

Boundary Layer Transition During the Orion Exploration Flight Test 1 (EFT-1)

Lindsay C. Kirk

NASA Johnson Space Center, Houston, TX 77058

Boundary layer transition was observed in the thermocouple data on the windside backshell of the Orion reentry capsule. Sensors along the windside centerline, as well as off-centerline, indicated transition late in the flight at approximately Mach 4 conditions. Transition progressed as expected, beginning at the sensors closest to the forward bay cover (FBC) and moving towards the heatshield. Sensors placed in off-centerline locations did not follow streamlines, so the progression of transition observed in these sensors is less intuitive. Future analysis will include comparisons to pre-flight predictions and expected transitional behavior will be investigated.

Sensors located within the centerline and off-centerline launch abort system (LAS) attach well cavities on the FBC also showed indications of boundary layer transition. The transition within the centerline cavity was observed in the temperature traces prior to transition onset on the sensors upstream of the cavity. Transition behavior within the off-centerline LAS attach well cavity will also be investigated.

Heatshield thermocouples were placed within Avcoat plugs to attempt to capture transitional behavior as well as better understand the aerothermal environments. Thermocouples were placed in stacks of two or five vertically within the plugs, but the temperature data obtained at the sensors closest to the surface did not immediately indicate transitional behavior. Efforts to use the in depth thermocouple temperatures to reconstruct the surface heat flux are ongoing and any results showing the onset of boundary layer transition obtained from those reconstructions will also be included in this paper. Transition on additional features of interest, including compression pad ramps, will be included if it becomes available.