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Compressibility effects on dynamic stall attributes PATRICK BOWLES, THOMAS CORKE, FLINT THOMAS, KATIE THORNE, DUSTIN COLEMAN, University of Notre Dame — An experimental study of the compressibility effects on the load, stability, and separation characteristics of a modern rotor-blade geometry is presented under dynamic stall conditions. The airfoil was oscillated in pitch about the quarter chord at free-stream Mach numbers from 0.2 to 0.55, reduced frequencies from 0.025 to 0.10, and Reynolds numbers up to 3.5 million - all values relevant to a helicopter retreating or advancing blade. Thirty high frequency absolute pressure transducers measured the airfoil's static pressure distribution. Emphasis was placed on the development of the leading edge vortex. Increased free stream Mach numbers resulted in a reduced ability of the near leading edge flow to overcome the adverse pressure gradient on the airfoil's suction side, limiting dynamic load overshoot as well as negative damping. Indeed, light dynamic stall conditions showed a greater aptitude to toward unstable motion. At free-stream Mach numbers greater than 0.4, airfoil local Mach numbers consistently neared 1.6 prior to an abrupt flow separation, considered to be the result of shock induced boundary layer interactions.

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