Assessment of Flow Efficiency Through a Closed Circuit Wind Tunnel With Recommendations for Improvements

Master of Science Thesis Defense

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Chair of Advisory Committee:  Dr. Edward White
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Abstract

Wind tunnels are designed for a certain range of test velocities and model sizes. The Oran W. Nicks Low Speed Wind Tunnel (LSWT) at Texas A&M, was designed to reach 200 mph ($M=0.26$) with its original 1250 hp motor and 7 x 10 ft test section. In 2012 the motor and main bearing were replaced with a new 3000 hp motor. With the increased power and motor efficiencies, the tunnel could potentially reach $M=0.42$ flow. However, the current structure still limits the testing speed to $M=0.26$. This thesis outlines modifications that may allow the LSWT to reach $M=0.5$ for testing and potentially $M=0.8$ for an empty test section. The flow throughout the circuit and concomitant losses will be investigated. Methods for improving the efficiency will be presented, along with their estimated reduction in power loss. In order to reach this higher velocity, a 6 x 5 ft reduced test section with higher structural strength is required. This reduction in test section size requires subsequent diffuser and contraction alterations. The method for designing the diffuser will be presented, along with the design chosen. With these modifications to the tunnel, as well as using estimations of the motor efficiency, and results from measured and estimated losses in the circuit, the testing speed of $M=0.5$ in an empty test section could be reached with 1,200 to 1,800 hp supplied to the motor.

John Guthery is an MS candidate in the Aerospace Engineering Department working under the supervision of Professor White. His research interests are in the areas of wind tunnel testing and aerodynamics. He is seeking employment with the Columbia Scientific Balloon Facility.