Effect of Axial Load on Turbocharger Friction Losses

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ABSTRACT

Though the turbocharger of an automotive engine is able to run up to 240 000 rpm, its rotational speed is most of the time less than 100 000 rpm in urban conditions. The compressor maps provided by turbocharger manufacturers do not give any information of compressor performance in this low speed area. Low speed behaviour demands that the air temperature be measured very precisely which is difficult to achieve with e standard mapping procedures. Standard mapping procedures use information from the compressor and turbine side but disregard the bearing system friction because it is included in the overall compressor performance. However, the bearing system friction can be assessed by subtracting the power given to the compressed air from the power provided to the shaft at the turbine side, in an isentropic process. Useful information will be given to automotive engineers by assessing friction losses which will improve engine modelling. Our turbocharger test bench has been equipped with a specific torquemeter, installed between the turbine and the compressor stages, allowing power shaft measurements up to 120000 rpm. In addition, a specific magnetic device has been implemented in order to generate an adjustable axial thrust force. The compressor housing has been removed and the compressor wheel replaced by a spacer that produces no power. Then, the torquemeter directly measures the friction torque of the bearing system assembly. Experiments have been conducted for various axial loads, oil temperatures and turbocharger speeds and the main outcomes are presented in this paper. Experimental results are also compared to CFD computations and show