



Early Warning Signs

Commercial Benefits—Spinoffs

The tiniest cracks may spell big trouble for aging aircraft. Fatigue damage of sufficient size and density can weaken metal, leading to possible failure of a structure.

Through Small Business Innovation Research (SBIR) contracts with NASA's Goddard Space Flight Center, JENTEK® Sensors, Inc., of Watertown, Massachusetts, is now offering a system for nondestructive material evaluation, including thermal spray coating for characterization of porosity and thickness.

JENTEK® developed the GridStation™ Measurement System, based in part on a NASA need for characterizing anodic coating thickness, spacecraft contamination, and thermal barrier coatings. The innovation can provide age degradation monitoring, including fatigue, corrosion, and thermal aging in numerous materials, such as ceramics, composites, and metals.

JENTEK® markets two devices. The first, called the Meandering Winding Magnetometer (MWM™), is used for conducting, as well as for magnetic media. The other, known as the InterDigital Electrode Dielectrometer (IDED), is used for relatively insulating media. With the MWM™, JENTEK®'s first commercialized sensor product, magnetic fields are used to inspect conducting materials, such as metals, both magnetic and nonmagnetic. The MWM™ can spot minuscule cracks down to one- to two-millionths of an inch in depth. By comparison, conventional devices that use eddy current cannot generally find cracks of that size. Indeed, this capability is essential because clusters of microscopic cracks can affect the service life of a structure.

To reveal the microscopic cracks, the MWM™ signals are induced by specially configured conformable sensor arrays. These arrays minimize the requirement for precise positioning of the device and permit mounting the sensors permanently at any critical location for continuous monitoring of fatigue. Also, because this advanced device uses conformable sensors, it can inspect not only flat surfaces, but also convex, concave, and conical surfaces. Accurate property determinations can be obtained, regardless of the shape of the part being tested. For some applications, sensor scanning can be done at a fast-paced rate, up to 2 feet per second. An initial calibration of the sensor system in the laboratory permits the measurement of a wide variety of materials, without requiring the operator to use any standards or reference parts. JENTEK® has rigorously



tested the system for performing very early stage crack detection in stainless steel, aluminum, and other materials.

Used with the company's product line of sensors, JENTEK®'s GridStation™ is a fully integrated and portable nondestructive property measurement system. Current and potential applications for the JENTEK® MWM™ and IDED sensors include characterization of coatings, fatigue damage mapping, crack detection and sizing, applied and residual stress measurement on ferromagnetic materials, object detection, material identification, and cure monitoring. On-line fatigue monitoring can be done in difficult-to-access locations on complex structures, such as aircraft, bridges, and heavy manufacturing equipment. The software environment uses measurement grid modules to convert impedance measurements to property estimates in real-time without requiring user interpretation. The data are stored in a "Grid Library."

While Goddard first considered use of the innovation for its spacecraft building and validation work, the Glenn Research Center capitalized the innovation and utilized the system to characterize ceramic thermal barrier coatings for turbine blade applications. The thermal barrier coatings allow operation of the turbine blades at higher temperatures. Monitoring the properties and degradation of the ceramic coatings, the metallic bond coat, and the super alloy blade material would provide for preventative maintenance, as opposed to costly unscheduled repairs when failures occur.

Neil Goldfine, JENTEK®'s president, says the NASA SBIR contract work helped advance the company's product into the commercial market. JENTEK® has sold and delivered GridStation™ measurement systems with JENTEK® MWM™ and IDED sensors to customers in government agencies, as well as those in the private sector. ❖

Jentek® Sensors' Gridstation™ Measurement System can provide age degradation monitoring, including fatigue, corrosion, and thermal aging in numerous materials.

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