First-time processing of the zinc die-cast series material Zamak in additive manufacturing

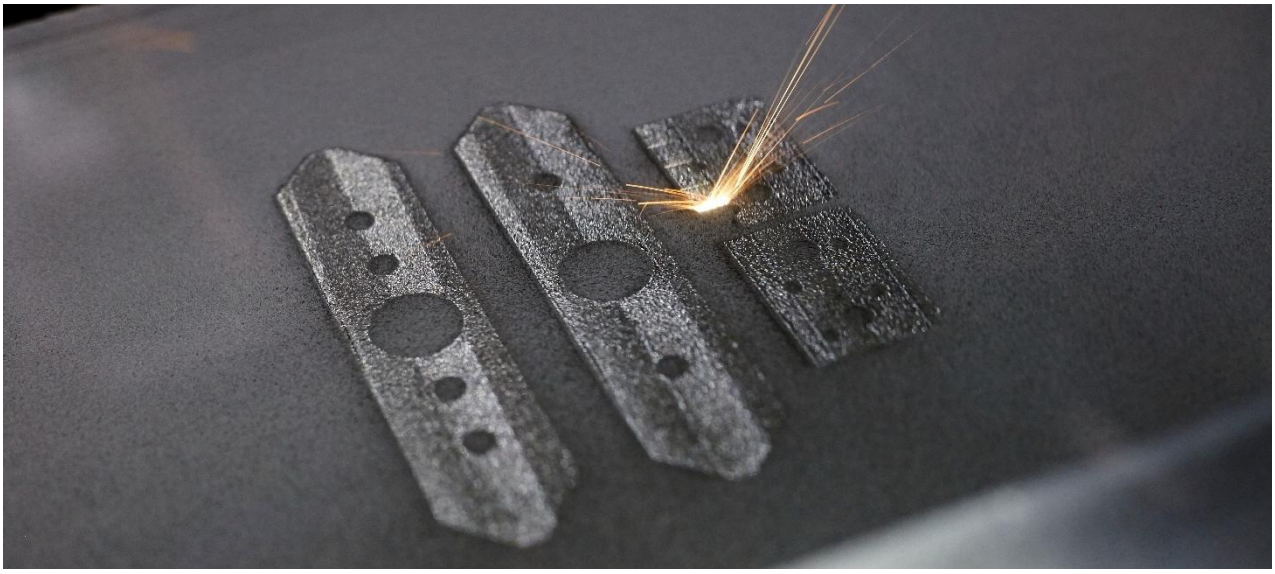
(A technical article from 2019, author: Max Wissing, Development Engineer, Johannes Lohn, Head of Development PROTIQ GmbH)

The production of prototypes using zinc die casting costs a lot of time and money. Protiq GmbH shows that it can be done differently.
Thanks to an innovative new process, zinc components can now also be produced from the Zamak 5 series material using the 3D printing process.

The range of materials for additive manufacturing is constantly expanded; as a service provider for industrial 3D printing Protiq now offers the series material from the Zamak 5 zinc die casting

For several years, 3D printing – also known as additive manufacturing – has been driving diverse innovations in numerous areas of industrial production. As the duration from design in the CAD program to the finished component is reduced, development times and time-to-market can also be shortened. Additionally, newfound design freedoms enable the economical production of components that could not previously be produced using conventional methods. The resulting potentials are utilized by Protiq GmbH, among other things, for the additive manufacturing of prototypes and series components in zinc die-casting series material Zamak.

Since the invention of 3D printing in the 1980s, the technology has developed rapidly. The first 3D printers used a UV laser and a photopolymer resin cured by UV rays. The resulting components were primarily suitable as demonstration models and prototypes. Since then, a variety of new 3D printing processes have become established – for example, selective laser melting or laser sintering – that allow the production of series components. Then, as now, the components are built up layer by layer across multiple processes. These processes allow even highly complex geometries – such as complex freeform surfaces or internal structures – to be produced efficiently. The wide range of available 3D printing processes also allows the processing of a wide range of materials. As a service provider for industrial 3D printing, Protiq uses numerous engineering plastics and metallic materials in additive manufacturing. Founded in 2016 as part of the Phoenix Contact Group, the company has since been characterized by high production quality and short delivery times



The process developed by Protiq for processing the zinc material Zamak using a selective laser melting process allows the production of prototypes and series components from series material.

Unnecessary restriction of the development process

A special feature is the process developed by Protiq for additive processing of the series material Zamak 5.
This zinc alloy, containing aluminum, copper, and small amounts of magnesium, is widely used in the zinc die-casting process and has established itself as a standard material in the industry. In this production process, the molten metal is pressed into a prefabricated steel mold – the tool – at high speed and under high pressure. This tool defines the geometry of the component as the molten metal solidifies. Depending on the component size, between a few hundred and over a thousand components can be produced per hour.

