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### A camshaft module that is 20 percent lighter

**The new lightweight camshaft module highlights the advantages of multi-material lightweight designs. Manufactured from fibre-reinforced thermoset polymers, it reduces the weight of the combustion engine; its production is more climate-friendly, and its modified design reduces assembly costs. The lightweight component was successfully developed by engineers at Mahle Group in cooperation with the Fraunhofer Institute for Chemical Technology (ICT) and other associated partners.**

*The Development Agency for Lightweighting Baden-Württemberg presents this innovation in its July 2020 edition of ThinKing. Under this label, Leichtbau BW GmbH provides a platform every month for new innovative lightweighting products or services from Baden-Württemberg.*

#### At a glance:

- ▼ **Lightweight:** 0.6 kg lighter than its conventional counterpart made from aluminium, resulting in a weight saving of around 20 percent.
- ▼ **Climate-friendly** in a number of ways, from production all the way through to use
- ▼ **Cost-effective:** Functionally integrated, monolithic design and improved manufacturing process
- ▼ **Silent:** The polymers have better noise damping properties

According to the scientists at the Fraunhofer ICT, the plastic camshaft module can be manufactured much more easily than its light-metal counterpart. In addition, it offers a weight saving of around 0.6 kg compared to the conventional component.

The project partners decided to use high-strength, fibre-reinforced thermoset polymers, as they can easily withstand high temperatures as well as the mechanical and chemical stresses such as those caused by synthetic engine oils and coolants.

#### Better driving dynamics and lower fuel consumption

The camshaft module is located in the upper installation space of the powertrain of a combustion engine. Therefore, its lightweight design using fibre-reinforced thermoset polymers with aluminium inserts is doubly effective: On the one hand, the lightweight design reduces energy consumption, and thus carbon emissions. On the other hand, it also lowers the vehicle's centre of gravity, thus improving the driving dynamics.

#### More climate-friendly through use of multi-materials

Starting with the production process, the new lightweight component is more climate-friendly, as plastics with a high fibre content have a lower carbon footprint than aluminium.

However, the camshaft module does require the use of some aluminium, making it a good example of multi-material lightweighting. As the stiffness of the thermoset polymers is only a quarter of that of aluminium, the team decided on a reinforced design of the bearing blocks for the camshaft. In addition, the steel camshaft does not move directly through the bearing

blocks but through aluminium inserts. The latter absorb the direct forces in highly stressed areas of the camshaft bearings.

### **Cost advantages in production**

The aluminium inserts are integrated already during the injection moulding process. This makes it possible to manufacture the monolithic component in just one step, without the need for additional assembly, and very near net shape. The cycle time is between 120 and 140 seconds. In contrast to the aluminium die casting process, there is no need for time-consuming reworking of the plastic camshaft module. It also requires less assembly effort at the engine plant.

### **Good damping properties**

Polymers have good damping properties, making it very easy to optimise the acoustic performance of the camshaft module. Automotive manufacturers place great importance on optimal NVH properties (noise, vibration, harshness), as they give them a clear competitive advantage.

### **Initial tests passed successfully**

After 600 hours of so-called cold testing on the engine test stand, the lightweight component demonstrated flawless functionality in a state-of-the-art internal combustion engine. Taking into account the gas forces of the combustion process, the project partners now plan to test the component's functionality and NVH properties with the help of hot tests – i.e. with an engine running under live, firing conditions.

Project partner MAHLE and associated partners Daimler AG, SBHPP/Vyncolit N.V. and Georges Pernoud are happy with the results so far. Pending further successful tests, a transfer to series production seems likely. The project was funded by the German Federal Ministry for Economic Affairs and Energy (BMWi).

*(4.406 characters including spaces)*

### **About Mahle**

Mahle is one of the world's largest automotive suppliers and a development partner for the automotive and engine industry. As a manufacturer of components and systems for internal combustion engines and engine peripherals, Mahle is one of the largest system suppliers of pistons, cylinders and valve controls/valve trains. The company employs approximately 77,000 people worldwide at around 160 production sites and 16 research and development centres.

**[www.mahle.com](http://www.mahle.com)**

### **About The Fraunhofer Institute for Chemical Technology (ICT)**

The Fraunhofer ICT currently has around 580 employees working on research and development projects in the core competencies of chemical processes, energy systems,

explosives technology, new drive systems, polymer technology and composite materials. The institute's main focus is on the scalability of processes and the transfer of research results from laboratory scale to pilot-plant scale, and in some cases even to pilot-level application.

[www.ict.fraunhofer.de](http://www.ict.fraunhofer.de)

### Press kit

A press kit with high-resolution photographs is available for download free of charge at: [\[link\]](#)

### Photographs



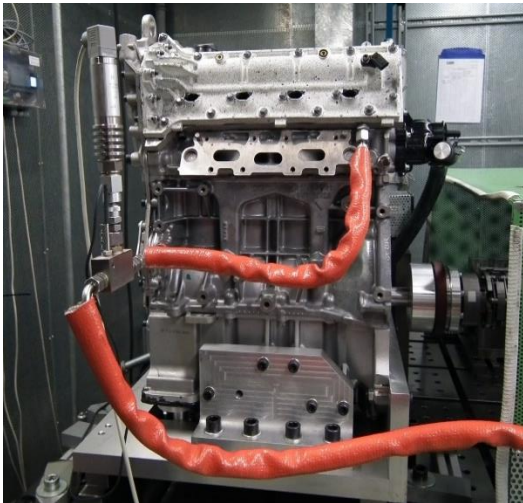
*Photo1.jpg*

The monolithic design with integrated bearings makes subsequent assembly of the plastic camshaft module easier. (Source: Fraunhofer ICT)



*Photo2.jpg*

The component made of fibre-reinforced thermoset polymers reduces the weight of the engine. (Source: Fraunhofer ICT)



*Photo3.jpg*

Engine test stand: In a 600-hour endurance test, the camshaft module was tested in a cold engine. For the purpose of optical measurement, a bright, dotted pattern was applied to the module. (Source: Mahle)

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