PROPULSION NOISE REDUCTION CONCEPTS AND PROGRESS

Reducing aircraft noise emissions is an important part of the ongoing efforts to make commercial aviation more environmentally friendly. As a major contributor to the overall noise produced by an aircraft, reducing propulsion noise is a pivotal element of any strategy for developing the quiet aircraft of the future. To that end, the NASA Subsonic Fixed Wing project and the Environmentally Responsible Aviation project have been funding basic and system level research into low-noise propulsion technologies that can meet the challenging noise goals set for the future subsonic transport aircraft. This presentation will provide a brief overview of the current research undertaken by NASA in developing noise reduction technologies for both the ultra high bypass ratio turbofans and open rotor systems.

Propulsion Noise Reduction Concepts and Progress

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On Behalf of NASA Acoustics Team

Supported by
Subsonic Fixed Wing Project
Environmentally Responsible Aviation Project

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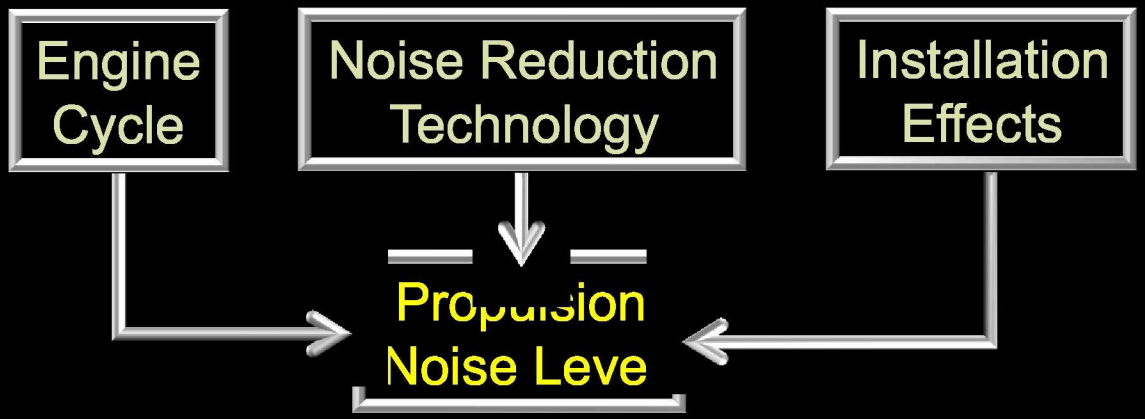
Reducing Aircraft Engine Noise



- There are three ways to reduce engine noise:
  - Change the engine cycle
  - Apply noise reduction technology
  - Take advantage of shielding by the airframe

- NASA has current research efforts in all three areas.

