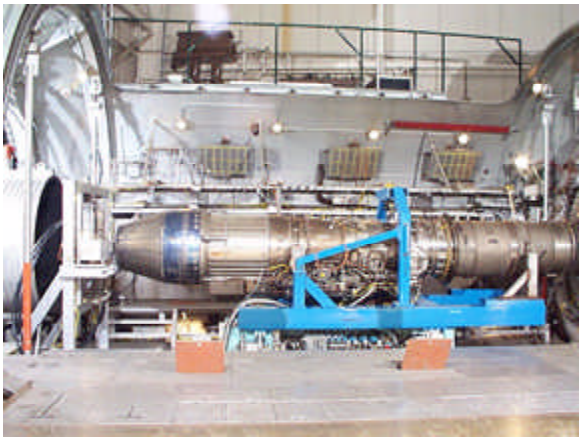
F100 Engine Emissions Tested in NASA Lewis' Propulsion Systems Laboratory



F100 engine test at NASA Lewis' Propulsion Systems Laboratory altitude chamber.

Recent advances in atmospheric sciences have shown that the chemical composition of the entire atmosphere of the planet (gases and airborne particles) has been changed due to human activity and that these changes have changed the heat balance of the planet. National Research Council findings indicate that anthropogenic aerosols[1] reduce the amount of solar radiation reaching the Earth's surface. Atmospheric global models suggest that sulfate aerosols change the energy balance of the Northern Hemisphere as much as anthropogenic greenhouse gases have. In response to these findings, NASA initiated the Atmospheric Effects of Aviation Project (AEAP) to advance the research needed to define present and future aircraft emissions and their effects on the Earth's atmosphere.

Although the importance of aerosols and their precursors is now well recognized, the characterization of current subsonic engines for these emissions is far from complete. Furthermore, since the relationship of engine operating parameters to aerosol emissions is not known, extrapolation to untested and unbuilt engines necessarily remains highly uncertain. Tests in 1997-an engine test at the NASA Lewis Research Center and the corresponding flight measurement test at the NASA Langley Research Center-attempted to address both issues by measuring emissions when fuels containing different levels of sulfur were burned. Measurement systems from four research groups were involved in the Lewis engine test:

1. A Lewis gas analyzer suite to measure the concentration of gaseous species including NO, NO_x, CO, CO_2, O_2, THC, and SO_2 as well as the smoke number

2. A University of Missouri-Rolla Mobile Aerosol Sampling System to measure aerosol and particulate properties including the total concentration, size distribution, volatility, and hydration property

3. An Air Force Research Laboratory Chemical Ionization Mass Spectrometer to measure the concentration of SO_2 and SO_3/H_2SO_4

4. An Aerodyne Research Inc. Tunable Diode Laser System to measure the concentrations of SO_2, SO_3, NO, NO_2, CO_2, and H_2O

By September 1997, an F100 engine operating at several power levels at sea level and up to six simulated altitudes had been tested with commercial jet fuels with three levels of sulfur content and one military jet fuel. The data are being vigorously analyzed. A complete report is anticipated for the 1998 Atmospheric Effects of Aviation Project Annual Conference.

[1]An aerosol is a suspension of solid or liquid particles in a gas. An anthropogenic aerosol is one created by humans that influences nature.

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