PROTIQ
A Phoenix Contact Company



MATERIAL EXPERTISE

ZAMAK 5 IN 3D PRINTING

Prototypes, small series and spare parts
in the zinc die-casting material – without tooling

Pioneer
first 3D printing service provider worldwide with Zamak 5

Batch size 1
cost-effective, without a die-casting tool

218 MPa
tensile strength (± 40 MPa, as built)

2022
awarded for “Intelligent Manufacturing”

PRINTING INSTEAD OF CASTING

Zamak 5 is the standard material in zinc die casting. As the first 3D printing service provider worldwide, PROTIQ has developed a process for processing Zamak 5 by selective laser melting (SLM).

In zinc die casting, molten metal is pressed into a steel mold under high pressure. This tool is the largest cost factor, and every change in geometry requires a new or modified tool. Prototypes in the series material are therefore usually only made once the geometry is largely fixed – when changes are hardly possible any more. In 3D printing, by contrast, parts are produced directly from CAD data, without tooling and within a few working days.



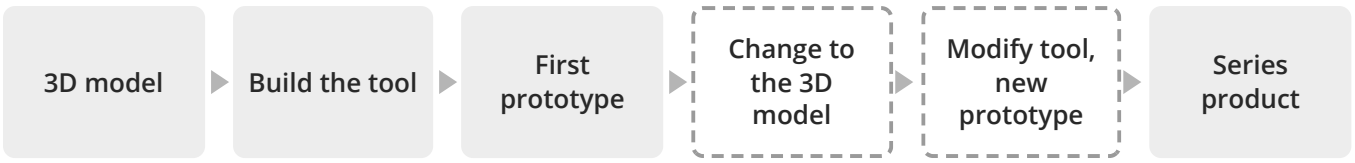
YOUR BENEFITS

- **No die-casting tool:** cost-effective from batch size 1
- **Test early:** functional prototypes in the series material in early development phases
- **Fast:** parts ready for delivery within a few working days
- **Design freely:** no parting lines, ejectors or draft angles
- **High-quality finishing:** can be electroplated, for example with a high-gloss chrome finish

FROM IDEA TO SERIES PRODUCT

In die casting, every development step depends on the tool. In 3D printing, a new 3D file is all it takes for each change – the next prototype arrives within a few working days.

ZINC DIE CASTING



3D PRINTING WITH ZAMAK 5



Dashed: steps that are repeated with every change.

ZINC DIE CASTING OR 3D PRINTING?

	Zinc die casting	3D printing (SLM)
Requirement	Die-casting tool (steel mold)	3D file
Start of production	Only after the tool has been built	Immediately after the order is received
Changes	Tool has to be modified	Any time in the 3D model, up to series maturity
Cost-effective for	Large series	One-offs, prototypes, small series, low-runners
Unit price	Drops sharply for large series	Does not drop to the same extent
Geometry	Parting lines, ejectors and draft angles required	Almost unrestricted, including internal structures
Surface	Smooth	Rougher, easy to post-process and can be electroplated

3D printing complements zinc die casting: for large series, die casting remains the more economical solution; for prototypes, one-offs, small series and spare parts, 3D printing is faster and more cost-effective.

THE MATERIAL ZAMAK 5

Zamak is a family of zinc alloys with aluminum, magnesium and copper. Zamak 5 contains around 4% aluminum and around 1% copper and is established as a standard material in zinc die casting.

- **Zinc**
  ensures good castability and durability.
- **Aluminum**
  increases strength and hardness.
- **Magnesium**
  improves corrosion resistance.
- **Copper**
  further increases strength.



Typical Zamak 5 parts

Zamak 5 is used wherever precise parts with good strength and a high-quality surface are required – for example in vehicle parts, connectors, fittings for windows and furniture, household appliances and electronics housings.

MATERIAL PROPERTIES

Laser-melted Zamak 5 in the “as built” condition – according to the PROTIQ material data sheet.

Mechanical

Tensile strength	**218 ± 40 MPa**
Yield strength Rp0.2	**185 ± 15 MPa**
Elongation at break	**1.5 ± 0.5%**
Young’s modulus	**28 ± 3 GPa**

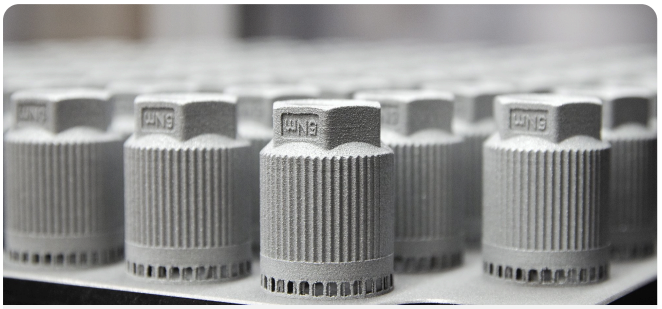
Physical

Density	**6.2–6.4 g/cm³**
Thermal conductivity	**85 W/(m·K)**
Specific heat capacity	**389 J/(kg·K)**

