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PERFORMANCE CHARACTERISTICS OF HYDROSTATIC JOURNAL BEARINGS IN BOTH LAMINAR AND TURBULENT REGIMES

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ABSTRACT

The desire to operate at high speeds and the use of low viscosity process fluids means that fluid film bearings must operate at large Reynolds numbers (i.e., in a range between 10^3 and 10^5).At these Reynolds numbers, the flow within the film thickness is turbulent. The aim of the paper work is to investigate and predict the performance characteristics of new four-pad hydrostatic journal bearings loaded between pads in both laminar and turbulent regimes. Linear modeling was performed using a numerical method to study the effects of Poiseuille Reynolds number, eccentricity, squeeze velocity and pressure ratio on the static and dynamic characteristics of hydrostatic journal bearings. The finite difference method has been used to solve Reynolds equation, based on Constantinescu's turbulent lubrication theory, governing the lubricant flow in film thickness of hydrostatic bearings. It assumed that the fluid flow is incompressible, isothermal, steady-state and inertialess fluid. The numerical model is validated by comparing the numerical results with analytical results. The numerical results obtained are discussed, analyzed and compared between four and three-lobe hybrid journal bearings available in the literature. The results show the four-pad Hydrostatic journal bearing has better dynamic characteristics than three and four-lobe hybrid journals bearing due to their high stiffness and zero cross-coupling terms. On the other hand, the present study reveals that the Reynolds numbers, squeeze velocity and eccentricity ratio have a major effect the performance characteristics, especially on the load capacity, equivalent damping and damping ratio of hydrostatic journals bearings. The results presented in this paper are expected to be quite useful to bearing designers, in order to use it as a device for actively controlling rotors operating at high speeds.

Keywords: hydrostatic journal bearings, laminar and turbulent regimes, squeeze velocity, eccentricity ratio and pressure ratio.