Stability Insights from Hybrid-Bearing Research at the Texas A&M University Turbomachinery Laboratory

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ABSTRACT

Test results are reviewed for a base-line, five-recess, hybrid bearing (diameter = 75 mm) using warm water as the test media with supply pressures out to 70 bars and running speeds out to 24600 rpm. The results show that the baseline bearing has a whirl-frequency ratio of approximately 0.5. Hence, a flexible rotor supported by conventional hybrid bearings would become unstable at speeds above twice the first critical speed. For stiff shafts, the high direct stiffness capability of hybrid bearings can be used to enhance stability by increasing the critical speed. Test results show that the whirl frequency ratio can be significantly reduced by either (i) tangential injection against shaft rotation, or (ii) using a deliberately roughened stator surface in the land area. Tangential injection can be better at low speeds. At higher speeds (24600 rpm) the roughened-stator bearing has a lower whirl-frequency ratio. Analysis shows that the whirl-frequency ratio can be reduced by deliberately introducing stiffness orthotropy into the bearing; however, no public-domain literature are available to support this proposition.