

Monitoring Structural Health

Delta TechOps developing technology and framework to make structural health monitoring the next NDT

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Delta TechOps is working on an innovative approach to airframe structural health monitoring (SHM) using embedded comparative vacuum monitoring (CVM) sensors to detect the formation of cracks in critical load-bearing structures.

Alex Melton, Delta TechOps nondestructive testing (NDT) program manager, points out that the goal is to integrate structural health monitoring into the regulatory framework so that the industry can use it. "SHM is the next level of NDT," says Melton. "Using the sensors enables a fair amount of access to structures on the aircraft that are generally very difficult to access for a time-consuming, visual inspection," he notes. "They will also eliminate the potential collateral damage risks, due to human factors, during an airframe inspection."

Delta TechOps, teamed with Boeing, the FAA, Sandia National Laboratories, Structural Monitoring Systems, and Aerodyne Electronics Manufacturing Corp., won the 12th annual Better Way award for the First Commercial Aviation Application of Structural Health Monitoring at the Airlines for America and Society of Automotive Engineers 57th Annual A4A Non-Destructive Testing Forum in San Francisco.

The SHM program is funded by the FAA, with overall management by San-

dia National Laboratories, which operates the FAA Airworthiness Assurance Validation Center.

David Piotrowski, principal engineer at Delta TechOps Enabling Technologies Group, explains that the current focus of the SHM program is to move the technology from its prototype status into mainstream maintenance. "The technology has been there, but what we did not have is a clear pathway to go from prototype testing into mainstream maintenance, and give the industry an alternative inspection technique."

Melton says that Delta TechOps is working with the FAA Transport Airplane Directorate—which is the customer—to provide guidance with the regulatory framework development, needed to integrate the use of CVM sensors into aircraft maintenance. In that regard, Delta TechOps will essentially "live through" the certification process for the SHM application. He predicts that as the regulatory picture becomes clear, CVM sensors will assume a greater role in the aircraft structural maintenance process. "This means, long term, there will be more on-condition maintenance of major structures."

Melton adds that while the sensor technology for SHM is already in place, it represents "a different philosophy" involving structural NDT. "It will require an industry educa-

tion effort for it to gain acceptance."

For crack detection, Delta TechOps installed three CVM sensors on the center wing box front spar shear fittings, at Body Station (STA) 540, on 10 of Delta Air Lines' Boeing 737-700s in February and March. The 737-700 was selected because the center wing box is prone to high stress levels and, according to Piotrowski, "had known cracking issues," as indicated by a Boeing service bulletin. The sensors, which are encased in Teflon tubes, weigh approximately 2 lb. Designed as a passive system, the sensors have what he called an array of embedded galleries to which a vacuum is applied. Any leaking path of atmospheric pressure detected produces a measurable change in vacuum level, indicating the presence of a crack. If no crack is present, a vacuum is achieved.

The data is downloaded from the sensors via a handheld device during overnight checks, on what is currently a 90-day repetitive schedule. The objective is to produce the data package within 12-18 months of monitoring, consisting of 5-6 readings following installation on the aircraft. In total, 70 installed sensors would be involved, resulting in the generation of 350 data points, based on five checks.

The data from the sensors is being monitored and tracked in conjunction with performance tests at Sandia National Laboratories to identify aircraft structural maintenance items earlier and more efficiently.

"We are collecting as many data points as possible in order to make sure that the system is working as it should be," says Piotrowski. "When we get enough flight-test data, we will take it to the FAA and Boeing for certification, hopefully by the spring/summer time period of 2015. Boeing is providing guidance, and we want them to bless the maintenance program changes that this will make possible."

He hopes the work accomplished, "will serve as the blueprint" for the future implementation of SHM on commercial aircraft. ☺

Delta TechOps applied its crack-detecting sensors to the center wing box on 10 Delta Air Lines Boeing 737-700s.



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