



**Sintered structural components**  
**Sintered bearings**  
**Metal Injection Mouldings (MIM)**

# Technology for the future



The technology of sintering is one of the oldest yet simultaneously most innovative branches of metallurgy. The compaction of metal powder and subsequent densification through sintering is a process on which many advanced companies depend nowadays. We produce a broad spectrum of components in sintered iron, steel and bronze and with a usage of more than 10,000 tons of metal powder annually, we are also one of the largest producers in the world. Our product range extends from bearings in the size range of a tenth of a gram for micro motors, up to complex components with item weights up to several kilograms.

## Schunk sintered parts – the ideal solution

In many industrial fields, Schunk sintered parts are the clear solution for demanding mechanical components and systems. Renowned customers from the following sectors, among others, have relied for decades on Schunk sintered parts:

- Automotive
- Audio/video
- Power tools
- Information technology
- Mechanical engineering
- Medical technology
- Measurement and control engineering
- Technology for house and garden



*Schunk Sintered bearings guarantee the highest level of reliability and almost unlimited life of the cooling systems found in more than 50% of all computers worldwide*

## Deciding factors

The advantages of products produced by powder metallurgical processes are obvious. Sintered component parts have the highest levels of dimensional and geometric accuracy and are characterized by repeatability over large production volumes. In cooperation with you, we define tailor-made material characteristics for your components and help design them suitably and appropriately for the sintering process.

## Our customers profit

Our customers profit from the advantages of the technology, from our experience extending over decades and our special "sinter know-how". A decision in favour of sintered products brings you solid advantages:

- Components, ready to be installed, with low unit costs
- Material yield of almost 100%
- Properties can be enhanced through a variety of additional processes
- Environmentally friendly due to high levels of material and energy efficiency
- Recycling potential

## Components, bearings and metal injection-moulded parts

In the following pages, we would like to introduce you to the technological advantages of sintering, special developments and to our particular expertise in the areas of components, bearings and metal injection-mouldings.

## Overview of the sintering process – Precision down the whole line

### Powder



Pure metals and alloys from leading powder manufacturers  
Quality control according to grain distribution, flow, filling and compaction characteristics

### Powder mixing



Pre-mixed or our own mixtures to specially developed and defined specifications

### Pressing



Utilising mechanical or hydraulic presses

Compaction forces from 3 to 1500 tons (largest range worldwide)

Powder is compacted in dies producing "green" components

### Sintering including Schunk ES process



Mechanically bound powder particles (green components) are "welded" to each other through thermal action

Highest strength and dimensional accuracy achieved through "hardening via the sintering heat" using the Schunk ES process

Strength up to 1400 N/mm<sup>2</sup>  
Hardness values up to 1000 HV 0.1

Dimensional changes (volume, length increase or decrease) are calculated exactly, in advance, for tool design

### Processing



Post processing of sintered parts to produce assembly ready components or sub-assemblies, via:

- Calibration
- Surface hardening
- Steam treatment
- Machining
- Oil impregnation of bearings
- Surface protection



Up to 50 Schunk components are used in most of European manufactured vehicles e.g. in servo drives, ancillaries and passenger safety systems

# We bring shape to components



*Camshaft chain wheel (duplex chain) for diesel engines using common-rail technology*

You can totally rely on Schunk sintered components. We give your components the exact form that you require, with the highest level of precision and using the most economical means. Our actions, in all development and manufacturing stages, are characterized by a zero-defect philosophy. From us you receive a complete solution from a single source: assembly ready components or sub-assemblies, and the certainty that, with Schunk sintered components, you have found the best of all possibilities for your application. In the production of sintered components, we cover the complete market with compaction forces from 3 to 1500 tons. Thus we can satisfy almost every customer requirement. We manufacture components of the highest density and strength using tools designed and produced in house. Our specialties include helical gears, high-strength warm-compacted parts, complex geometries (multiple-plate technology), intricate structures and many other areas.



*Sub-assembly for electrical seating adjustment comprising three welded components, including helical gear pinion, ES hardened*

## **From conception to production**

We support you through the entire production process, from the preliminary development stage, up to series-production with advisory support, consultation, and recommendations concerning:

- Process-oriented design
- Material selection and value optimisation

You also profit very significantly from our long-standing experience with the largest variety of materials and their properties, functional requirements, processing steps and quality assurance measures.

## **The Schunk ES-Process**

We achieve the optimal combination of hardness and strength through our special ES-Process (endogas thermal-shock cooling).

This "hardening using the sintering heat" guarantees you higher dimensional accuracy for your component parts but with the same hardness and strength as with traditional hardening processes.

In addition, we can offer you all known heat treatment processes.

If required, with hardened components, we can guarantee them to be absolutely oil free.

## **Ideal surface finish**

According to your requirements we mutually decide the best surface treatment for your application. Everything is possible – from simple rust proofing, through galvanising, to anti-friction coatings.

