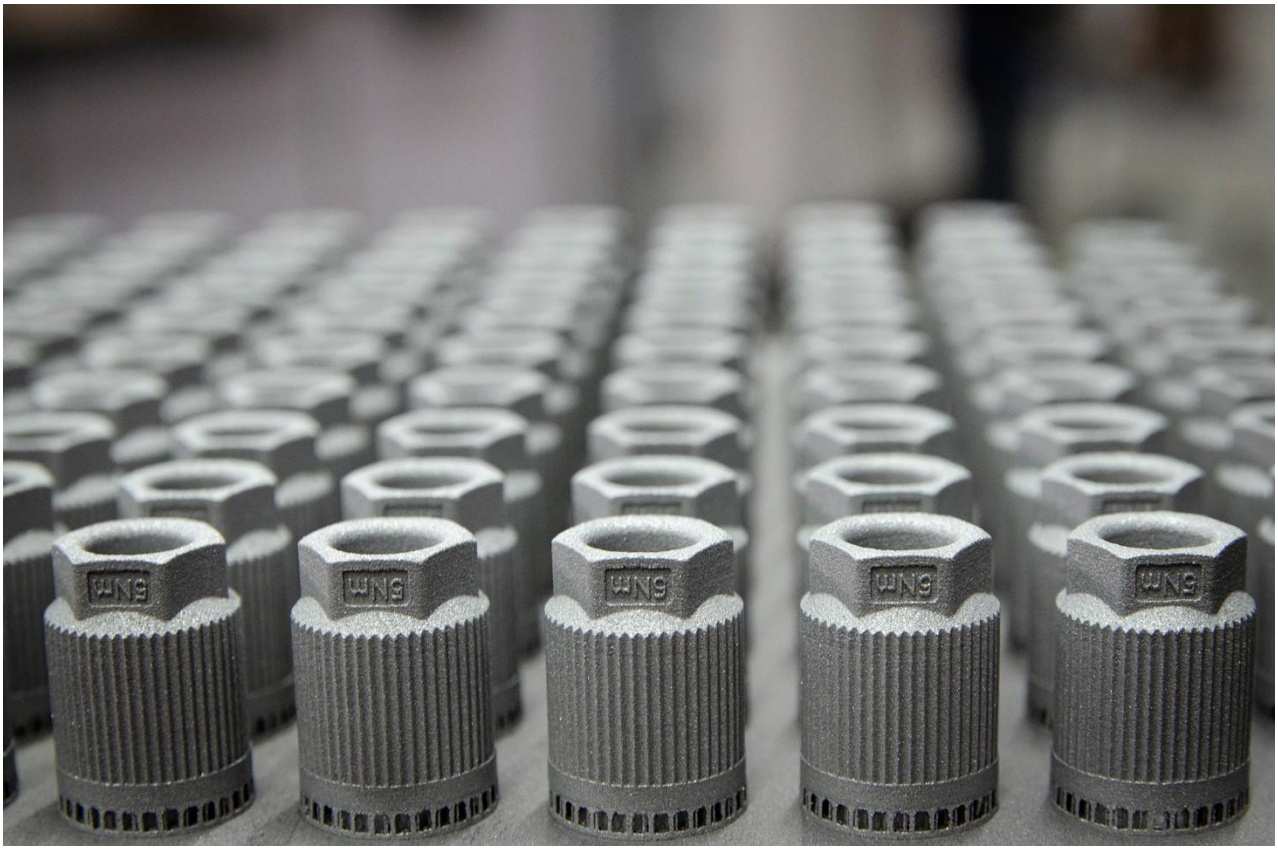
# Printing instead of casting?
# 3D printing as an alternative to zinc die casting

(A technical article from 2023, author: Mona Ohms, Protiq GmbH, Blomberg)

The production of zinc prototypes used to take a lot of time and money.
However, this problem can now be solved with the help of additive manufacturing: Thanks to a process developed by PROTIQ, components made of Zamak 5 can now be 3D printed.



Additive manufactured small series made of Zamak 5.

