... has been known as a leading manufacturer in the machining production of plastic components for machine construction for many decades. In addition, the Dortmund-based mid-sized company has been using additive manufacturing for the construction and production of industrial-quality individual components, resilient prototypes, spare parts and small series since 2016.

65 years of experience in the machining of customised plastic solutions here, 5 years of start-up dynamics in 3D printing there: for a year now, customers have been benefiting from the partnership between Dortmund-based Murtfeldt Kunststoffe and Tübingen-based Jomatik. Both companies are united in their cross-sectoral expertise and service focus in relation to individual plastic solutions in machine construction. In doing so, tradition goes hand in hand with a focus on the future.
Additive manufacturing, which is also known under the collective term „3D printing“, now represents a whole set of additive manufacturing technologies that work in accordance with various principle and are each suitable only for extremely specific materials. The common denominator: During additive manufacturing, a three-dimensional object is created through the layering of material.

The advantages of 3D printing do not lie only in the production of challenging components and prototypes, fast delivery times, and lower planning costs; in addition, the design freedom allowed by the technology is greater than that of traditional manufacturing procedures. This means that extremely complex components with interior hollows, ducts, and various wall thicknesses can be produced, since the components basically consist of stacked 2D layers.

**EXAMPLE APPLICATION AREAS**

- Spare parts
- Virtual prototypes
- Functional prototypes
- Delicate components
- Small series
- Functional components
- Complex components with hollows and ducts
WHEN IS ADDITIVE MANUFACTURING WORTHWHILE?

Additive manufacturing is useful whenever certain requirements placed upon products cannot be met by traditional manufacturing processes.

Just one of these points might be sufficient to justify additive manufacturing. If all three points apply, other manufacturing methods are practically ruled out.

**These points are:**

**FUNCTIONAL INTEGRATION**
Additive manufacturing allows us to unite various functions in a single component – without additional assembly efforts! This enables the realization of components that are otherwise possible only as an assembly. This includes, for example, moving components, hinges, joints, and snap-fits. In the broadest sense, it also includes the integration of air ducts or other guides. The resulting advantages are diverse - from the reduced weight to easy assembly and lower warehousing costs.

**COMPLEX GEOMETRY**
Complex geometries are difficult or impossible to produce using traditional methods, since undercuts and cavities often cause problems or, at least, lead to high costs.

**INDIVIDUALIZATION**
Additive manufacturing enables the production of tailored products from an order quantity of 1 up to small series in accordance with customer requirements. Each component can be designed individually without additional costs.
THE DESIGN

The design is not subject to any limitations, or only very minor limitations, with additive manufacturing. In actual fact, it is more so the design engineer’s approach, tried and tested for conventional production, that limits ideas when designing components. There therefore needs to be a quantum shift in thinking by design engineers: components that were designed for traditional production methods need to be completely reconsidered to fully exploit the potential of 3D printing. After all, the potential of additive manufacturing can really be maximised first and foremost through clever designs.

DESIGNING FOR 3D PRINTING

The Murtfeldt Kunststoffe team can help you with the planning and formatting of your 3D print data for additive manufacturing or can take on the entire design of the printable CAD data that you require.

Optimization

To fully exploit the potential of additive manufacturing, components that were designed for traditional production methods must be completely reconsidered. We can help you to discover the potential of your designs – from weight savings with the help of bionic designs, for example, to the integral design of multiple components in a single part and the design of typical plastic construction elements such as hinges and snap-fits.

Design

Do you want to turn an idea into reality, but do not have your own design department or lack other vital aspects? We can cover the entire product creation cycle - from the idea to the finished component. Whether you require an expert to help with your design process or a contract developer, we have what your project needs.

3D SCANS AND REVERSE ENGINEERING

3D scanners

3D scanners can be used to transmit even challenging objects from the physical to the digital world. Once they’ve been digitalized, even modifications, changes, and complete reverse engineering requirements no longer pose an obstacle.

Reverse engineering

In 3D printing, components are based on a computer model. Don’t have a model? We can also work with drawings or use existing components to reconstruct the object you require.
SELECTIVE LASER SINTERING (SLS)

Selective laser sintering (SLS) involves sintering powdered plastic to create a solid component. To do this, the plastic powder is applied in layers in the construction space and is then heated by a laser in the relevant places. Similarly to in a CT scan, the component is created from lots of individual layers sintered on top of each other.

