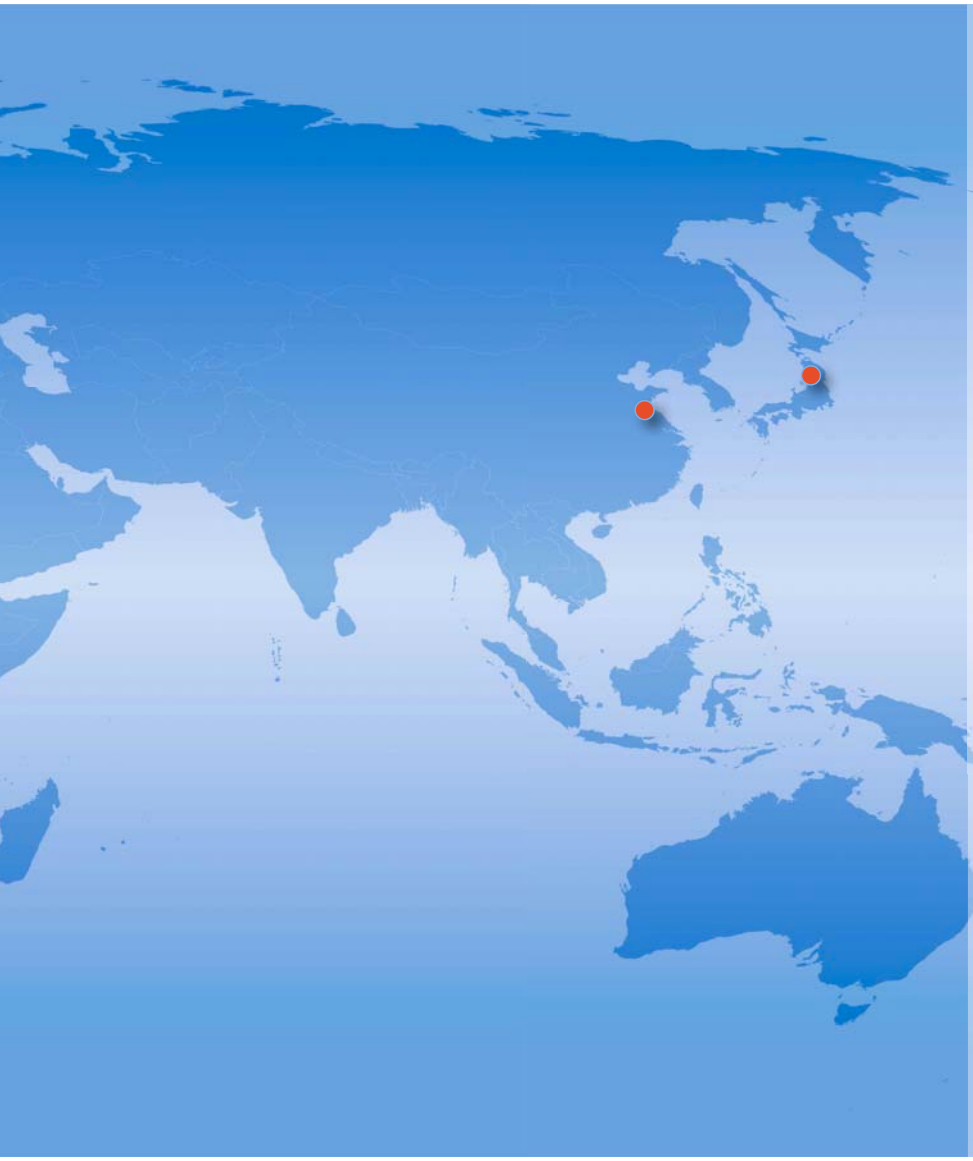
HAM
PRÄZISION

Machining of Lightweight Materials

Lightweight Materials

Thanks to our more than 50 years of experience in machining, HAM has developed a profound process understanding in machining lightweight materials.



More than
***50** years of experience*
in machining

Over
***350** employees*
worldwide

Branches and representatives in
***23** countries*

Family business already in the
***3**rd generation*

Production area of
***25.000** m²*
in Schwendi-Hörenhausen

Günter Eberle
General Manager

Petra Eberle
General Manager

Raffael Eberle
General Manager

The company Hartmetallwerkzeugfabrik Andreas Maier GmbH has been producing tools from solid carbide and polycrystalline diamonds (PCD) since 1969 for demanding customers all over the world.

