

Innovative systems for exhaust gas recirculation

Stuttgart, Germany, September 2007 — Systems for Exhaust Gas Recirculation (EGR) are increasingly used to reduce nitrogen oxide emissions of internal combustion engines. The automotive supplier MAHLE, headquartered in Stuttgart, Germany, develops various technologies for diesel and gasoline engines to support and control cooled external exhaust gas recirculation.

More stringent emissions legislation indirectly places ever-higher demands on EGR systems, particularly with respect to the quality of control and endurance. To control the flow of the recirculated exhaust gas, electrically driven EGR valves are increasingly used. They enable precise metering as well as feedback concerning the current valve position. In addition, it must be ensured that the valves do not seize, even with considerable pollution. Alongside these technical requirements are endeavors to reduce the cost, installation space, and weight of components.

The EGR valve of MAHLE combines familiar technologies, such as the electric drive with a direct current motor, the transmission with spur gears and the successfully applied flat-seat valve with a special bent lever solution. In this way, non-linear opening characteristics with low actuating speed and high opening forces are achieved, particularly for small opening cross-sections. As a result, metering is optimized for operational states in which only low exhaust gas recirculation rates are permitted. Due to the powerful opening forces, large valve cross-sections for a high flow rate can be realized, effectively preventing the valve from seizing. The special design enables the valve to assume a defined “fail-safe” position in the event of an error. To maintain optimum control precision in the long term, MAHLE optionally offers the EGR valves with integrated control electronics, including wear-resistant position sensors. This design meets even the highest EMC requirements.

The MAHLE EGR valve has demonstrated its excellent control precision and reliability in numerous engine applications over long running times without malfunctions. In passenger car diesel engines, the use of this valve reduces untreated nitrogen oxide emissions by up to 8 percent compared to a conventional EGR valve. At present, MAHLE is developing integrated systems with coolers based on this valve. This will provide a system concept that unites a compact and robust design with excellent actuator precision. These modules include additional functionalities, such as a by-pass valve for cold start.

At the same time, MAHLE introduces a fundamentally new EGR technology that is based on a rotating fast-switching charge air valve (SLV-R). In this system, an electromagnetic valve with rotating flap movement is positioned in the fresh air line upstream of the EGR inlet point. By briefly closing the valve, a temporary vacuum is generated on the charge air side, which creates the necessary pressure gradient for exhaust gas recirculation. Another advantage over conventional EGR valves is that the charge air valve is installed in the fresh air path and is consequently not directly exposed to the recirculated exhaust gas. This minimizes thermal stress as well as pollution of the valve. In addition, the continuously rotating movement of the flap ensures simple control and a long service life.

The benefits of the fast-switching valves consist in the considerably higher achievable EGR rate and a quick adaptation to load level changes of the engine. MAHLE has demonstrated the effectiveness of these valves in numerous test engines.

MAHLE offers a broad spectrum of innovative EGR systems for modern internal combustion engines. These systems set new milestones with respect to control precision, opening forces, and map-wide increases of the absolute recirculation rate in high EGR systems. MAHLE develops these complex innovative EGR systems in close collaboration with advanced engineering, series application product development, and the experts at MAHLE Powertrain, the engineering subsidiary. The systems are produced

in state-of-the-art facilities, which meet maximum quality and precision requirements. With its innovative EGR systems, MAHLE emphatically supports the development of modern diesel and gasoline engines, particularly with regard to the steadily rising requirements.

The MAHLE Group is one of the 30 largest automotive suppliers worldwide. As the leading manufacturer of components and systems for the internal combustion engine and its peripherals, MAHLE is among the top 3 systems suppliers for piston systems, cylinder components, valve train systems, air management systems, and liquid management systems. With more than 40,000 employees in 110 production plants and seven research and development centers, MAHLE generated sales in excess of EUR 4.3 billion (USD 5.8 billion) in 2006.

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