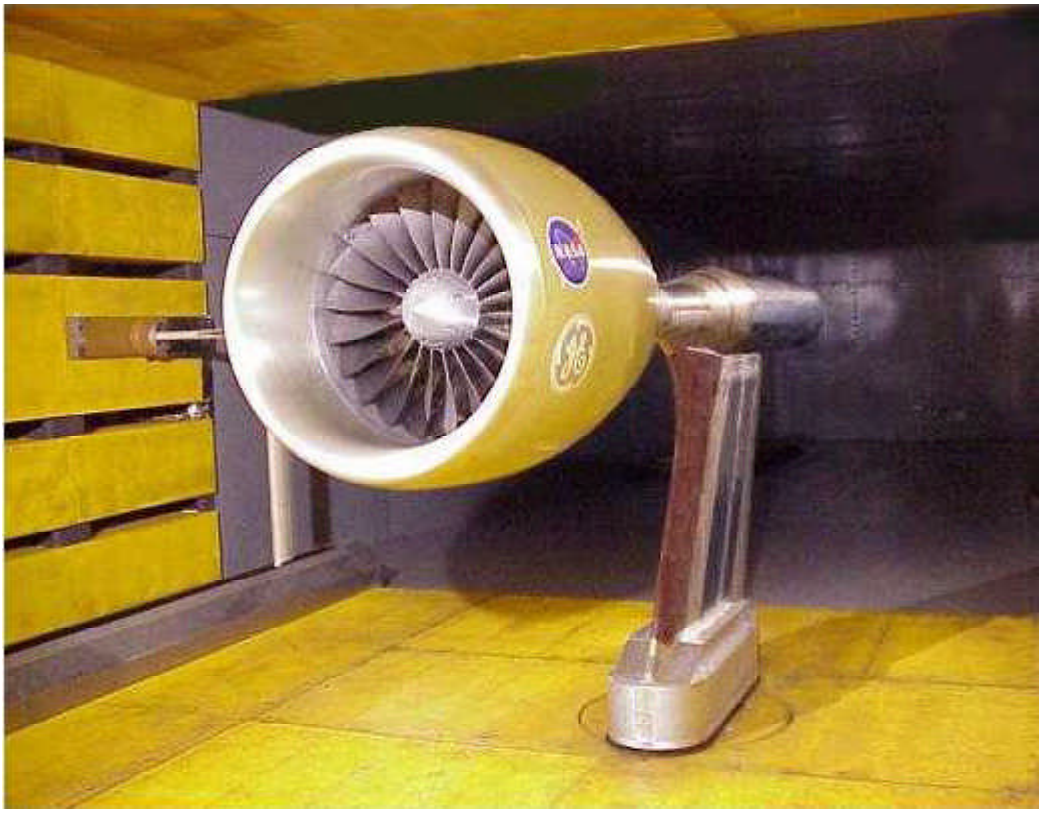
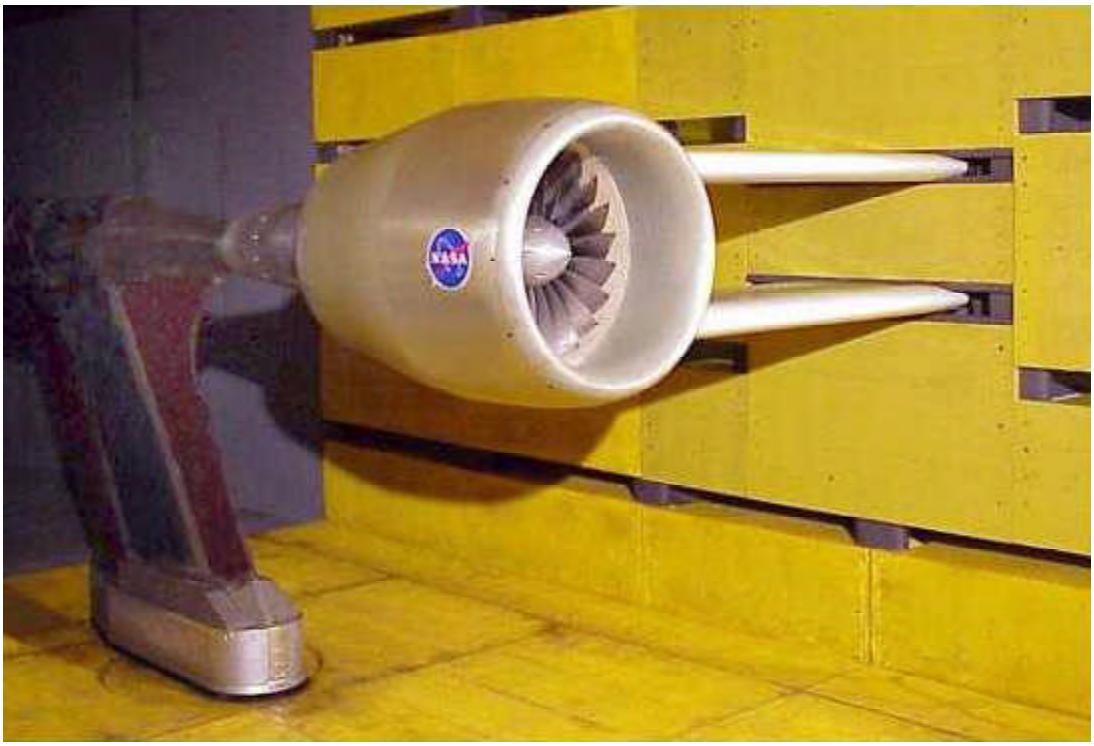
Fan Noise Source Diagnostic Test Completed and Documented



