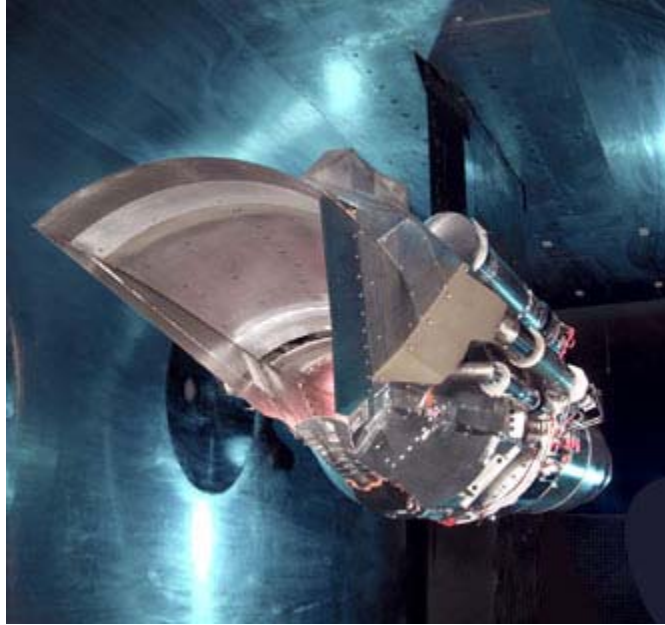


Parametric Inlet Tested in Glenn's 10- by 10-Foot Supersonic Wind Tunnel

The Parametric Inlet is an innovative concept for the inlet of a gas-turbine propulsion system for supersonic aircraft. The concept approaches the performance of past inlet concepts, but with less mechanical complexity, lower weight, and greater aerodynamic stability and safety. Potential applications include supersonic cruise aircraft and missiles.

The Parametric Inlet uses tailored surfaces to turn the incoming supersonic flow inward toward an axis of symmetry. The terminal shock spans the opening of the subsonic diffuser leading to the engine. The external cowl area is smaller, which reduces cowl drag. The use of only external supersonic compression avoids inlet unstart--an unsafe shock instability present in previous inlet designs that use internal supersonic compression. This eliminates the need for complex mechanical systems to control unstart, which reduces weight.

The conceptual design was conceived by TechLand Research, Inc. (North Olmsted, OH), which received funding through NASA's Small-Business Innovation Research program. The Boeing Company (Seattle, WA) also participated in the conceptual design. The NASA Glenn Research Center became involved starting with the preliminary design of a model for testing in Glenn's 10- by 10-Foot Supersonic Wind Tunnel (10×10 SWT). The inlet was sized for a speed of Mach 2.35 while matching requirements of an existing cold pipe used in previous inlet tests. The parametric aspects of the model included interchangeable components for different cowl lip, throat slot, and sidewall leading-edge shapes and different vortex generator configurations. Glenn researchers used computational fluid dynamics (CFD) tools for three-dimensional, turbulent flow analysis to further refine the aerodynamic design.



Parametric Inlet mounted in Glenn's 10- by 10-Foot Supersonic Wind Tunnel.

Long description of figure. The Parametric Inlet is mounted on a support strut attached to the ceiling of the wind tunnel. Attached to the rear of the inlet is a cold pipe and mass flow plug assembly.

The mechanical design focused on four key requirements: (1) adhere to the flow-path shape, (2) provide variable geometry for off-design conditions, (3) allow parametric components, and (4) allow rapid changeover of components. These competing requirements led to an unconventional open-top "hull" design. The inlet was split between a top portion containing the motion assembly with moveable ramps and a bottom portion, or hull, consisting of the sidewalls and cowl. This approach allowed the top part to lift off the hull via jackscrews, which exposed components for changeover.

There were eight metered bleed compartments in the region of the inlet throat. To avoid crosstalk between compartments, a custom curtain seal was used. This seal accommodated the large range of motion of the ramps, whereas the stroke of the inflatable seal edges accommodated the shape change at off-design positions.

The inlet model was fabricated using NASA's Aerospace Test Article Development Cooperative, which split fabrication across five NASA centers. Final assembly and instrumentation were done at Glenn.

The Parametric Inlet underwent 75 hr of testing in Glenn's 10×10 SWT, covering design and off-design conditions. Parameters were varied to reduce spillage and improve performance. A performance level of 92-percent total pressure recovery at a mass-flow ratio of 92 percent was achieved, demonstrating that the concept is a viable alternative to a mixed-compression inlet design. The experimental data are being used to examine the validity of the CFD methods. This will assist in the development of CFD tools for future supersonic inlet design.

Find out more about this research:

Glenn's Inlet Branch at <http://www.grc.nasa.gov/WWW/Inlet/>

Glenn's Mechanical and Rotating Systems Branch at

<http://www.grc.nasa.gov/WWW/7725/>

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