Influence of Engine Cycle

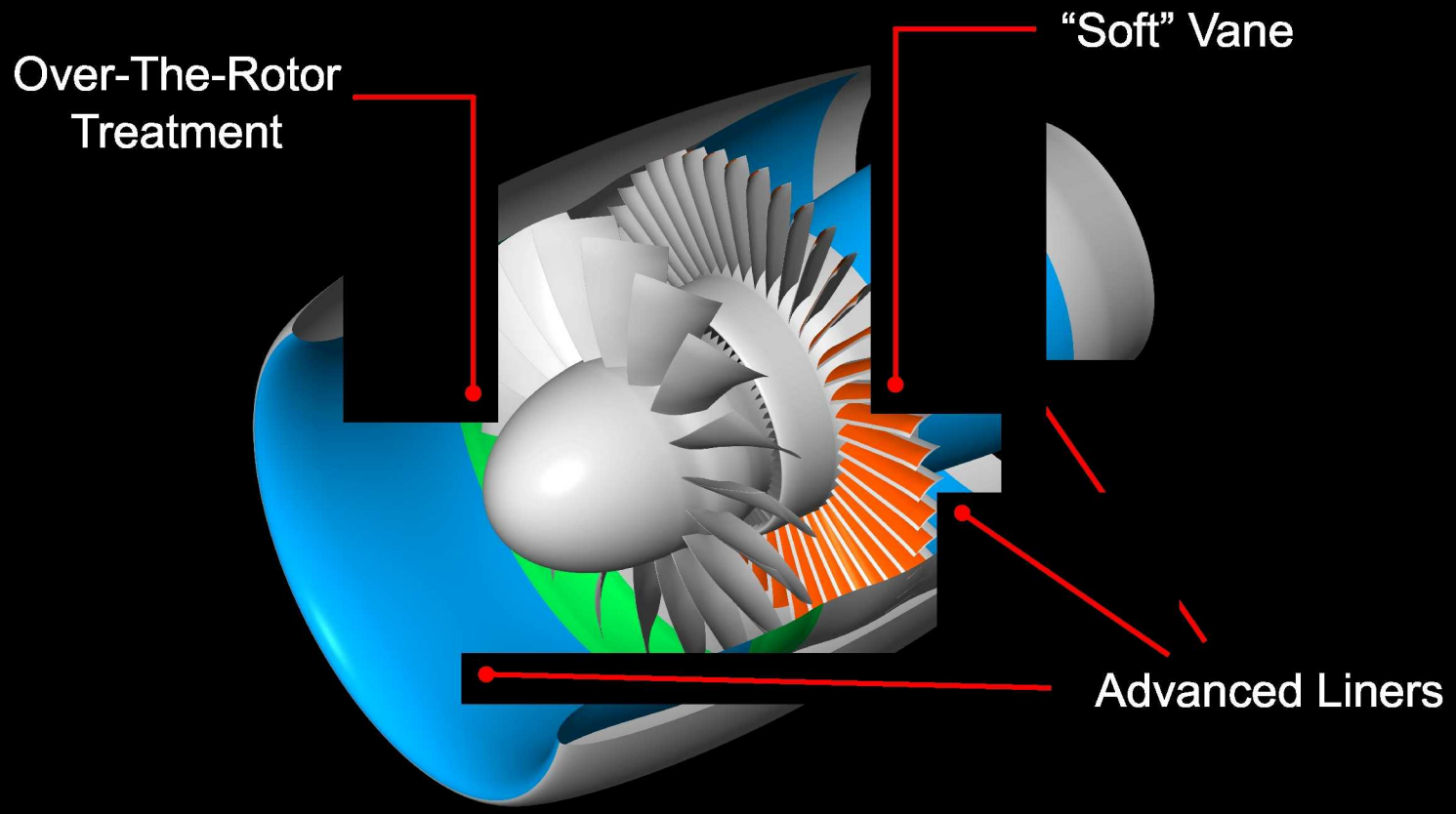
- Increasing engine bypass ratio reduces flow velocities in the engine, thus reducing the strength of engines noise sources.
- Ultra high bypass ratio (UHB) turbofan engines, like P&W geared turbofan, hold significant promise for reducing engine noise.

Top Picture: NASA/P&W Geared Turbofan (GTF) Rig

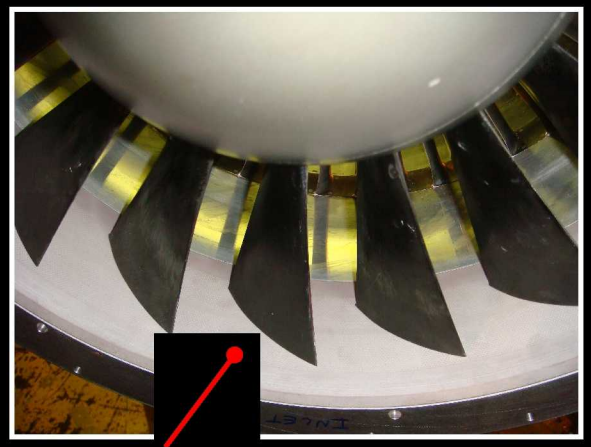
Bottom Picture: P&W GTF Engine Demonstrator

