

Characteristics of Boundary Layer Transition in a Multi-Stage Low-Pressure Turbine

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An experimental investigation of boundary layer transition in a multi-stage turbine has been completed using surface-mounted hot-film sensors. Tests were carried out using the two-stage Low Speed Research Turbine of the Aerodynamics Research Laboratory of GE Aircraft Engines. Blading in this facility models current, state-of-the-art low pressure turbine configurations. The instrumentation technique involved arrays of densely-packed hot-film sensors on the surfaces of second stage rotor and nozzle blades. The arrays were located at mid-span on both the suction and pressure surfaces.

Boundary layer measurements were acquired over a complete range of relevant Reynolds numbers. Data acquisition capabilities provided means for detailed data interrogation in both time and frequency domains. Data indicate that significant regions of laminar and transitional boundary layer flow exist on the rotor and nozzle suction surfaces. Evidence of relaminarization both near the leading edge of the suction surface and along much of the pressure surface was observed. Measurements also reveal the nature of the turbulent bursts occurring within and between the wake segments convecting through the blade row. The complex character of boundary layer transition resulting from flow unsteadiness due to nozzle/nozzle, rotor/nozzle, and nozzle/rotor wake interactions are elucidated using these data. These measurements underscore the need to provide turbomachinery designers with models of boundary layer transition to facilitate accurate prediction of aerodynamic loss and heat transfer.

No figures available.

