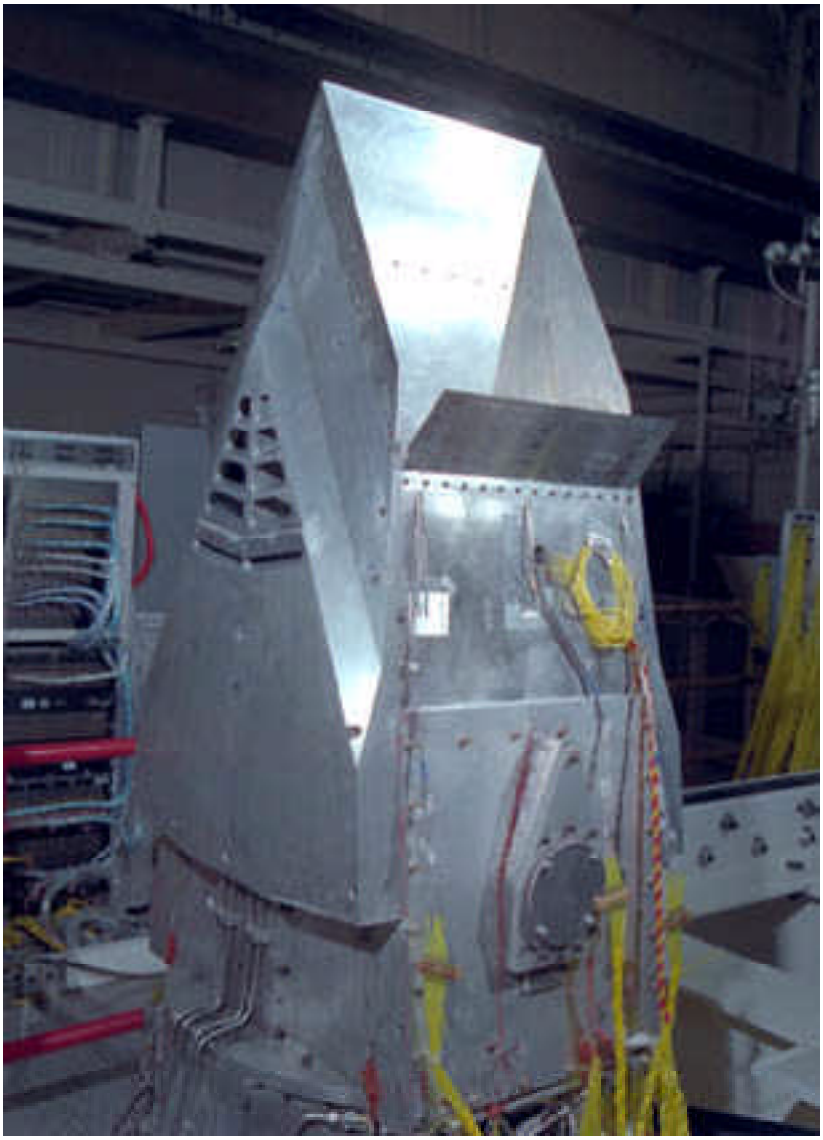
Two-Dimensional Bifurcated Inlet Variable Cowl Lip Test Completed in 10- by 10-Foot Supersonic Wind Tunnel