In this context, tool manufacturing proves to be a significant cost driver and can quickly add up to five- to six-figure sums.
This generates high costs, particularly during the development phase of new products, before the final component geometry is determined.
Even minimal changes to the geometry require adjustment or even the production of a new tool.
Therefore, the use of prototype tools is resorted to relatively late in component development, when the final component geometry has already been largely defined. As a result, functional prototypes made from series material are only available late, so that hardly any changes can be made.
This unnecessarily restricts the development process.
In times of ever shorter product life cycles and development times, the situation described above presents a major challenge for companies in a competitive market.

Fast availability within a few days

These limitations can be overcome with the process developed by Protiq for additive processing of the series material Zamak. Functional prototypes with the properties of the later series component can be produced using 3D printing right from the start of component development – without the need for expensive tooling. The additively manufactured component surfaces are, as usual, easily electroplated, for example, for a sophisticated, high-gloss chrome finish. Here, Protiq collaborated with HDO Druckguß- und Oberflächentechnik GmbH from Paderborn, an expert in electroplating surface finishing with the highest quality standards, right from the early stages of process development.

Additively manufactured components with subsequent chrome surface coating; component design and electroplating surface finishing by HDO Druckguß- und Oberflächentechnik GmbH

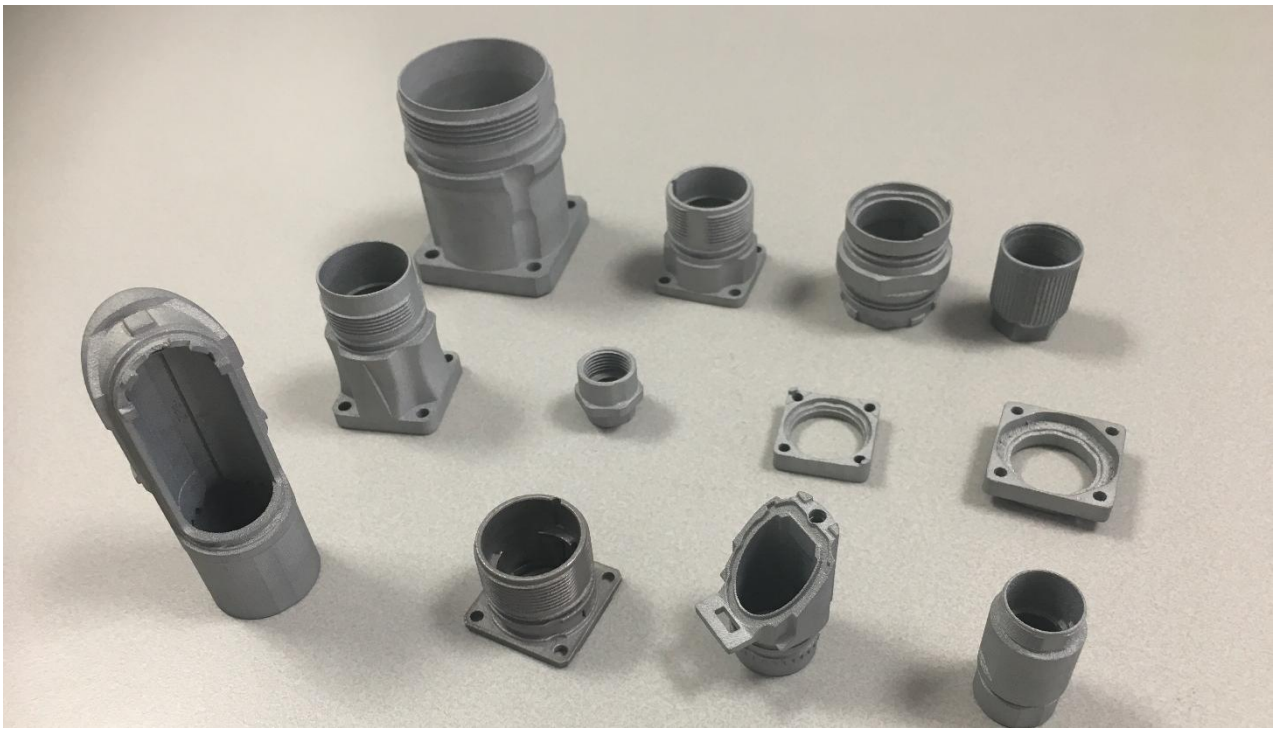
Thanks to Protiq's efficient processes, ordered components are available to developers within a few days. Developers no longer have to wait several weeks for the tool to be manufactured, as was previously the case. This saves valuable time and enables developers to conduct early component testing. Having functional prototypes for every component change creates greater flexibility and significant added value in component development.

