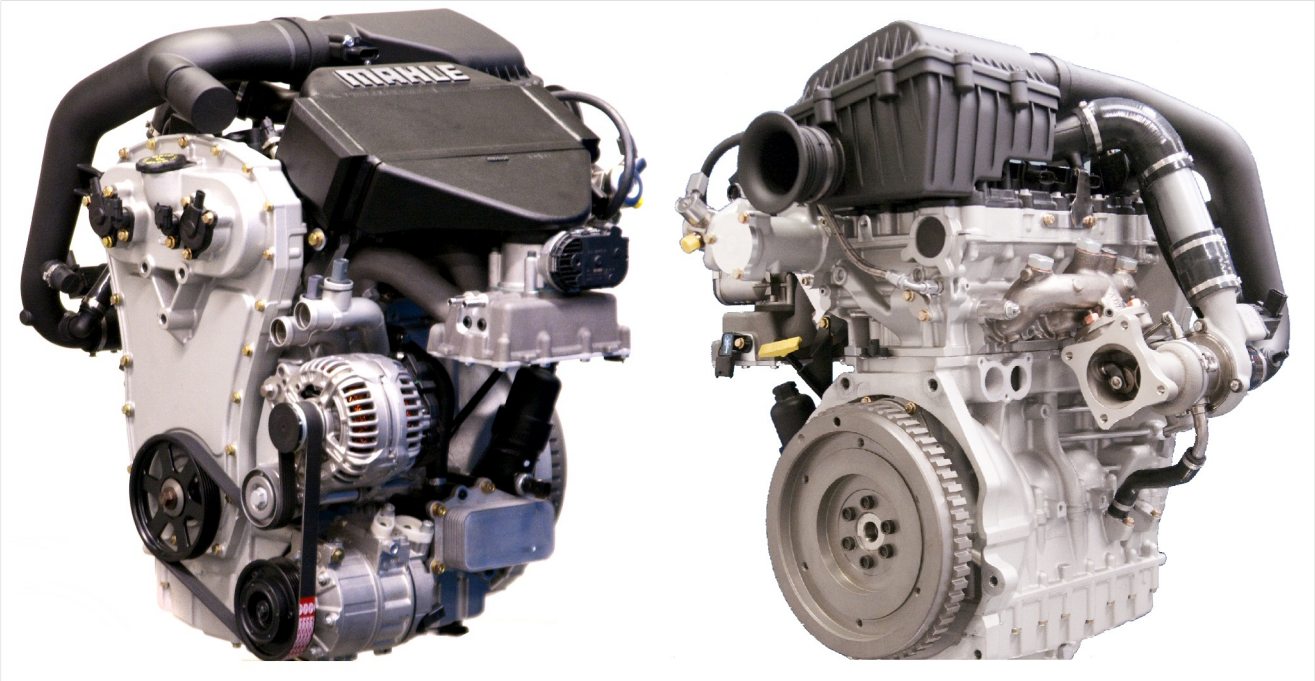
MAHLE
Powertrain

MAHLE Downsizing Demonstrator Engine – Second Generation



The downsizing of engines, especially gasoline, is now firmly established as a proven approach for delivering significant fuel economy benefits. A reduction in relative displacement improves fuel economy whilst the use of high boost turbocharging maintains acceptable power and torque outputs.

The reduced engine displacement also enables lower friction losses, lower weight and lower gas exchange losses to be achieved. But as the degree of downsizing increases, greater demands are made on the key engine systems and components to deliver the optimum benefits. Together with applied downspeeding the CO_2 emission could be further improved.

MAHLE and its engineering service provider MAHLE Powertrain started the development of its own advanced downsizing engine in 2006. The first generation MAHLE downsizing engine was designed and developed from clean sheet to running prototype in 12 months.

Technical specifications

- 3 cylinder, 1.2 litre displacement
- Central spray-guided GDI
- Low friction valve train and power cell
- Single turbocharger by BMTS
- Split cooling system

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Two-stage turbocharging was initially employed to demonstrate the higher levels of performance which can be achieved, while still maintaining the inherent efficiency advantages of a small displacement unit. The next steps included a detailed optimisation of the combustion system and engine mechanics as well as the turbocharger layout.

In order to provide a production feasible, near term solution and still deliver acceptable performance, the second generation downsizing engine was further developed with a bespoke single turbocharger from sister company Bosch Mahle Turbo Systems (BMTS). The original torque curve targets from the first generation twin-turbo engine were carried over with a peak BMEP value of 30 bar, and the power output target was set at an aggressive 100 kW / litre. The aim was to achieve excellent dynamic performance in a medium-sized vehicle, while still providing significant CO_2 reductions, and delivering a predicted fuel consumption of 5.8 l /100 km (~49 UK mpg) in the "New European Driving Cycle" (NEDC). During 2010, the second generation engine was installed in a series production vehicle (weighing 1600 kg), and extensive driving has confirmed that the fuel economy and CO_2 targets are achieved.

This vehicle and several engines are currently being used as platforms for MAHLE future gasoline R&D technology development activities. The advanced technology, structural layout and cutting-edge performance levels mean that new technologies and ideas relevant to future generations of engines can be tested to give MAHLE a competitive advantage. Full integration of new components into the engine is enabled by access to the engine CAD data for all areas of the MAHLE group, resulting in the ability to conduct research into new areas without compromise.