# Eddy current array (ECA)-enabled inspection of orbital welds and jet engine components

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The recent advances of eddy current array testing (ECA) in the aviation and aerospace industries have expanded the range of components that can be inspected for surface flaws. This technology stands out by its capability to adapt to a variety of materials and geometries. From the curved surface of titanium blades to aluminum friction-stir welds, ECA is being used increasingly to replace dye penetrant testing (PT) and conventional eddy current testing (ECT) in applications involving the detection of surface-breaking and near-surface cracks. By transmitting and receiving signals from one another, ECA sensors enable detection performance that cannot be reached with traditional single-element probes. Additionally, ECA is significantly faster, less operator-dependent, and easier to automate. One lesser-known benefit of ECA is its capability to penetrate non-ferromagnetic surfaces and detect subsurface flaws that are invisible to visual inspection. By controlling the frequency of the currents, the multiplexing pattern of the array as well as the size and impedance of the sensors, it becomes possible to inspect both sides of a thin conductive wall with a single scan. This is especially useful for the assessment of thin-walled tubes in jet engines, which often offer restricted access from the outside only. Tubes assembled by automated orbital welding are of particular interest: even with a highly controlled welding process, small cracks and clusters of porosities can be present in the joints and eventually propagate, leading to fuel leakage and the potential failure of propulsion systems. An advanced ECA system was developed for the inspection of thin-walled feed lines and hydraulic lines in aircraft and spacecraft. The results validate rapid circumferential scanning of orbital welds, and the detection of both external and internal flaws in a matter of seconds. The adaptation of this same technology is also explored for the inspection of various engine components, including turbine disks, blades, and cooling holes. The use of ECA as a replacement of conventional inspection methods is discussed and promises significant time savings for the non-destructive evaluation of jet engines.