SLS production enables practically any geometry. Polyamide 12 is currently the powdered source material for SLS. Thanks to the use of a laser, SLS parts are more precise than those created using FLM production, and anisotropy does not apply. SLS components are characterized by their rough surface, which is due to the powder grain size. In addition, components produced using SLS are ideally suited to various kinds of finishing.

| Resolution | + + + + + |
| Precision  | + + + +    |
| Surface    | + + + +    |
| Complex designs | + + + + + |

**Advantages**
- Really good mechanical strengths
- High freedom of geometry
- Extensive finishing options

**Disadvantages**
- Limited material selection
- Rough surfaces of untreated components (finishing is generally required)
FUSED LAYER MODELLING (FLM)

The procedure known as fused layer modelling or fused layer manufacturing (FLM) is one of the best known additive manufacturing methods. The FLM procedure uses a computer-controlled print head to construct parts in layers from the bottom up. The source material for the process is filament of extruded plastic that the machine selectively fuses for each cross section of the desired part and applies layer by layer. Thanks to the precise control and regulation of the process, this enables the production of even complex (and sometimes hollow) components.

Support material is sometimes required here in order to bridge undercuts and overhangs. Because the filament does not become completely liquefied, the layer structure of the component can be seen. In addition, the component might behave differently in the direction of construction than within the layers, so even very fine structures might not be printable as a result. Moreover, it is sometimes difficult to achieve really narrow tolerances with this method.

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**Resolution**

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+++++
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**Precision**

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+++++
```

**Surface**

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+++++
```

**Complex designs**

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+++++
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**Advantages**

- FLM parts are extremely robust and suitable for certain functional tests
- Enables the production of parts with complex geometries
- Large material selection with corresponding range of properties

**Disadvantages**

- Low layer resolution
- Restricted design compatibility
PLASTIC SAMPLE

SUITEBLE FOR SLS METHOD

Murprint PA
GB natur
SLS

Murprint PA
Alu grau
SLS

Murprint PA
natur
SLS

SUITEBLE FOR FLM METHOD

Murprint TPU
schwarz
FLM

Murprint PA
schwarz
FLM

Murprint PA
CFK schwarz
FLM

Murprint ABS
schwarz
FLM
QUALITY MANAGEMENT
WE CHECK YOUR COMPONENTS THROUGH THE ENTIRE PRODUCT CREATION PROCESS.

**Design check**
We support you throughout the product creation process. We validate your design using functional models in repeat development and production loops. These models can be printed, checked, and adjusted quickly - to ensure the most cost-effective product development possible.

**Quality assurance**
We ensure top quality - and we’re happy for our specialist department to verify that. The corresponding processes and associated measurement methods are firmly integrated into our production processes. Measurement methods include tactile and optical systems that we use to check the dimensional accuracy of the components we produce and can use for initial sampling or reverse engineering.
FINISHING. WE CAN CARRY OUT OPTIMIZATION IN ACCORDANCE WITH YOUR SPECIFICATIONS.
ENHANCEMENTS TO FUNCTION AND GEOMETRY

INFILL
The infill refers to the quantity and structure of the material to be integrated inside the desired component. The targeted design of this inner structure is characterized by a low use of material while retaining good mechanical properties. The more infill used, the more robust and the heavier the 3D component. The infill structures can vary, and must be chosen and applied to the component in accordance with the load state. In addition to the strength, rigidity, and material savings, the anisotropy of such structures must be taken into account.

FUNCTIONAL INTEGRATION
Additive manufacturing allows you to completely rethink components. This includes giving you the freedom and ability to directly integrate mechanical functions into a component and to manufacture all required components including functional components in a single step. Here, snap-fits, hinges, and latches are just simple examples. If you focus on a high level of functional integration with the lowest possible component weight as your design objective, organic or structure-optimized models spring to mind. Thanks to additive manufacturing, complex models of this kind that could not be produced with traditional production methods or that would be extremely hard to manufacture can be achieved.

