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Experimental and numerical study of windage losses in the small gap region of a high speed electric motor. KEVIN ANDERSON[1], JUN T. LIN[2], ALEXANDER J. WONG[3], Cal Poly - Pomona — Research findings of an experimental and numerical investigation of windage losses in the small annular air gap region between the stator and rotor of a high speed electric motor are presented herein. The experimental set-up is used to empirically measure the windage losses in the motor by measuring torque and rotational speed. The motor rotor spins at roughly 30,000 rpm and the rotor sets up windage losses on the order of 100 W. Axial air flow of 200 L/min is used to cool the motor, thus setting up a pseudo Taylor-Couette Poiseuille type of flow. Details of the experimental test apparatus, instrumentation and data acquisition are given. Experimental data for spin-down (both actively and passively cooled) and calibration of bearing windage losses are discussed. A Computational Fluid Dynamics (CFD) model is developed and used to predict the torque speed curve and windage losses in the motor. The CFD model is correlated with the experimental data. The CFD model is also used to predict the formation of the Taylor-Couette cells in the small gap region of the high speed motor. Results for windage losses, spin-down time constant, bearing losses, and torque of the motor versus cooling air mass flow rate and rotational speed are presented in this study.

[1]Mechanical Engineering
[2]Mechanical Engineering
[3]Mechanical Engineering

Kevin Anderson
Cal Poly - Pomona

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