

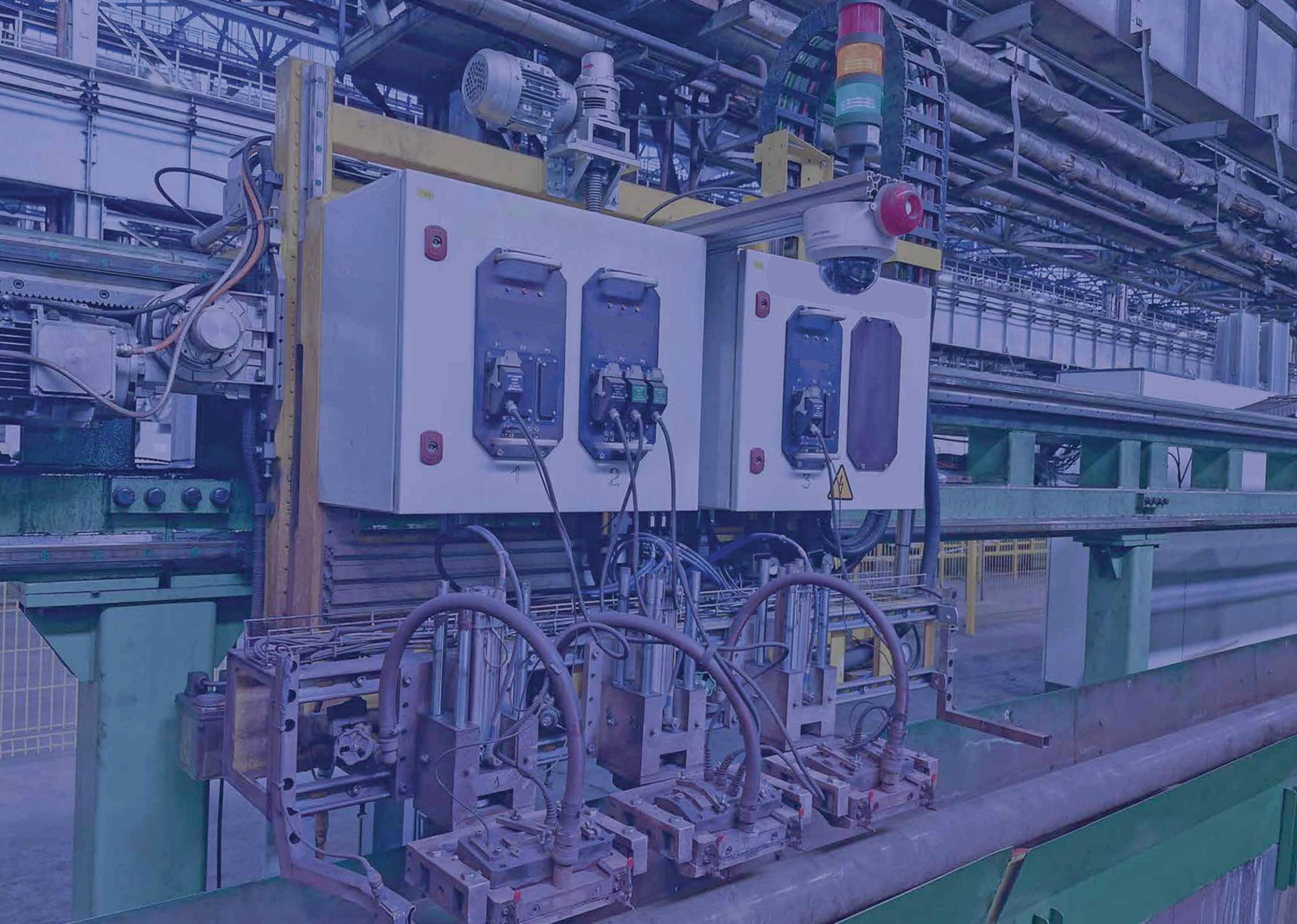
# AUTOMATED TEST SYSTEMS GANTRY TYPE

inspection of pipes, tubes and bars



AUTOMATED ULTRASONIC  
INSPECTION

DIAMETER PIPE RANGE  
FROM 60 MM TO 920 MM



## Application

The gantry-type automated test system for high-speed ultrasonic inspection (AUT) of round-section tubes and pipes made of various steel grades with diameters ranging from 60 mm to 920 mm.