Direct printing of small and medium-sized series

In addition to producing prototypes during the development phase, additive manufacturing in Zamak also offers the potential to print series components directly and without the need for tools. Due to the high tooling costs, zinc die-casting components had to be produced conventionally in very large quantities to keep the component price low. Typically, zinc die-casting tools are designed for quantities ranging from several hundred thousand to several million components. However, it is also possible for components to be produced in significantly smaller quantities using zinc die-casting. This occurs when a few special shapes of a series item need to be produced in large quantities.

For these so-called low-runners, the production of an expensive tool can quickly become uneconomical. If the item is manufactured using additive manufacturing processes at Protiq, the high tooling costs can be saved.

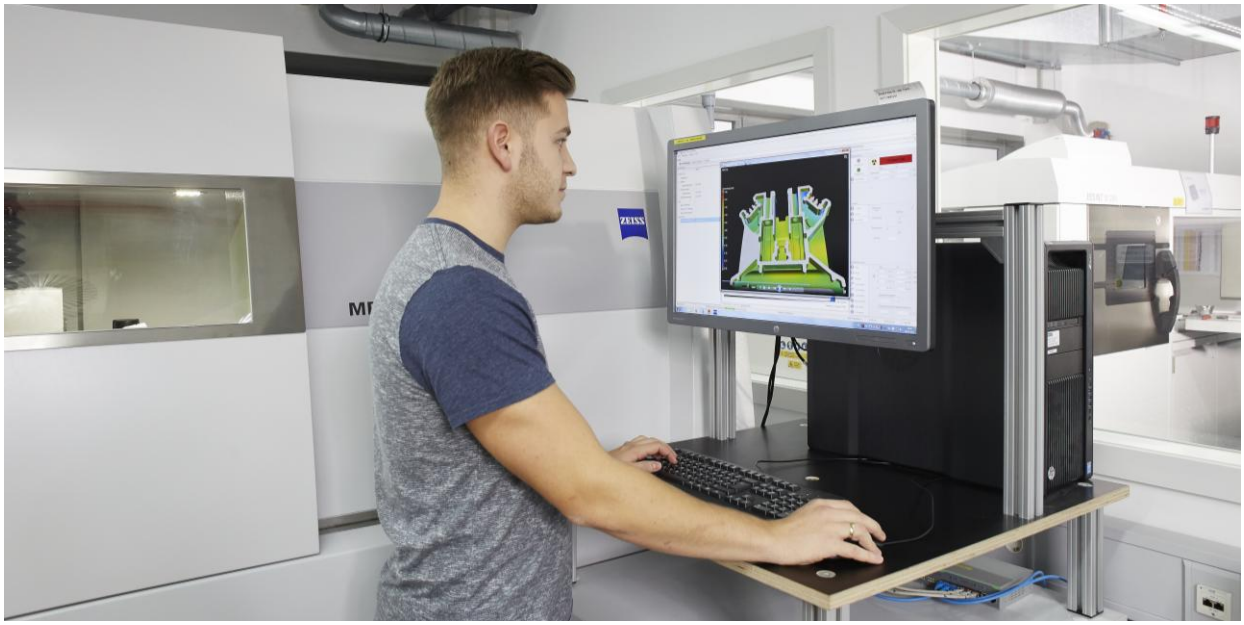
Additional potential arises for spare parts that are rarely requested but for which long-term supplier commitments exist. Old tools generate high storage costs in these cases. When such tools become damaged and require extensive rework or repair, 3D printing on demand becomes worthwhile. Protiq thus offers the ideal conditions for producing small and medium-sized series to the highest quality standards, in addition to producing prototypes. The company's certifications according to DIN ISO 9001 and as an Additive Manufacturer – in accordance with the PPP 11001:2018 standards from TÜV Süd – naturally ensure the highest quality standards.



Thanks to its DIN ISO 9001 certification and TÜV Süd certification as an additive manufacturer, Protiq GmbH is ideally prepared for series production.

Fully digitalized ordering process

To avoid slowing down the speed of the additive manufacturing process due to the conventional ordering process, Protiq provides its customers with a fully digital online platform. Customers upload their customized component as a three-dimensional model to the platform and immediately receive information about manufacturing costs and delivery times. Within minutes, an official quote can be created and the order placed with Protiq. During the upload process, a quality control check of the submitted data is automatically performed. Minor errors can be automatically corrected using a repair algorithm.



The uploaded components, displayed in a 3D preview, can be intuitively configured according to the desired material and quantity. For special requirements, additional quality assurance measures can be selected and added, such as the production of tensile specimens or a CT scan of the component including a measurement report. Here, too, the customer is constantly informed about the changing, quantity-dependent price and can then place the order directly online.