Flexible Wedge Phased Array Transducers for Inspecting Variable-Geometry or Complex Components

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The transmission of ultrasound from the transducer into the inspected component is a determining factor in the performance of ultrasound inspections.

Various coupling solutions exist to ensure this transmission. The most frequently used are:

- **Immersion of the component in water tank:** This coupling presents the best acoustic performance (low attenuation, coupling homogeneity, no intermediate interface). However, the inspected parts need to be fully immersed and thus complex control systems are required.

- **Coupling by direct contact with a liquid couplant, or via a rigid wedge or a delay line with liquid couplant at the interfaces:** This coupling requires simpler control systems for the inspection, but the homogeneity of the couplant film and attenuation in the wedges deteriorate the signal.

The geometry of the inspected part can make the coupling more difficult to setup, particularly if the surface is complex or varies from one point to another. The problem becomes critical when the dimensions of the transducer are large in comparison with the local curvature of the interface.

The use of transducers that are flexible, or that are fitted with a flexible wedge, improves the quality of the coupling for components with complex or variable geometry, and in some cases, makes it possible to do certain inspections that currently have no solution. This article presents the recent developments and results obtained in the context of transducers with flexible wedges, in particular:

- Design options;
- Flexible membranes and mechanical interfaces development for PA transducers;
- Mechanical supports development for manual or automated use;
- Acoustic performance, and wear resistance tests;

These studies have demonstrated the contribution of flexible wedge transducers to various applications, with acoustic performances similar to that of immersion and easy implementation comparable to standard contact inspections, while remaining compatible with an industrial use.

The detailed results will be presented, as well as the possibilities for the future developments of transducers with flexible wedges.