

Weight-optimized connecting rod for maximum stress

Stuttgart, Germany, September 2007 — The automotive supplier MAHLE, headquartered in Stuttgart, Germany, specializes in high-strength and reduced-mass connecting rods made of forged steel. A favorable fiber orientation, which is achieved in the forging process, in conjunction with high-strength steel types constitutes another step toward the structurally optimized connecting rod. Highly developed forging processes ensure that mass deviations remain within tight tolerances and a precise net shape. These new and robust connecting rods meet even the highest requirements of modern engines.

Trends in engine design, such as downsizing, higher performance, more stringent exhaust gas limits, and higher driving comfort require new approaches in the design of connecting rods, innovative materials, and advanced process technology. MAHLE offers the best combination of lightweight construction, strength, and modern connecting rod designs at competitive costs.

MAHLE has developed a series of innovative weight savings solutions without sacrificing optimal functionality:

The launch of the new 36MnVS4 material provides a steel grade with a unique chemical composition. It has a fine-grained microstructure and its fatigue resistance is up to 30 percent higher than existing materials for fracture split connecting rods. The excellent material properties of 36MnVS4 as well as its outstanding fatigue resistance enable a variety of innovative connecting rod designs combined with considerable weight savings. Laboratory tests revealed a considerably longer service life for the drilling and thread-forming tools thanks to the fine-grained material microstructure. The lower machining cost compensates for the higher raw materials cost, which is due to the material composition. In the future, the 36MnVS4 material will be the material of choice for MAHLE in the design of connecting rods.

The design features that contribute to the weight reduction of the crank mechanism include a trapezoidal or stepped small end for a compact pin boss support using short pins. Another feature is the elimination of the bushing. To take the high loads into account, MAHLE has incorporated a friction-lowering coating and a special pin bore profile for bushing-less connecting rods, thus improving the tribological properties and pressure distribution. Under dynamic forces and high cylinder pressures, the optimized functionality of the running surfaces between the piston pin and pin bore is guaranteed with the help of the finite element method.

A careful analysis of the crank end leads to further innovations. For example, blind screw assembly bore holes neutralize the notch factor and improve component integrity. In addition, MAHLE has optimized the crank end to maximum rigidity with minimized material stress.

All measures are aimed at minimizing the weight of the crank mechanism and thus contribute to lower engine emissions.

MAHLE is the globally leading supplier of forged connecting rod blanks and the largest independent manufacturer of finished connecting rods.

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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