Performance of a Foil-Magnetic Hybrid Bearing

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To meet the advanced bearing needs of modern turbomachinery, a hybrid foil-magnetic hybrid bearing system was designed, fabricated, and tested in a test rig designed to simulate the rotor dynamics of a small gas turbine engine (31 kN to 53 kN thrust class). This oil-free bearing system combines the excellent low and zero-speed capabilities of the magnetic bearing with the high-load capacity and high-speed performance of the compliant foil bearing. An experimental program is described which documents the capabilities of the bearing system for sharing load during operation at up to 30,000 rpm and the foil bearing component's ability to function as a backup in case of magnetic bearing failure. At an operating speed of 22,000 rpm, loads exceeding 5300 N were carried by the system. This load sharing could be manipulated by an especially designed electronic control algorithm. In all tests, rotor excursions were small and stable. During deliberately staged magnetic bearing malfunctions, the foil bearing proved capable of supporting the rotor during continued operation at full load and speed, as well as allowing a safe rotor coastdown. The hybrid system tripled the load capacity of the magnetic bearing alone and can offer a significant reduction in total bearing weight compared to a comparable magnetic bearing. [DOI: 10.1115/1.1417485]