Components made from the zinc alloy Zamak 5 are widely used in industry.
The areas of application for this standard material range from car components and connectors to fittings in the window and furniture industry. With zinc die casting, such components can be produced economically in large quantities. Molten metal is pressed at high pressure into a previously produced steel mold. This master mold, the tool, determines the geometry of the components and also represents the greatest financial outlay in production. The tool costs are normally allocated to the planned number of units; for large quantities, the proportion is usually only a few cents - but for small batches, the tool becomes a problematic cost factor.

Even minimal changes to the geometry require adaptation or even the production of a new tool. For this reason, prototype tools are only used in component development when the final component geometry has already been largely determined. However, this means that functional prototypes made from Zamak 5 are only available so late that changes can hardly be made. In times of ever shorter product life cycles and shorter development times, this represents a major challenge for companies in a competitive market. Additive manufacturing can help here.

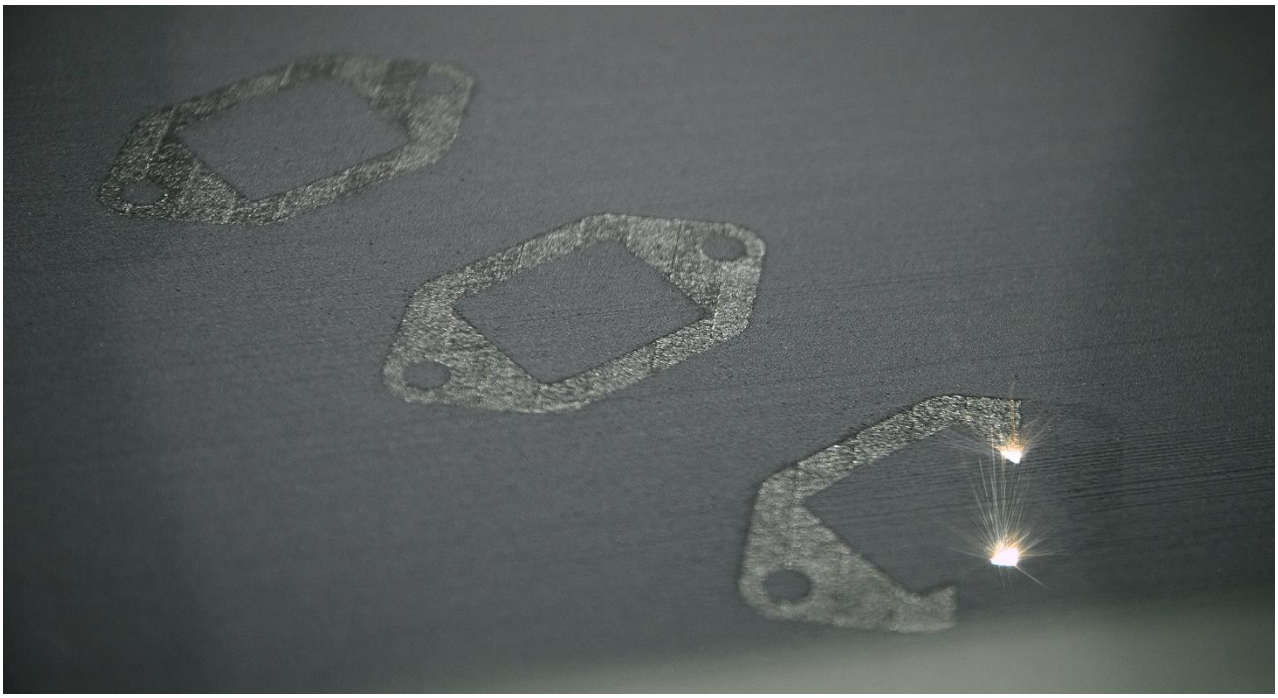
## 3D printing as an innovative manufacturing process

Since the invention of 3D printing in the 1980s, the technology has developed rapidly. The first 3D printers worked with a UV laser and a photopolymer resin that hardened due to the UV rays. The components created in this way were primarily suitable as visual samples and prototypes. In the meantime, a number of new 3D printing processes have been established, such as selective laser melting or laser sintering, which also enable the production of series components. Then as now, the components are built up layer by layer across all processes. The processes can even be used to efficiently produce highly complex geometries, such as elaborate free-form surfaces or internal structures.