## Test objects

- Oil-grade pipes according to API 5CT and 5L standards
- Seamless and welded pipes
- Boiler tubes
- Round section bars and tubes

## Types of defects

- **Pipes and tubes inspection:** Detection of longitudinal and transverse defects relative to the pipe axis, as well as oblique defects. Furthermore, lamination control and wall thickness measurement are performed.
- **Bars inspection:** 100% cross-sectional inspection of the bar for internal defects.

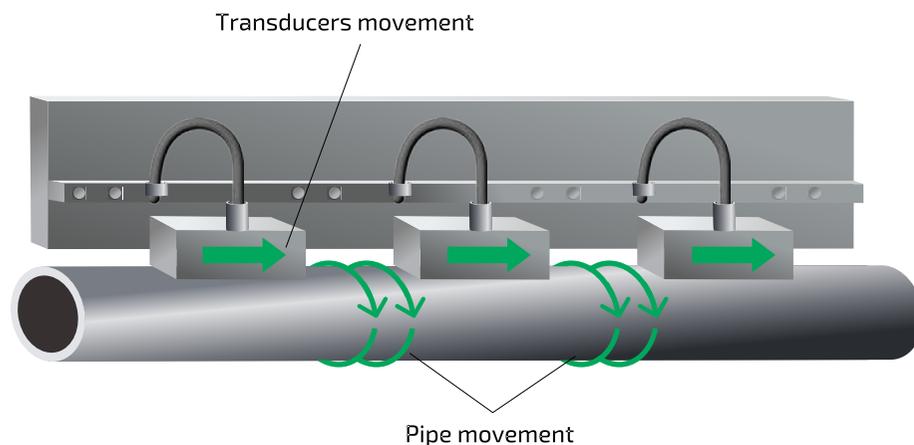


## Inspection scheme

In the gantry-type automated ultrasonic testing (AUT) system, the block with transducers moves in a straight line, while the test object—a pipe or round-section bar—is rotated in place on turning rollers.

The AUT is performed using immersion, gap, or jet coupling methods. Water is supplied to the transducer acoustic blocks during their linear movement.

The UT electronics is either a conventional multi-channel flaw detector or a flaw detector supporting phased array (PA) technology, depending on the inspection requirements.

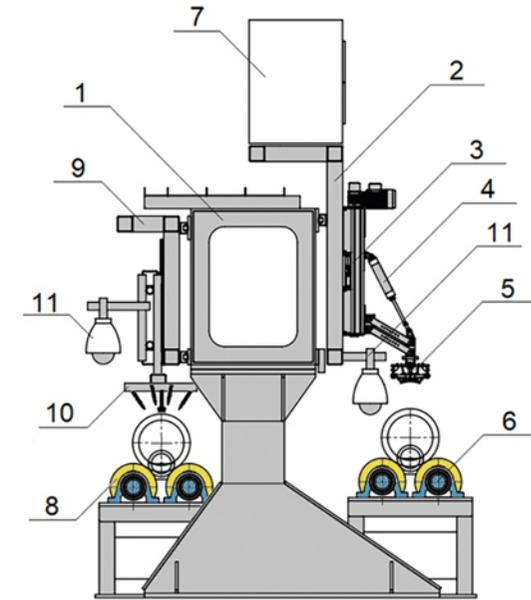
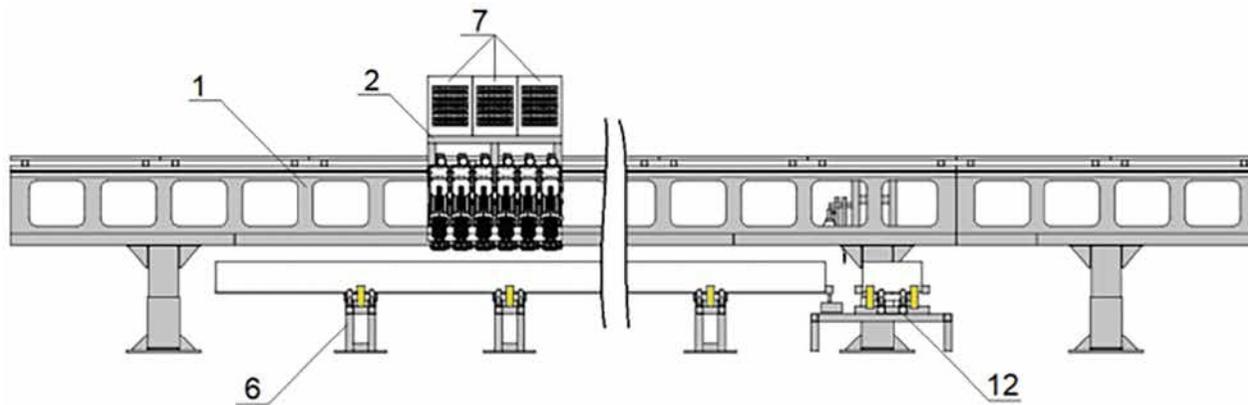


