MIMplus Technologies GmbH & Co. KG

Endless design possibilities

Member of OBE group

Endless design possibilities

Highly complex forms in nature have often served as a basis for the design of new components and systems; their complete realisation can however often be compromised by the limitations of conventional production processes. MIMplus Technologies therefore offers a highly innovative powder metallurgy forming process in the form of metal injection moulding (MIM) for the near-net-shape manufacture of metal components in a wide variety of forms which e.g. would not be possible with machined production.

Among other things, the process is also suitable for difficult-to-machine materials and can be combined with processes such as laser processing or surface finishing. This resource-conserving process is particularly advantageous when a complex component geometry meets a difficult-to-process material. Near-net-shape MIM components can be produced directly off-tool and if required, they can easily be machine finished or refined.

Metal powder injection molding as an economical production method for high volume products is particularly suitable for the production of smaller to medium sized components with an average weight of 0.1 to about 150 g. The applications of MIM components are very versatile and range from the automotive sector to medical technology, mechanical engineering, precision engineering, electronics and jewelry, all the way to aerospace.

From the idea to the series component

MIM technology is always at an advantage if the time and costs for machined production are high and/or if additional added or assembly processes can be omitted.

The investment in an injection moulding tool must be considered as part of the economic calculation, as the MIM procedure is a process that involves tooling. As a rule of thumb, one can say that the MIM process is especially suited for large-scale production runs; economic feasibility can however be guaranteed for a wide range of production run number scenarios depending on the industry and the complexity of the component. As MIMplus experts have many years of experience in a variety of industries from luxury goods and medical technology right up the optical and automobile industries, you can be sure that the competent evaluation of your project is safe in our hands.

The development and manufacture of components and subassemblies

MIMplus Technologies offers a “full service” for its customers from development right through to series production: Our product management team will advise you right from the first draft for the optimum design of the component for the MIM process and will accompany you professionally throughout the entire project until it has reached series production.

We designs your mould in our very own mould design department and develops an optimum mould concept, where single or multiple cavities and manual, semi-automatic or fully-automatic handling concepts are employed, together with you based on the your final projected production run numbers.

Before the series mould is produced, sample parts can be produced in our prototype production department either via the machined manufacture of green parts, 3D print or by using the sample tool for very small production runs.

The MIM process

The MIM process is a powder metallurgical production process in four steps:

Feedstock production
A metal powder of the desired composition is mixed with a thermoplastic binder and a small quantity of a lubricant (e.g. paraffin) and granulated to become a feedstock. The compound increases the injection capacity of the metal powder and guarantees the shape retention of the blanks.

Injection moulding
The feedstock is formed and demoulded in a mould using conventional injection moulding machines. Blanks produced like this are called “green parts”. They are up to 20% larger than the finished product as a result of the volume quantity of binder, but still however exhibit all the typical geometrical characteristics of the finished component. The sprues can be removed and directly regranulated for the next injection moulding process.

Debinding
Debinding can be carried out catalytically, thermally or via water depending on the type of feedstock. The binder is hereby removed from the component until a residual binder content of 2-3 % remains. This backbone guarantees the stability of the “brown part” for the subsequent process.

Sintering
The components are sintered at temperatures of between 1200°C und 1400°C in the last processing step. The remaining binder content is completely removed in special sintering ovens in an inert gas atmosphere. The shrinkage of the component as a result of the sintering is already calculated as a dimensional feature of the mould.

Components produced using the MIM process are free of residue and attain density values of almost 100 %. They have similar characteristics to e.g. machined components; the MIM process is environmentally-friendly and does not waste resources as the granulates are recycled.

Guidelines for MIM components

MIM technology is especially suited for small components; therefore MIMplus Technologies has specialised in the production of components with a weight of between 0.1 g to approx. 150 g.

The attainable tolerances are project-specific and are calculated by our experts together with you.

In addition to the geometric requirements it is very important to determine the following data at an early stage in the project in order to design the optimum component for you :

