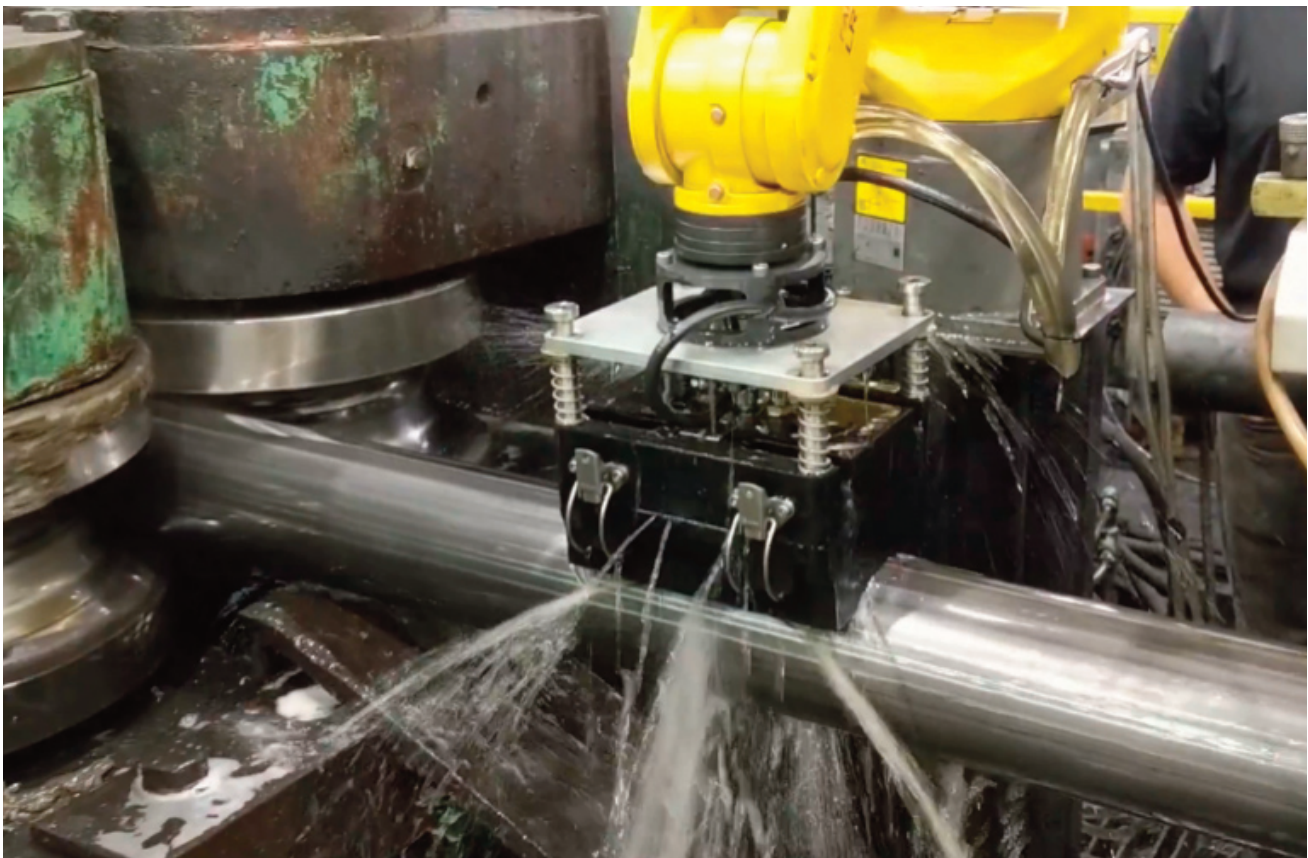


Turnkey Ultrasonic Test System for ERW Tube

Using Echomac[®] UT Phased Array PA TW



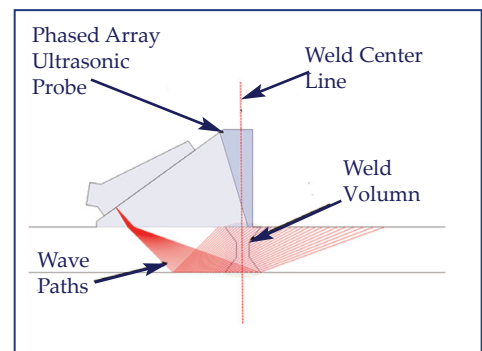
A New Turnkey Ultrasonic Solution for Evaluating ERW Welded Tube

MAC's Phased Array system offers a high performance, automated solution to detect longitudinal and lamination weld zone defects and monitor weld profiles, with minimal operator interaction. Installation can be on-line in the hot zone immediately after the welder, or in a lower temperature area after forming and shaping.

