

Still less weight: the new MAHLE lightweight valve

Stuttgart, Germany, October 2007 — The engineers of the automotive supplier MAHLE have developed intake and exhaust valves for new engine generations that are up to 55 percent lighter and can withstand higher temperatures than conventional solutions. These are ideal conditions for innovative lightweight engine designs with higher performance and improved fuel consumption as well as lower exhaust gas emissions.

In engine design, lightweight engine valves have always been a development goal. After all, at an average rotational speed of 3,600 revolutions per minute, for example, the valves of a gasoline engine open and close 30 times a second. The mass of the valves is accelerated and again decelerated with every revolution of the camshaft. So far, attempts were aimed at lowering the valve weight with exotic materials. However, ceramics, titanium, and titanium aluminide are very expensive alternatives.

MAHLE's innovative solution: a unique lightweight valve made of formed sheet metal parts. The valve is a hollow body, and the cone and disc are produced from sheet metal parts in a multi-stage metal-forming process. The stem is made of a precision steel pipe. The individual components are joined by means of high-precision laser welding. As a result, mechanical finishing is reduced by 25 percent compared to forged steel valves. Thanks to the hollow design, the valves can be filled with sodium, enabling considerably higher combustion chamber temperatures and an optimized engine operation with respect to fuel consumption.

Extreme thermal conditions

The new MAHLE lightweight valve technology withstands exhaust gas temperatures of more than 1,000 degrees Celsius. Peak temperature can thus be increased by approximately 100 degrees

Celsius, which represents a significant advantage, especially in future turbocharged gasoline engines with lean operation.

The MAHLE lightweight valve is designed for higher rotational speeds, which in turn has a positive influence on the maximum achievable power output per liter. This means: engines with smaller displacements, improved fuel economy, and lower emissions. Since the forces acting on the components are generally lower in smaller engines, the moving parts of the valve train can be designed with thinner wall thicknesses and smaller contact surfaces. Wear and frictional loss of the moving parts decrease considerably, which in turn results in a lower noise level and lower camshaft driving power.

The results of engine tests conducted at MAHLE and several of its customers have demonstrated that the new lightweight valve meets all requirements. In the future, this design will open up additional performance potential for engines and offer persuasive advantages with regard to wear, thermal stability, greater power, and lower noise, especially for supercharged engines with direct injection in downsizing concepts.

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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