Status: Flight tests completed. Gen. 2 under development.
Technology Readiness Level: 8

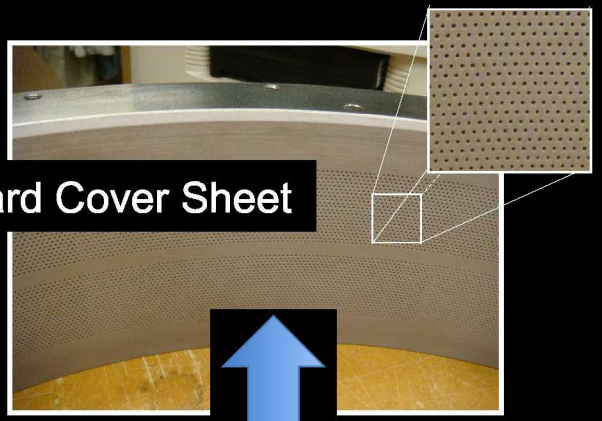
Noise Reduction (NR) Technology
Technologies Under Development for Turbofan



NR Tech: Over-The-Rotor Treatment

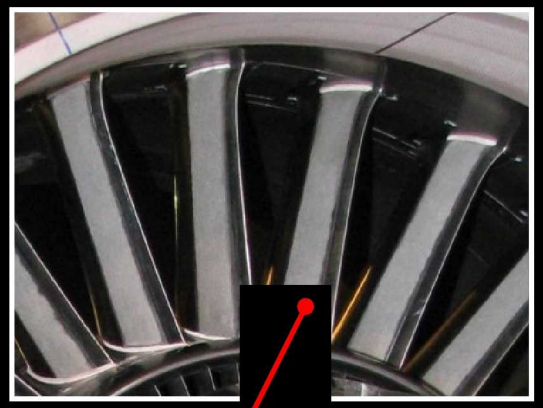


OTR Treatment Installed
in NASA UHB Fan Rig



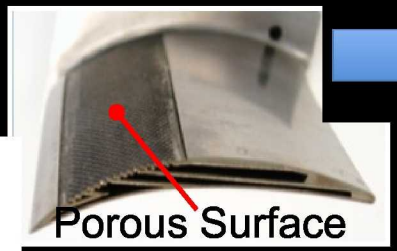
Status: Gen. 1 testing completed. Gen. 2 design under development.
Technology Readiness Level: 4

