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Experimental Investigation of Ventilation of a Surface Piercing Hydrofoil[1] CASEY HARWOOD, FRANCISCO MIGUEL MONTERO, YIN LU YOUNG, STEVEN CECCIO, University of Michigan — Bodies that pierce a liquid free-surface are prone to entrainment of atmospheric and/or vaporous gases. This process, called ventilation, can occur suddenly and violently, drastically altering hydrodynamic response. Experiments have been conducted at the free-surface towing-tank in the University of Michigan Marine Hydrodynamics Laboratory to investigate fully attached, partially ventilated, and fully ventilated flows around a canonical surface-piercing hydrofoil. The objectives of the work are: (i) to gain a broad and improved understanding of the physics of ventilation, (ii) to classify the physical mechanisms by which ventilation inception and washout may occur and quantify the conditions required for each mechanism and (iii) to quantify the effects of ventilation on global hydrodynamic responses, including the six force and moment components. Experimental data and high-speed video will be used to illustrate the impact of ventilation on hydrodynamic loads, pressures, and flow structures. The completion of this study is expected to contribute significantly toward a comprehensive understanding of ventilation physics, and toward an improved ability to design safe and controllable ventilated lifting surfaces for use in propulsion, energy harvesting, and turbomachinery.

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