

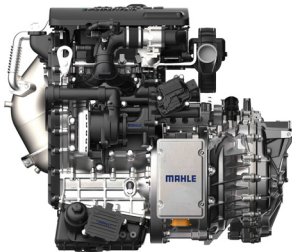
MAHLE Modular Hybrid Powertrain



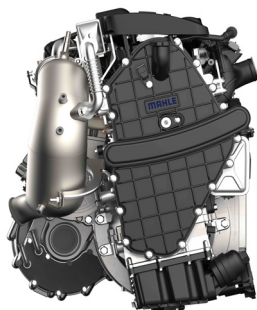
Powertrain modularity for multiple applications

Reduced complexity for lower costs

Low, weighted drive cycle CO2



>> Powertrain Front View



>> Powertrain Left View

Electrification and hybrid technologies are now widely accepted as the preferred approach to achieving future vehicle emissions targets. In Europe, for example, OEMs must comply with a fleet average CO2 emissions target of <60 g/km by 2030.

So, there is an urgent need for the rapid adoption of appropriate, scalable solutions across a broad spectrum of vehicle segments to meet these objectives. In response, MAHLE has developed the Modular Hybrid Powertrain concept using a dual-mode (series and parallel) configuration to provide the best features of both series and parallel architectures.

Description

- Dual mode plug-in hybrid (PHEV) powertrain
- Integrated series - parallel hybrid electric drive
- Dedicated Hybrid Internal Combustion Engine (DHE)
- Scalable across multiple vehicle applications

Benefits & Motivation

- Improved emissions and reduced after treatment complexity
- Seamless torque delivery provided by the traction motor
- Low, weighted drive cycle CO2 (< 2030 proposed target)
- Increased efficiency with parallel hybrid direct drive mode

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MAHLE Modular Hybrid Powertrain

With an IC engine, traction motor, generator and transmission, all arranged in a compact, fully integrated package, the vehicle can operate in a number of different modes according to battery state of charge and driving speed. With the traction motor being directly connected to the wheels, the engine itself is de-coupled by the transmission and therefore runs in a limited speed / load range to ensure low fuel consumption and CO2 emissions.

The engine, motor and HV battery can all be scaled easily to different outputs to cater for a wide range of vehicle applications from B- to J-segment across multiple platforms. The Modular Hybrid Powertrain offers several advantages compared to existing hybrid technologies including scalability, fuel efficiency, low emissions, reduced weight, easier packaging and lower production costs.

Dedicated Hybrid IC Engine (DHE)

Description

- Parallel twin cylinder, with contra-rotating balancer shaft
- 2 valves per cylinder, SOHC, fixed valve event timing
- Port fuel injection with MAHLE Jet Ignition (MJI®)
- Turbocharger with MAHLE electronic wastegate actuator
- Miller-cycle operation with high geometric compression ratio
- Limited speed / load range operation for fuel efficiency
- Minimum BSFC = 207 g/kWhr (target < 200g)

Benefits & Motivation

- Compact, light weight and low cost engine
- Low technology requirement
- Very low specific fuel consumption and emissions
- Readily scalable for multiple vehicle applications
- Potential for higher efficiency with ultra-lean MJI®



>> Dedicated Hybrid Engine



>> Hybrid electric drive and 2 speed transmission

Hybrid Electric Drive and transmission

Description

- Direct drive HV MAHLE traction motor with optimised cooling
- HV MAHLE generator mounted on transmission input shaft
- MAHLE Inverters integrated into motor and generator housing
- Simplified transmission - no torque interruption

Benefits & Motivation

- Traction motor provides full vehicle dynamic performance
- No clutch as neutral selection decouples DHE from driveline
- 1, 2 and 4 speed transmission family use common ratios & main casing for modular approach
- Low cost, compact and adaptable unit