Advantages of Phased Array for Weld Zone Testing

100% Inspection of the Weld Zone for Longitudinal and Lamination Defects Without Moving the Transducer

Phased array offers the unique ability to scan the weld without moving or changing the ultrasonic transducer. For longitudinal flaw detection, the ability to scan means that the entire weld area, including the heat affected zone, is tested. In the weld process the weld area is not always tightly controlled with respect to its position on the circumferential axis. Phased array scanning covers this variation. Additionally, by varying the pulse timing of the individual elements, the weld zone can be inspected with multiple angles if needed.



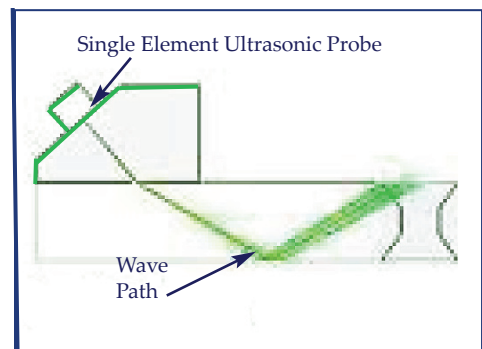
Phased Array Multi Element Sound Coverage

Flaw Detection & Profile Monitoring in a Single Probe

The same advantages are present when using the system to evaluate the scarf trim tool operation. As the array has a wide coverage area, several inches can be inspected to ensure a smooth OD and ID free of weld flash, or evaluate laminar defects in the heat affected zone. Phased array allows sequential flaw detection and profile wall monitoring using the same phased array transducer.

Lower Maintenance and Minimal Operator Intervention compared to Conventional UT

Testing with conventional single element ultrasonic transducers offers a fixed coverage area based on the beam characteristics of each transducer. Covering a larger area requires multiple probes or complicated mechanics for moving the transducers. Both methods require increased maintenance and more operator intervention. If multiple transducers are used, multiple adjustments and operator monitoring is needed to ensure they are constantly focused in the weld area.



Single Element Sound Coverage

For weld profile monitoring, a mechanically scanned single element transducer results in issues with coupling and mechanical variations leading to erroneous readings. The data requires heavy filtering, resulting in measurement error and missed indications. No averaging or AGC is used in MAC's phased array solution. Additionally, the slow moving mechanical scanner covers a greatly reduced area compared with a high speed phased array.

Echomac® PA TW System

MAC is offering a turnkey ultrasonic solution for the evaluation of ERW welded tubes. Our solution consists of a phased array electronically controlled transducer test head, held, and positioned by a robot. The system will monitor the welding process and provide real-time feedback on the quality of the weld and optionally, the quality of the seam trim tool. Echomac® PA TW will test longitudinally for typical weld defects such as:

- Lack of fusion
- Pin hole penetrators
- Hook Cracks
- Misalignment of the parent material

Additionally the system can be configured for straight beam testing to monitor the scarf removal tool or looking for laminar defects in the Heat Affected Zone.



Robot with test head on the tube

5- Axis Robot

The 5-Axis Fanuc robot's motion is controlled by connecting to the customer's PLC, or through the HMI panel. The Robot can be programmed to move to the calibration, weld line test, or home positions. This allows the operator to easily move the test head to the calibration tube and scan the length of the standard to verify correct settings, then quickly return to the weld line test position. A quick retract to safety position is automatically activated when the system receives a signal of an approaching open weld, cut outs, or similar condition. The positions can be customized and options are available.

Echomac® Phased Array Test Head



Customized, exchangeable test shoe and captive water chamber array head

The test head is a custom designed assembly that houses the transducer array, provides coupling (usually mill coolant), and follows the surface of the tube. The design utilizes a spring and bushing system that keeps the test head normalized to the tube surface ensuring correct angular entry of the sound beam to the test area. Because of the possibility of testing tubes with an elevated surface temperature, a critical design parameter is the ability to remove the heat that could interfere with the sound path. MAC's test head has ports that allow the escape of any air/steam to be vented from the top of the head ensuring optimum sound transfer. This constant laminar coupling provides the highest measurement accuracy resulting in optimum data without the need to filter spurious readings.

