

ABSTRACT

SOFIA

Flying the Telescope



The primary focus of this paper is how the flight test team for the Stratospheric Observatory For Infrared Astronomy (SOFIA) re-cast an extensive developmental test program to meet key milestones while simultaneously ensuring safe certification of the airframe and delivery of an operationally relevant platform, ultimately saving the overall program from financial demise.

Following a brief introduction to the observatory and what it is designed to do, SOFIA's planned developmental test program is summarized, including analysis and design philosophy, envelope expansion, model validation and airframe certification. How NASA used lessons learned from other aircraft that employed open cavities in flight is explained as well as how and why the chosen design was selected. The approach to aerodynamic analysis, including bare airframe testing, wind tunnel testing, computational fluid dynamics and finite element modeling proved absolutely critical. Despite a solid analytical foundation, many unknowns remained. History provides several examples of disastrous effects on both systems and flight safety if cavity design is not approached properly. For these reasons, an extensive test plan was developed to ensure a safe and thorough build-up for envelope expansion, airframe certification and early science missions.

Unfortunately, as is often the case, because of chronic delays in overall program execution, severe schedule and funding pressures were present. If critical milestones were not met, domestic as well as international funding was in serious jeopardy, and the demise of the entire program loomed large. Concentrating on rigorous model validation, the test team challenged certification requirements, increased test efficiency and streamlined engineering analysis. This resulted in the safe reduction of test point count by 72%, meeting all program milestones and a platform that soundly satisfied all operational science requirements. Results from early science missions are shown and a 'proof of concept' mission for which SOFIA was opportunely positioned is showcased. Success on this time-critical mission to observe a rare astronomical event proved the usefulness of an airborne observatory and the value in waiting for the capability provided by SOFIA.

Finally, lessons learned in the test program are presented with emphasis on how lessons from previous aircraft and successful test programs were applied to SOFIA. Effective application of these lessons was crucial to the success of the SOFIA flight test program.

SOFIA is an international cooperative program between NASA and the German Space Agency, DLR. It is a 2.5 meter (100-inch) telescope mounted in a Boeing 747SP aircraft used for astronomical observations at altitudes above 35,000 feet. SOFIA will accommodate a host of scientific instruments from the international science community and has a planned operational lifespan of more than 20 years.