

In this paper, a high-speed permanent-magnet (PM) electrical machine is designed for centrifugal air blower application with consideration of the multiphysics constraints, including the mechanical strength, rotor dynamics, mechanical losses, and thermal field. In order to minimize the probabilities of mechanical failure and to realize the compact structure, the length and the outer diameter of rotor from mechanical point of view are designed and optimized. The optimization of sleeve thickness is performed by an accurate finite-element modeling which the interference is equivalent to the contact pressure. The optimization of rotor strength is based on the length-diameter ratio curve by using the finite-element method, which is followed behind the optimization of sleeve thickness. An assessment of machine cooling design from thermal point of view is performed by using the computational fluid dynamics modeling. Finally, in order to verify the accuracy of theoretical analysis, the prototype is fabricated with consideration of all critical values of the design parameters, and measured on the test bench.