



CUSTOMER:
L-3 Communications Integrated Systems

INDUSTRY:
Aerospace

PROJECT NAME:
747SP Aircraft Ground Vibration Test for the Stratospheric Observatory for Infrared Astronomy (SOFIA) Program

CUSTOMER LOCATION:
Waco, Texas

INSTRUMENTS UTILIZED:
MB Dynamics Modal 50A and Modal 110 Shakers

OVERVIEW

A Boeing 747SP aircraft has been modified by L-3 Communications Integrated Systems to accommodate a 2.5 meter reflecting telescope as part of the SOFIA program. SOFIA, which will be the largest airborne observatory in the world, is a collaborative effort of NASA and the DLR, German Aerospace Center. This flying observatory is being developed and operated for NASA by a team of industry experts led by the Universities Space Research Association (USRA).

One of the crucial steps in preparing the aircraft for flight was a ground vibration test (GVT) which characterizes the dynamic properties of the aircraft. This is required since major structural modifications to the aircraft were made to accommodate the telescope and all of the supporting equipment. L-3 performed detailed finite element analysis of the modified aircraft to allow dynamic analysis and flutter studies to be performed. ATA conducted the GVT of the aircraft in support of the L-3 analysis efforts. ATA provided all of the instrumentation and data collection and analysis systems required to conduct the GVT. Among the critical instruments for the test were two models of MB Dynamics' excitation shakers, Modal 50A and Modal 110. ATA regularly uses MB Dynamics shakers because of the ease of setup time, especially with such shaker conveniences in fixturing and setup like the clearance hole through the armature and shaker and a collet chuck for gripping a threadless stinger. This makes it easy to connect a stinger to the test structure.



Two shaker excitation methods were used. The first was multiple-point random (MPR) excitation where various combinations of the eight MB Dynamics shakers were used simultaneously to excite the aircraft. The second method used a sinusoidal sweep excitation. The overall modal survey used MPR excitation followed by sine sweep testing conducted with two shakers at a time.



Further testing allowed dynamic interaction between the aircraft and the telescope assembly (TA) to be studied so that the TA vibration isolation system performance could be evaluated. ATA's data system allowed all aircraft and telescope responses to be monitored while the TA control system was actuated. In addition, local components (telescope cavity doors, aperture, bulkheads, etc.) were studied in a number of configurations to observe dynamic interaction with the aircraft.

Overall test results allowed the finite element model to be confirmed in addition to providing comparisons of the modified aircraft with the unmodified aircraft. This was an excellent example of ATA's participation in a large scale modal test program where numerous configurations were required for study and correlation to analysis models were essential.

ATA SUPPORT INCLUDED:

- ▷ Coordination of sensor location selection with L-3 and other team members
- ▷ Conduct complete GVT of the 747SP SOFIA aircraft for 18 unique configurations
- ▷ Provide detailed test results to L-3 analysis engineers during and at the conclusion of the GVT program
- ▷ Evaluate the TA isolation system characteristics and collect overall aircraft and telescope data during TA drive system excitation to assess servo-elastic properties

ATA WESTERN REGION CONTACT:
Ronan Cunningham
 ronan.cunningham@ata-e.com
 858.480.2015

ATA EASTERN REGION CONTACT:
Chris Kubik
 chris.kubik@ata-e.com
 703.796.9181

