F2014-TMH-016

Development of a Range Extender Engine Family

Dr. Mike Bassett, Jonathan Hall, Dr. Marco Warth, Dr. Bernd Mahr
MAHLE Powertrain Ltd.

ABSTRACT

MAHLE has developed a dedicated Range Extender (REx) unit, focussed on meeting the requirements determined for a compact-class Range Extended Electric Vehicle (REEV), and the resulting design produces 30 kW at 4000 min-1 from a 0.9 litre twin-cylinder, four-stroke gasoline engine which features a fully integrated electrical generator. During the concept phase for the original 30 kW REx unit, key attributes for the REx unit were identified and a full evaluation of the different possible layouts for the Range Extender engine was undertaken to assess the most suitable for the intended application. A key attribute of the 30 kW unit is its very compact package envelope.
To broaden the scope of the applicability of the REx unit MAHLE has investigated methods to increase the power output of the unit with minimal modifications. To limit the changes required, and maintain a compact unit, the specific output of the existing unit has been increased. This has been achieved in a combination of two ways, these being increasing the maximum operating speed of the engine to 5500 min-1 and supercharging the engine. By adopting this dual approach, MAHLE has set the target to offer a family of REx engines based on identical architectures which can deliver 30, 40 or 50 kW of mechanical power.
The engine has been analysed to assess the potential for upgrading the maximum operating speed and power output. Performance analysis has been undertaken to determine the changes required in the inlet and exhaust systems to enable the target power levels to be achieved. The mechanical integrity of the crankshaft and valvetrain system have also been analysed and redesigned so that they are suitable for coping with the increased engine speed and performance. Details of the analysis and design activities are presented in the paper, along with initial results from the testbed.