### **Rapid prototyping**

We produce for you, in the shortest possible time:

- Material blanks for your own sample production
- Non functional prototype models (for inspection purposes)
- Prototypes ready to be installed, using 3-D modelling

### **Looking for a development partner?**

Contact us!

For any questions, from the initial idea up to the stage of ongoing manufacture, we are available for you as a development partner and a reliable series supplier. Further information on the advantages of Schunk sintered components can be found on our technical CD-ROM, directly from our sales employees and on the Internet.



# We know what goes on inside bearings



Schunk self-lubricating, sintered plain bearings are associated worldwide as the most proven and reliable products in this category and are employed, for example a million times over in computer hardware, in the automotive industry, in electrical appliances and in home entertainment electronics. In order to meet the high expectations of our customers, we apply a comprehensive analysis of the Tribological system at the beginning of any cooperative work. We prepare this analysis with both reference to theoretical basics and with the application of our know-how gained from several decades of practical experience in the development and production of high-quality porous bearings.

## **Quiet running through precision and cleanliness**

If you place high emphasis on quiet running bearings, Schunk porous bearings are an excellent option. We produce porous bearings with the highest precision in the world (bore tolerances down to 2  $\mu\text{m}$ ). Thus contributing to an outstanding repeatability of the properties of your product.



*From precision technology, up to general engineering - the Schunk double-bearing range meets every challenge*

After years of optimisation of our manufacturing processes, we additionally achieve outstanding component cleanliness, which counters premature wear and noise generation.

### Optimal characteristics with hydrodynamics

In the stationary position the gap between the shaft and the bearing bore is filled with oil, depending on clearance and pore size. Allowing that the design of the tribological system is optimal, rotation of the shaft, together with the oil adhering to the shaft surface, leads to the formation of a pressure wedge. The hydrodynamic lubrication film resulting from this action guarantees contact-free running between the components. In this operating condition, the bearing runs wear-free. Therefore the lifetime is primarily determined by the lubricant selected.

### In house test methods and material development

The pore structure is of great importance for the running properties. Therefore, we developed, in the early 80's, our own test methods, the results are used to provide feedback for our material development. In addition to standardised materials, we can also develop bespoke solutions for you, even specifications for special lubricants if no suitable product is currently available. With this, we can also offer optimum system solutions for mixed friction operation.

### Double bearings with life of more than 30,000 hours

Our Schunk patented double-bearing offers, as an integrated component, a design to meet the most demanding system requirements:

- Unsurpassed alignment of the two bearing surfaces
- Use of the pore space between the bearing surfaces for oil storage
- Robustness of the bearing surfaces during assembly

These particular features of Schunk double-bearings provide the basis for a bearing life of more than 30,000 hours.

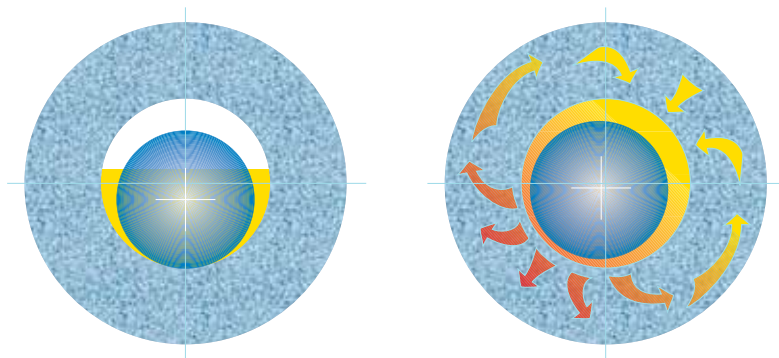
### Use our knowledge

We are available to answer all your questions regarding porous bearings, their materials and properties. Further information can be found on our technical CD-ROM, directly from our sales employees and on the Internet.



### Self-lubricating sintered plain bearings

Lubricant distribution in a sintered plain bearing



*In the stationary position, the bearing clearance is partially filled with oil; shaft and bearing are in contact with each other*

*During operation, a hydrodynamic oil film separates the shaft and bearing*

# MIM – an (almost) limitless process

Metal Injection Moulding (MIM) is one of the most advanced manufacturing processes used in Powder metal technology. Schunk have been producing MIM parts for over 10 years at our factories in Giessen and Thale, and are the market leaders in Europe. With the MIM process, hitherto undreamt-of combinations of material and geometries have been made possible for the design of mechanical components. Material combinations, which were previously inconceivable, can be tailor-made for you by Schunk.

## The process

The finest grained metal powders are mixed with binders producing a uniform mass containing 50 to 70% metal powder by volume. In the subsequent metal injection moulding process, shaped bodies are produced, with all the geometric features of the finished component. These “green components”, however, still contain the binder.