NR Tech: Soft Vane



Soft Vane Stator Pack
Installed in NASA UHB Fan Rig

Internal Vane Chambers
Tuned to Various Frequencies

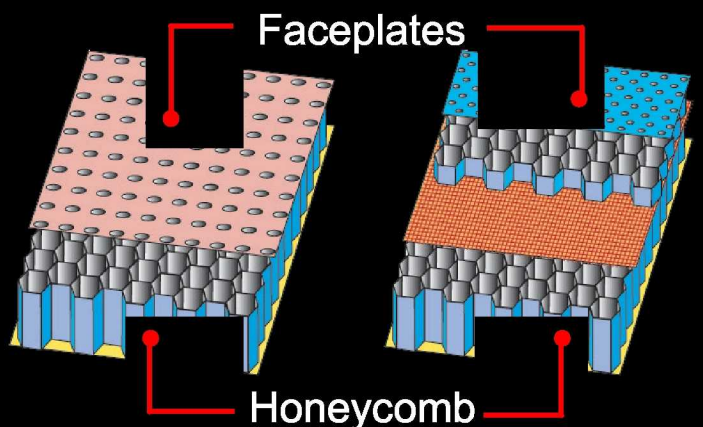


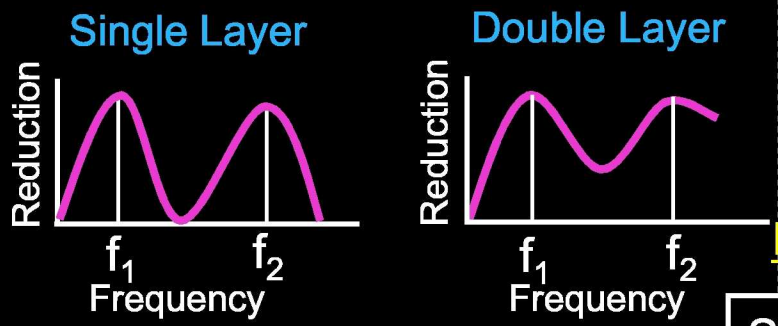
Porous Surface

Felt Metal
Cover Sheet

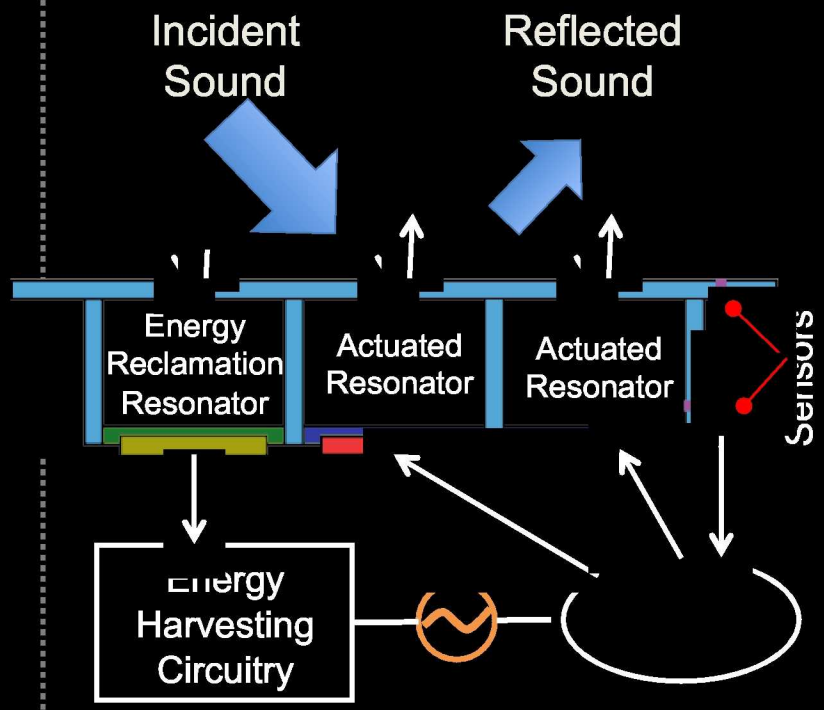
Status: Gen. 1 testing completed. Gen. 2 design under development.
Technology Readiness Level: 4

