**Proceedings of 2006 ASME Turbo Expo:**
**Power for Land, Sea & Air**
**May, 2006 – Barcelona, Spain**

# GT2006-90791

# SMALL GAS TURBINE ENGINE OPERATING WITH HIGH-TEMPERATURE FOIL BEARINGS

**Hooshang Heshmat, Ph.D. (ASME/STLE Fellow)**
hheshmat@miti.cc
Mohawk Innovative Technology Inc.
Albany, NY 12205

**Michael J. Tomaszewski**
mtomaszewski@miti.cc
Mohawk Innovative Technology Inc.
Albany, NY 12205

**James F. Walton II (ASME /SAE Member)**
jwalton@miti.cc
Mohawk Innovative Technology Inc.
**Albany, NY 12205**

## ABSTRACT

A 134 Newton thrust class, 120,000 rpm turbojet was redesigned to incorporate a high-temperature compliant foil bearing aft of the turbine rotor and a compliantly mounted ball bearing forward of the centrifugal compressor—cold section. Two rotor-bearing system configurations were evaluated, one for operation above the bending critical speed and one for rigid rotor operation. Required characteristics for the foil bearing and ball bearing equipped with compliant foil damper mount were determined through a series of design tradeoff studies evaluating critical speeds and system stability. Following the design studies, the necessary hardware was fabricated, the engine assembled and operation to full speed achieved. Engine speed, rotor vibrations, compressor discharge pressure, exhaust gas temperature, thrust and fuel consumption were all recorded for both a baseline fluid lubricated ball bearing supported engine and the new turbojet engine using the hybrid foil bearing support system. Issues related to high-speed operation above the bending critical speed are identified and recommendations offered. Engine test data show that approximately 10% less fuel is consumed by the hybrid foil bearing mount system than the baseline conventional design. It is also shown that the foil bearing life was longer than the ball bearing life even though the foil bearing operated in the exhaust gas stream at temperatures exceeding 800°C. The results of this program demonstrate the feasibility of developing a completely oil-free foil bearing gas turbine engine.