Smallest holes, materials that are difficult to machine or limited storage space in the tool magazine?
We are sure to find an effective solution for any of your challenges.

Our product portfolio includes drills, reamers, milling cutters, countersinks, threading tools, indexable insert tools in solid carbide, PCD and CBN (cubic boron nitride), as well as special tools for the PCB production and for the dental and medical sectors.

We also produce innovative products in the area of crystal technology components for solid-state lasers and optical components.

Lightweight Materials

Fibre Composite Materials

CFRP, GFRP, AFRP and CFRC consist of one matrix material and reinforcing fibres. Through mutual combination of each component, fibre composite materials get higher quality properties.

Aluminium

Aluminium and its alloys are used, where mass is important. Due to the low density weight is saved.

Titanium

Titanium and its alloys are characterized by relatively low density, high strength and thermal as well as good corrosion resistance.

Honeycomb

The honeycomb structure is made of plastics, aramid fibres or aluminium, which are covered with various top layer materials to increase the stability of the structure.

Lightweight Materials

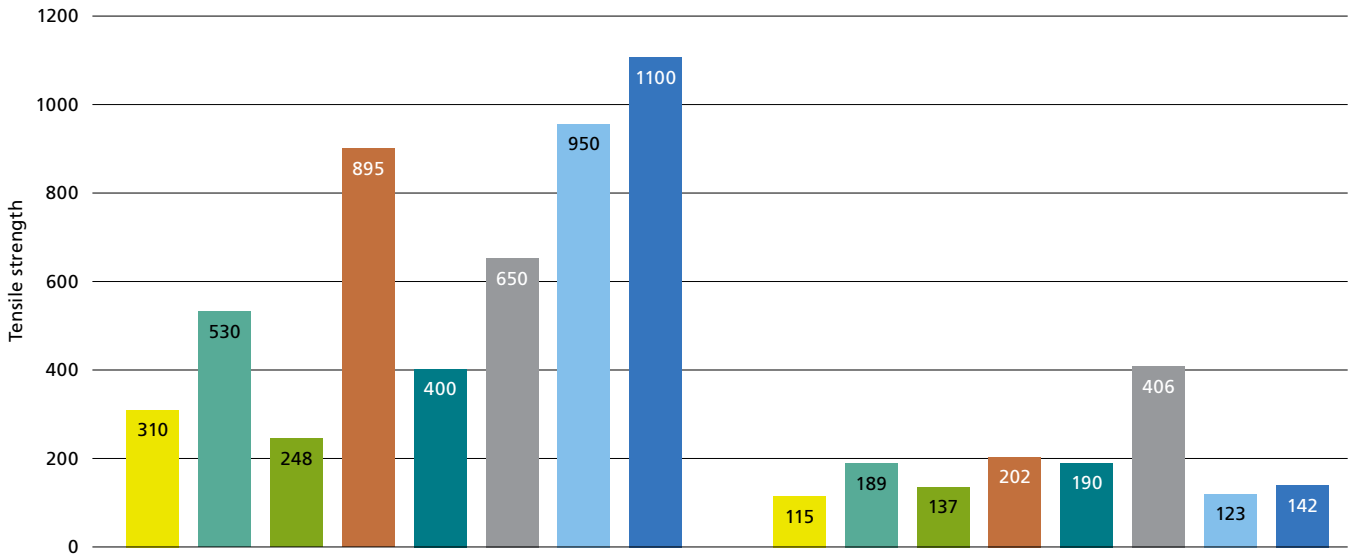
Material specific data

The decisive factor for the lightweight design potential of a material is not exclusively to its density and its weight, but to the relationship between density and the mechanical properties essential for the application.

The main factors here are the modulus of elasticity and the tensile strength of the material.

Dividing the tensile strength by the respective density the result is the density-related tensile strength.