Using our in-house developed debinding processes, the binders are removed either by thermal decomposition and vaporization or by complete solvent extraction.

These porous “brown components” are then sintered either under various protective gases or in a vacuum, producing components of the required size and form. Linear shrinkage during this process results in final densities of up to 96% of solid. Any residual pores present are evenly distributed and are closed. If required many heat and surface treatments can be applied via subsequent processing.

## Industrial applications

Schunk MIM parts can be used in almost any industrial field. Our two factories and their binder systems make it possible to produce differing features using the same basic technology. Depending on the requirements of the parts to be produced, these unique (Schunk) characteristics, enable the best features of either technology to be applied.

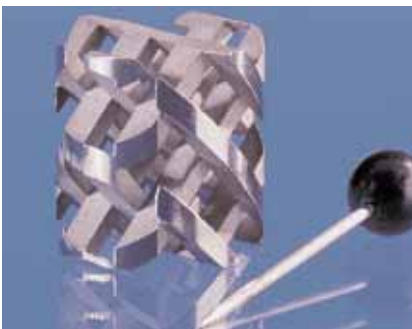
For very demanding parts which traditionally required a high manufacturing outlay, joining operations and additional processes or with alloys, which are difficult to work with, then the MIM option may provide decisive cost advantages.

Ongoing production series of millions of items prove the repeatability and reliability of our Schunk MIM process.

## Maximum degree of freedom of material and form

MIM parts from Schunk allow designs with highly complex geometry over high production volumes – particularly with components combining very small dimensions and intricate design.

We have opened up new, previously inconceivable possibilities through the combination of metal injection moulding technology and the enormous degrees of freedom provided by Schunk MIM materials, resulting in very high levels of customer satisfaction. Our customers are delighted that our process overcomes the constraints of plastic injection moulding or pressure die-casting, without them having to change their component design.



*Unlimited possibilities: Space Lattice in highly wear-resistant cobalt alloy for the homogenisation of a media. Size: 10 mm*



*Gear head of an electric toothbrush: corrosion-proof and wear resistant MIM parts, even in an aggressive media. The alternative, if plastic fails*

We have also convinced those customers with demanding material requirements involving very high production costs of the benefits of our MIM technology, which makes further processing unnecessary. Those customers who used alternative expensive processes e.g. precision lost-wax casting are also convinced of the economic advantages we can offer.

### **High efficiency**

With our MIM process, there is almost no raw material wastage. Process by-products such as runners, can be recycled back into production adding to both the efficiency and the environmental friendliness of this process.

### **Interested in MIM? Call us**

If you are planning a project and would like to know more about the (almost) unlimited possibilities that our MIM process can open up for you, we would be pleased to advise you. Further information can be found on our technical CD-ROM, directly from our sales employees and on the Internet.



# Research and development



As a forward-looking company, we are continuously researching, developing and optimising new materials and processes for Schunk sintered metal technology. Part of this work is improving the performance of materials through alloy and heat-treatment optimisation, increasing density through hot pressing and high-temperature sintering and also continuous process improvement of tolerances and accuracy. In conjunction with our customers we also develop exclusive materials with tailor made characteristics to suit their specific applications.

As well as continual development of our technology we are also involved in the following important product areas:

## **Aluminium foam**

The use of foamed aluminium in the manufacture of vehicles promises significant weight savings in comparison to conventional materials, with a simultaneous increase of component stiffness.

In addition to net shaped foamed components, aluminium foam sandwiches and aluminium foam/glass or carbon fibre reinforced plastic composite components, are appropriate in structural applications.

### **Aluminium components for engines in the automotive industry**

Components, which have been traditionally produced from sintered steel or conventional steel, will be replaced by corresponding parts of sintered aluminium, in order to gain significant weight savings.

### **High-temperature materials**

In partnership with our customers, we are developing heat-resistant sintered steel, with optimised mechanical and physical properties.

### **Micro MIM**

"Turning the impossible into reality", means to us that we venture into areas that are scarcely conceivable for others. Thus, we are continuously developing our Schunk MIM process. New applications demand complex-shaped, micro component parts, with the finest structures down to 50 µm.

### **Joint research**

Together with universities, institutes and in close cooperation with our partners and customers, we keep on top of current trends and are actively pushing ahead with new developments. Following on our past successes, we continue to expand our expertise in key areas of sintered metal technology.

### **Challenge us!**

Experience shows that it is of extreme importance to become acquainted, at the beginning of a project, with the performance capability, the possibilities, the opportunities and the potential of a technology and, in particular, to profit directly through that.

Ask us, we will be glad to advise you.



*Aluminium Foam Sandwich (AFS): As its name implies, outer layers of aluminium or steel sheet alloyed to an aluminium foam core*



*Demonstration vehicle, developed in cooperation with the Karmann GmbH, using integrated AFS shown at the Detroit Motor Show '98*

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