

# Advancing the Load Capacity and Operating Temperature of Foil Thrust Bearings

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## Abstract

Compliant foil bearings offer many advantages over rolling element bearings in high-speed and high-temperature applications. Foil bearings are stable at high speeds, operate with process fluids (gas or liquid), and can operate at temperatures up to 800 °C. While journal bearings received more research attention in the past, and a bearing with 670 kPa load capacity was reported in 1994, the load capacity of foil thrust bearings available at the time was in the 150 kPa to 200 kPa range. This paper discusses a recent major breakthrough in the improvement of the load capacity of compliant foil thrust bearings, and in extending their operating temperature range to 800 °C. Applying the available analytical tools and newly developed coatings, new thrust bearings were designed with improved pad geometry and stiffness, and excellent tolerance to intermittent high-speed rubs. The new bearings, with an ID of 47 mm and an OD of 97 mm, demonstrated the load capacity of 570 kPa at 200 m/s runner tip speed. This achievement constitutes a 100% improvement over the state of the art hydrodynamic foil thrust bearings and significantly extends the envelope of possible bearing applications. Improving the bearing load capacity at speeds near Mach 1 and higher is also discussed in this paper. In addition, hydrodynamic operation of foil bearing pads at 800 °C is reported here.

Key words: compliant foil thrust bearing, load capacity, high-temperature coatings