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HIGH TEMPERATURE PERFORMANCE EVALUATION OF A COMPLIANT FOIL SEAL

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ABSTRACT

This paper presents performance of a novel non-contacting compliant foil seal (CFS) in a small gas turbine simulator. The preliminary numerical study on a CFS for the hot section of a gas turbine engine was discussed in the previous work by the authors. A high temperature hybrid dynamic simulator representative of a small gas turbine engine spool was developed. The developed air turbine driven hybrid simulator includes a compliant foil bearing (CFB) and a CFS in the simulated hot turbine section and an oil mist lubricated ball bearing in the cold compressor section of the engine. The hybrid simulator is successfully tested at speeds up to 56,000 rpm and temperatures up to 600 ˚C . A solid lubricant film, PS304 developed by NASA, was used for the CFB and CFS journals. The coating is employed to provide a smooth contact surface between the journal and CFS and to prevent wear at startup/shutdown where the hydrodynamic lift off effects are minimal. The CFS features the following three distinguishing characteristics: lower leakage flow rate compared to Labyrinth and brush seal; capability of handling larger shaft excursions; and the ability to support dynamic loads. The CFS performance at different operating speeds and temperatures , and differential pressures was investigated. In a similar condition, a leakage flow comparison was made among a Labyrinth seal , a brush seal and a CFS. The experimental results indicate superior performance of the CFS over the other two types of seals. Unlike brush seal, CFS showed no evidence of rub or induced wear on the journal or seal surface.