The wealth of 3D printing processes now available also allows an ever-increasing bandwidth of materials to be processed.

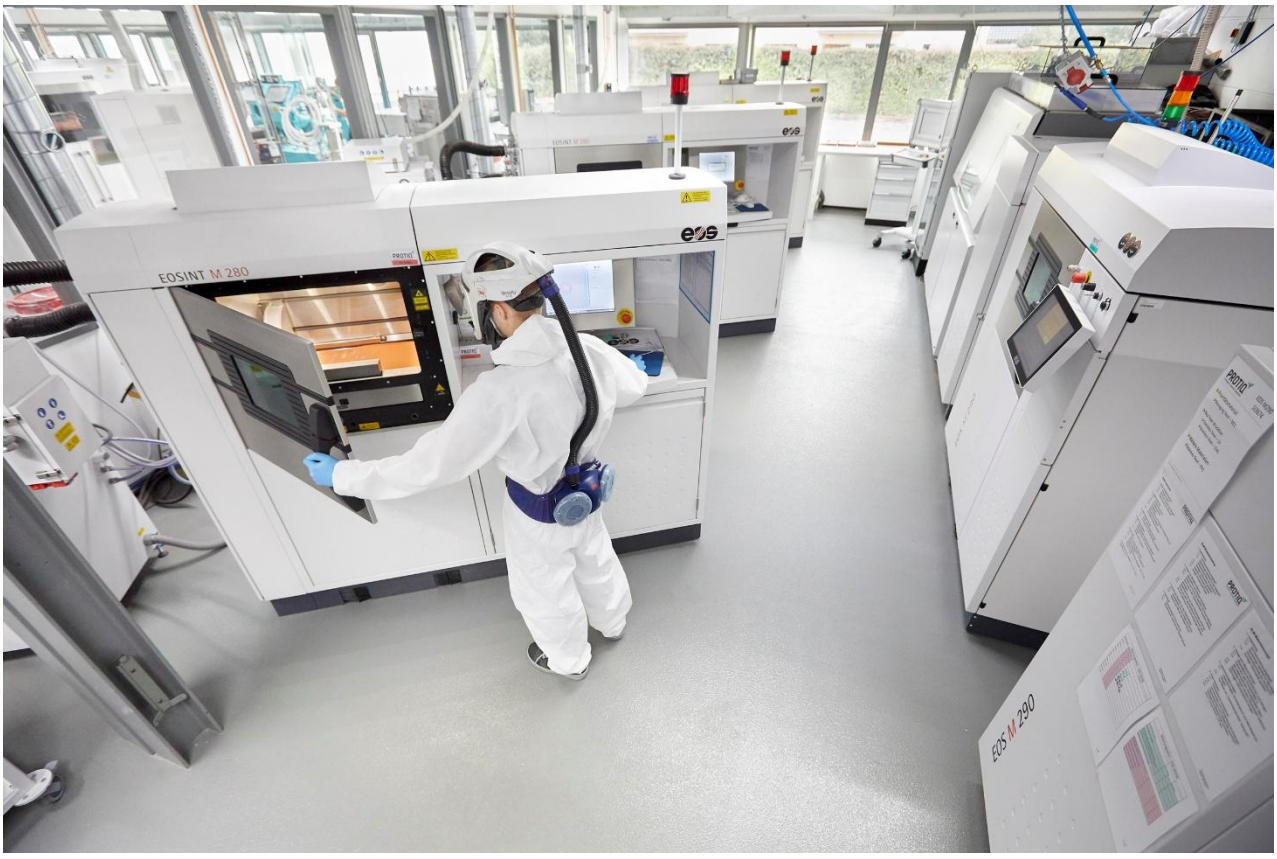
## Zinc components without expensive tools

In order to increase freedom in the product development of zinc components, PROTIQ GmbH is the world's first 3D printing service provider to develop a process for the additive processing of the series material Zamak 5. Selective laser melting is used for this purpose: In the first step of this process, a thin layer of metal powder is applied to a build platform. A laser melts the metal powder at the coordinates specified by a CAD file, after which the building platform is lowered and another layer of powder is applied. This creates a metal object layer by layer, which only needs to be freed of excess powder and support structures and removed from the building platform at the end of the production process.



