

Control of charge air and exhaust gas streams essential for achieving ultra-high EGR rates

Stuttgart/Germany, September 2009—With dynamic flap and valve solutions, MAHLE lays the groundwork for utilizing exhaust gas recirculation (EGR) rates of up to 50 percent in the future without negatively impacting fuel efficiency. EGR rates in this range further reduce the nitrogen oxide emissions of an engine.

High EGR rates are an effective means for reducing nitrogen oxide emissions in combustion engines because the portion of gas remaining in the combustion chamber lowers the peak combustion temperature—resulting in decreased NO_x formation. Under certain operating conditions, however, the exhaust gas pressure is not sufficient to feed an appreciable amount of exhaust gas into the charge air line. The drawback of all corrective methods used to date is that they drive fuel consumption up.

Fast-switching charge air valve

This is not the case with the mechatronic control flap system for the charge air line developed by MAHLE: Unlike current solutions, the fast-switching charge air valve does not operate as a continuous throttle and therefore does not affect the charge cycle work. The charge air valve is fitted in the charge air line upstream of the EGR feed point. In the fast-switching charge air valve, a brushless DC motor actuates a rapidly revolving flap, which briefly closes off the cross section of the charge air line each time it revolves. This temporarily reduces the charge air pressure level, and the recirculated exhaust gas can be metered precisely and directed into the charge air line. The high dynamic mechanism and flexible electronic actuation of the fast-switching charge air valve make it possible to achieve EGR rates that meet the requirements at hand.

During a test implementation in a commercial vehicle engine, ultra-high exhaust gas return rates of up to 50 percent were achieved across broad engine map areas with this solution. Significant advantages in NO_x emissions and specific fuel consumption, compared to conventional high EGR systems, were measured during the test. Thus, the fast-switching charge air valve also shows potential for achieving a significant reduction in the complexity of exhaust gas aftertreatment solutions.

Optimized valves in the EGR line

The MAHLE knee-lever flat seat valve was developed specifically for use in the EGR line. With its extremely high opening forces, this valve is suitable even for large EGR line cross sections and therefore for the large gas throughputs involved in high EGR concepts. Passenger car diesel engines using this high-precision valve produce up to eight percent less NO_x compared to common EGR valves.

Based on this valve, MAHLE has developed an innovative EGR valve for gasoline engines for high-load applications that significantly reduces the exhaust gas temperature and thus the need for air-fuel mixture enrichment in the efficient downsizing engines, with their higher specific load. As a result, fuel consumption is reduced in these map areas by up to nine percent.

MAHLE even offers a fast-switching valve for exhaust gas recirculation lines: The MAHLE fast-switching exhaust gas valve is fitted in the exhaust gas line of diesel engines downstream of the charge air cooler and achieves ultra-high exhaust gas return rates through amplification and extremely precise control of exhaust pulses. Thanks to its responsive system dynamics, the fast-switching exhaust gas valve enables controlled adjustment of the EGR even under transient engine operating conditions.

The MAHLE Group is one of the top 30 automotive suppliers and the globally leading manufacturer of components and systems for the internal combustion engine and its peripherals. Around 45,000 employees work at over 100 production plants and eight research and development centers. In 2008, MAHLE generated sales in excess of EUR 5 billion (USD 7.3 billion).

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