Changes in Hardware in Order to Accommodate Compliant Foil Air Bearings of a Larger Size

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Compliant foil air bearings are at the forefront of the Oil-Free turbomachinery revolution of supporting gas turbine engines with air lubricated hydrodynamic bearings. Foil air bearings have existed for almost fifty years, yet their commercialization has been confined to relatively small, high-speed systems characterized by low temperatures and loads, such as in air cycle machines, turbocompressors and microturbines. Recent breakthroughs in foil air bearing design and solid lubricant coating technology, have caused a resurgence of research towards applying Oil-Free technology to more demanding applications on the scale of small and mid range aircraft gas turbine engines.

In order to foster the transition of Oil-Free technology into gas turbine engines, in-house experiments need to be performed on foil air bearings to further the understanding of their complex operating principles. During my internship at NASA Glenn in the summer of 2003, a series of tests were performed to determine the internal temperature profile in a compliant bump-type foil journal air bearing operating at room temperature under various speeds and load conditions. From these tests, a temperature profile was compiled, indicating that the circumferential thermal gradients were negligible. The tests further indicated that both journal rotational speed and radial load are responsible for heat generation with speed playing a more significant role in the magnitude of the temperatures.

As a result of the findings from the tests done during the summer of 2003, it was decided that further testing would need to be done, but with a bearing of a larger diameter. The bearing diameter would now be increased from two inches to three inches. All of the currently used testing apparatus was designed specifically for a bearing that was two inches in diameter. Thus, my project for the summer of 2004 was to focus specifically on the scatter shield put around the testing rig while running the bearings. Essentially I was to design a scatter shield that would be able to accommodate the three inch bearing and that would also meet all safety requirements. Furthermore, the new scatter shield also had to house a heater, used for high-speed and temperature testing. Using Solidworks, a computer aided modeling program, I was able to accomplish the task set out for me and designed the new scatter shield. Furthermore, I also guided the fabrication process.

As a result of this containment shield being designed, the Oil-Free turbomachinery team now has the ability to test bearings of larger diameters. Finally, it is expected that these tests will provide information useful for the validation of future analytical modeling codes.