

FAA STRUCTURAL HEALTH MONITORING RESEARCH PROGRAM

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Federal Aviation
Administration



Structural Health Monitoring (SHM)

- Past
- Present
- Future



SHM - Past

- In 2011, Transport Aircraft Directorate Seattle Sponsored SHM work:
 - Develop an overarching roadmap for SHM:
 - Guide the adoption of SHM in commercial transport aircraft
 - Provide regulatory guidance of SHM use
 - Assess state of SHM
 - Develop guidelines for assessing reliability and maintainability of SHM

SHM - Past

- Work accomplished via an Interagency Agreement with Sandia National Labs at the FAA's Airworthiness Assurance NDI Validation Center (AANC)
- Work is being coordinated with the Aerospace Industry Steering Committee (AISC) on SHM (SAE G-11SHM)



SHM ROADMAP DEVELOPMENT

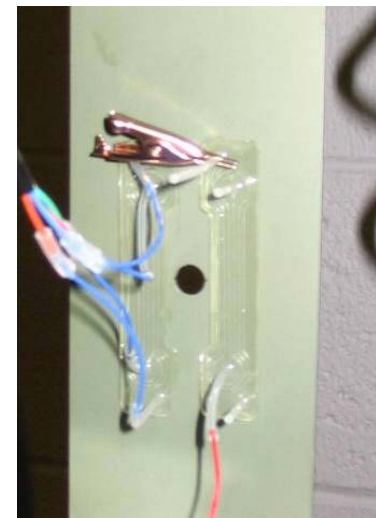
- **SHM Industry Survey** – addressed deployment, validation, certification, standardization & cost-benefit
- **SHM Technology Readiness Assessment (database)** – determined the potential adoption of SHM practices and issues affecting the operational performance of an SHM system
- **SHM Sensor Database** - indicates SHM possibilities (candidate technologies) and how to safely integrate them
- **FAA Documents and Precedents Review** – studied ACs, ADs, ARPs, Mil Hndbks, Certification Guidelines, MSG-3, HUMS, etc. to establish an SHM foundation
- Results of this work is documented in a report that is currently in editing and should be published in FY15

SHM PRESENT

- **Conduct trial SHM certification & integration activity with an operator which establishes an optimum OEM-airline-regulator process**
- **Partnered with the AANC, Delta Air Lines and Boeing:**
 - Determine most likely SHM candidate to move forward with
 - Pick an application for its use with a cost/benefit that satisfies Delta management
 - Most likely application will be a NDI inspection replacement
 - Determine all flight parameters affecting sensor/system
 - Develop a validation plan
 - Determine most likely applicant to gain FAA approval for use
 - Determine affect to maintenance program of aircraft and develop procedures for use
 - Perform flight test and gather data
 - Validate the effort by following the AISC's ARP 6461 published in Sept 2013.

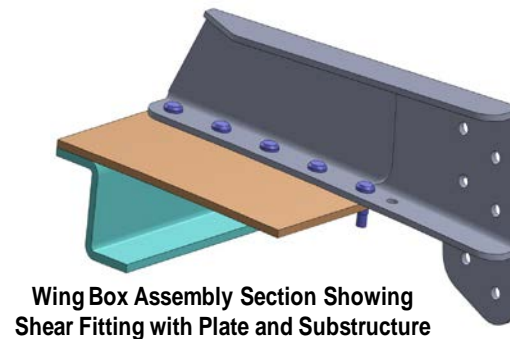
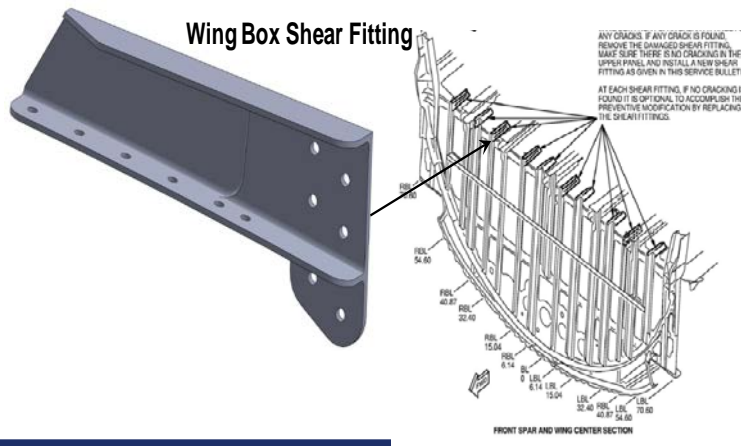
SHM PRESENT

