Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Phase-Resolved Magnetic Resonance Velocity Measurement for Rotating Turbomachinery[1] DAVIS HOFFMAN, Stanford University, LAURA VILLAFANE, University of Illinois at Urbana-Champaign, CHRISTOPHER ELKINS, JOHN EATON, Stanford University — Three-component, time-averaged velocity fields have been measured within a low-speed centrifugal fan with forward curved blades using Magnetic Resonance Velocimetry (MRV). The specific model consists of an impeller with outside diameter of 165 mm inside a hard casing. The design is most suited for automotive HVAC applications. Time-averaged experiments were conducted at Reynolds numbers of 95,700 and 25,000 based on impeller diameter and bulk outlet velocity, yielding three-dimensional mean velocity fields within the entire casing volume. The blade tip speed ratio is maintained at 1.5 in both cases. The mean velocity distribution near the leading and trailing edge of the blades is found to be insensitive to Reynolds number, except where the spacing between the volute wall and the blades is very small. Phase-locked experiments were conducted at the lower Reynolds number to ensure best measurement quality, yielding phase-locked velocity fields between the blades at five positions within a blade passing cycle. Alternating jet-wake structures are observed protruding from each blade passage around the impeller simultaneously. The varying size and shape of separation bubbles on the suction side of the blades is also analyzed as they rotate through an entire revolution.

[1]Support by DENSO Corporation

Davis Hoffman
Stanford University

Date submitted: 31 Jul 2019 Electronic form version 1.4