NR Tech: Advanced Liners





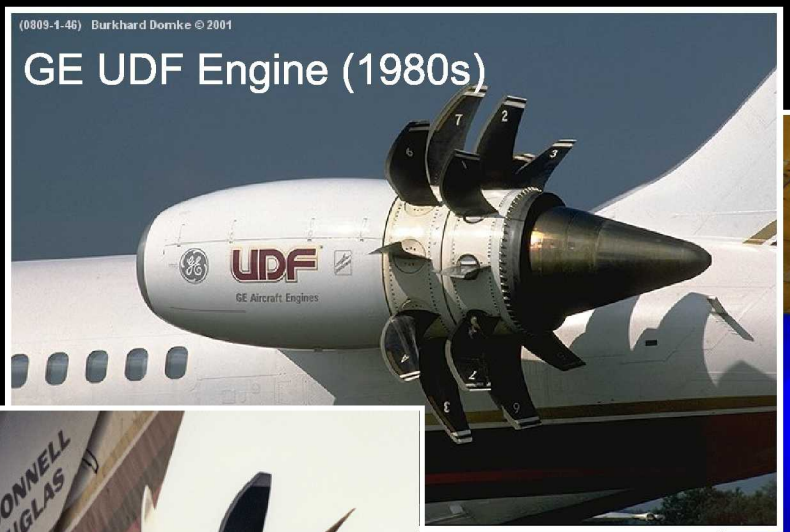
Conventional Liners

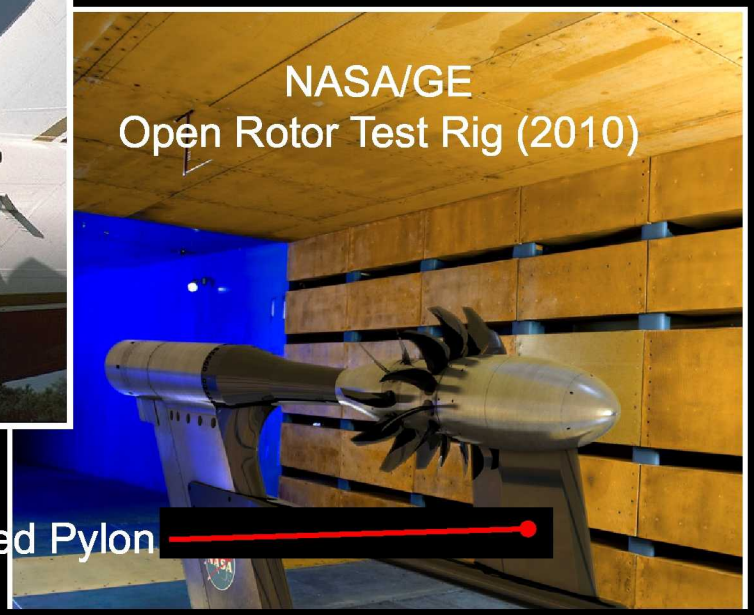


Electromechanical Self-Powered Liners

