

In-Line ERW Tube Inspection

Phased Array Technology



- Weld inspection
- Flaw detection
- Weld profiling

Introduction

Olympus' industrial turnkey solutions are adaptable to fit the needs of each customer. Our high-quality inspection solutions use ultrasonic phased array probes integrated into fully automated testing systems to meet even the most stringent requirements for inspections. Our systems enable customers to meet strict quality control standards while maintaining productivity.

Project-Based Turnkey Solutions

Project-based, automated turnkey solutions include:

- Dedicated project management
- Electronic instrumentation and probes
- Advanced software
- Mechanical equipment
- Water management system
- Commissioning
- Training and after-sales support

Designed for:

- Electric resistance welded tube
- Quality control
- Post welding, annealing, and sizing
- Tubes of infinite length
- Ease of operation

Key Features

Weld tracking

Automatic tracking of the heat-affected zone

Weld profiling

Real-time visualization

Automatic Calibration

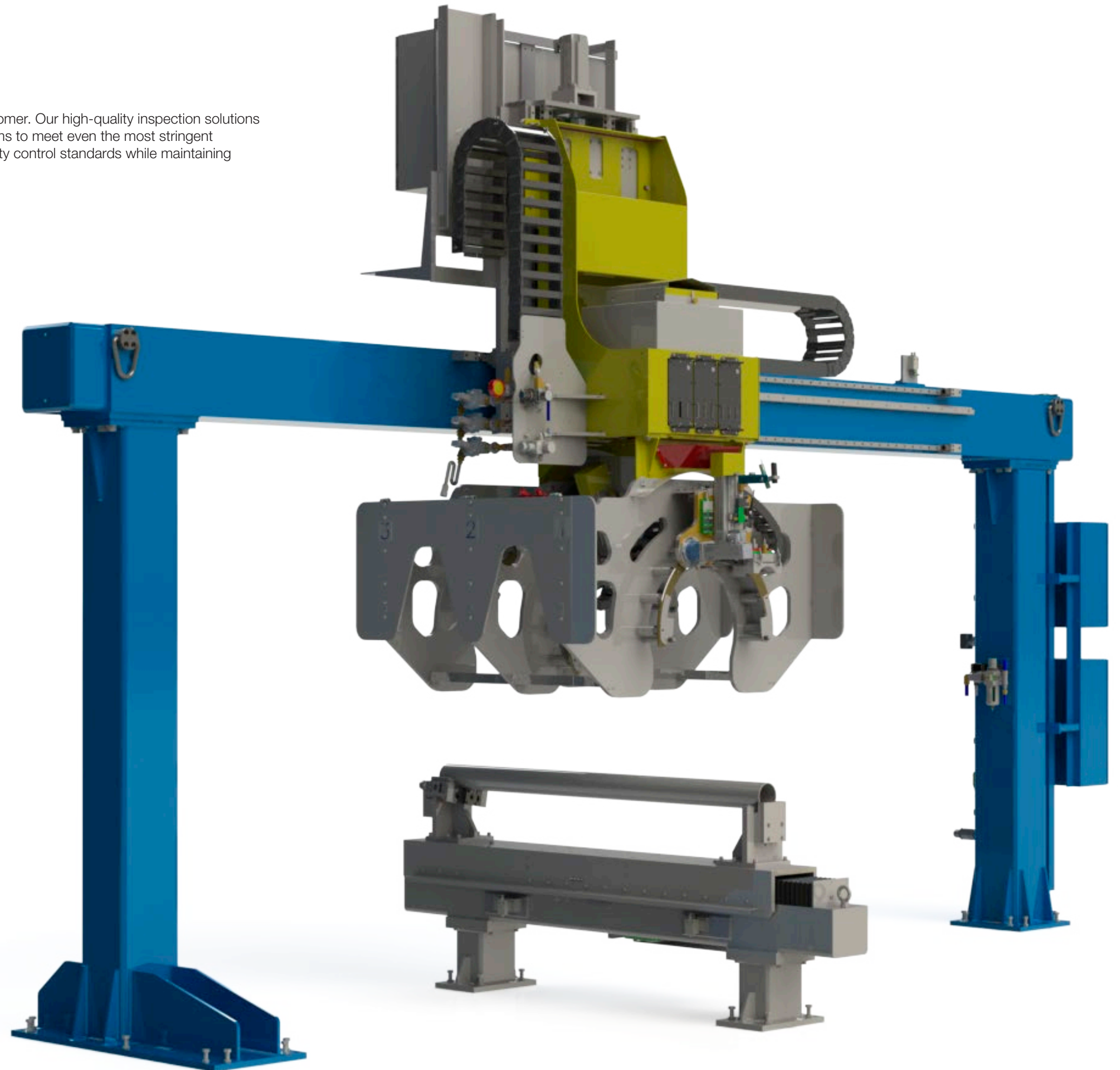
Minimize operator skill dependency

Calibration check

Helps ensure defect detectability at production speed

Pipe Window Detector

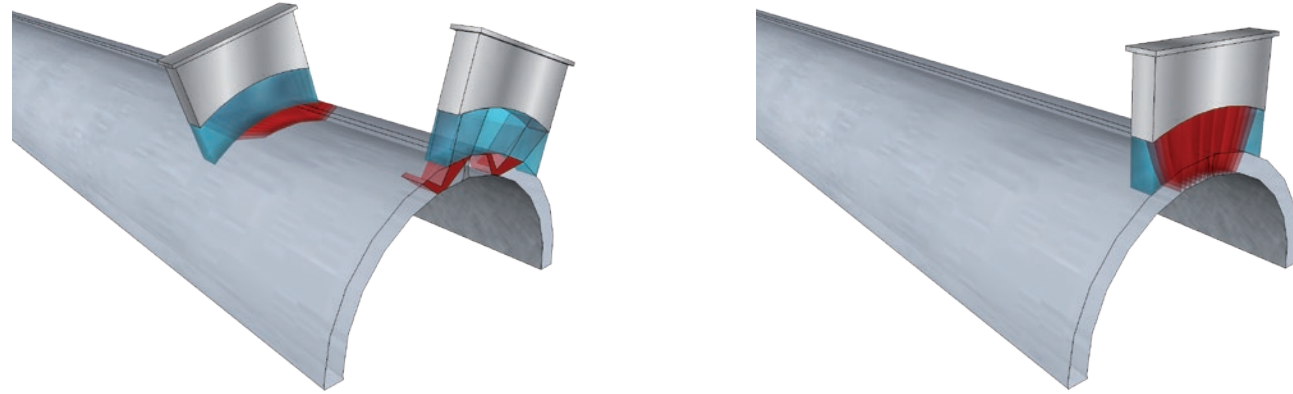
Reduce risk of damage to the equipment



In-Line Electrical Resistance Welded (ERW) Tube Inspection

Phased Array Weld Inspection