Tensile strength / Density-related tensile strength



	Tensile strength MPa (N/mm²)
Aluminium 6082 / 3.2315	310
Aluminium 7075 / 3.4365	530
Magnesium AZ91	248
Titanium Grade 5 / Ti6Al4V	895
GFRP 43Vol.%	400
CFRP 50Vol.%	650
25CrMo4 1.7218	950
42CrMo4 1.7225	1100

	Density-related tensile strength
Aluminium 6082 / 3.2315	115
Aluminium 7075 / 3.4365	189
Magnesium AZ91	137
Titanium Grade 5 / Ti6Al4V	202
GFRP 43Vol.%	190
CFRP 50Vol.%	406
25CrMo4 1.7218	123
42CrMo4 1.7225	142

Fibre Composite

Fibre Composite Materials

- Aerospace
- Automotive engineering
- Motorsports
- Cycling
- Marine engineering
- Wind energy engineering
- Protheses- and orthoses construction

Fibre Composite Materials

Fibre composite materials have been used for decades wherever weight reduction, dynamics and energy saving play a major role: in aerospace, in automotive engineering with motorsports and cycling as pioneers, in marine engineering, where competitiveness has also high importance.

Wind energy engineering is not possible without using fibre composite materials. Also in the medical field FCM applications are present, for example in protheses- and orthoses construction.

There are of course numerous other applications and more will be added in the future. Fibre composite materials have enormous future potential.

What are Composite Materials / Composites?

Composites are macroscopically homogeneous and consist of at least two material components. A matrix (base material) is reinforced by at least another material component.

Fibre composite materials, or even more detailed, fibre composite plastics / fibre-reinforced plastics (FRP) consisting of a matrix and fibres.

Thermosetting plastics as a resin matrix are most common, e.g. polyester, vinyl ester and epoxy resins. These form when hardened under the influence of polymers that are strongly cross-linked with heat and / or pressure insoluble and infusible rigid bonds. Thermoset FRP's are resistant to high temperatures.

Thermoplastics as a matrix, primarily polyurethane, are getting more and more popular. These are defined as thermoplastic fibre-reinforced plastics (TP-FRP).
The characteristic is that the parts are shaped by the effect of heat and can be reshaped again and again.

Which fibres are used for Fibre Composite Materials?

- Glass fibre
- Carbon fibre
- Synthetic fibres like Aramid (Kevlar)
- Natural fibres like cotton, hemp or flax
- Basalt etc.

A distinction is made between short fibres 0,1 – 1 mm, long fibres 1 – 50 mm and continuous fibres > 50 mm.

The short fibre is used in injection molding / extruders in conjunction with thermoplastics.

The long fibre is used in extruders or in fibre spraying with thermosets, but also for further processing into fleece.

So-called rovings (fibre bundles, strands) are made from the continuous fibre. From these, matrix semi-finished products such as tapes, mats, braids, fabrics or even knitted fabrics are made.

These can then be further processed into so-called Prepregs > PREimPREGnated – here they are impregnated with thermoset resins, which only harden in a highly reactive manner at elevated temperatures.

For the final workpiece, several layers are then usually laid and wrapped in the desired directions.

Another option is organic sheets / TP-FRP. Here, several layers of fibre matrix semi-finished products are usually embedded in thermoplastic.
The usual commercial form is plates, which can be formed by heating.

Side part (racing sports)

When every second counts, particularly light and robust materials such as carbon fibre are used in racing.

The various machining processes such as milling and drilling require special precision tools.

2 Solid carbide special end mill
- Chip removal upwards
- Special point geometry

1 UT RAU
Special surface treatment
for a longer tool life

3 UT RPEMU
- Chip removal upwards
- Special fishtail point geometry
- Special rainbow-coloured coating
  for improved tool life

Brake lever (racing sports / cycling)

Modern top-class sport demands ever higher standards in terms of accuracy and weight reduction, even for the smallest components such as a brake lever.

These ergonomic brake levers still have to be precisely machined.

1 HAM 40-1600 Solid carbide router

- G-point
- Special diamond profiled teeth
- Diamond coated

2 HAM 30-1320 Spiral drill

- Special point ground for fibre compound materials
- Periphery cutting edge in sickle design
- Especially for thin-walled components

