

Application of Foil Bearings to Turbomachinery Including Vertical Operation

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A review is made of the function of compliant surface bearings in serving the needs of modern turbomachinery. This service extends over a wide spectrum of severe operational and environmental conditions such as extreme low and high temperatures, speeds over 100,000 rpm, and the use of cryogenics as lubricants. The importance of using appropriate simulators that duplicate the actual equipment in evaluating the application of compliant bearings is demonstrated via two specific examples; one, a simulator to evaluate bearings for an air cycle machine and another for an advanced cryogenic device. In view of the known difficulties in using hydrodynamic bearings in vertical machines a new preloaded compliant journal bearing design is offered which performs as well with a vertically mounted shaft as it does in horizontal operation. In terms of the location of the first two rigid-body criticals, the test data show the compliant bearing's vertical operation to be at most 15 percent lower than for the horizontal case, whereas the maximum vibrational amplitude stayed the same for both modes of operation. This new class of hydrodynamic compliant surface journal bearings now makes possible development of oil-free machines capable of all attitude operation, such as aircraft gas turbine engines undergoing severe pitch maneuvers or machines that must be operated vertically due to space constraints. [DOI: 10.1115/1.1392986]