With phased array (PA) technology, a linear electronic scan is performed by moving the acoustic beam along the axis of the array without any mechanical movement. The beam movement is performed by time-multiplexing the active elements.



Flaw Detection

A cylindrical phased array probe is located on each side of the weld to inspect in both clockwise and counterclockwise directions. Ultrasonic (UT) beams are electronically steered to generate the desired refraction angle in the tube radial direction.

Weld Profiling and Tracking

A cylindrical phased array probe located on the weld fires at zero degrees. Scarfing is automatically monitored, and the weld is profiled to create a true side view of the weld for fast profile analysis.

Multimode

System is capable of firing more than one acoustical configuration within the same phased array probe. Pitch-Catch or high angle Pulse Echo modes can be programmed with the standard Pulse Echo mode to complement the inspection of a pipe mid-wall.

In-Line Testing Machine

The Olympus mechanical solution for ERW pipe inspection is based on a small automated bridge (gantry type) that positions the inspection head in-line or off-line when performing inspections, automatic calibrations, or maintenance operations.

Increased Productivity

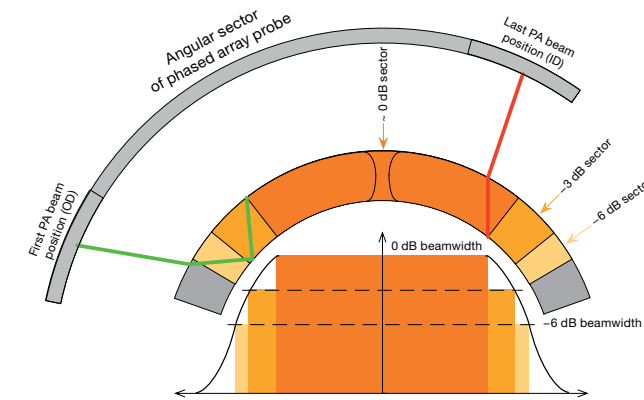
Olympus inspection systems are developed to meet the productivity requirements of the metal manufacturing industry. Our high-speed inspection systems are designed to adhere to the highest international quality standards, without compromising productivity.