3 HAM Special router

- Special spiral teeth
- Right hand cutting

Aluminium

Aluminium

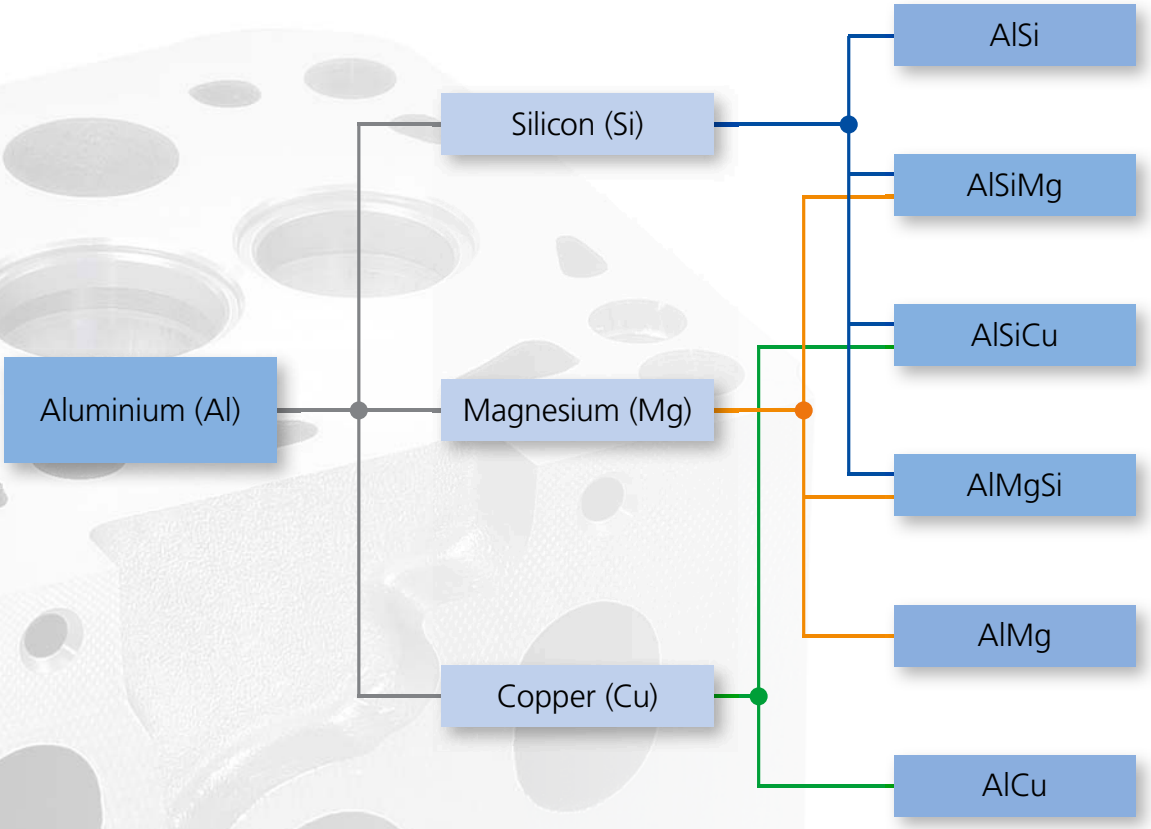
- Aerospace
- Mechanical engineering
- Automotive engineering
- Motor sports
- Cycling
- Marine engineering

Aluminium

In general, when it comes to aluminium, a distinction is made between hardenable and non-hardenable alloys and between wrought and cast alloys.

Not all alloy groups can be machined well.
It has therefore proven useful to divide aluminium alloys into three classes.

The higher the silicon content, the more wear protection such as DLC diamond coating or even polycrystalline cutting edges (PCD) must be considered.



