PROTIQ
A Phoenix Contact Company

First-Ever Processing
of the Zinc Die-Casting Series Material Zamak in Additive Manufacturing

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

Producing prototypes by zinc die casting costs a great deal of time and money. Protiq GmbH shows that there is another way. Thanks to an innovative new process, zinc components made from the series material Zamak 5 can now also be produced by 3D printing.

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

For several years now, 3D printing – also known as additive manufacturing – has been driving a wide range of innovations in numerous areas of industrial production. Because the time from design in the CAD program to the finished component is shortened, development times and time-to-market can be reduced as well. In addition, newly gained design freedom makes it possible to economically produce components that previously could not be manufactured conventionally. Protiq GmbH uses the resulting potential for purposes including the additive manufacturing of prototypes and series components in the zinc die-casting series material Zamak.

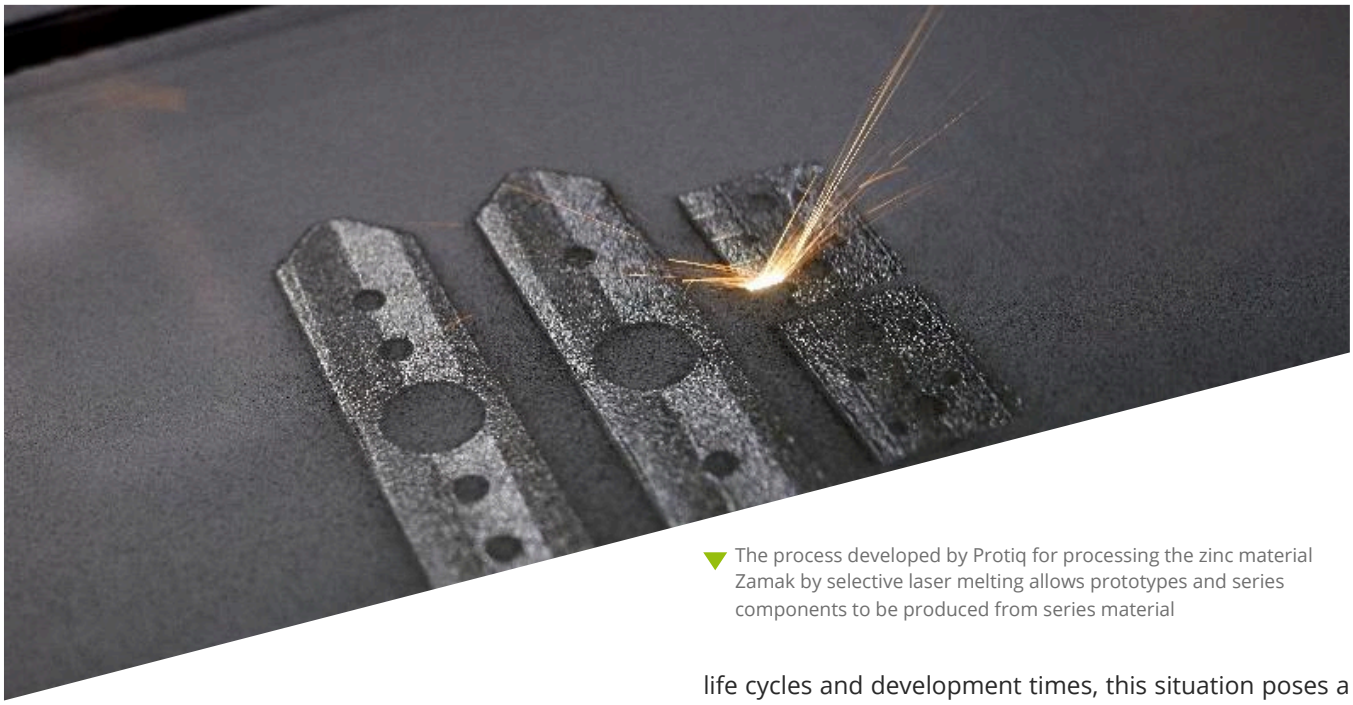
Since 3D printing was invented in the 1980s, the technology has advanced rapidly. The first 3D printers worked with a UV laser and a photopolymer resin that cured under the UV radiation. The components produced in this way were mainly suitable as visual models and prototypes. In the meantime, a large number of new 3D printing processes have become established – for example selective laser melting or laser sintering – that allow series components to be produced. Then as now, the components are built up layer by layer, regardless of the process. These processes make it possible to efficiently produce even highly complex geometries – such as elaborate freeform surfaces or internal structures. Furthermore, the wealth of available 3D printing processes allows a wide range of materials to be processed.

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 distinguished by high production quality and short delivery times.

Unnecessary Constraints on the Development Process

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

In this context, manufacturing the tool proves to be a major cost driver and can quickly amount to five- to six-figure sums. This generates high costs, particularly in



