

Experimental Investigation of 150 mm Diameter Large Hybrid Foil/Magnetic Bearing

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ABSTRACT

By combining both compliant foil bearing (CFB) and active magnetic bearing (AMB) advantages, the hybrid foil/magnetic bearing (HFMB) can obtain high load capacity at all speeds.

A brief overview of a universal test rig with the largest 150 mm HFMB is presented. Experimental investigation was performed in different modes by means of switching AMB on or off: AMB mode at low speed, CFB mode at high speed, hybrid mode with AMB as a bearing and hybrid mode with AMB as a loader. Data from a series of rotor-bearing system tests are presented. Having recently made efforts to complete the HFMB test (side-by-side), the largest 150 mm CFB passed through its first (3,820 rpm) and second (11,770 rpm) critical speed and reached 26,923 rpm (i.e. 4 MDN).

On the other extreme side, the 150 mm CFB testing has shown that it can bear as low as 645 rpm without shaft/foil touch, high temperature rise and large motor torque increases. That means the lift off or touch down speed is very low with a surface velocity U of less than 5 m/s. The coating used on the foil was Korolon 800 and the rotor surface was electrolyzed.

Transient tests, simulating magnetic bearing failures at speeds as low as 700rpm were also completed. It is shown that CFB has the ability to be a reliable auxiliary/backup bearing for the magnetic bearing system.

This $\phi 150$ mm foil bearing is sized to meet a wide range of potential applications such as gas turbine engines for high-performance commercial and general aviation aircraft systems as well as larger industrial compressors.