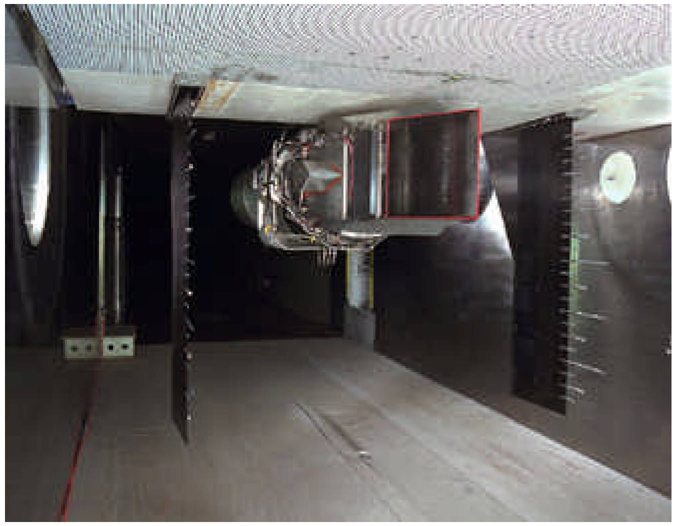
Inlet Unstart Propulsion Integration Wind Tunnel Test Program Completed for High-Speed Civil Transport

One of the propulsion system concepts to be considered for the High-Speed Civil Transport (HSCT) is an underwing, dual-propulsion, pod-per-wing installation. Adverse transient phenomena such as engine compressor stall and inlet unstart could severely degrade the performance of one of these propulsion pods. The subsequent loss of thrust and increased drag could cause aircraft stability and control problems that could lead to a catastrophic accident if countermeasures are not in place to anticipate and control these detrimental transient events. Aircraft system engineers must understand what happens during an engine compressor stall and inlet unstart so that they can design effective control systems to avoid and/or alleviate the effects of a propulsion pod engine compressor stall and inlet unstart.

The objective of the Inlet Unstart Propulsion Airframe Integration test program was to assess the underwing flow field of a High-Speed Civil Transport propulsion system during an engine compressor stall and subsequent inlet unstart. Experimental research testing was conducted in the 10- by 10-Foot Supersonic Wind Tunnel at the NASA Glenn Research Center at Lewis Field. The representative propulsion pod consisted of a two-dimensional, bifurcated inlet mated to a live turbojet engine. The propulsion pod was mounted below a large flat plate that acted as a wing simulator. Because of the plate's long length (nominally 10-ft wide by 18-ft long), realistic boundary layers could form at the inlet cowl plane.

Transient instrumentation was used to document the aerodynamic flow-field conditions during an unstart sequence. Acquiring these data was a significant technical challenge because a typical unstart sequence disrupts the local flow field for about only 50 msec. Flow surface information was acquired via static pressure taps installed in the wing simulator, and intrusive pressure probes were used to acquire flow-field information. These data were extensively analyzed to determine the impact of the unstart transient on the surrounding flow field.

This wind tunnel test program was a success, and for the first time, researchers acquired flow-field aerodynamic data during a supersonic propulsion system engine compressor stall and inlet unstart sequence. In addition to obtaining flow-field pressure data, Glenn researchers determined other properties such as the transient flow angle and Mach number. Data are still being reduced, and a comprehensive final report will be released during calendar year 2000.



View of test model and instrumentation installed in Glenn's 10- by 10- Foot Supersonic Wind Tunnel.

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