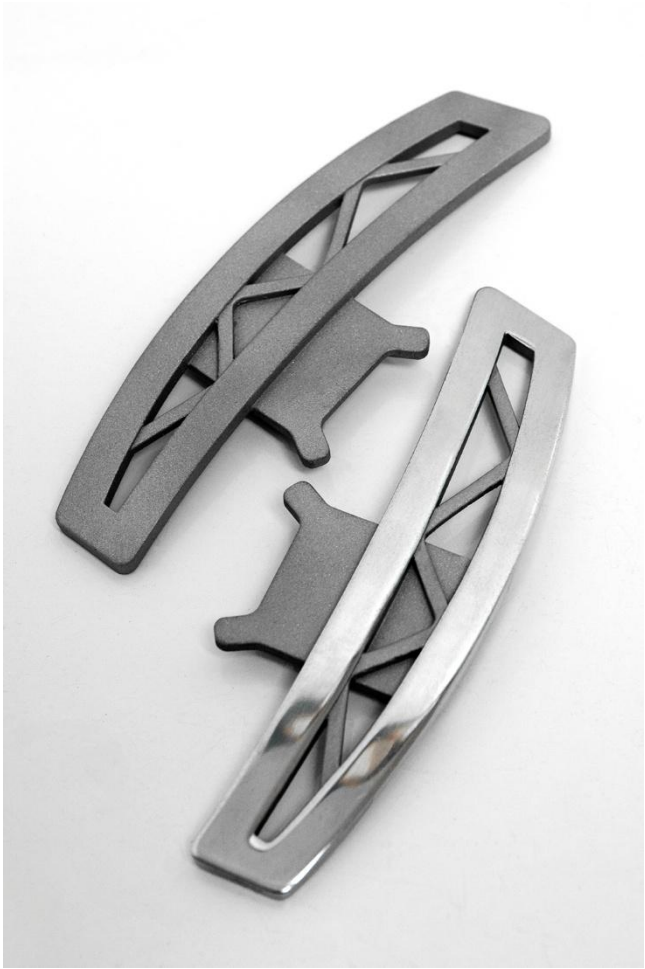
A view of the installation space during selective laser melting.

With the help of this additive manufacturing process, it is possible to overcome the high time and cost requirements of zinc die casting when producing small quantities. Prototypes and small batches can now be produced at the lowest possible component price. This type of production is a world first, but the material remains the tried and tested one. The material Zamak 5 has an elongation at break of 2 ± 0.5 percent and a modulus of elasticity of 70 ± 10 GPa. The accuracy is ± 0.1 millimeters and the minimum wall thickness is 0.4 millimeters. The tensile strength value is 218 ± 40 MPa, while the component density is greater than 95 percent.



After the production process, the components are freed from excess powder and removed from the system.

By using additive manufacturing, functional prototypes can be produced from Zamak 5 with the properties of the subsequent series component at an early stage of product development. No additional tools are required for this, as production is carried out directly from the CAD data.
After polishing, the additively manufactured workpieces can be electroplated as usual to achieve an elegant, high-gloss chrome look.

