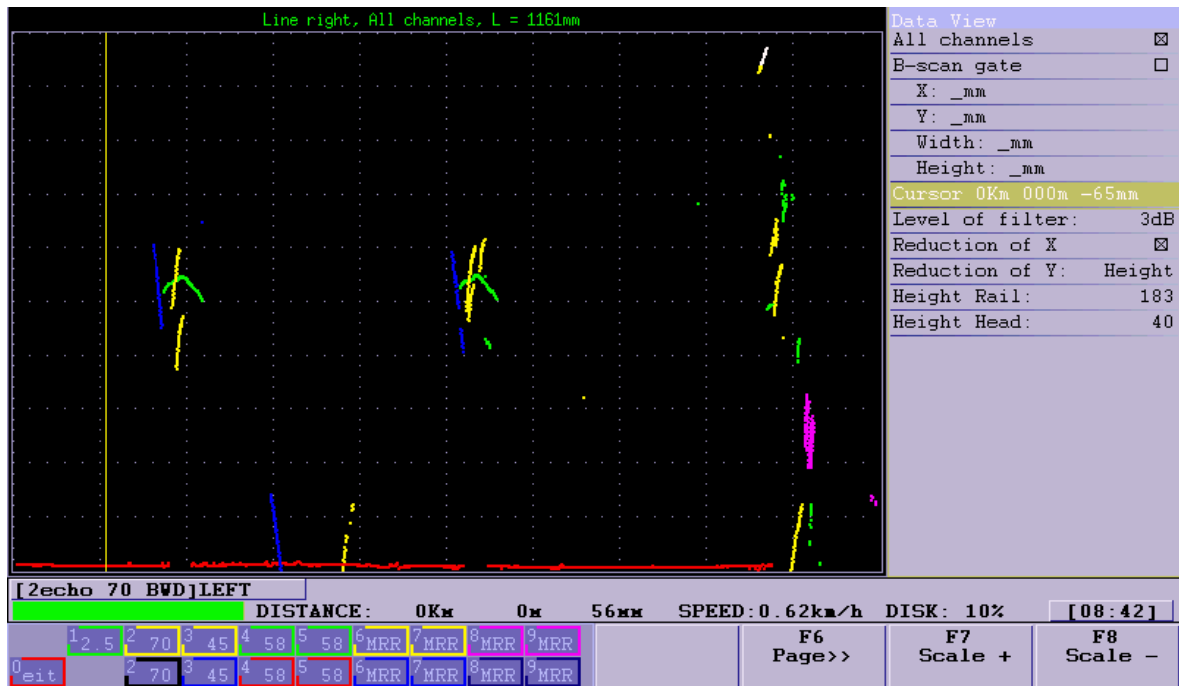**Figure 3 - One-channel mode**

Working with Data View menu:

B-scan + Peak mode serves to analyze test results using amplitude characteristics.