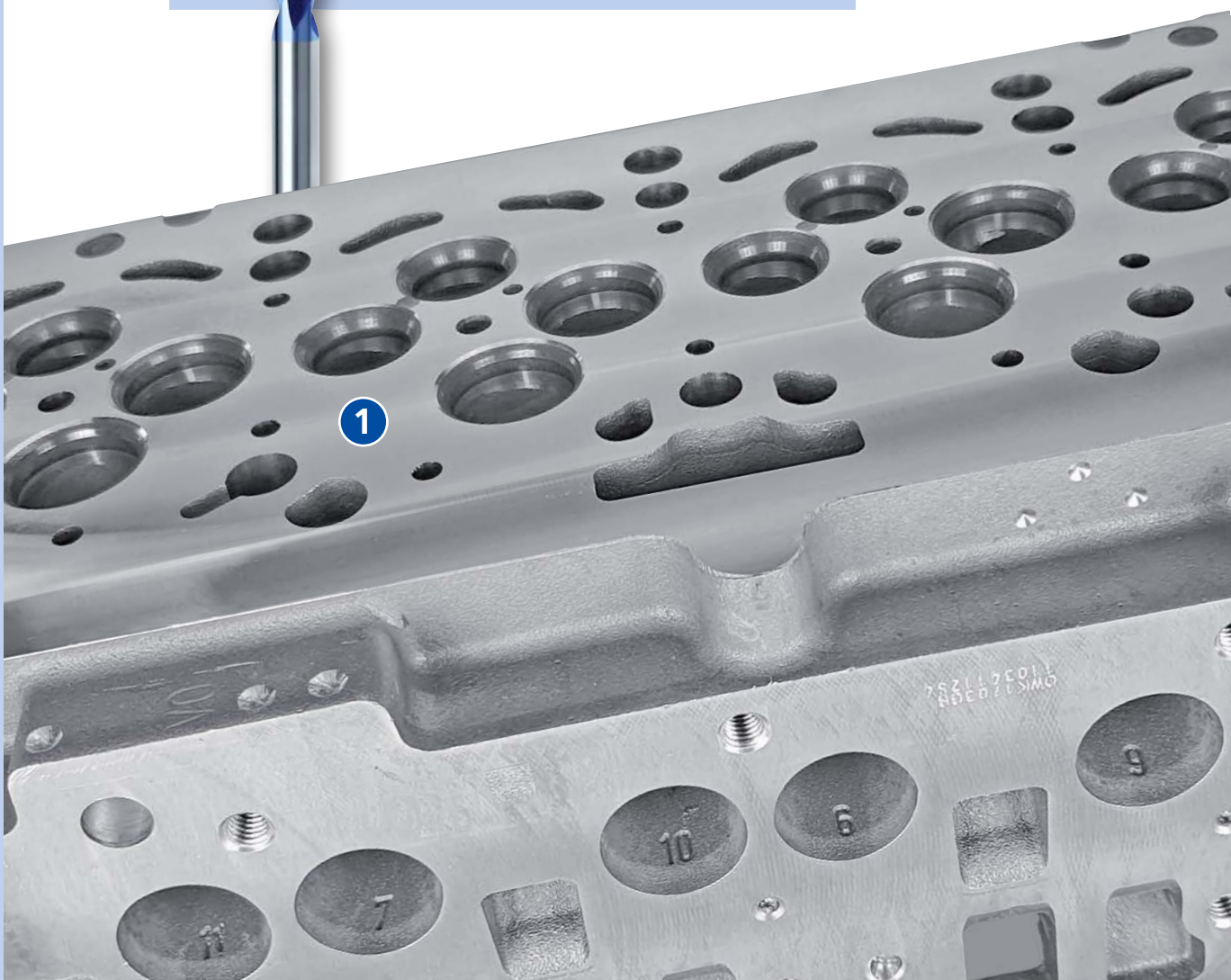
Cylinder head

A cylinder head closes off the top of the combustion chamber of an engine and is mounted on the engine block.

The complicated manufacturing process makes the cylinder head one of the most expensive and complex parts of an engine, which is why the highest precision is required in the machining of a cylinder head.

3 Nirodrill solid carbide HPC drill

- Special chip flute geometry
- Internal coolant supply
- Special point ground for machining of stainless steel
- Special surface treatment HSF



2 PCD step reamer

- High precision reamer
- Greater tool life
- Internal coolant exiting to each cutting edge

1 HAM 40-7670 PCD milling cutter

- Highest possible productivity thanks to the maximum number of cutting edges
- Optimal surface quality and long tool life
- Very easy cutting adjustment

4 Solid carbide deep hole drill

- Special 4-facet ground
- Internal coolant
- Special cutting edge preparation / chip flute geometry with HSF finishing
- Double guide chamfer / 15° helix angle

