2016-01-2363

Heavily Downsized Demonstrator Engine Optimised for CNG Operation

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ABSTRACT

The complexity of modern powertrain development is demonstrated by the combination of requirements to meet future emission regulations and test procedures such as Real Driving Emissions (RDE), reduction of fuel consumption and CO2 emissions as well as customer expectations for good driving performance. Gasoline engine downsizing is already established as a proven technology to reduce automotive fleet CO2 emissions. Additionally, alternative fuels such as natural gas, offer the potential to significantly reduce both tailpipe CO2 and other regulated exhaust gas emissions without compromising driving performance and driving range.

This paper presents results showing how the positive fuel properties of natural gas can be fully utilised in a heavily downsized engine. The engine has been modified to cope with the significantly higher mechanical and thermal loads when operating at high specific outputs on compressed natural gas (CNG). In this study, peak cylinder pressures of up to 180 bar and specific power output levels of 110 kW/litre have been realised. It is also shown that having cylinder components specific to natural gas can yield significant reductions in fuel consumption, and, in conjunction with a variable geometry turbine, a port-fuelled CNG engine can achieve impressive low-speed torque (27 bar BMEP at 1500 rpm) and good transient response characteristics.

The results achieved from the test engine whilst operating on CNG are compared to measurements from the baseline, gasoline-fueled, direction injection (GDI) engine. The potential CO2 savings offered by this heavily downsized CNG engine, of up to 50% at peak power and 20-40% for the drive-cycle region (including real driving emissions (RDE) testing), are presented and discussed.