- Team selected the Comparative Vacuum Monitoring (CVM) system to find cracks in known hot spots
- Through previous research in the Inspection program, this sensor has flown for over 6 years on several Delta and Northwest Airline Aircraft
- Past testing has given environmental reliability data
- Sandia has performed Probability of Detection analysis
- CVM is in Boeing's NDT manual as an approved method for use
- Delta/Boeing has selected 737 NG Wing Box fitting cracking problem as application
- Boeing issued a service bulletin as a result of cracking after 21k cycles
- Discussed with FAA Transport Aircraft Directorate, Seattle and Atlanta ACO



SHM PRESENT FY13

- Plan was to install on aircraft by AAR-Indy (MRO) as aircraft are scheduled for 24 day checks-Sept 2013 for approx 70 aircraft (15k cycles)
- First 3 aircraft had cracked fittings-scrapped this idea

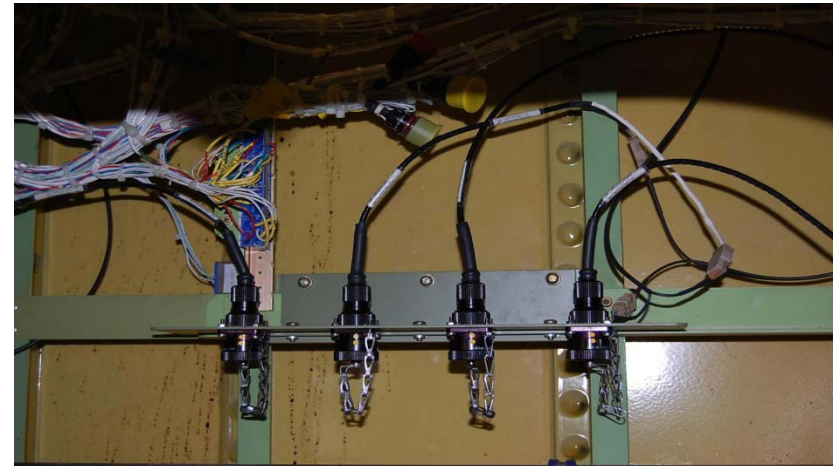


SHM FY14 Efforts

- **New plan is to install on 737-700 going thru Atlanta for 5 ½ day checks (6k cycles)**
- **7 aircraft completed in Feb/March 2014**
- **Delta is collecting CVM data every 90 days as well as performing required NDI inspection**



CVM Install



SHM Future Efforts

- Review CVM project against ARP and determine what has been validated
- Assess FAA rules and determine if adequate for SHM use
- Delta and Boeing developing a list of future SHM applications
- Formal certification of CVM with Delta/Boeing and ACO once adequate data available.

SHM FY14 Efforts - Rotorcraft

- Intent to move to next level of SHM use working with Sikorsky and AANC
- Sikorsky has suggested 2 potential areas of the S-92 that could be possible test sites
- Can we tie the SHM sensors into the HUMS system? Is there a correlation of the HUMS data to the problem areas? This is AISC G-11 committee's future plans for guidance for Rotorcraft.

SHM Issues

- Many members of the G-11 committee are concerned about SHM/POD.
- Defining a reliability methodology for SHM, is POD valid for SHM
- 1st International SHM Reliability Workshop to be held:
 - April 14-15th, 2015 in Boston
 - IWSHM September 2015 at Stanford

FAA Point of Contact

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