Defect parameters measuring mode is intended for estimating flaw parameters. Signals inside the gate are subject to measurement.
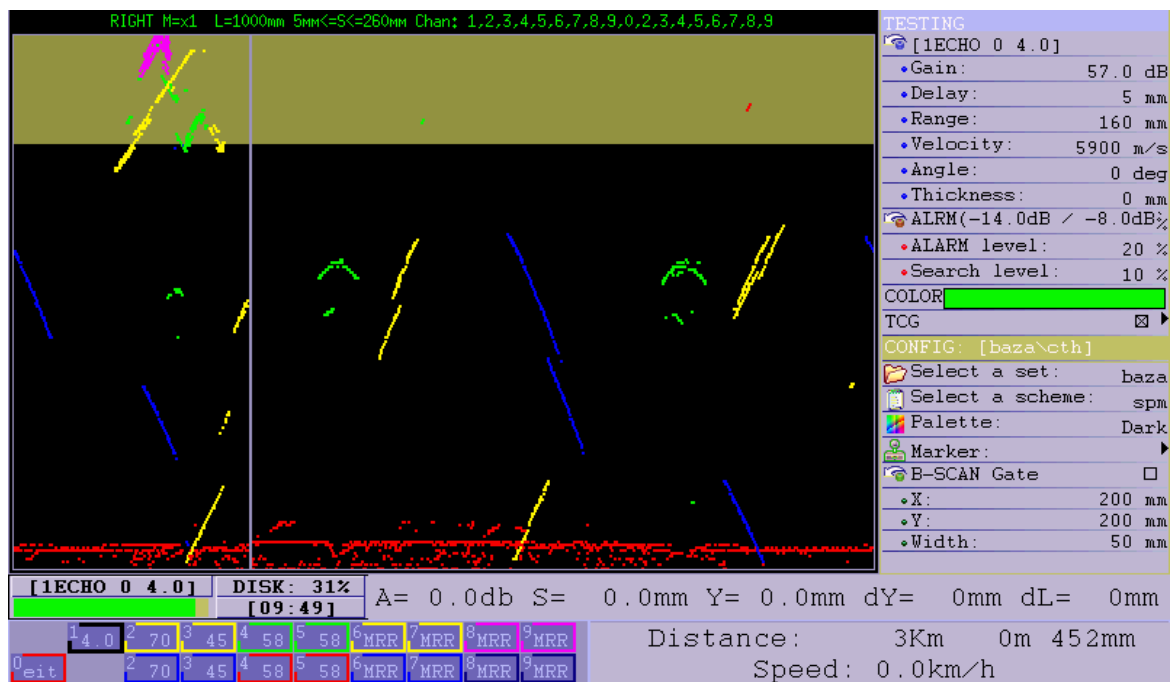