Water Wedge Concept

Olympus' unique water wedge has degrees of freedom so the wedge can follow pipe movement. The water wedge utilizes an Aqualene elastomer membrane that maintains a thin film of water for excellent coupling between the probe and inspected product. Keeping the water path undisturbed inside the water wedge yields high repeatability on a small reference defect. Wear plates are attached to the wedge and are available in different sizes to fit each product diameter. Pneumatic suspension enables the water wedge to follow the product movement.



Phased Array Probe Concept



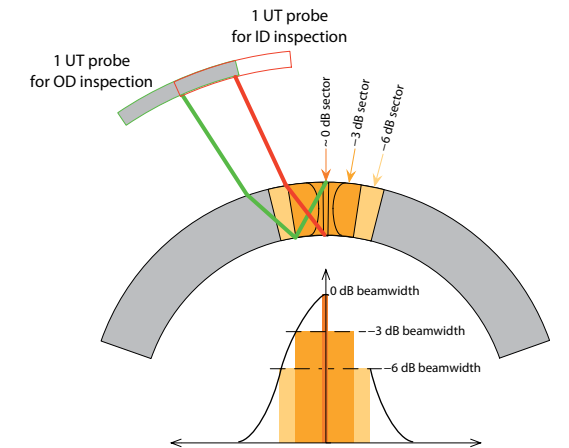
Using only one PA probe on each side of the weld provides wide sector coverage of the heat-affected zone (HAZ) with constant amplitude. This unique solution provides constant amplitude detection within the entire inspection area, even when there is significant mechanical movement (positioning).

Calibration Bench

The calibration bench is an optional stand designed to perform automatic calibration and calibration check sequences at standard inspection speeds.



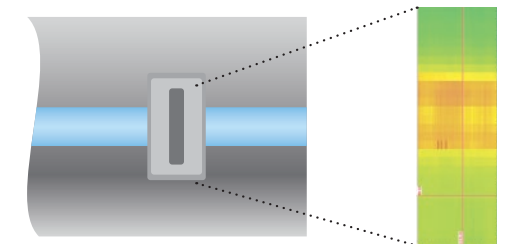
Comparison with Conventional UT



When two conventional UT probes are used on each side of the weld (one for ID and one for OD inspection), only a very narrow zone in the center of the HAZ is covered at 0 dB attenuation due to the UT probe's beam width profile. Slight mechanical movement (positioning) can result in high variations of the detection amplitude.

Automatic Weld Tracking

A unique, patented algorithm based on time-of-flight analysis performs automatic detection of the scarfing area and sends feedback to the PLC to automatically adjust the inspection for each water wedge.

