

Industrial ready integrated Phased Array immersion system for Inspection of rectilinear machined components(discs) of jet engines

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The non-destructive testing (NDT) industry has undergone a substantial evolution due to the growing adoption of phased array ultrasonic technology. This technology has been in use for several years now, and its integration has resulted in improvements in NDT practices, leading to increased productivity, expanded inspection capabilities, and enhanced overall inspection efficiency. Phased array ultrasonics have become indispensable tools for the assessment of raw materials like plates, bars, pipes, and composite components. What sets these inspections apart is their remarkable simplicity in terms of configuration. Once the initial settings are established, the need for further adjustments becomes a rare occurrence. However, the inherent diversity in jet engine's part shapes and the array of inspection requirements, spanning longitudinal waves, multi-angle inspections, and multi-zone assessments, present formidable challenges to the NDT community. This complexity demands not only a high level of expertise from both programmers and operators but also escalates the risk of errors. Most commercially available phased array hardware instruments are designed to be versatile, intended to serve a range of NDT applications. While this versatility is advantageous, it often results in complex user interfaces and operational logic, which can be a considerable obstacle in the context of disk inspections. The solution developed by ScanMaster Systems (IRT) allows to overcome the challenges mentioned above. A solution grounded in a few fundamental principles:

- **Precise Phased Array Probe Definition:** A meticulous definition of the phased array probe's characteristics.
- **Inspection Type Templates:** Pre-defined templates that are customized to the specific probe, simplifying inspection configuration.
- **Generation of Scan Data:** The creation of scan data that is compatible with conventional ultrasonic testing, allowing the seamless integration of conventional and phased array ultrasound techniques.

Each probe's definition is complemented by a template tailored to the inspection type. The template includes a set of focal laws, offering the flexibility to modify parameters within the probe definition, such as focus points or beam angles. Furthermore, the probe stores essential UT parameters, including filter settings, gain/DAC settings, and more. This approach ensures that almost all conceivable combinations required for disk inspections are addressed. The inspection results are stored in the same format as traditional ultrasonic inspections. Beyond individual C-scans per focal point or angle, the software generates combined C-scans and B-scans. These data sets simplify data analysis, shielding inspectors and evaluators from the intricacies of data collection and settings, thereby facilitating efficient and rapid analysis. This approach also guarantees compliance with existing industry standards for data evaluation. The Probe/Template paradigm facilitates seamless utilization of both traditional and phased array hardware and probes within the same inspection process. When combined with a proprietary rapid tool exchange system, this framework addresses the persisting challenge of inspecting near-surface zones (within 1.5 mm or less), historically problematic for phased array technology. The deep-rooted integration of phased array technology into immersion systems introduces a host of advantages, including the deployment of the "Column of Focus" method, where electronically generated focal points counteract material-based attenuation. This method extends the inspection depth while enhancing the Signal-to-Noise Ratio. Moreover, it supports the adoption of multi-angle approaches for disc inspections, now the prevailing standard among leading jet-engine manufacturers. Phased array technology allows simultaneous surface inspection along a single path, capturing data from multiple angles. Practical trials undertaken by ScanMaster serve as testament to the swift implementation of phased array-based disc inspection systems within industrial settings. This translates into a substantial increase in productivity, without compromising inspection quality, and necessitating minimal investment in operator training for phased array technology.