

THERMAL BALANCE TESTING OF THE ATMOSPHERIC INFRARED SOUNDER INSTRUMENT

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Abstract

The Atmospheric Infrared Sounder (AIRS) is one instrument in suite of six instruments which will fly onboard NASA's Earth Observing System (EOS) Aqua spacecraft with a scheduled launch date of March 2002. It is a cryogenic instrument developed under a Jet Propulsion Laboratory contract by BAe Systems formerly Lockheed Martin Infrared Imaging Systems for NASA. AIRS will provide new and more accurate data about the atmosphere, land and oceans which provides a powerful new tool for climate studies and enables the advancement of weather prediction models. AIRS observations will permit the measurement of the atmospheric temperature with an accuracy of 1 K in 1 km thick-layers in the troposphere and surface temperatures with an accuracy of 0.5 K.

The Aqua spacecraft will be placed in a sun-synchronous near-circular polar orbit with an inclination of 98.2 degrees, mean altitude of 705 km, 98.72 minute orbit period and 1:30 pm ascending node. The nominal on-orbit mission lifetime for the instrument is 6 years. AIRS measurements are based on passive infrared remote sensing using a precisely calibrated, high spectral resolution grating spectrometer with an infrared coverage from 3.74 to 15.4 μm . To achieve this high performance over this broad wavelength range, the spectrometer is cooled to 150 K and the Mercury Cadmium Telluride focal plane is cooled to 58 K. The thermal design provides three temperature zones required by the instrument, namely 58 K, 150 K and ambient temperature near 15°C. The detectors are cooled by long-life, low vibration, state-of-the-art pulsetube mechanical cooler to 58 K and a two-stage passive cooler with a deployable Earth shade provides cooling for the spectrometer to achieve a stable temperature near 150 K. The system electronics including the mechanical cooler electronics require ambient temperatures near 15°C. This is achieved by means of a spacecraft provided heat rejection system using variable conductance heat pipes to transfer the electronics waste heat from cold plates to the cold space viewing radiators.

All six instruments including AIRS have been integrated on the Aqua spacecraft and have undergone spacecraft-level thermal vacuum/balance testing at TRW in Redondo Beach, California. The test was performed on August 25 to October 10, 2001 and included instrument comprehensive performance tests, orbital simulations, thermal balance tests and special calibration tests. This paper presents a general overview of the thermal control system as well as the thermal vacuum test approach and key test results.

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