## Features

- Possible inspection with **Phased-array transducers**.
- High level of **defects detectability**.
- **Automatic calibration procedure** available .
- **Short untested ends**.
- **Scalability**. Optionally multiple acoustic blocks and carriages can be installed to increase throughput or the variety of detectable defect types..
- The test system **can be equipped with additional inspection methods**: eddy-current, MFL and other depending on the test requirements.
- **Detailed and informative inspection results** — defect locations are automatically marked on the pipe based on the inspection outcome, and the system generates a comprehensive, detailed inspection report for each pipe.

## Installation layout

The gantry is designed to carry the platform with acoustic blocks on which the ultrasonic transducers are mounted.



**The platform is equipped with the following systems:**

- Longitudinal drive that moves the platform along the axis of the pipe being inspected at a set speed.;
- Height adjustment drive for the acoustic blocks;
- Pneumatic clamping system for the acoustic blocks, which raises and lowers them during pipe loading/unloading, and during inspection when an acoustic block enters its designated inspection zone. Each acoustic block uses an independent pneumatic system.

**For each acoustic block, an independent pneumatic system is used:**

- Acoustic blocks with ultrasonic transducers;
- Pre-wetting unit for the pipe surface;
- Ultrasonic flaw detectors.

1. Gantry
2. Platform with the measurement electronics
3. Height adjustment drive of the acoustic block
4. Pneumatic clamping system for the acoustic blocks
5. Acoustic block with ultrasonic transducers
6. Pipe rotation rollers
7. Cabinet housing the ultrasonic flaw detectors
8. Pipe rotation rollers at the defect marking position
9. Defect marking system carriage
10. Pipe air blow-off and defect markers
11. Video monitoring system
12. Calibration stand

## Acoustic block

Several acoustic blocks can be mounted on the platform (depending on the inspection setup). These blocks are designed to carry either conventional ultrasonic transducers or phased array (PA) transducers with immersion coupling.

When using immersion-type transducers, a local tank with a polymer membrane can be employed. This membrane has acoustic properties similar to those of the immersion couplant (water).

The immersion tanks in the carriages are mounted on hinges, allowing free movement within a certain range in all directions. This ensures stable acoustic contact regardless of deviations in the surface of the pipe being inspected.

Each acoustic block is equipped with a replaceable wear foot featuring carbide inserts sized for the diameter of the pipe being inspected. The design of the replaceable foot, secured with special fasteners, allows for quick and easy changeover when switching to a different pipe size.

Depending on the inspection configuration and pipe wall thickness, replaceable local immersion tanks are used. These have the appropriate immersion layer height and ultrasound entry angle and are made from high-strength plastic.

Each acoustic block is additionally fitted with a separate, unfocused transducer to monitor acoustic contact.

### Phased Array Transducer Configuration\*

The standard phased array transducer is a 168-element type focused along the pipe axis.