Status: Component testing completed.
Technology Readiness Level: 2

Open Rotor Noise Reduction Concepts

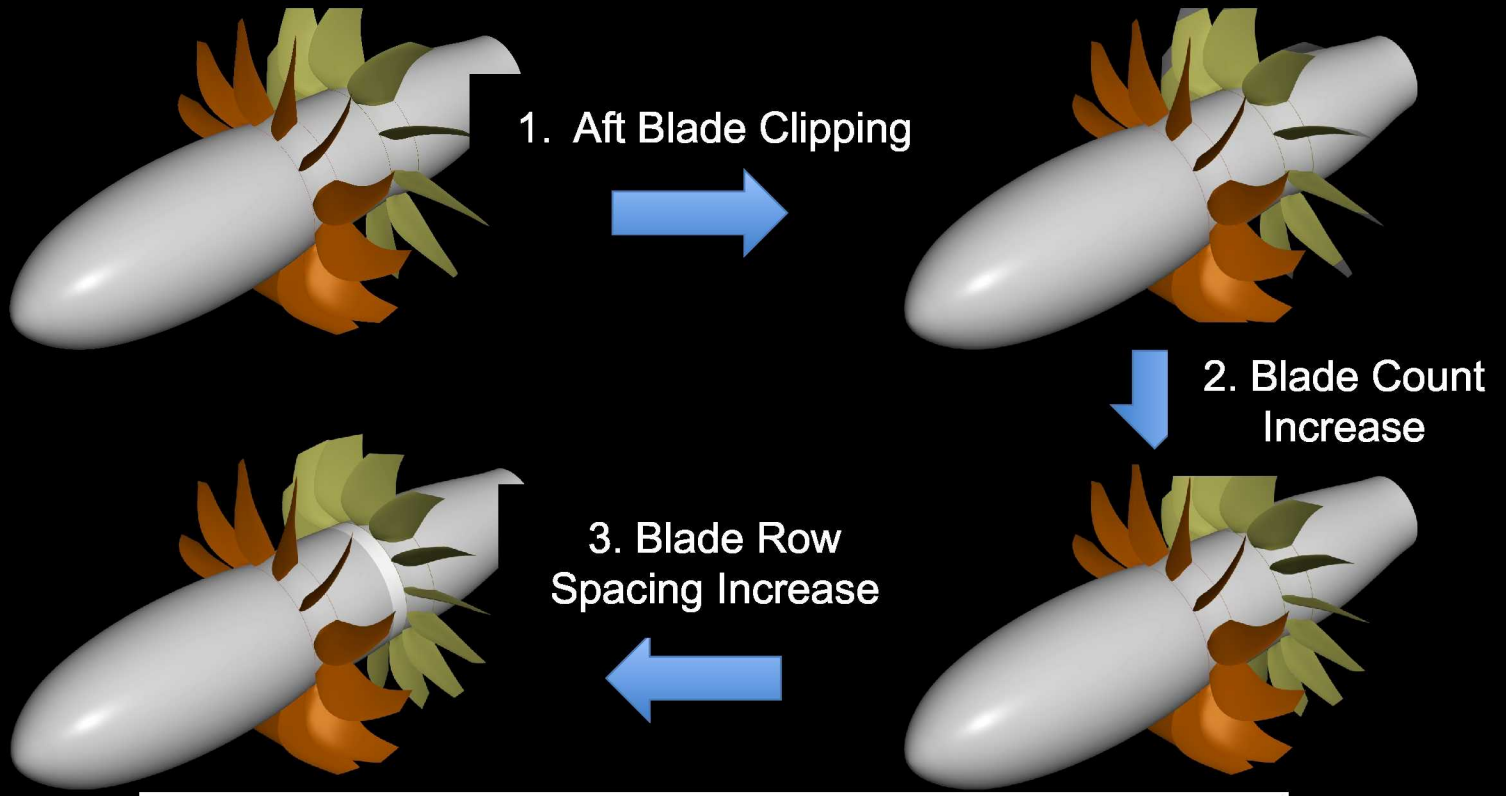




Open Rotor NR concepts being considered:

- Tip Speed Reduction
- Noise Spectrum Tailoring
- Rotor & Pylon Wake Management

Illustrations of Three NR Concepts

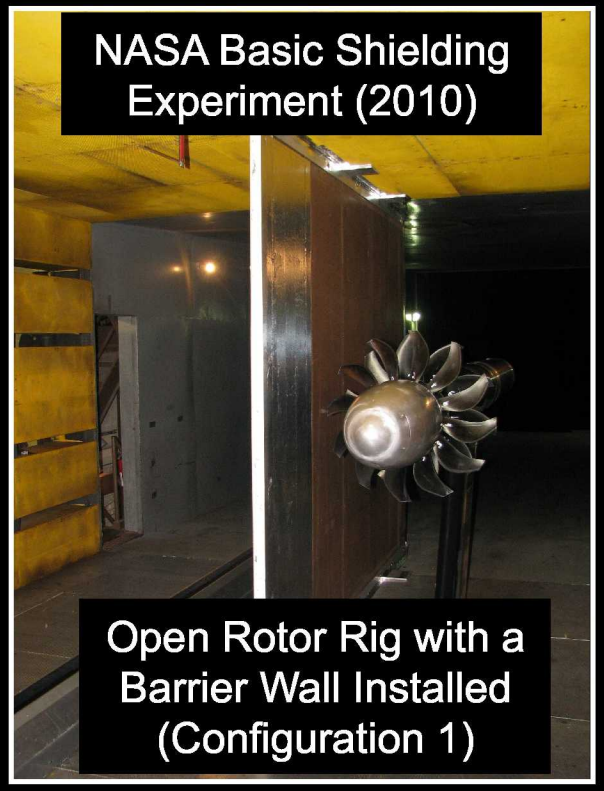


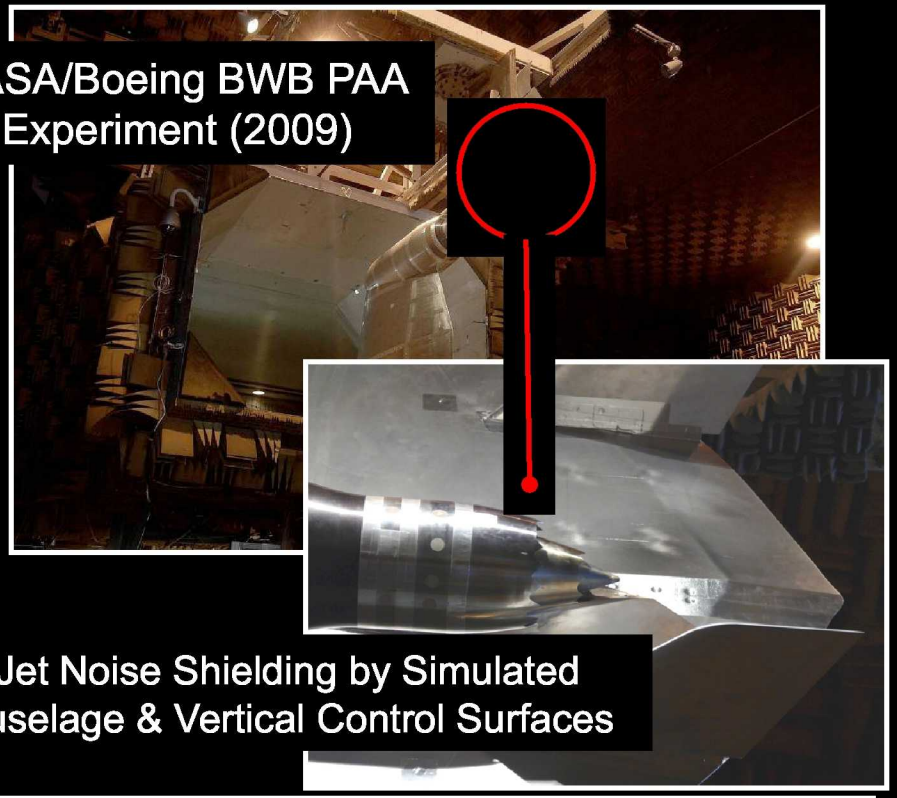
Status: Concepts being studied for future testing.
Technology Readiness Level: 2

Installation Effects: Shielding

Significant potential exists for blocking some of the engine noise directed towards the ground by judicious installation of the engines.

Investigation of Acoustic Shielding Benefits





Status: Gen. 1 testing completed. Gen. 2 tests under development.
Technology Readiness Level: 4

Summary

- NASA is researching a number of noise mitigation strategies for reducing propulsion noise for future aircraft.
- Some of the concepts have been tested or soon will be tested. Others are in conceptual development stages.
- The goal is to provide a portfolio of low-noise strategies for aircraft designers that do not compromise the other performance aspects of the aircraft.
- A complementary objective is to develop, improve and assess NASA noise prediction tools for advanced engines and installation configurations.

ABSTRACT

Reducing aircraft noise emissions is an important part of the ongoing efforts to make commercial aviation more environmentally friendly. As a major contributor to the overall noise produced by an aircraft, reducing propulsion noise is a pivotal element of any strategy for developing the quiet aircraft of the future. To that end, the NASA Subsonic Fixed Wing project and the Environmentally Responsible Aviation project have been funding basic and system level research into low-noise propulsion technologies that can meet the challenging noise goals set for the future subsonic transport aircraft. This presentation will provide a brief overview of the current research undertaken by NASA in developing noise reduction technologies for both the ultra high bypass ratio turbofans and open rotor systems.