

A ROTORDYNAMIC MODEL FOR USE IN HIGH-SPEED GAS BEARING TESTING

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ABSTRACT

A series of tests were performed to evaluate the stiffness and damping characteristics of externally pressurized gas bearings suitable for application to industrial machinery. The bearings tested were all 1.76 inches in diameter, with an L/D ratio of 1. Diametrical clearances ranged from 1.8 to 2.5 mil, although only 1.8 and 2.0 mil results are presented in this paper. Both single- and double-plane inlet systems were tested, with and without orifices. The series of tests were conducted using air or nitrogen with supply pressures ranging from 62.2 to 412.2 psia, all with an ambient exhaust pressure of 12.2 psia. Synchronous perturbation testing was performed from low speed to as high as 40,000 rpm. Stiffness and damping coefficients were calculated using a two-mode rotordynamics model of the test rotor and bearing system. While theory predicts constant stiffness and damping over the testing speed range, stiffness data clearly shows changes over speed that are related to the type of inlet system geometry used. These changes are thought to be due to a combination of centrifugal and thermal distortion of the bearing clearances. The data suggest that the single-plane inlet system design is superior for high-speed bearing applications where maintaining high stiffness is critical.

Keywords: Gas Bearings, Externally Pressurized, Stiffness, Damping.