The PA array pitch is 0.75 mm. The element width is 12 mm. The active length of the PA transducer is 126 mm.

The pulse density coverage on the pipe surface is 1 pulse/mm.

The productivity will correspond to the specific inspection configuration.



Scanning is performed with overlapping virtual apertures of the PA transducers for defect and lamination detection. The overlap can be adjusted in the software based on inspection requirements, which in turn affects productivity.

The scanning system allows the simultaneous operation of 4 virtual transducers to increase inspection throughput.

### Typical Connection Configuration for Phased Array (PA) Acoustic Blocks (AB)

1. AB (L) – Inspection of longitudinal defects in two directions.
2. AB (22°) – Inspection for defects inclined up to 22° in two directions (optional).

3. AB (>22°) – Inspection for defects inclined more than 22° in two directions (optional).
4. AB (T) – Inspection for transverse defects in the direction from the pipe end towards its center.
5. AB (T) – Inspection for transverse defects in the direction from the pipe center towards its end.
6. AB (WT/Lam) – Inspection for pipe wall thickness and laminations.

### Conventional Transducers Configuration \*

Transducer length: 120 mm.

Number of transducer elements:

- for transverse defect inspection: **27 elements**;

- for longitudinal defect inspection:  
**10 elements;**
- for lamination inspection and wall thickness measurement:  
**20 elements.**

### Typical Connection Configuration for Conventional Acoustic Blocks (AB)

1. AB (T) Transverse Block: contains 1 UT Probe for transverse defect inspection in the direction of platform movement; includes a separate contact control probe.
2. AB (L, WT/Lam) Longitudinal/Wall Thickness/Lamination Block: contains 2 x UT Probes for longitudinal defect inspection in two opposing directions and 1 x UT Probe for lamination inspection/wall thickness measurement. In this block, acoustic contact is monitored by the lamination inspection probe.
3. AB (T) Transverse Blocks: each contains 1 UT Probe for transverse defect inspection in the direction opposite to platform movement; each includes a separate contact control probe.

One channel is required to control each element. Therefore, the system utilizes 94 channels.

Maximum Pipe Feed Rate: 110 mm/revolution

## Ultrasonic Testing Electronics

The measurement system is based on multi-channel embedded ultrasonic flaw detectors of the UMD series, available in configurations for both conventional ultrasonic testing and for operation with phased arrays (PA).

The flaw detectors are connected via a local Ethernet network to the inspection result registration system, to which they transmit measurement results in real time.

The flaw detector is certified measuring unit within Russian State Standard for Measuring devices.



- Number of inspection gates: 4, one of which can operate in immersion synchronization mode.
- Standard software solutions for pipe inspections tasks:

to detect longitudinal and transverse defects, laminations, and to differentiate between outer/inner/inclined defects for wall thickness control.



## Transport Mechanization of the Inspection Line\*

The transport mechanization in the inspection zone is a roller conveyor with pipe rotation rollers.

The rollers are coated with high-hardness, impact-resistant polyurethane and ensure pipe rotation at the specified speed without damaging the pipe surface.

The rollers are driven via a chain drive for each roller from a common shaft. This shaft is composed of individual sections connected by couplings.

The chain drive and drive shaft are protected from water ingress by metal covers.

At the front end of the pipe, the rotators are equipped with end stops with rollers that prevent the pipe from shifting during rotation, whether during inspection or equipment setup.

Pipe Transportation Method along the Inspection Line:

Linear Motion: Translational, crosswise movement along the line.

At the Inspection Position: Rotational movement.

The rotator design is simple, user-friendly, and intended for operation in harsh industrial conditions.

Maximum speed of transducer movement relative to the pipe surface: Up to 2 m/s.



## Water preparation and supply system

The water preparation system is designed for storing, purifying, temperature control, and supplying immersion fluid to the installation.

Technical water is used as the coupling fluid in the line.

- Pump station;
- Fabric separator for preliminary purification and return of used fluid to the filtration system tank..

The preparation system operates on a closed cycle and includes the following components:

- Tank with a filtration system;
- Temperature control system (heating and cooling);

Temperature control accuracy for the coupling fluid:  $\pm 2 \text{ }^\circ\text{C}$ .