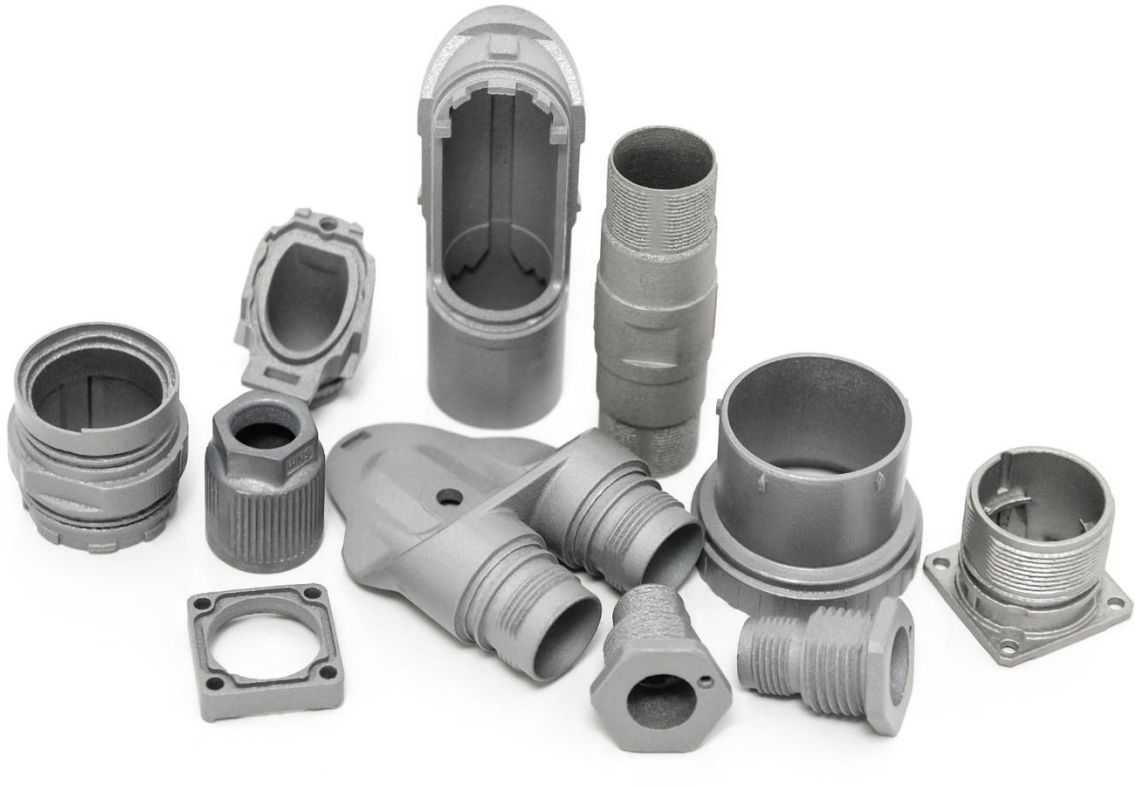


3D-printed shift paddles made of zinc, unfinished and polished.

In contrast to zinc die casting, which only pays off from very large quantities, 3D printing enables the economical production of individual items and small series, so-called low-runners. Thanks to additive manufacturing, product development, the start of series production and the supply of spare parts also pay off for small quantities.

