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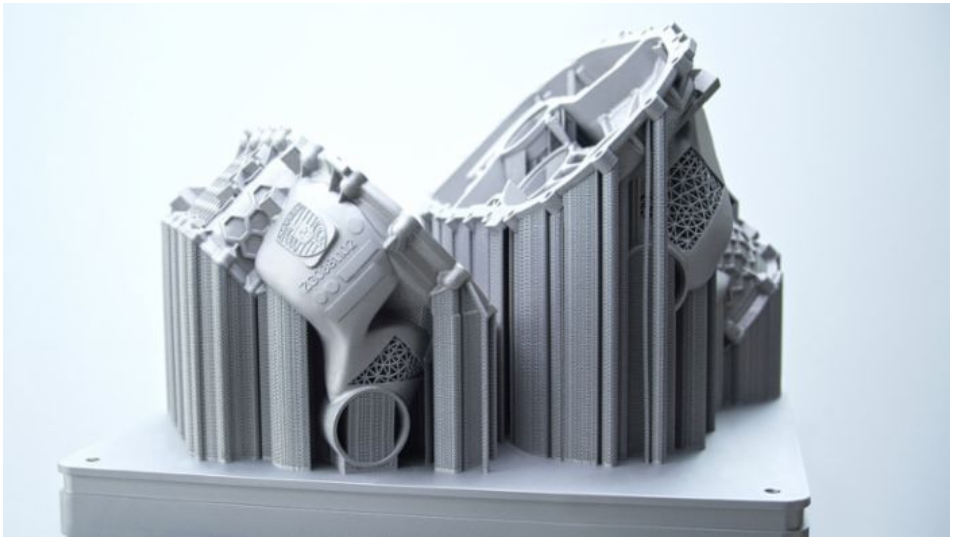
Prototype for small-series production: electric drive housing from a 3D printer

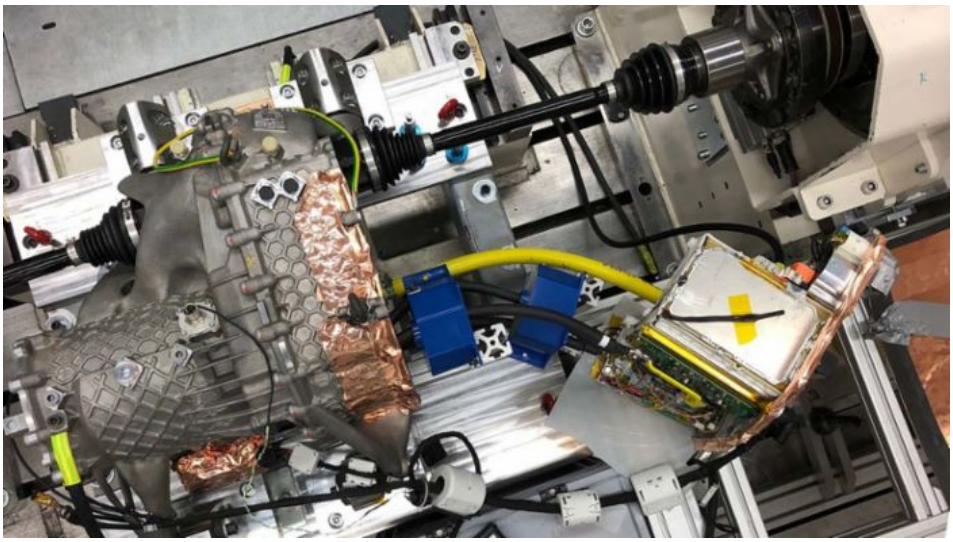
Lighter, more rigid, more compact: Porsche has produced its first complete housing for an electric drive using 3D printing.



"This proves that additive manufacturing with all its advantages is also suitable for larger and highly-stressed components in electric sports cars," says Falk Heilfort, Project Manager in the Powertrain Advance Development department at the Porsche Development Centre in Weissach. It is conceivable that the optimised electric drive could be used in a limited-edition super sports car, for example.

Prototype bundles several development steps

Engineers in the Advanced Development department were able to carry out several development steps at once with the prototype. The additively manufactured alloy housing is more lightweight than a conventionally cast part, and reduces the overall weight of the drive by approximately ten percent. Thanks to special structures that have only become possible due to 3D printing, the stiffness in highly stressed areas has nevertheless been doubled. Another advantage of additive manufacturing is the fact that numerous functions and parts can be integrated. This considerably reduces assembly work and directly benefits part quality.



3D printing opens up new opportunities in development and manufacture of low-volume parts. Porsche is intensively driving forward the use of additive manufacturing for optimisation of highly-stressed parts. A few months ago, new printed pistons successfully proved themselves in the 911 GT2 RS high-performance sports car. The housing for a complete electric drive now developed also fulfils high quality requirements. In the same housing as the electric motor, the downstream two-speed gearbox is integrated. This highly integrated approach is designed for use on the front axle of a sports car.

Designs are possible in almost any geometry

Optimisation of the electric drive started with the design integration of components such as bearings, heat exchangers and oil supply. This was followed by the computer-calculated definition of loads and interfaces. Determination of the load paths then took place on this basis. The next step in the virtual development method was optimisation of the load paths by integrating the so-called lattice structures. These structures take their cue from nature, and can also be seen in similar form in bones or plants, for example. "We were able to expand and improve our software solutions and methods for creating such parts and are now able to virtually implement them in a very short space of time," says Sebastian Wachter, Specialist in Design Methodology and Topology Optimisation in the Powertrain Advance Development department. When combined with artificial intelligence, interesting approaches for optimising development methods arise here for the future.

3D printing has specific design requirements

The weight of the housing parts was reduced by approximately 40 percent due to the integration of functions and optimisation of the topology. This represents a weight savings of around ten percent for the entire drive due to the lightweight construction. The stiffness was increased significantly at the same time. Despite a continuous wall thickness of only 1.5 millimetres, the stiffness between the electric motor and the gearbox was increased by 100 percent due to the lattice structures. The honeycomb structure reduces the oscillations of the thin housing walls and thus considerably improves the acoustics of the drive as a whole. The integration of parts made the drive unit more compact, significantly improved the drive package, and reduced the assembly work by around 40 work steps. This is equivalent to reduction in the production time of approximately 20 minutes. An additional benefit: integration of the gearbox heat exchanger with optimised heat transmission improves the cooling of the drive as a whole. This is a basic requirement for further increases in performance.

Additive manufacturing offers great potential

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