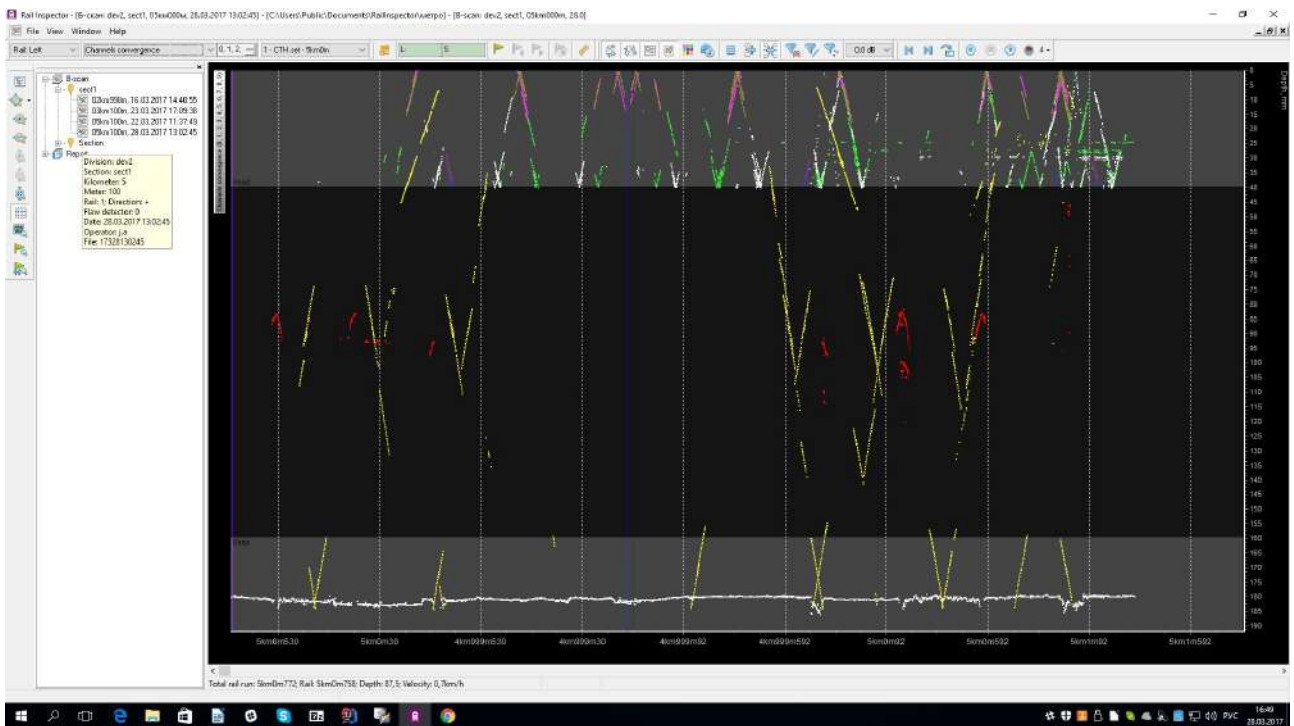Operation mode with test results compensation ON/OFF
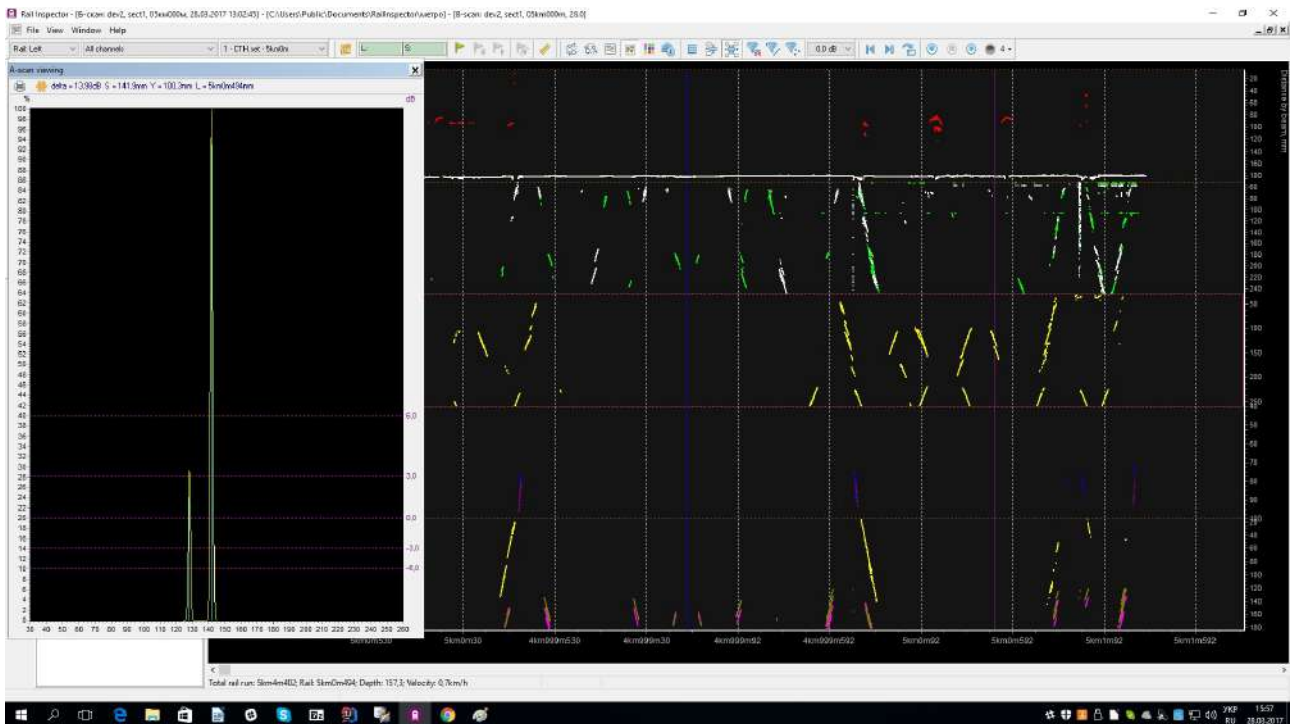
- Testing mode

Representation of test results in a form of B-scan images, particularly test result outputs in conversion to the rail height – see Figure 4 .

Rail Inspector software for viewing test results on PC

General View Software for viewing test results

Mode viewing A-scan