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MAHLE
Powertrain

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Modular Hybrid Powertrain Concept

Vehicle manufacturers are facing increasing pressure by legislation and economics to reduce vehicle emissions and deliver improved fuel economy. Over the coming years, significant reductions in carbon dioxide (CO2) emissions need to be achieved to meet fleet targets, whilst at the same time satisfying the more stringent forthcoming Euro7 emissions regulations. This focus on techniques to reduce the tailpipe CO2 is increasing the interest in hybrid and electric vehicle technologies. Pure electric vehicles require bulky and expensive battery packs, with a high embedded CO2 content, to enable an acceptable driving range. Range Extended Electric Vehicles (REEVs) partly overcome the limitations of current battery technology by having a range extender (REx) unit that allows a reduction of the traction battery storage capacity, whilst still maintaining an acceptable vehicle driving range. MAHLE Powertrain have designed a plug-in hybrid driveline in which the systems have been fully integrated and optimised.

The hybrid drive-line features a cost effective and high-efficiency, Miller-cycle, turbocharged, two-cylinder gasoline engine, with external exhaust gas re-circulation (EGR) and a pre-chamber combustion system, achieving over 40 % brake thermal efficiency from a very low-cost architecture. This compact engine is combined with an electric traction system which can satisfy the full-dynamic requirements of the vehicle, even during pure-electric operation. The internal combustion engine can be operated in either series hybrid, or direct drive modes, via a compact multi-speed transmission. Key features of the hybrid drivetrain, and the various modes of operation in the vehicle, as presented. Results of testing to validate the pre-chamber combustion system, coupled with a very high geometric compression ratio (CR) and external cooled EGR, are also summerised. Finally, the scalability of the concept across a range of vehicle classes is discussed.