The test head houses a single phased array transducer and can support a range of tube diameters using a wear shoe that MAC customizes for the exact tube OD being tested. A test head supplied to test a 4" diameter tube, for example, can handle tube diameters ranging from approximately 2" to 4". The test head has quick-disconnect latches for changing the wear shoes. For weld mills with a large diameter range, multiple test heads and arrays can be supplied to support an entire range up to 12" diameter. Any changes to the transducer settings are handled electronically, and the robot's concentric position stays constant with respect to the tube and requires no adjustment when changing test shoes. In case of unanticipated damage, the system has an inexpensive mechanical connection to allow the test head to break away without damage to the robot.

Instrument Control, Display & Outputs

The PA is preprogrammed with the delay laws and ultrasonic setting for each pipe diameter. Once test settings have been saved, minimal operator intervention is needed. The display shows the results of the test using A-scan, B-scan and C-scan views. An integrated strip chart records the test for a permanent record for review. The system is provided with real-time outputs that can be configured for paint markers and horns.

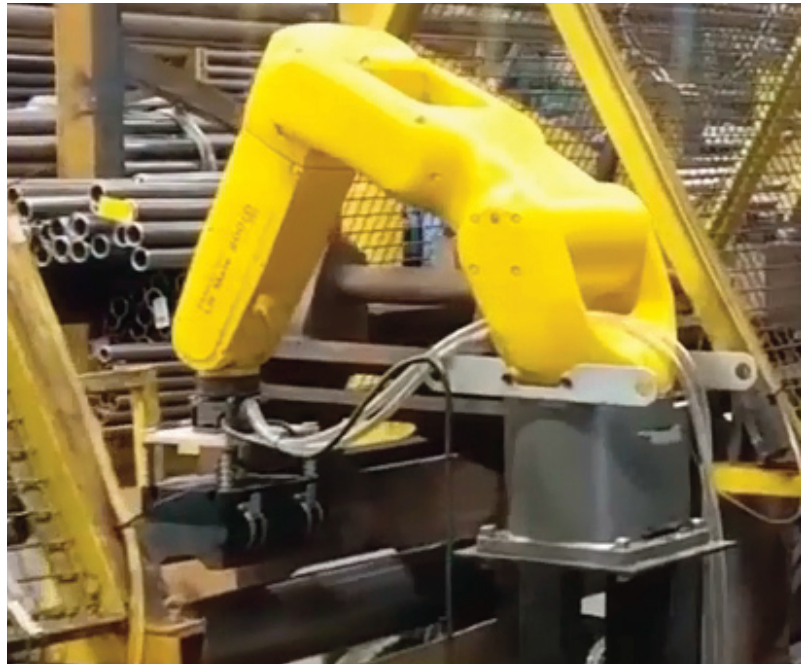
Echomac PA TW Applications

Mechanical Tube Manufacturers

MAC has a very long-established relationships with many manufacturers of tubing being tested to internal quality standards. Our phased array solution offers longitudinal defect testing and can be sold alone, or as a complimentary test to an eddy current encircling coil system. The defect criteria is typically a 5% or 10% longitudinal notch 1" long.

OCTG and Automotive Manufacturers

For customers with stringent end user or industry defined requirements such as those for OCTG or Automotive markets, the Echomac PA TW solution can be configured for the longitudinal defects defined above as well as for monitoring the seam trim tool. All these tests can be configured with the same system using only one array. For larger diameter tubes or installations that require a larger scan area, multiple arrays can be used to increase the test coverage.



5 Axis robot holds the test head prior to positioning it on the tube.

The core strength of MAC is the ability to offer complete testing solutions. The ERW solution can be supplied with other modalities of testing like eddy current or magnetic flux leakage. MAC's Rotoflux® Magnetic Flux Leakage system is frequently used where a second mode of NDT is required by API specifications.

System Location

The test system is used for the monitoring of the weld process and is installed in-line on the weld system before the tubes are cut to length. The system can be installed immediately after the welder, which is advantageous for quick notification and prompt correction of weld forming issues. When testing immediately after the welder, the system is required to test at a highly elevated temperature when the tube shape has not yet been formed to an ideal round. The mis-shape of the tube can cause reduced accuracy. For better flaw detection, a location after the forming rolls may be preferred. Installing after the forming rolls offers the advantage of testing a tube that is ambient in temperature and has a finalized round shape.

The Robot's small footprint allows for non-invasive installation in the mill line. The ability to locate the system in the optimum line location provides the customer with immediate feedback of the welding process. Quickly identifying welding problems allows for process monitoring ensuring that the customer is aware of problems and can make immediate corrections before large amounts of material have been manufactured out of tolerance.

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