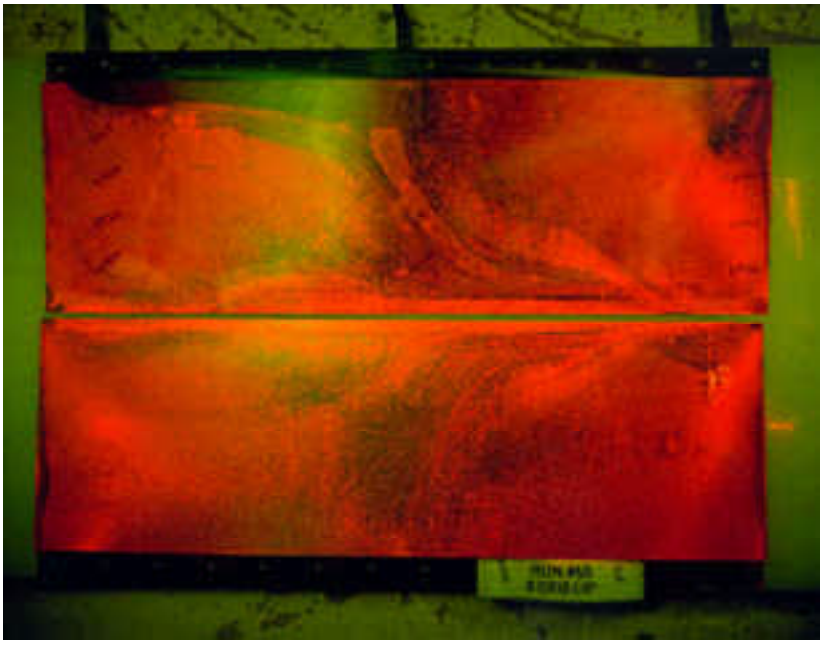


2DB Inlet with 45° cowl lips attached and exit vents open.

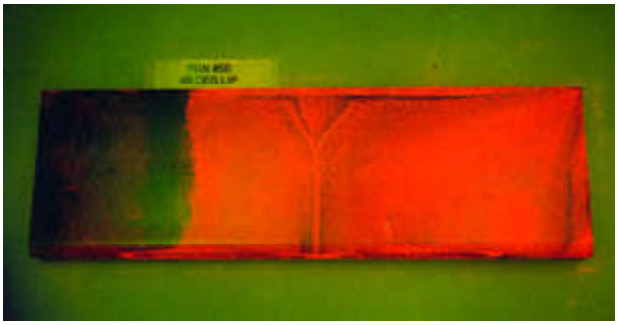
Researchers at the NASA Glenn Research Center at Lewis Field successfully tested a variable cowl lip inlet at simulated takeoff conditions in Glenn's 10- by 10-Foot Supersonic Wind Tunnel (10×10 SWT) as part of the High-Speed Research Program. The test was a follow-on to the Two-Dimensional Bifurcated (2DB) Inlet/Engine test as described in reference 1.

At the takeoff condition for a High-Speed Civil Transport aircraft, the inlet must provide adequate airflow to the engine with an acceptable distortion level and high-pressure recovery. The test was conducted to study the effectiveness of installing two rotating lips on the 2DB Inlet cowls to increase mass flow rate and eliminate or reduce boundary layer flow separation near the lips.

Hardware was mounted vertically in the test section so that it extended through the tunnel ceiling and that the 2DB Inlet was exposed to the atmosphere above the test section. The tunnel was configured in the aerodynamic mode, and exhausters were used to pump down the tunnel to vacuum levels and to provide a maximum flow rate of approximately 58 lb/sec.



Flow visualization of 0° cowl lips under ultraviolet light.



Flow visualization of 60° cowl lips under ultraviolet light. This picture shows much improvement in flow quality over the 0° baseline case.

The test determined the (1) maximum flow in the 2DB Inlet for each variable cowl lip, (2) distortion level and pressure recovery for each lip configuration, (3) boundary layer

conditions near variable lips inside the 2DB Inlet, (4) effects of a wing structure adjacent to the 2DB Inlet, and (5) effects of different 2DB Inlet exit configurations. It also employed flow visualization to generate enough qualitative data on variable lips to optimize the variable lip concept.

This test was a collaborative effort between the Boeing Company and Glenn. Extensive in-house support at Glenn contributed significantly to the progress and accomplishment of this test.

References

1. Two-Dimensional Bifurcated Inlet/Engine Tests Completed in 10- by 10-Foot Supersonic Wind Tunnel. Research and Technology 1998. NASA TM—1999-208815, 1999, p. 107.

Glenn contacts: Hyun D. Kim, (216) 433–8344, Hyun.D.Kim@grc.nasa.gov; John D. Saunders, (216) 433–6278, John.D.Saunders@grc.nasa.gov; and Thomas R. Hoffman, (216) 433–5637, Thomas.R.Hoffman@grc.nasa.gov

Author: T.R. Hoffman

Headquarters program office: OAST

Programs/Projects: HSR