FIBRE REINFORCEMENT
To achieve greater rigidities and (tensile) strengths in a component, you can completely change or improve the mechanical properties of a standard base material by inserting a fibre-reinforced continuous filament. If particularly high forces act on a component, the component can be reinforced through the insertion of a carbon, Kevlar, or glass fibre so that the force exerted on the component is optimized. In places under a high load, fibre reinforcement can prove to be an impressive benefit that can be adjusted individually for each layer of a component.
FINISHING

VIBRATORY GRINDING
In this finishing procedure, the surface of the component is machined so that it no longer feels raw and porous. Together with abrasives (made from ceramics or plastic), the components are placed into a tub and are polished by relative movements. The surface of the components, the residual roughness, and the material abrasion can vary greatly depending on the duration of the process. This finishing technique can be effectively combined with dyeing and infiltrating.

GLASS BEAD BLASTING
In general, SLS components are blasted with glass beads to remove excess powder. Internal ducts are cleaned with compressed air.

CERAMIC BLASTING/SHOT PEENING
Components that require an improved surface density are blasted with ceramic beads. The aim is to compress - and thus strengthen – the component surface. Because this can result in discolouration, these components are then dyed in a subsequent process.

DYEING
Because SLS components are always the colour of the material and the surface is slightly rough due to the SLS process, we always recommend the dyeing of these components. This is because dirt quickly accumulates due to the surface roughness. The component then looks grubby. When components are dip-dyed, dye penetrates the component to a depth of 0.3 mm. This eliminates additional material deposit and the properties of the component are retained. A wide range of colours are available (but not RAL colours). Dyeing is easily combined with the finishing techniques of vibratory grinding and infiltration.

FILLING/PAINTING
Painting is suitable for components that need to have a particularly high-quality appearance (for example, fair exhibits). As the first step, the SLS part is filler-coated, smoothed down and cleaned. Next, the component is painted in the chosen colour (RAL colour) and dried. The choice of paint depends on the usage of the component. Depending on requirements, there are diverse possibilities such as matt, gloss, or textured. Special paints can also be applied, e.g. ESD paint for electrostatic protection.

CHEMICAL/THERMAL SMOOTHING
The smoothing process that we developed ourselves allows us to smooth SLS components so that they are 100% water-resistant and dirt-repellent. The components are chemically/thermally sealed in an immersion bath - without additional material deposit. After this process, our components receive the Murtfeldt rating „[FS] Food Safe”. This attests to compliance with legal requirements for the food industry as follows:
- Compliance with requirements of Regulation (EU) No. 10/2011 in the amended version up to and including Regulation (EU) No. 2016/1416
- Compliance with requirements of Regulation (EC) No. 1935/2004 and its amendments on materials and articles intended to come into contact with food
- Production as per Regulation (EC) No. 2023/2006 on good practices for materials and articles intended to come into contact with food (GMP)
- Full migration and specific migration tested in accordance with Regulation (EU) No. 10/2011. Suitable for repeat contact with all types of food at application temperatures between 5°C and 70°C and contact times of up to 5 minutes.
INFILTRATION
Infiltration impregnates and seals the surface of the component. During the process, a colourless epoxy resin is applied to the SLS component. This can ensure an air-tight and water-tight seal even in humid atmospheres and at high temperatures. Infiltration can be effectively combined with dyeing.

PRINTING
We can use UV LED printing technology to print high-resolution colour images, apply markings, and add labels to components produced using additive manufacturing. Components with a size of up to 300 mm × 420 mm (A3) and 150 mm thickness are suitable for the addition of printing. Since the print image – similar to inkjet printing – is only applied to the surface of the component, it is more sensitive to mechanical abrasion and picking up dirt.

LASER PRINTING
This procedure involves labelling and marking components with the help of an intensive laser beam. Unlike UV LED printing, the plastic that is printed on changes in itself. Labelling printed on using a laser is smear-resistant and extremely durable. The addition of really small, machine-readable labels (e.g. QR code, Data Matrix code) directly to the product is also possible.