\* Different table configurations are possible depending on the specific inspection tasks.



## Software-Hardware Complex

The software/hardware complex for the ultrasonic system is managing the operation of the measurement test system and recording inspection results.

The complex provides the following:

- Input of signals from the transport system position sensors;
- Setup of operating parameters for the measurement system channels
- Calibration of inspection channels sensitivity;
- Input of initial data for the test object;
- Display of the inspection equipment status;
- Generation and storage of inspection reports;
- Generation of batch, shift, and date-based inspection reports and summaries;
- Printing of inspection reports and summaries;
- Data transfer to a local network;
- Data export to external storage devices, such as flash cards.

## Defect Marking Unit

The defect marking system is designed to mark sections of the inspected product where discrepancies (defects) have been identified.

- Number of marking channels: typically 4 (pre-agreed with the customer);
- Marking accuracy:  $\pm 50$  mm;
- Selection of the marking operation mode is set in the software;
- Marking can be done by an ink marker / paint.

# Specification

## Typical Equipment Setup

**Gantry-type ultrasonic test system** for the body and ends of pipes. It is designed to detect defects of longitudinal, transverse, and inclined (22°, 45°, and 67°, optionally) orientation on the outer and inner pipe wall, as well as to check for laminations and measure wall thickness, using phased array (PA) transducer technology

**Operator workstation** for monitoring and controlling the equipment.

**Defect marking unit.**

**Closed-loop water preparation and supply system.**

**Set of standard reference blocks** (SRB/ Calibration Blocks), manufactured from the Customer's material. The quantity and designs are agreed upon during the basic engineering phase.

**Three-position transportation system** for moving pipes from the inspection station to the pipe marking station (for cross-feed of pipes into the inspection zone). Alternatively, entry and exit roller tables with rotating roller blocks (for longitudinal feed of pipes into the inspection zone).

## Length of Untested End Sections During Pipe Body Inspection

The size of untested ends depends on the bevel size (if the pipe is beveled), cutting angle, mechanical tolerances, inspection direction, and the width of the ultrasonic beam's directivity pattern.

### Length of untested pipe ends:

- Longitudinal defects: no more than 10 mm;
- Laminations: no more than 10 mm;
- Wall thickness reduction: no more than 10 mm;
- Transverse defects (when inspected in both directions): no more than 3 times the wall thickness;
- Oblique defects: no more than 10 mm of pipe feed into the inspection zone