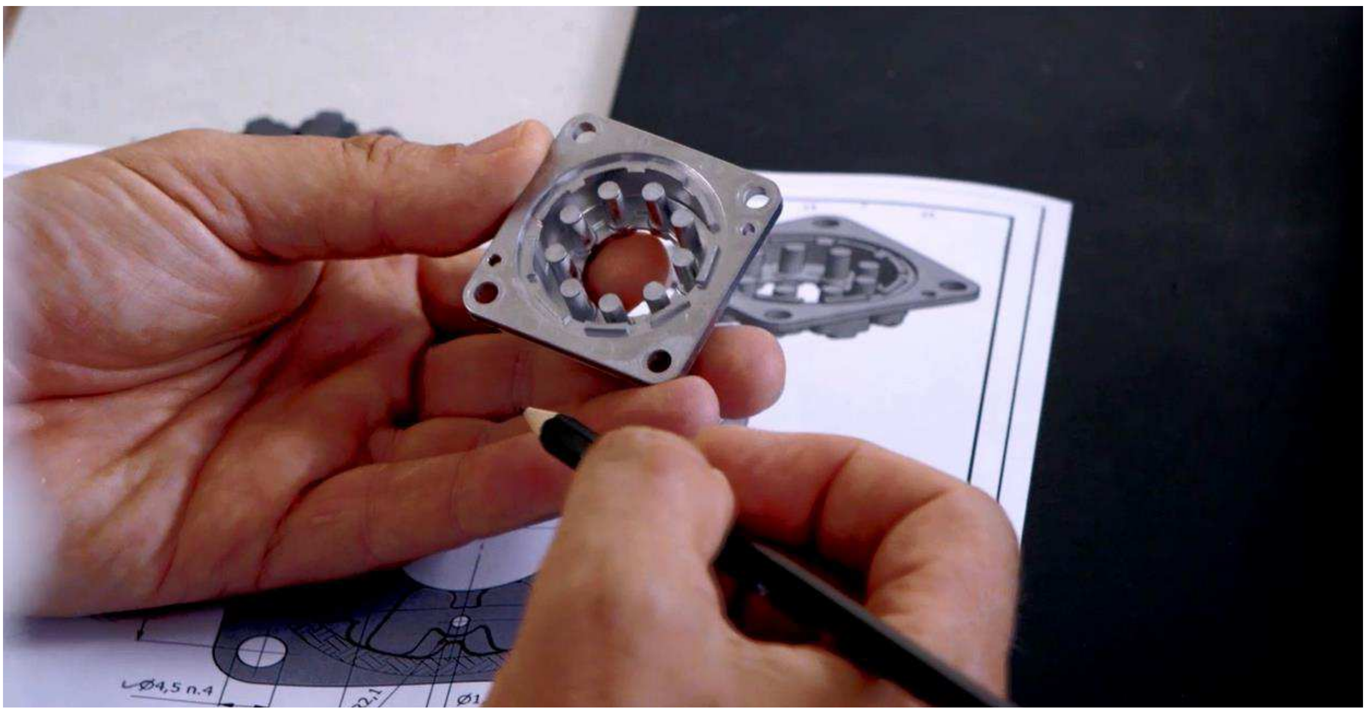
- Place of installation of the component/subassembly
- Functional requirements
- Load types
- Structural requirements
- Hardness values
- Surface finishing

It also makes sense to observe the following guidelines from a very early stage in the design of MIM components in order to avoid refinishing and extra calibration steps and thus optimise unit costs:

Contact surface
A flat contact surface prevents the component from deforming during the sintering process.

Wall thickness distribution
Constant and even wall thicknesses enable the highest degree of dimensional accuracy and reproducibility.

Transitions and sprues
Generally speaking rounded edges should be preferred to sharp-formed edges. Optimally located sprues mean a higher degree of stability and facilitate the injection process of the green parts.



Additional operations

Many MIM components are supplied without further processing as products which can be directly used. The additional services which go beyond the finished MIM product are however one of MIMplus's specialities:

Surface technology
A large number of MIM components are tumbled after they have been sintered on MIMplus own systems, in order e.g. to improve the surface structure for parts that are externally visible or perhaps to remove sharp edges or possible burrs. After they have been tumbled, it is possible to create matt, calendared or high-gloss surfaces depending on the application required. MIMplus is able to guarantee a constantly high level of surface finishing quality due to their many years of experience and access to their own specialised machines.

Coating technology
Components can be e.g. copper-plated, nickel-plated, silver-plated or gold-plated in the company's own electroplating shop which has been designed according to the latest environmental guidelines; additional coating options such as anodic oxidation, painting, PVD coating and other decorative or functional coatings are possible for MIM components via an established network of competent partner companies.

Mechanical processing and assembly
MIM components can be additionally milled on CNC processing centres in order to obtain the highest possible tolerance requirements for high precision applications. MIMplus is also capable of carrying out all subsequent mechanical processing steps from drilling and calibration right up to heat treatment processes.

Furthermore, if required, MIM components can also be assembled to form assemblies or even subsystems.

Quality as result of competence

Certified quality

At MIMplus Technologies serial production does not start until the first sample phase has been successfully completed, in which the injection moulding tool is completely dimensionally recorded at the earliest possible instance, in order to eliminate the causes of even the smallest of dimensional deviations. The entire sequence of the production process is documented step by step and optimised. Material and processing parameter analyses as well as the comprehensive appraisal of the pre-series parts, integrated within a consistent approval process guarantees a run up to series production that is free of problems.

During series production MIMplus Technologies also carries out density tests, tensile strength inspections, cracking tests, dimensional tests, contour inspections and surface quality checks according to the requirements. The quality management system is certified on a yearly basis according to the requirements laid down in DIN EN ISO 9001. Furthermore we are also certificated according to IATF 16949 for the production of high precision components in MIM process for the automotive industry.

A CAQ system records and documents the data which are relevant for quality. Worker self-control, regular checking of the processes as well as the continuous monitoring of the produced articles enables MIMplus not only to maintain its high level of quality but also to increase its own quality standards.

Finally MIMplus Technologies has established an environmental management system according to DIN EN ISO 14001 and to the European regulation 1221/2009 EMAS.