RUBBERIZING
A further finishing type is rubberizing. This type of finishing is recommended for components that are not allowed to bring about slide or slipping processes and for high-quality parts that should not leave behind impressions. This coating also protects components from minor knocks and provides support for gripping, retaining, and tensioning. Flexible elastic coatings encircle the contour of the part upon contact, disperse the contact pressure, and reduce point loads.

ASSEMBLY
Most customers gladly use our assembly services. Here, we assemble and finish complete components or even assemblies for you. The parts are then packaged individually or as a group and sent directly to you or shipped on your behalf as desired.

MACHINING FINISHING
Processes such as drilling, turning, milling, grinding, and thread cutting can improve the precision and quality of your component. In particular for parts where precise fit sizes need to be observed, mechanical finishing really is recommended.

PUR COATING
Components that should not cause any slide and slipping processes or leave behind impressions can benefit from a PUR coating. This also protects against knocks and provides support for gripping, retaining, and tensioning. We offer different surfaces and Shore hardnesses.

FLOCK COATING
Flock coating involves applying individual fibres to components to create a soft surface. This can prevent parts from damage and optimize their slide properties. In addition to different flock fibre lengths, different colour variants can easily be provided.
## FINISHING OPTIONS

<table>
<thead>
<tr>
<th>Vibratory grinding</th>
<th>Blasting/shot peening</th>
<th>Ceramic blasting/Shot Peening (surface compaction if components are dyed)</th>
<th>Painting</th>
<th>Filling/Painting</th>
<th>Chemical/thermal smoothing</th>
<th>Printing</th>
<th>Laser printing</th>
<th>Rubberizing</th>
<th>Mounting of assemblies</th>
<th>Machining finishing</th>
<th>PUR coatings</th>
<th>Printing/flock coating</th>
<th>Various kinds of coating</th>
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</table>
TOLERANCE TABLE AS PER DIN ISO 2768-1
General tolerances for length dimensions enable the simplification of technical drawings. These are regulated in DIN ISO 2768 Part 1. The following tolerance table (based on DIN ISO 2768-1) contains guidelines that are also applicable for additive manufacturing.

In each case, the tolerance class shows the usual workshop precision. Murtfeldt Plastics works in tolerance class C (roughly) for additive manufacturing. This is due to the procedures used. During production with additive manufacturing methods, the length dimension is defined by the alignment of the component in the construction space. The alignment on the horizontal plane (XY) is always considered here.

<table>
<thead>
<tr>
<th>Tolerance class</th>
<th>To 0,5</th>
<th>Above 0,5</th>
<th>Above 3</th>
<th>Above 6</th>
<th>Above 30</th>
<th>Above 120</th>
<th>Above 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>C (approx.) N/s</td>
<td>k.A.</td>
<td>± 0,15</td>
<td>± 0,2</td>
<td>± 0,5</td>
<td>± 0,8</td>
<td>± 1,2</td>
<td>± 2,0</td>
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</tbody>
</table>

MAX. AVAILABLE CONSTRUCTION SPACE
680 × 380 × 580 mm (usable construction space)

LAYER THICKNESSES
0.06 / 0.10 / 0.12 / 0.15 / 0.18 mm (depending on printing procedure and plastic)

MINIMUM WALL THICKNESSES
Possible as of 0.45 mm (but minimum wall thickness of 1.5 mm required for reproducible dimensions and mechanical properties)

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THE MURTFELDT 360° ALL-ROUND SERVICE – AN OVERVIEW

We design and produce custom components, resilient prototypes, spare parts, and small series in industrial quality. We also offer lots of finishing options.

Before printing
- Scanning and reverse engineering
- Design suitable for 3D printing
  - Optimization
  - New designs
- Advice on plastics and manufacturing
- Training courses

Printing phase
- Printers and procedures including:
  - SLS (selective laser sintering)
  - FLM (fused layer modelling)
- Various materials including:
  - Murprint PA
  - Murprint ABS
  - Murprint PC
  - Murprint "P" Green
  - Other fibre-reinforced, metal-filled, or glass-filled 3D printing materials

After printing
- All kinds of finishing:
  - Vibratory grinding, blasting, gluing, filling, grinding, printing, laser printing, painting, drilling, turning, milling, thread cutting
- Design check
- Assembly production/mounting
- Quality assurance

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