CASE STUDY

EDAG AND NIKON SLM SOLUTIONS

HOW AN ENGINE HOOD LIGHT HINGE WAS 3D PRINTED

EDAG

Nikon SLM SOLUTIONS

A Nikon Company Nikon

EDAG

EDAG is an independent engineering services provider to the global automotive industry. The company offers complementary engineering services across its Vehicle Engineering Electrics Electronics and Production Solutions businesses Based on these extensive capabilities, EDAG can support clients across the entire value chain from the original design idea to product development and prototype construction all the way to the delivery of turkey production systems.

As a technology and innovation leader, EDAG also operates established coriters of excellence that design landmark technologies for future applications in the automotive industry lightweight construction, electric mobility, car IT, integral Safety and new production technologies.

ADDITIVE MANUFACTURING IN THE WELDING PROCESS

Stringent safety and functionality demands imposed on active hinge systems for engine hoods mean they are very complex. In the event of an accident with a pedestrian, they extend the distance between the impacting object and any hard engine components by raising the engine hood. An pyrotechnically triggered actuator kicks in within fractions of a second and raises the hood. These ge systems can be manufactured by stapping casting or forging for large-scale production series in excess of 30,000 units per annum The complex kinematics involved require many individual parts (approximately 40/components per vehicle) and high assembly and tooling costs. Active hinges made from sheet metal nowadays weigh around 1506 g each and thus generate considerable additional weight in vehicles.

However, economic constraints prevent small production runs of between 80 and 30,000 units per annum being covered ing large-scale production technologies. Furthermore, design and the lack of assembly space in the front section of sports cars generally prevent sheet-metal methods from being used for active engine hood hinges. Carry- cer strategies aiming to minimize investments for small production runs usually cause package and design problems due to the adoption of active hinges from large-scale production. The collaboration between EDAG voestalpine Additive Manufacturing and simufact engineering was thus intended to exploit the potential of additive manufacturing to solve these issues.

AM DESIGN OPTOMIZED FOR IMPROVED PERFORMANCE

From the beginning, the requirements for the hood hinge were very high, needing to meet the requirements of strength and rigidity with the largest possible weight savings. In addition, functional integration and the associated reduction in the number of parts was important.

First a topology optimization took place - involved calculating minimum material requirements based on actual loads. The resulting complex geometries are usually only possible through laser beam melting with considerable support structures. For the LightHinge+, the share of support structures to be subsequently removed would have comprised around 50% of the total melted material volume.

In the course of the collaboration, this share could be removed in several iterations, to initially 30% and finally to under 18%. In other words eliminating most of the processing steps and achieving considerable material efficiency.

Despite the extensive structural changes vis-à-vis topology optimization for reducing post- processing, the final result successfully achieved weight savings of 52% compared with the reference sheet metal construction, thanks to applying bionic principles.

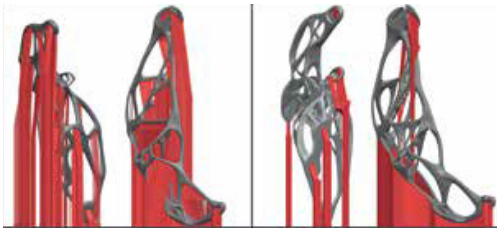

Fig. 2
Minimization of the support structures with more than 50% (left) and less than 30% of the material volume © EDAG

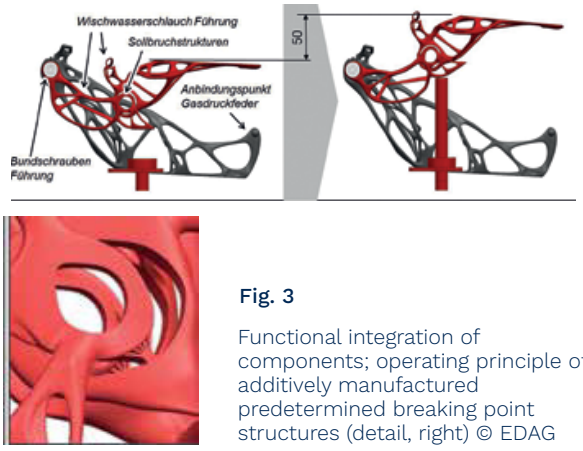

Fig. 3
Functional integration of components; operating principle of additively manufactured predetermined breaking point structures (detail, right) © EDAG

FUNCTIONAL INTEGRATION

The hinge also comes complete with an automatic hood function. The geometric freedoms of AM allowed EDAG engineers to develop complex, predetermined breaking point structures. Furthermore, it was also possible to integrate the connection point for the gas pressure spring and the mounts for the wash-wiper tubing and collar screw into the hinge. This functional integration reduces the number of parts by 68% compared to the sheet-metal reference part, eliminating much of the assembly's original weight. This integrated hinge function can be deployed in significantly more compact spaces in sports cars or other high-performance vehicles.

ENGINE HOOD LIGHT HINGE OPTIMIZED WITH ADDITIVE MANUFACTURING

- Stringent safety demands and a complex design reduction of weight despite functional integration
- Part development follows a holistic approach considering the entire process chain of additive manufacturing
- Minimization of the support structures lead to a reduction of material and post-production processes.

NIKON SLM SOLUTIONS

Nikon SLM Solutions is a global provider of integrated metal additive manufacturing solutions. Leading the industry since its inception, it continues to drive the future of metal AM in every major industry with its customers' long-term success at its core. Nikon SLM Solutions is home to the world's fastest metal additive manufacturing machines boasting up to 12 lasers and enabling build rates of <1000ccm/h. With a portfolio of systems to suit every customer's needs, along with its team of experts closely collaborating at every stage of the process, Nikon SLM Solutions leads the way on return on investment with maximum efficiency, productivity, and profitability. Nikon SLM Solutions believes that additive manufacturing is the future of manufacturing and has the desire and capability to take its customers there – right now.

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