Testing of a Centrifugal Blood Pump With a High Efficiency Hybrid Magnetic Bearing

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The purpose of this article is to present test results for a second generation, high efficiency, nonpulsatile centrifugal blood pump that is being developed for use as a left ventricular assist device (LVAD). The LVAD pump uses a hybrid passive–active magnetic bearing support system that exhibits extremely low power loss, low vibration, and high reliability under transient conditions and varying pump orientations. A unique feature of the second generation design configuration is the very simple and direct flow path for both main and washing blood flows. The pump was tested in both vertical and horizontal orientations using a standard flow loop to demonstrate the performance and durability of the second generation LVAD. Steady state and transient orientation pump operating characteristics including pressure, flow, speed, temperatures, vibration, and rotor orientation were measured. During the tests, pump performance was mapped at several operating conditions including points above and below the nominal design of 5 L/min at 100 mm Hg pressure rise. Flow rates from 2 to 7 L/min and pressure rises from 50 to 150 mm Hg were measured. Pump speeds were varied during these tests from 2,500 to 3,500 rpm. The nominal design flow of 5 L/min at 100 mm Hg pressure rise was successfully achieved at the design speed of 3,000 rpm. After LVAD performance testing, both 28 day continuous duty and 5 day transient orientation durability tests were completed without incident. A hydrodynamic backup bearing design feasibility study was also conducted. Results from this design study indicate that an integral hydrodynamic backup bearing may be readily incorporated into the second generation LVAD and other magnetically levitated pump rotors. *ASAIO Journal* 2003; 49:737–743.

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