Manufacturing

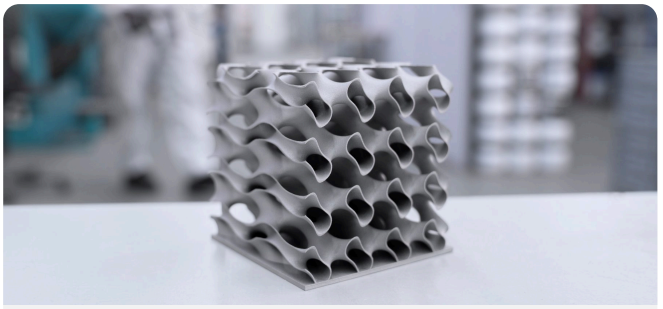
Accuracy	**± 0.7%, min. ± 0.1 mm**
Minimum wall thickness	**0.6 mm**
Roughness after sandblasting	**Ra 4–6 µm, Rz 25–35 µm**

Properties may vary depending on part geometry and environmental influences and are not guaranteed.



Surface and finishing

Printed surfaces are rougher than cast ones but are easy to post-process. After polishing, the parts can be electroplated as usual – for example for a high-gloss chrome finish.



New design freedom

Undercuts and internal geometries are created in a single production step – like the gyroid we submitted as a sample part in the 2022 competition. It cannot be produced conventionally.

ZINC IN LASER MELTING

For a long time, zinc was considered almost impossible to process by laser melting. The fact that Zamak 5 is now available in 3D printing is the result of our own material and process development.

THE CHALLENGES

- Melting point around 400 °C, boiling point around 900 °C – the powder evaporates easily
- Poor weldability
- Risk of thermal stress cracks
- Brittle, low elongation at break (below 3%)
- Highest thermal expansion among common metals: $\alpha = 30 \times 10^{-6}$ 1/K (steel ≈ 16, aluminum ≈ 23)

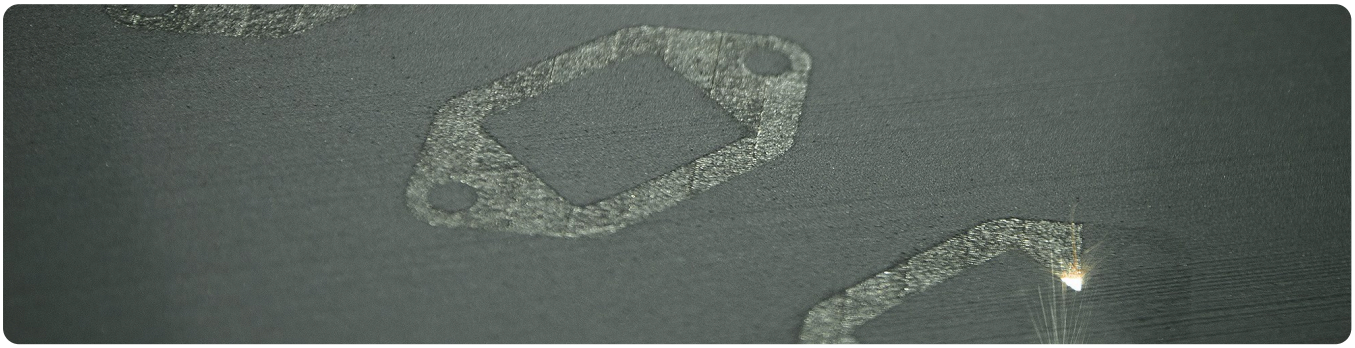
OUR QUALIFICATION PATH

- In-house powder production
- Variation of spot geometry, laser power, scan speed and hatch distance
- Variation of layer thickness
- Alternative preheating and adapted heat input
- Change of substrate material



Expertise from our own development

Our self-developed laser melting system stands for our expertise in additive manufacturing. As an open development platform – with its own software, control technology and a powder coater with a high-purity inert gas atmosphere – it gives us plenty of room to try out new materials and process parameters.



APPLICATIONS

3D-printed Zamak 5 is suitable wherever a die-casting tool does not pay off – or not yet.



Functional prototypes

Tests with the series material in early development phases – without a prototype tool.



Small series and production ramp-up

Produce one-offs, small series and low-runners cost-effectively – or bridge the time until the die-casting tool is ready.



Classic cars and spare parts

Die-cast zinc handles, emblems or trim parts are often no longer available. 3D printing produces them in the original material, and they can be chrome-plated.



Customized parts

Product variants or lettering in series – without a new tool for each variant.

YOUR ZAMAK PROJECT WITH PROTIQ

Manufactured in Blomberg, ISO 9001 certified.

2022

Awarded: “Intelligent Manufacturing”

In 2022, PROTIQ was honored at the International Zinc Die Casting Competition in Koblenz for its process for the additive processing of zinc. The jury recognized that it opens up new business areas for the zinc die-casting industry.



Request a free sample part

Find out whether Zamak 5 suits your application – free of charge and deliberately in the “as printed” condition, so you get a realistic impression of the process.

Send your request to **service@protiq.com**, subject “Zamak 5 sample part”

Upload file

Upload 3D data to protiq.com, choose Zamak 5, see price and delivery time instantly.

Discuss your project

Series, post-processing or special requests:
+49 5235 34 38 00

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