## Test Object (Pipe) Parameters

**Outer Diameter:** 60–920 mm

**Wall Thickness:** 4–75 mm

**Length:** 6–15 m

**Pipe Rotation Speed (mm/sec):**

Ø 60 mm: 2000 mm/s

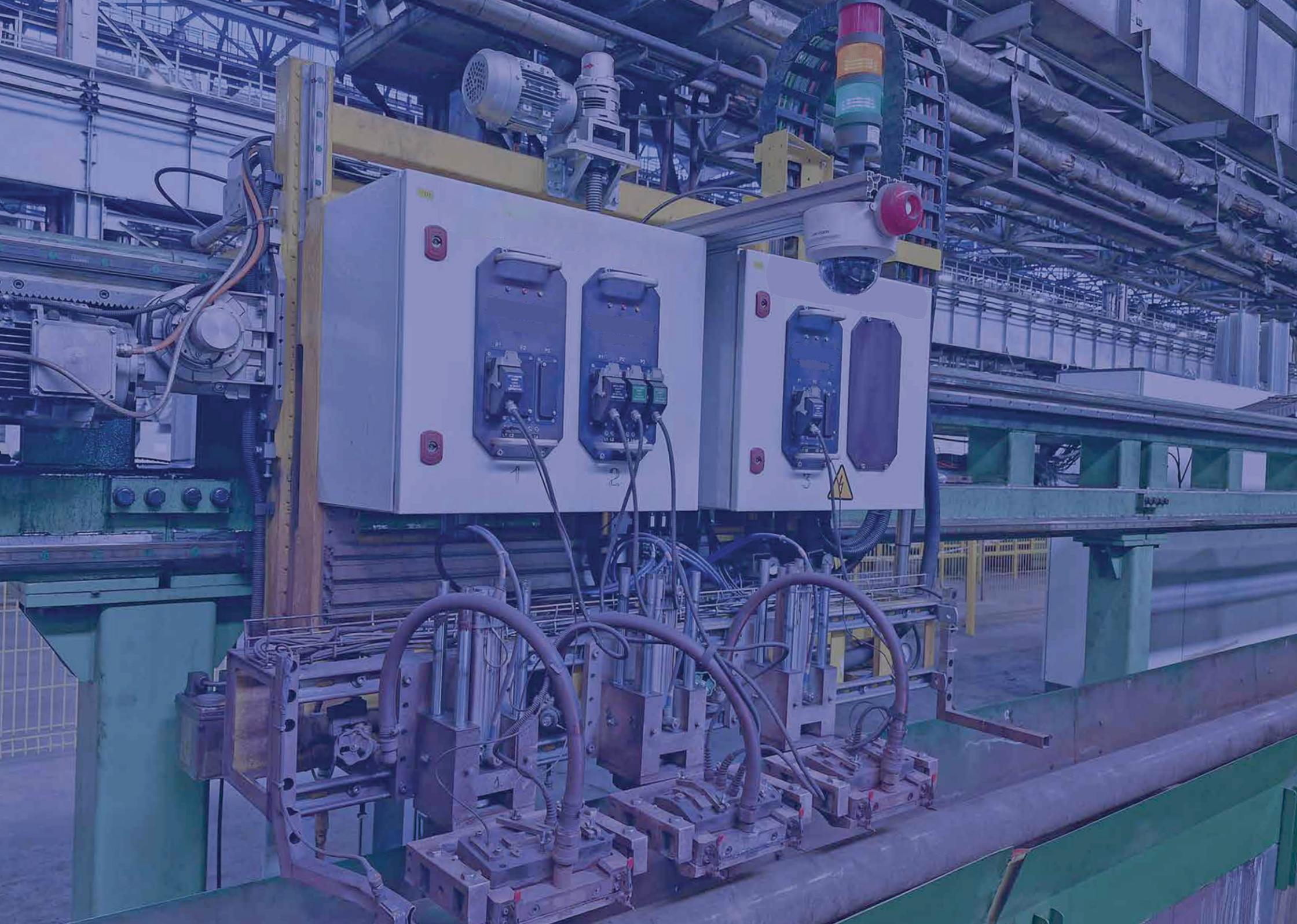
Ø 245 mm: 250 mm/s

Ø 426 mm: 150 mm/s

Transducer Motion Speed: Maximum speed relative to the pipe surface: up to 2 m/s

## Inspection parameters

Inspection zones	Pulse Density Along the Pipe Axis (APD)	Adjustable (overlap from 0% to > 50%)
	Pulse Density in the Radial Direction (RPD):	Adjustable (from 1 mm to 2 mm)
Inspection results display	Real-time imaging	C-scan, strip charts, alarm system
	Parameters setup	A-scan, B-scan
Inspection modes	Standard inspection modes	Inspection for longitudinal, transverse and oblique defects. Lamination and wall thickness measurement.
	UT method	PA, Pulse-echo
	Inspection mode setup	For Phased Array (PA): Multiple inspection modes can be configured simultaneously for each PA transducer
PoD	Compliance with GOST and API	Longitudinal, transverse, and oblique notches: length 12.7 mm or 25.4 mm, depth 10% or 5% of the wall thickness; on the outer and inner surface; through hole Ø 3.2 mm or Ø 1.6 mm; flat-bottom hole Ø 6.35 mm
	SNR	> 12 dB
	Repeatability	Longitudinal notch: < 2 dB Transverse and oblique notch: < 3 dB Through-hole 3.2 mm and flat-bottom hole 6.35 mm: < 4 dB
Reporting and archiving	Types of reports	Inspection results report, calibration report, calibration verification reports with user-configurable parameters
	Archiving	Database for real-time inspection data storage





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