Electromagnetic design of a 1.12-MW, 18 000-r/min high-speed permanent-magnet motor (HSPMM) is carried out based on the analysis of pole number, stator slot number, rotor outer diameter, air-gap length, permanent magnet material, thickness, and pole arc. The no-load and full-load performance of the HSPMM is investigated in this paper by using 2-D finite element method (FEM). In addition, the power losses in the HSPMM including core loss, winding loss, rotor eddy current loss, and air friction loss are predicted. Based on the analysis, a prototype motor is manufactured and experimentally tested to verify the machine design.