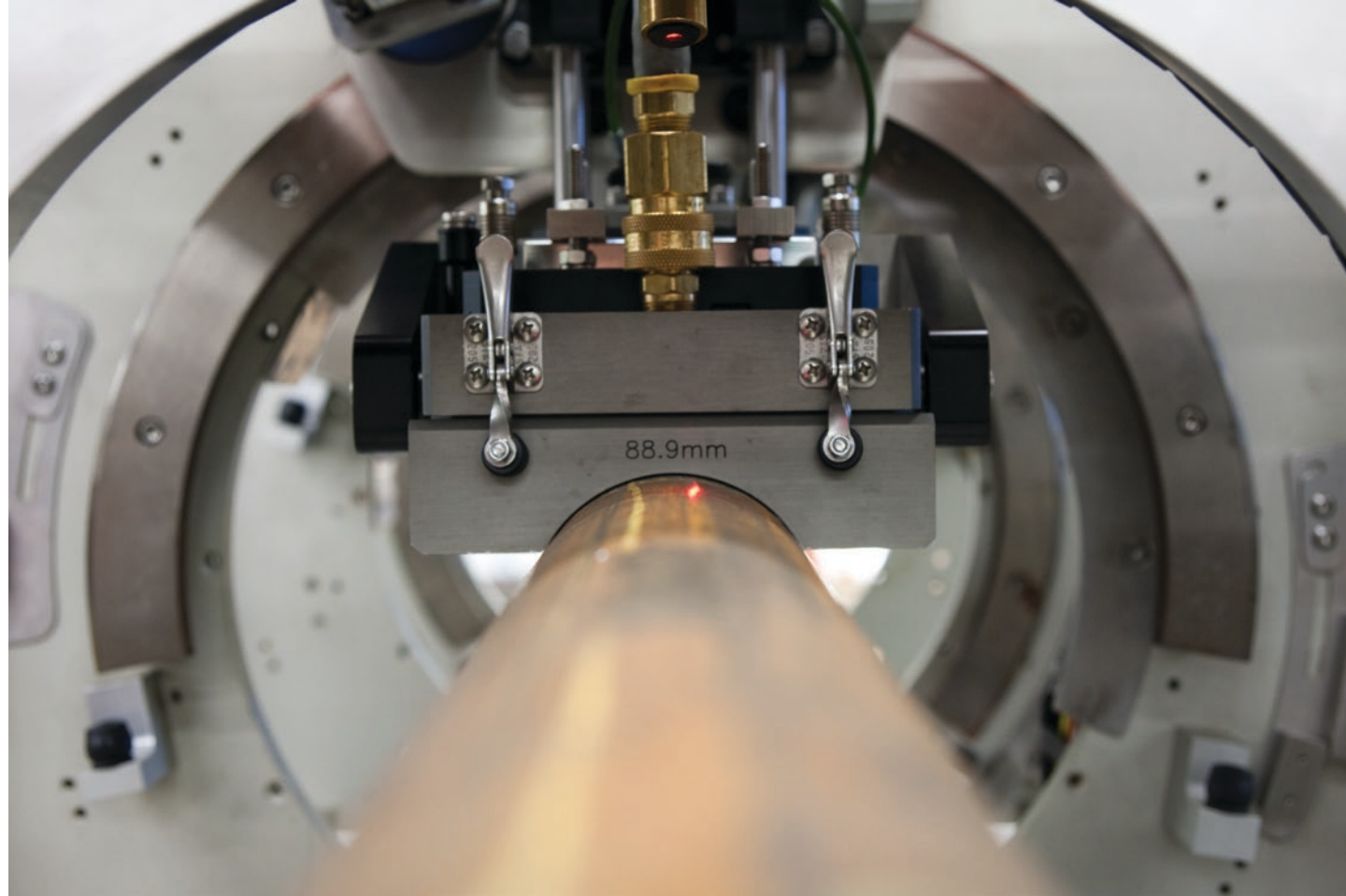


Automatic Calibration

To achieve thorough inspections, each phased array probe must be calibrated to receive the same response no matter which probe detects the defect. To calibrate the probe, the apertures of each probe are passed over a known defect, and the probe's gain level is adjusted automatically. The automated calibration sequence enables users to easily perform and validate a precise calibration of each focal law, saving time without relying on the operator's skills.

The calibration check sequence is performed under the normal production conditions of the inspection process. Each reference defect is validated to help ensure that they will be detected above the alarm level. The results are displayed in an easy-to-interpret strip chart and weld mapping view.

Channel	Type	Amplitude
11Pu1	C	72%
11Pu2	C	69%
11Pu3	C	72%
11Pu4	C	62%
11Pu5	C	60%
11Pu6	C	7%
11Pu7	C	61%
11Pu8	C	75%
11Pu9	C	72%
11Pu10	C	74%
11Pu11	C	74%
11Pu12	C	72%
11Pu13	C	75%
11Su1	C	61%
11Su2	C	62%
11Su3	C	62%
11Su4	C	64%
11Su5	C	62%



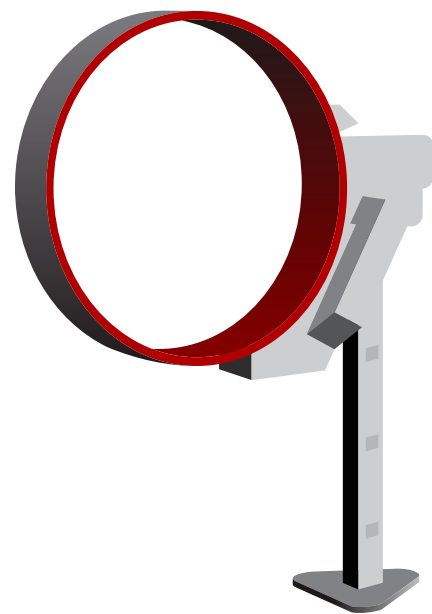
Weld Profile Visualization

Real-time data enables users to visualize the weld profile and scarring area, providing immediate feedback on the welding and scarring process. Operators can monitor an accurate and continuous view of the profile of the weld area and heat-affected zone (HAZ) so they can perform their analysis without having to wait until the pipe is cut. This minimizes the quantity of material affected if the weld profile becomes out of tolerance.

