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Oil-Free Turbocharger Demonstration Paves Way to Gas Turbine Engine Applications

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ABSTRACT

An oil-free, 150 Hp turbocharger was successfully operated to 100% speed (95,000 rpm), with turbine inlet temperatures to 650°C on a turbocharger gas test stand. Development of this high speed turbomachine included bearing and lubricant component development tests, rotor-bearing dynamic simulator qualification and gas stand tests of the assembled turbocharger. Self acting, compliant foil hydrodynamic air bearings capable of sustained operation at 650°C and maximum loads to 750 N were used in conjunction with a newly designed shaft and system center housing. Gas stand and simulator test results revealed stable bearing temperatures, low rotor vibrations, good shock tolerance and the ability of the rotor bearing system to sustain overspeed conditions to 121,500 rpm. Bearing component development tests demonstrated 100,000 start stop cycles at 650°C with a newly developed solid film lubricant coating. In a separate demonstration of a 100 mm compliant foil bearing, loads approaching 4,500 N were supported by a compliant foil bearing. This combination of component and integrated rotor-bearing system technology demonstrations addresses many of the issues associated with application of compliant foil bearings to gas turbine engines.