

Development of a Family of Range Extender Engines

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Abstract

MAHLE has developed a Range Extender (REx) unit, designed specifically to meet the requirements for a compact-class Range Extended Electric Vehicle (REEV). The resulting design produces 30 kW at 4000 rev/min 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 were identified and an evaluation of different layouts for the REx engine was undertaken to determine the most suitable. A key focus of this study was to achieve a very compact package envelope.

To broaden the scope of applicability of the REx unit methods to increase the power output of the unit with minimal modifications have been investigated. 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 rev/min and supercharging the engine. By adopting this dual approach, MAHLE is able to offer a family of REx engines, based on a common architecture, which can deliver 30, 40 or 50 kW of mechanical power.

The base engine has been analysed to assess the potential for upgrading the maximum operating speed and power output and performance analysis was undertaken to determine the changes required in the inlet and exhaust systems to enable the target power levels to be achieved. The crankshaft and valvetrain systems have been analysed and redesigned to ensure that they have mechanical integrity at increased engine speed and performance. An overview of the analysis and design activities is presented, along with test results achieved for the upgraded REx units.