International SA
Inspection & Engineering Services

Phased Array

Ultrasonic Inspection

Introduction

Phased Array is one of the advanced NDT methods that SA International offers its clients. The ultrasonic technique can be widely used in different sectors to determine component quality and to detect failure s like flaws or cracks.
Phased Array can also be effectively used for thickness measurements in conjunction with Corrosion testing.
The combined use of many angles and focus depths during the inspection through one probe guarantees the efficiency of the tool, as several different inspections can be conducted without the need for changing the transducer assembly.

Development of Phased Array

During their first couple decades, commercial ultrasonic instruments relied entirely on single element transducers that used one piezoelectric crystal to generate and receive sound waves, dual element transducers that had separate transmitting and receiving crystals, and pitch/ catch or through transmission systems that used a pair of single-element transducers in tandem.
The principle of constructive and destructive interaction of waves was demonstrated by English scientist Thomas Young in 1801 in a notable experiment that utilized two point sources of light to create interference patterns. Waves that combine in phase reinforce each other, while waves that combine out-of-phase will cancel each other.
Phase shifting, or phasing, is in turn a way of controlling these interactions by time-shifting wave fronts that originate from two or more sources. It can be used to bend, steer, or focus the energy of a wave front. In the 1960s, researchers began developing ultrasonic phased array systems that utilized multiple point source transducers that were pulsed so as to direct sound beams by means of these controlled interference patterns.
Portable, battery-powered phased array instruments for industrial use appeared in the 1990s. Nowadays, Phased Array tools allow electronic setup, data processing, display and analysis all within a portable device, and so the doors are opened to more widespread use across the Industrial sector.
Phased Array holds the promise of being able to efficiently detect all significant flaws by combining many angles and focus depths into one probe and image the resulting reflections in an understandable way.

Benefits of Phased Array:

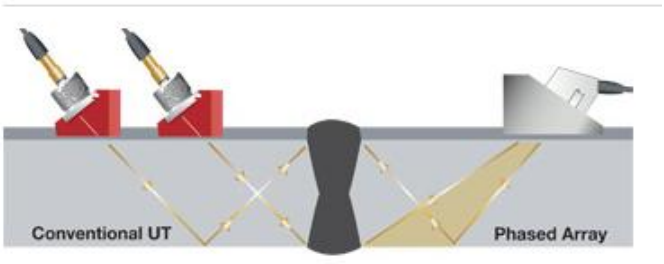
- Simplified inspection of components that have complex geometry.
- Inspection of many different materials possible.
- High temperature inspections possible up to over 350°C.
- Speedy inspection compared to conventional ultrasonic testing.
- Higher probability of problem detection thanks to testing from multiple angles with a single probe.
- All inspection data presented in an understandable graphic format.
- Well qualified operators.

Advantages compared to Conventional Ultrasonic

Ultrasonic phased array systems can potentially be employed in almost any test where conventional ultrasonic flaw detectors have traditionally been used; weld inspection and crack detection being the most important applications,.
Phased arrays can also be effectively used to profile remaining wall thickness in corrosion survey applications.

The benefits of phased array technology over conventional UT come from its ability to use multiple elements to steer, focus and scan beams with a single transducer assembly:

- Beam steering, commonly referred to sectorial scanning, can be used for mapping components at appropriate angles. This can greatly simplify the inspection of components with complex geometry.
- The small footprint of the transducer and the ability to sweep the beam without moving the probe aids inspection of such components in situations where there is limited access for mechanical scanning.
- The ability to test welds with multiple angles from a single probe greatly increases the probability for detection of anomalies.
- Electronic focusing permits optimizing the beam shape and size at the expected defect location, as well as further optimizing probability of detection.
- The ability to focus at multiple depths also improves the ability for sizing critical defects for volumetric inspections.
- Focusing can significantly improve signal-to-noise ratio in challenging applications, and electronic scanning across many groups of elements allows for C-Scan images to be produced very rapidly.



Imaging:

Phased array instruments are naturally multi-channel as they need to provide excitation patterns (focal laws) to transducer assemblies with from 16 to as many as 256 elements. Unlike conventional flaw detectors, phased array systems can sweep a sound beam from one probe through a range of refracted angles, along a linear path, or dynamically focus at a number of different depths, thus increasing both flexibility and capability in inspection setups.
This added ability to generate multiple transducer paths within one probe adds a powerful advantage in detection and naturally adds the ability to "visualize" an inspection by creating an image of the inspection zone. Phased array imaging provides the user with the ability to see relative point to point changes and multi-angular defect responses, which can assist in flaw discrimination and sizing. While this may seem inherently complex, it can actually simplify expanding inspection coverage with increased detection by eliminating the complex fixtures and multiple transducers that are often required by conventional UT inspection methods.

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