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Vortex interactions with membrane wings RYE M. WALDMAN, KENNETH S. BREUER, Brown University — Membrane wings are common in flying animals such as bats, as well as in low Reynolds number Micro Air Vehicles. Vortices shed from the sharp leading- and trailing-edges and wing-tips of membrane wings, and the vortex interactions with the membrane play an important role in the wing's performance. When looking at compliant membrane wings that are initially tension-free at rest, there are two issues to consider: the static relationship between the net aerodynamic forces and the bulk wing deformation and the interaction between the membrane dynamics and unsteady flow structures. Nonlinear membrane deformation affects the membrane vibration modes, which in turn affects the coupling between the membrane and vortex shedding. We present coupled force, kinematic, and flow field measurements on low aspect ratio membrane wings of different thickness, with and without wing-tip support, over a range of angles of attack and freestream velocities. Wings with different tip support but of similar stiffness show similar static behavior, but different wing dynamics result in markedly different behavior in both the unsteady forces and the character of stall at high incidence angles.

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