The 22-in. rig used for the Fan Noise Source Diagnostic Test shown in Glenn's 9- by 15-Foot Low-Speed Wind Tunnel.

Partially assembled fan stages showing the three outlet guide vanes (OGV) tested. From left to right, the baseline 54-vane radial OGV, and the 26-vane radial OGV and the 26-vane swept OGV.



The SDT rig in its rotor-alone configuration. The centerbody and the fan nacelle are independently supported, and the position of the nacelle relative to the centerbody is controlled in real time using an active centering system.

In June of 2002, a comprehensive aeroacoustic research project called the Fan Noise Source Diagnostic Test (SDT) culminated in a dedicated session in the 8th AIAA/CEAS Aeroacoustics Conference in Breckenridge, Colorado.

The specially organized session offered an international forum to disseminate the results (see refs. 1 to 6) from a yearlong test that was conducted in 1999 in NASA Glenn Research Center's 9- by 15-Foot Low-Speed Wind Tunnel on a 22-in. scale-model turbofan bypass stage, which was designed to be representative of current aircraft engine technology. The test was a cooperative effort involving Glenn, the NASA Langley Research Center, GE Aircraft Engines, and the Boeing Company. The principal objective of the project was to study the source mechanisms of noise in a modern high-bypass-ratio turbofan engine through detailed aerodynamic and acoustic measurements.

The test involved assessing the noise characteristics of three outlet guide vane designs, identifying and characterizing specific broadband noise sources within the model bypass stage, and investigating the characteristics of the fan steady (mean) and unsteady (perturbation) flow fields using advanced diagnostic test methods. The database of the acquired data includes detailed hot-wire and laser Doppler velocimetry (LDV) diagnostics of the fan tip and wake flows, outlet guide vane unsteady surface pressure measurements, in-duct and far-field noise measurements, and fan and stage performance characteristics. A special feature of the SDT fan rig is its ability to be run in a rotor-alone mode: that is, without stators. Using a unique active centering system for which the design team received

the 2000 Steve V. Szabo Engineering Excellence Award, the independently supported rig centerbody and fan nacelle can be positioned, in real time, to within specified tolerances, thus enabling meaningful rotor-alone measurements of the fan flow and noise characteristics. For years to come, the resulting aggregate of aero and acoustic databases obtained in the SDT test will be used by NASA and the U.S. aerospace industry to validate theoretical aerodynamic and aeroacoustic codes and guide the direction of future modeling efforts.

References

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