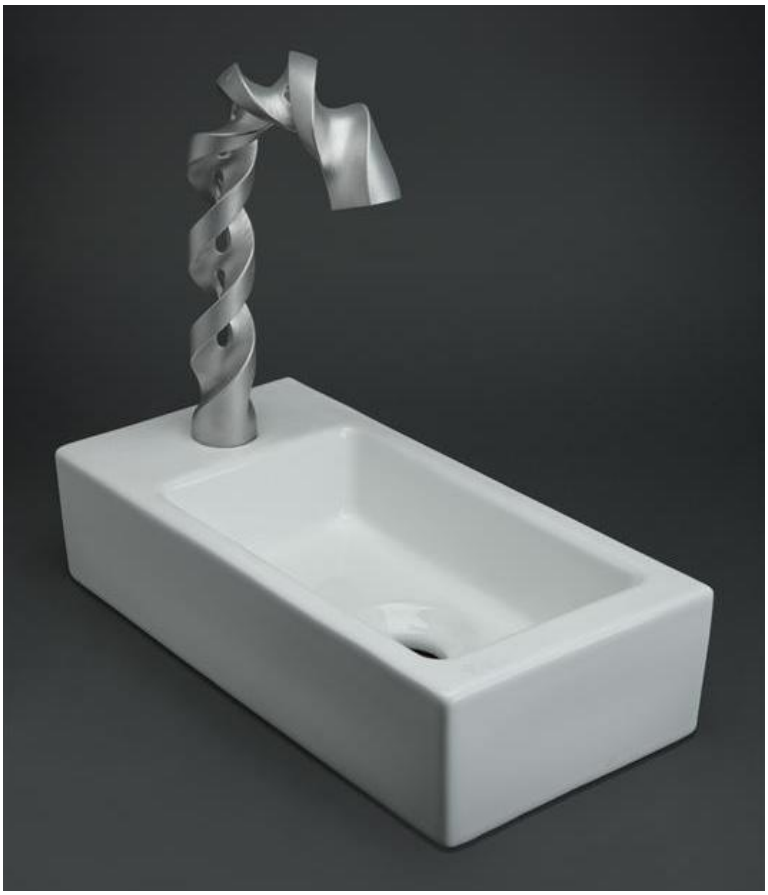
## New design possibilities

In contrast to zinc die casting, almost any conceivable geometry can be created using the layered structure in additive manufacturing. Restrictions due to material accumulations, parting planes or ejectors are no longer an issue. Small and intricate components in particular can be brought to market within a day or produced in series using selective laser melting. Another interesting feature is the ability to simultaneously produce any number of different geometries on one system.
geometries on one system at the same time.



A wide variety of component geometries can be manufactured in a single process run

Print-on-demand allows products to be produced immediately after the order is received. In this way, the customer saves on storage costs and logistics costs are reduced to a minimum.
Such business models have already become established in the paper printing sector: The customer orders their book online and automatically triggers the printing process. The product is then sent to them the next day, hot off the press. The new additive manufacturing technology for zinc components is now also opening up this business area for the production of industrial components. If the advantage of immediate, fast production is also combined with the new freedom of geometry, there is the opportunity to produce customized components in series: "Complexity for free" is the keyword. With additive manufacturing technology, product variants or labeling, for example, can be freely defined and implemented without great effort.



Additive manufacturing opens up completely new possibilities for design

## Key differences between zinc die casting and additive manufacturing

One of the most fundamental differences between zinc die casting and the additive manufacturing of zinc components has already been mentioned several times: While a tool is required for casting, a 3D file is sufficient for printing. This also means that additive manufacturing can generally start more quickly and is also much more flexible, as no preparatory steps are necessary apart from creating the model: As soon as the data is available, production can begin.

The surface of additively manufactured components is generally rougher than that of cast parts, but can be reworked after the printing process. In most cases, however, the subsequent assembly of more complex geometries is no longer necessary, as internal components and structures can also be produced directly in the additive process.

When it comes to large series, the unit price of additive manufacturing is not reduced to the same extent as that of zinc die casting. For this reason, additive manufacturing is particularly suitable for small series, prototypes, individualized products and low-runners, while zinc die casting remains the more economical solution for large series. Additive manufacturing of Zamak 5 components is therefore a good addition to existing processes and is not intended to completely replace zinc die casting.

## The PROTIQ platform

PROTIQ provides its customers with an end-to-end digital online platform so that the speed of the additive manufacturing process is not delayed by the conventional ordering process. Customers upload their individual component to the platform as a three-dimensional model and immediately receive information on manufacturing costs and delivery times. An official quotation can be created and the order placed within a few minutes. A quality check of the supplied data takes place automatically during the upload.

Minor errors are automatically corrected by a repair algorithm to prevent unsuitable data from being printed in the first step.

In addition to the printing service, PROTIQ also offers several free online configurators on its website, which can be used to quickly and easily generate 3D data, for example of gears or inductors. There is also an engineering service that supports the creation of individual CAD data, as well as numerous finishing and quality assurance options.

In addition to the production of prototypes, PROTIQ can also manufacture small and medium-sized series to the highest quality standards. Certification in accordance with DIN ISO 9001 and as an additive manufacturer in accordance with the PPP 11001:2018 standards by TÜV Süd ensures high standards.

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