Hydrodynamics of a Contracting Cylinder in Translation\textsuperscript{1} GORDON HOLLOWAY, University of New Brunswick, TIGER JEANS, USAFA Colorado Springs, ANDREW GERBER, SYDNEY RYAN, UNB — The present study examines the effects of body contraction on the hydrodynamics of a circular cylinder shortly after it is subjected to an impulsive start. Results for the development of the fluid vorticity, hydrodynamic impulse and drag were obtained using computational fluid dynamics and a transient re-meshing scheme that allowed accurate computation of the viscous layers in the vicinity of the cylinder surface. Computational results were obtained for $Re = (Ua/\nu) = 9500$, and a constant cylinder diameter, up to $t^* = tU/a = 6$; $U$ is the cross flow velocity and “$a$” is the cylinder radius. In this case the drag force increased with time and exhibited undulations that were correlated with vortex shedding events. Computations for a contracting cylinder were initiated at $t^* = 3.6$ using average contraction rates of $r = (da/dt)/U = -0.38$ and -0.50. These revealed a symmetric but very complex vortex shedding pattern. The drag force on the gradually contracting cylinder decreased initially and then oscillated about zero. For the more rapid contraction the cylinder experienced a strong thrust, due to the hydrodynamic impulse of the shed vorticity, before tapering off.

\textsuperscript{1}Support provided by NSERC

Gordon Holloway
University of New Brunswick

Date submitted: 01 Aug 2008

Electronic form version 1.4