

3-D laser sintering technology creates possibility of significant weight savings in aircraft fabrication

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More than 50 percent weight savings in aircraft construction is now possible using hypermodern production techniques. A process called 3-D laser sintering of the raw material permits a completely new kind of fabrication. This process can reduce aircraft component part counts and improve designs, leading to enormous savings in weight and volume. The only equipment for this process in Austria - and at its time the second in the world - is located at FOTEC in Wiener Neustadt. The research subsidiary of the University of Applied Sciences located there is presently optimising the monitoring and quality control of the production process, while manufacturing a fuel collector for an aircraft engine that is even around 75 percent lighter than before.

In aeronautical engineering, every kilogram counts. Reducing weight saves [kerosene](#) and makes a fleet operator more competitive. However, safety requirements and construction-related restraints place limits in the quest to drop weight. These restrictions are set to be eased now by a completely innovative kind of 3-D manufacturing process: metal [laser sintering](#).

LASER SINTERING TAKES OFF

The method is still so new that there are only a few professional production machines worldwide. One of them is located at FOTEC Forschungs- und Technologietransfer GmbH in Wiener Neustadt. Using

this machine, a laser-sintered prototype fuel collector has now been fabricated for Austrian [aircraft manufacturer](#) Diamond Aircraft Industries GmbH. According to Dr. Gerhard Pramhas, Managing Director of FOTEC, "Using laser sintering, we were able to reduce the number of components from five down to one. Along with that went a [weight reduction](#) of 77 percent. This was made possible through the unique manufacturing technique."

The raw material for laser sintering is a metallic powder. This is mechanically built up layer-by-layer to a powder base. After applying each layer, the powder is melted by a laser at specified locations. Subsequently, an additional layer of powder is applied and melted again at the pre-calculated locations. In this way, even the most complex components can be manufactured as one piece, one layer at a time. Basically, this is what is known as a rapid prototyping process, carried out in this case with metal using a laser. The responsible department head, Dr. Rolf Seemann, explains: "We are speaking of additive manufacturing in this case. It is common to create components from an amorphous raw material by accumulation. The innovative leap is the capability of processing metal. So instead of plaster or plastic prototype models, fully functional individual parts can be produced - such as a fuel collector - thanks to this material."

Until now, the part had consisted of five individual pieces produced on a lathe that subsequently were customarily welded together. The pieces are partly hollow to facilitate fuel flow. And in addition, one of the components is threaded, which requires a separate step during production. With laser sintering of metal, the entire fuel collector with galleys and threads is able to be fabricated in one step. The production accuracies are in the range of hundreds of a millimetre and, in addition to the weight, the volume of the fuel collector could be reduced by almost 60 percent.

CREATION INSTEAD OF REPLICATION

Dr. Seemann's team actually succeeded in manufacturing an exact geometrical and functional replica of the original fuel collector. "But replication is actually only something compulsory," explains Dr. Pramhas. "The real leap is creating completely new construction designs for work pieces that utilise all of the advantages of 3-D laser sintering. Because this opens up options that can never even be realised for metallic work pieces using traditional manufacturing methods such as milling, turning and drilling. A simple example of this is a drill hole that previously could only run straight, but can now be led around a corner with any arc you want."

Although the facility at FOTEC is actually suited to industrial fabrication, the present focus of activity is directed elsewhere, as Dr. Pramhas explains: "The quality of the process strongly depends upon the optimal laser melting process. To control this, we would like to develop an optical technique that operates during the production process. In the next stage of development, optical monitoring will provide direct information to an adaptive control [process](#) so that the quality of the work pieces remains just as high for larger production runs." Although metal sintering with lasers is more suited for production of single pieces, production can easily be increased to several hundred per year. Certainly a sufficient number for aircraft constructions, in which laser sintering of metal could play a greater role in the future.

More information: A video about 3-D laser sintering at FOTEC can be viewed here (in German only):

www.wntv.at/hd/?module=player&id=6933

Provided by FOTEC

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