Constant innovation

Variety of materials

MIMplus Technologies develops and tests new materials for the MIM process. In addition to various stainless steels and other materials, MIMplus is one of the few MIM companies offering titanium parts in a high and constant quality.

MIMplus has placed a special emphasis during development on the optimisation of selected MIM materials with regard to their surface finishing qualities. In close cooperation with well-known feedstock suppliers, recipes can be developed which e.g. enable the production of high-polished stainless steel MIM components with a surface finish that is second to none compared to equivalents made from solid materials.

Depending on customer requirements, the specific characteristics of materials can be adapted, such as e.g. an increased strength, optimised protection against corrosion or magnetisability. In individual cases it is also possible to specify the specific proportion of certain alloy components such as e.g. the nickel content.

Cooperation with scientific institutions

MIMplus Technologies has built up close relations with universities and research institutes. Placements, projects, final papers, lectures, workshops and publications as well as participating in research projects transfer scientific impulses into practice.

Awards at tradeshows or from customers

The innovative initiatives with regards to MIM technology have been recognised with several awards. In 2017, we received the Environmental Technology Award and the Resource Efficiency Award of the Federal Ministry of Economics for the development of complex magnets made from recycled materials.

Standard materials

The following material table shows a selection of MIMplus‘s standard materials. The details of the mechanical properties listed in the table are typical values, detailed specifications and other materials on request.

Material	Condition	Equivalent material designation	Density g/cm³	Yield point Rp 0,2 MPa	Tensile strength Rm MPa	Breaking strain A %	Hardness	Notes
Low alloyed steels for heat treatment								
FN02	sintered	Fe-2Ni	≥7,50	≥120	≥260	≥25	80-110 HV10	case-hardenable
	surface hardened			-	-	-	≥600 HV 0,2	
100Cr6	sintered	DIN 1.3505	≥7,50	≥500	≥900	≥5	230-290 HV10	heat treatable, wear-resistant
	heat treated			-	-	-	635-720 HV10	
42CrMo4	sintered	DIN 1.7225	≥7,40	≥400	≥700	≥3	130-230 HV10	temperable, surface hardenable, conditionally weldable
	heat treated			≥700	≥1000	≥2	28-36 HRC	
	surface hardened			-	-	-	> 600 HV1	
Tool steels								
M2	sintered	DIN 1.3342	≥7.90	≥800	≥1050	≥1	50-58 HRC	age-hardenable, wear-resistant
	heat treated			-	-	-	60-66 HRC	
Stainless steels								
Nitronic 50	sintered	DIN 1.4565	≥7.80	≥340	≥570	≥16	180-240 HV10	austenitic, non-magnetic
316L	sintered	DIN 1.4404	≥7.75	≥150	≥450	≥40	100-150 HV10	austenitic, non-magnetic, can be polished
17-4-PH	sintered	DIN 1.4542	≥7.60	≥660	≥800	≥3	290-340 HV10	martensitic precipitation, hardening, ferromagnetic, can be polished
	heat treated			-	-	-	36-40 HRC	
430	sintered	DIN 1.4016	≥7.60	≥200	≥350	≥30	100-150 HV10	heat-resistant, ferromagnetic
440C	sintered	DIN 1.4125	≥7.54	-	-	-	39 HRC	martensitic, hardenable, heat-resistant, ferromagnetic
	heat treated			-	-	-	61 HRC	
Titanium								
Ti Grade2	sintered	DIN 3.7035	≥4.30	≥270	≥340	≥20	≥170 HV10	non-magnetic, corrosion-resistant, light
Ti Grade4	sintered	DIN 3.7065	≥4.20	≥480	≥550	≥5	160-240 HV10	non-magnetic, corrosion-resistant, light
Ti Grade5	sintered	DIN 3.7164	≥4.30	-	-	-	330-355 HV10	non-magnetic, corrosion-resistant, light
Other alloys								
FN50	sintered	DIN 1.3926	≥7.60	≥150	≥400	≥20	90-120 HV10	magnetically soft alloy
FeSi3	sintered	DIN 1.0884	≥7.50	≥280	≥440	≥20	140-170 HV10	magnetically soft alloy
Inconel 601	sintered	DIN 2.4851	≥7,6	≥210	≥620	≥30	135-160 HV10	nickel based alloy
Cu 99.9	sintered	DIN 2.0060	≥8.50	≥40	≥200	≥40	36-38 HV10	electric conductivity 50 MS/m, good thermal conductivity

The material table is subject to alterations.

MIMplus Technologies GmbH & Co. KG

Founded in 2019, MIMplus Technologies was a business unit of OBE Ohnmacht & Baumgärtner GmbH & Co. KG between 1996 and 2018.

Business purpose is the industrial production and distribution of precision components, assemblies, systems and tools by means of metal powder injection molding, additive and other manufacturing technologies.

The area of activity also includes the further processing of powder-metallurgically and additively produced components using various manufacturing technologies, as well as the assembly of component groups, engineering services and the development and commercialization of materials and processes.

At the headquarters in Ispringen in the northern Black Forest, a production area of 15,000 m² is available.

MIMplus Technologies employs 80 people at the Ispringen site and is a wholly-owned subsidiary of OBE Holding GmbH.

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