



## IN-FLIGHT BOUNDARY-LAYER TRANSITION ON A LARGE FLAT PLATE AT SUPERSONIC SPEEDS

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### KEYWORDS:

**Main subjects:** boundary-layer transition, flow visualization

**Fluid:** high speed flows, flows with shocks

**Visualization method(s):** infrared thermography

**Other keywords:** image processing, turbulence

**ABSTRACT:** A flight experiment was conducted to investigate the pressure distribution, local flow conditions, and boundary-layer transition characteristics on a large flat plate in flight at supersonic speeds up to Mach 2.0. The primary objective of the test was to characterize the local flow field in preparation for future tests of a high Reynolds number natural laminar flow test article. The tests used a F-15B testbed aircraft with a bottom centerline mounted test fixture. A second objective was to determine the boundary-layer transition characteristics on the flat plate and the effectiveness of using a simplified surface coating for future laminar flow flight tests employing infrared thermography. Boundary-layer transition was captured using an onboard infrared imaging system. The infrared imagery was captured in both analog and digital formats. Surface pressures were measured with electronically scanned pressure modules connected to 60 surface-mounted pressure orifices. The local flow field was measured with five 5-hole conical probes mounted near the leading edge of the test fixture. Flow field measurements revealed the local flow characteristics including downwash, sidewash, and local Mach number. Results also indicated that the simplified surface coating did not provide sufficient insulation from the metallic structure, which likely had a substantial effect on boundary-layer transition compared with that of an adiabatic surface. Cold wall conditions were predominant during the acceleration to maximum Mach number, and warm wall conditions were evident during the subsequent deceleration. The infrared imaging system was able to capture shock wave impingement on the surface of the flat plate in addition to indicating laminar-to-turbulent boundary-layer transition.

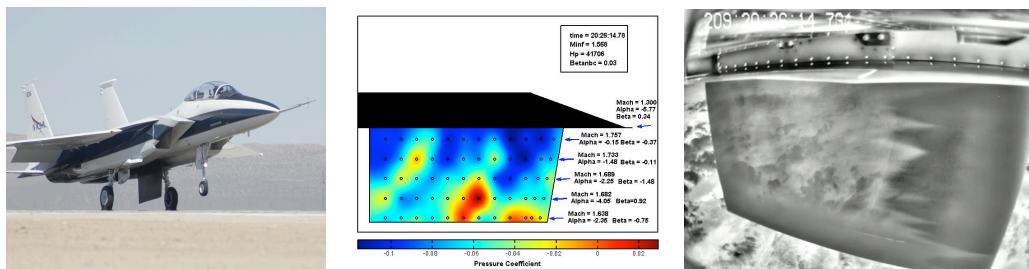


Figure 1. F-15B testbed aircraft with flat plate test article (left), pressure distributions and local-flow properties (center), and infrared image of flat plate showing boundary-layer transition (right).

### References

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