

GT2006-90796

ON THE DEVELOPMENT OF AN OIL-FREE ELECTRIC TURBOCHARGER FOR FUEL CELLS

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ABSTRACT

Proton Exchange Membrane, fuel cells intended for automotive applications require widely varying flows of contaminant free air for high efficiency and successful long-term operation. One machine being considered for this application is the oil-free electric turbocharger, which combines a centrifugal compressor, radial inflow turbine, permanent magnet electric motor and air lubricated compliant foil bearings. In this paper the results of a preliminary system design study integrating a motor, foil bearings and aerodynamic wheels, as well as performance testing of a crucial element, the compliant foil thrust bearing, are presented. Several different thrust bearings were tested in sizes suitable for operation to speeds over 250,000 rpm and operating thrust loads greater than 98 Newtons. Additional tradeoff studies are presented for a preliminary design of 12 kW permanent magnet motor driven, 120,000 rpm motorized turbocompressor operating above its bending critical speed.