Pipe Window Detector

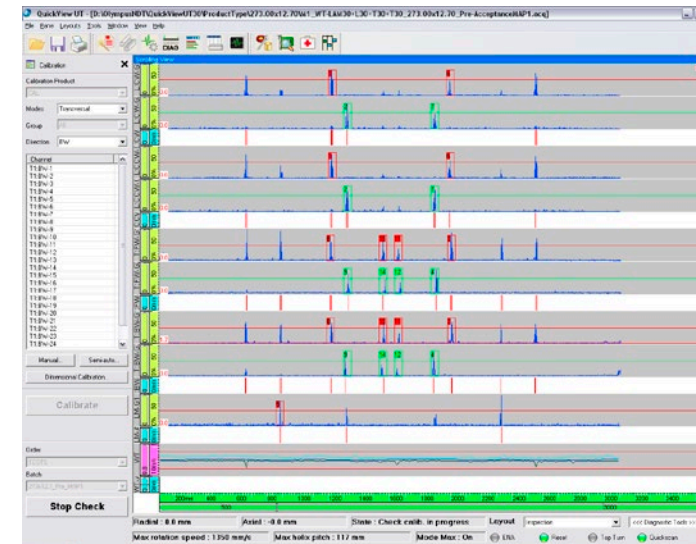
Openings on ERW pipes are normally cut to enable adjustment of the ID scarfing tools used after the welding process.

The Olympus solution for opening detection consists of an eddy current encircling probe that is designed to detect any discontinuities in the material properties to mitigate the risk of damaging the equipment on the line.



Phased Array Acquisition Unit

The QuickScan™ PA 32:256 module is the phased array acquisition unit developed by Olympus for industrial inspection systems. The acquisition unit meets IP55 standards and was specifically designed for easy integration into industrial environments. The unit is managed by QuickView™ advanced software designed for ultrasonic and eddy current inspection.



Advanced Software

Olympus' advanced QuickView software makes it easy to set up the system, acquire data, and manage data.

QuickView software includes a user-friendly wizard, making it simple to create various inspection setups for each part size. The inspection configuration and calibration parameters for each pipe diameter are saved and can be retrieved by the operator within a few seconds. The final inspection results are merged and displayed to clearly differentiate between accepted and rejected tubes.

The QuickView software helps simplify the inspection process with features including:

- Software available in multiple languages.
- Advanced software configuration can restrict access to certain users to help minimize operator errors.
- Calibration and inspection information is stored for future reference and traceability. Acquisition files are generated for every inspected tube, and these data can be stored locally or remotely.
- A communication protocol is available for a programmable logic controller (PLC); users can integrate the system into their own inspection application, facilitating an automatic operating mode that requires minimal human intervention.
- Access to parameters and results enable custom reports and advanced process control tools.

Standard Inspection System Specifications

STANDARD PRODUCT RANGE

Diameter	Medium size range: 60.3 to 244.5 mm (2.4 to 9.6 in.) Large size range: 101.6 to 406.4 mm (4 to 16 in.) Extra large size range: 152.4 to 609.6 mm (6 to 24 in.)
Wall thickness	3 mm to 16 mm (0.1 in. to 0.16 in.)
Speed	Up to 1.5 m/s (295 ft/m)

INSPECTION COVERAGE

Weld sector coverage	At least 25 mm for entire product range (adjustable)
Axial Pulse Density (APD)	1 mm (adjustable)
Weld tracking capacity	Medium size range: -90° to +90° Large size range: -60° to +60° Extra Large size range: -30° to +30°

DATA PRESENTATION

Real-time inspection result	C-scan, strip charts, and alarms
Parameter setup	A-scan, B-scan
Inspection layouts	20 different user-configurable layouts

INSPECTION MODES

Typical inspection modes	45°, 60°, 70° (typical inspection configuration: 45° pulse-echo mode and 45° pitch-catch mode)
Firing modes	Pulse-echo, pitch-catch
Inspection mode configuration	Several inspection modes can be performed simultaneously on the same PA probe.

DETECTION CAPABILITIES FOR TYPICAL REFERENCE DEFECTS

API References	1/2 in./1 in. (12.7 mm/25.4 mm) N10 and N5, ID and OD longitudinal notches 1/8 in. (3.2 mm) through-drilled hole (TDH) 1/16 in. (1.6 mm) TDH
Non-API References	1/32 in. (0.8 mm) TDH 1/8 in. (3.2 mm) half wall drilled hole 1/16 in. (1.6 mm) half wall drilled hole 1/32 in. (0.8 mm) half wall drilled hole
Minimum SNR	9 dB to 12 dB
Repeatability	LID/LOD notches: ≤ 1.5 dB 1/8 in. (3.2 mm) TDH : ≤ 2.0 dB 1/16 in. (1.6 mm) TDH : ≤ 2.5 dB

REPORTING AND DATA STORAGE

Report types	Inspection, calibration, and calibration-check user-configurable reports
Storage	Real-time database inspection data storage

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