

MAHLE compact range extender engine



Current focus on techniques to reduce the tailpipe carbon dioxide (CO₂) emissions of road vehicles is increasing the interest in hybrid and electric vehicle technologies. Extended-range electric vehicles (E-REVs) partly overcome the limitations of current battery technology by enabling reduced battery storage capacity to be used, whilst still maintaining an acceptable vehicle range.

The E-REV is essentially a vehicle that functions as a full-performance electric vehicle when energy is available from an on board rechargeable energy storage system, typically a battery, and having an auxiliary energy supply that is only engaged when battery energy is depleted. It is desirable that for the majority of time the vehicle will operate in a purely electric-only mode and that the user recharges the vehicle (by connecting to an external supply) when it is not in use, e.g. over-night. Thus, the battery should be sized to cope with the majority of daily usage that the vehicle will encounter, and only rely on the range extender for infrequent, longer journeys.

Compact range extender engine

- 4-stroke gasoline engine
- 900 cc twin cylinder
- 30 kW output
- Horizontal or vertical installation capability
- Weight 50 kg (70 kg with generator)
- Compact design

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MAHLE has developed a range extender engine to identify the requirements, and challenges faced in the development of the components, for such future engines. The MAHLE range extender engine has been sized to be suitable for a typical C-segment passenger car. Fleet vehicle drive data was analyzed, using a drive style analysis toolset developed by MAHLE Powertrain, to identify the typical daily usage pattern of such passenger cars.

This analysis enabled the requirements for electrical components and the range extender to be determined. The key attributes for the range extender engine were identified; these being low cost, small package volume, good NVH attributes and reasonable fuel efficiency. A detailed design study led to the selection of a 900 cc twin cylinder 4-stroke gasoline engine layout.

The resulting design incorporates a fully integrated axial flux generator, which is housed within the crankcase of the engine, leading to a lightweight, small and cost-effective solution. A key feature of the engine is the oil system which enables the engine to be installed vertically or horizontally for increased package flexibility.

Technical specifications

Engine displacement:	900 cc
No. of cylinders:	2 in-line, 4-stroke, gasoline
Bore/stroke:	83.0 / 83.0 mm
Compression ratio:	9.8 : 1
Fuel injection:	Port fuel injection
Installation angle:	Vertical or horizontal
Engine control:	MAHLE flexible ECU
Maximum power:	30 kW [4000 min ⁻¹]
Dimensions:	327 x 416 x 481 mm
Engine dry weight:	50 kg (70 kg with generator)
Fuel consumption:	240 g/kWh minimum
Emissions target:	Euro 6