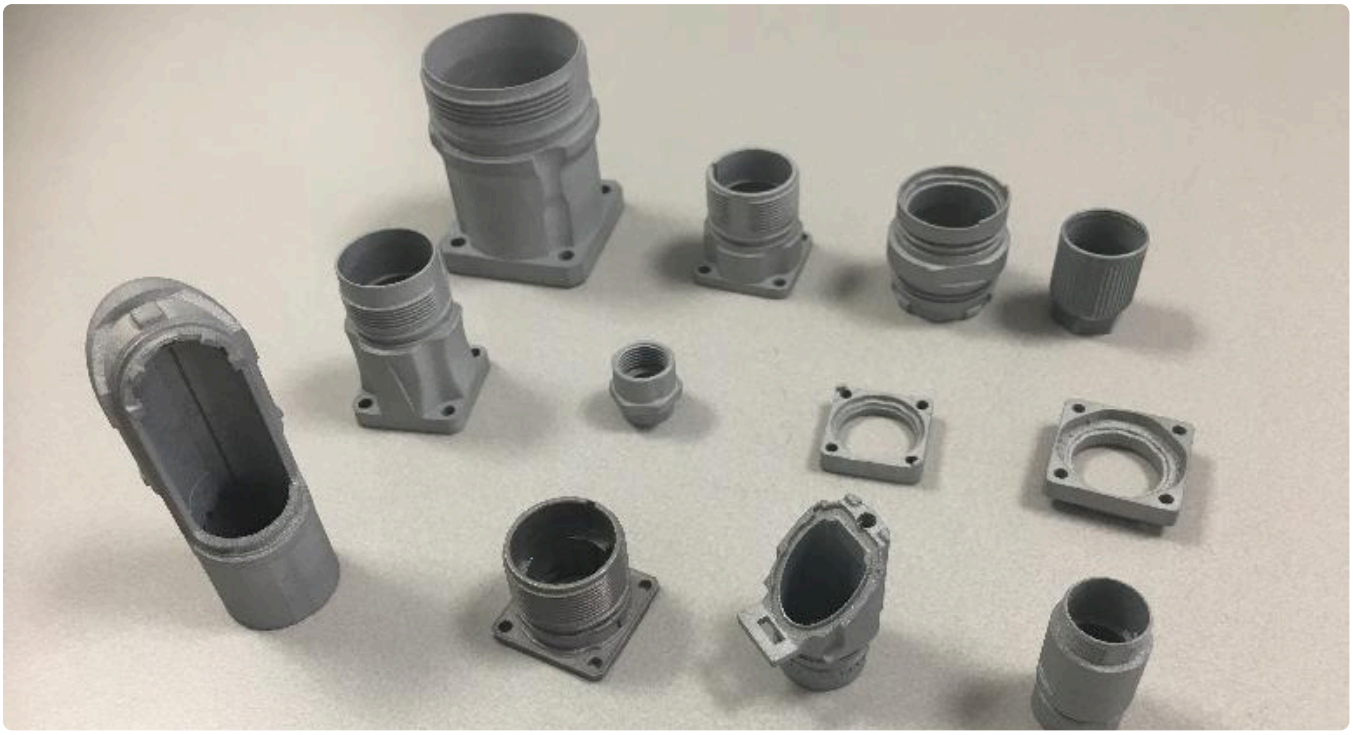
The process developed by Protiq for processing the zinc material Zamak by selective laser melting allows prototypes and series components to be produced from series material

the development phase of new products, before the final component geometry has been defined. Even minimal changes to the geometry require the tool to be modified or even a new tool to be manufactured. For this reason, prototype tools are used comparatively late in component development, when the final component geometry has already been largely defined. As a result, functional prototypes made from the series material are not available until late, by which time hardly any changes can be made. This constrains the development process unnecessarily. In times of ever shorter product life cycles and development times, this situation poses a major challenge for companies in a competitive market.

Fast Availability Within a Few Days

The process designed by Protiq for the additive processing of the series material Zamak makes it possible to overcome these constraints. Right from the start of component development, functional prototypes with the properties of the later series component can be produced by 3D printing – and without the need for expensive tools. As usual, the additively manufactured component surfaces can be readily electroplated, for example for an elegant, high-gloss chrome finish. Protiq cooper-

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



Thanks to the certification obtained in accordance with DIN ISO 9001, Protiq GmbH is ideally prepared for series production

ated on this early in process development with HDO Druckguß- und Oberflächentechnik GmbH from Paderborn, an expert in electroplated surface finishing with the highest quality standards.

Thanks to Protiq's efficient workflows, the ordered components are available to the developer within a few days. So, unlike before, the developer no longer has to wait several weeks for the tool to be manufactured. This saves valuable time and enables developers to test components early. Because functional prototypes are available for every component change made, greater flexibility and significant added value are created in component development.

Direct Printing of Small and Medium-Sized Series

In addition to producing prototypes in the development phase, additive manufacturing in Zamak also offers the potential to print series components directly and without tooling. Because of the high tooling costs, components made by zinc die casting conventionally had to be produced in very large quantities in order to keep the unit price low. Zinc die-casting tools are typically designed for quantities ranging from several hundred thousand to a few million components. Nevertheless, components are sometimes also produced by zinc die casting in considerably smaller quantities. This happens when a few special variants of a series article with larger quantities need to be produced. For these so-called low-runners, producing an expensive tool can quickly become uneconomical. If the article is produced at Protiq using additive manufacturing processes, the high tooling costs can be avoided.

Additional potential arises for spare-part articles that are rarely requested but for which long-term supplier obligations exist. Here, the old tools generate high storage costs. At the latest when such tools are damaged and require extensive reworking or repair, it pays to manufacture the articles by 3D printing – on demand. Protiq therefore offers the best conditions for producing not only prototypes but also small and medium-sized series to the highest quality standards. The certification obtained in accordance with DIN ISO 9001 naturally ensures that the high quality standards are met.

Fully Digitalized Ordering Process

To prevent the speed of the additive manufacturing process from being slowed down by the conventional ordering process, Protiq provides its customers with a fully digital online platform. Customers upload their individual component as a three-dimensional model to the platform and immediately receive information on manufacturing costs and delivery times. Within a few minutes, an official quotation can then be generated and the order placed with Protiq.

The uploaded components, which are displayed in a 3D preview, can be configured intuitively by the desired material and quantity. In addition, for special requirements, further quality assurance measures can be selected and added, for example the production of tensile test 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.