Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Ventilation Inception and Washout, Scaling, and Effects on Hydrodynamic Performance of a Surface Piercing Strut[1] CASEY HARWOOD, YIN LU YOUNG, STEVEN CECCIO, University of Michigan — High-lift devices that operate at or near a fluid free surface (such as surface-piercing or shallowly-submerged propellers and hydrofoils) are prone to a multiphase flow phenomenon called ventilation, wherein non-condensable gas is entrained in the low-pressure flow, forming a cavity around the body and dramatically altering the global hydrodynamic forces. Experiments are being conducted at the University of Michigan's towing tank using a canonical surface-piercing strut to investigate atmospheric ventilation. The goals of the work are (i) to gain an understanding of the dominant physics in fully wetted, partially ventilated, and fully ventilated flow regimes, (ii) to quantify the effects of governing dimensionless parameters on the transition between flow regimes, and (iii) to develop scaling relations for the transition between flow regimes. Using theoretical arguments and flow visualization techniques, new criteria are developed for classifying flow regimes and transition mechanisms. Unsteady transition mechanisms are described and mapped as functions of the governing non-dimensional parameters. A theoretical scaling relationship is developed for ventilation washout, which is shown to adequately capture the experimentally-observed washout boundary.

[1]This material is based upon work supported by the National Science Foundation Graduate Student Research Fellowship under Grant No. DGE 1256260. Support also comes from the Naval Engineering Education Center (Award No. N65540-10-C-003).

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Date submitted: 01 Aug 2014 Electronic form version 1.4