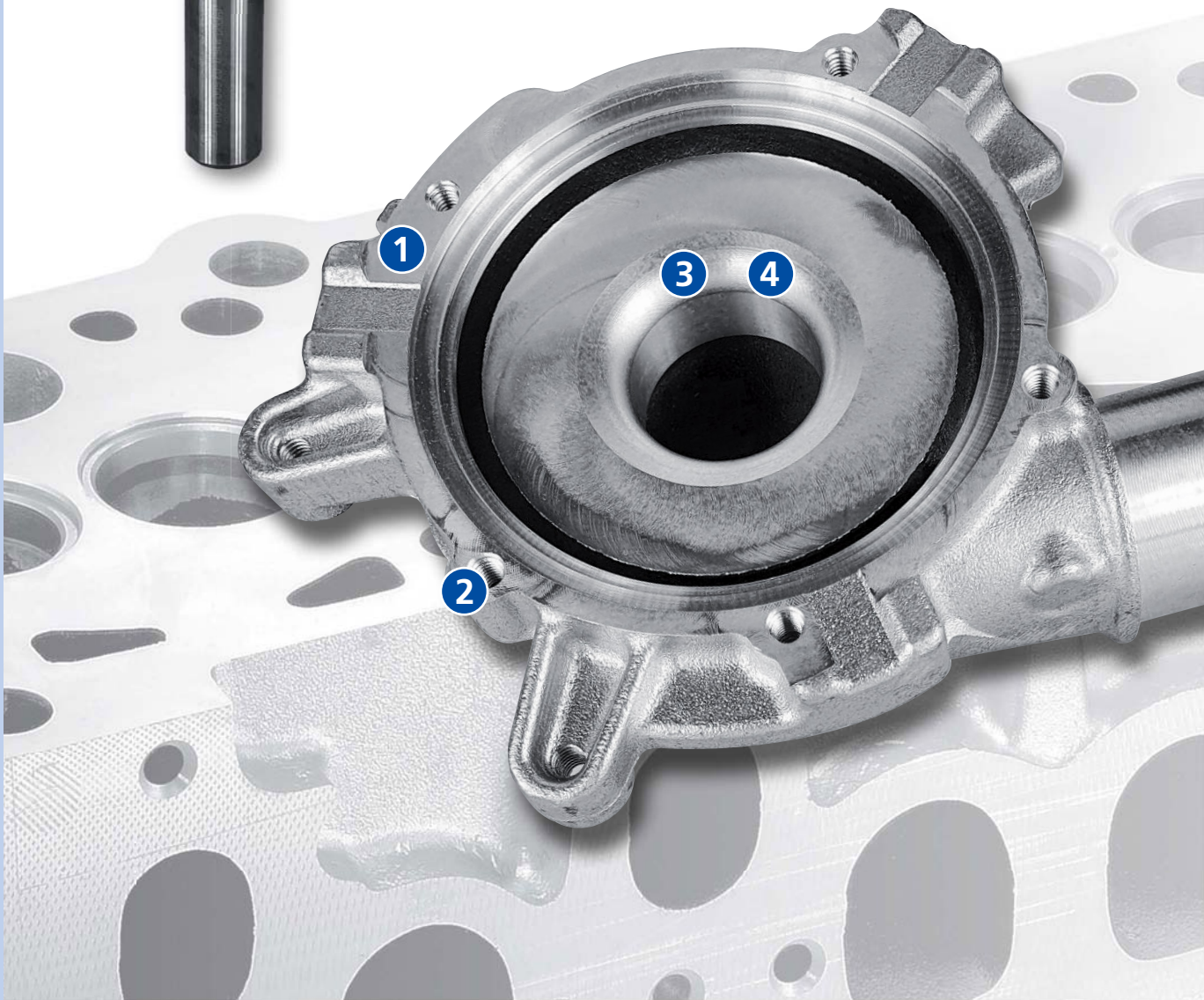
Turbocharger

A turbocharger is an engine component that increases the performance of an internal combustion engine. It uses the engine's exhaust gases to drive a turbine, which in turn drives a compressor.

This forces more air into the cylinder, resulting in better combustion and increased performance. Turbochargers are found in many vehicles and help increase performance and efficiency.

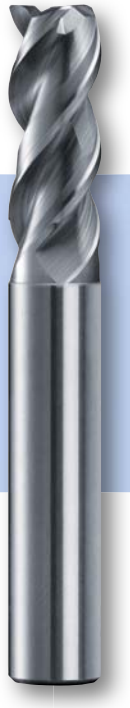
2 Solid carbide step drill

- Higher productivity by drilling and countersinking in one operation
- Special surface treatment HSF



4 PCD finishing tool

- Multitool for multiple processes in one operation
- Optimal surface quality and long tool life



1 HAM 40-5380 Alu HPC end mill

- Special geometry for smooth running and very little vibrations during machining
- High chipping volume
- With one central internal coolant hole for even more performance

3 PCD pre-processing tool

- Multitool with multiple processes in one operation
- Optimal surface quality and long tool life

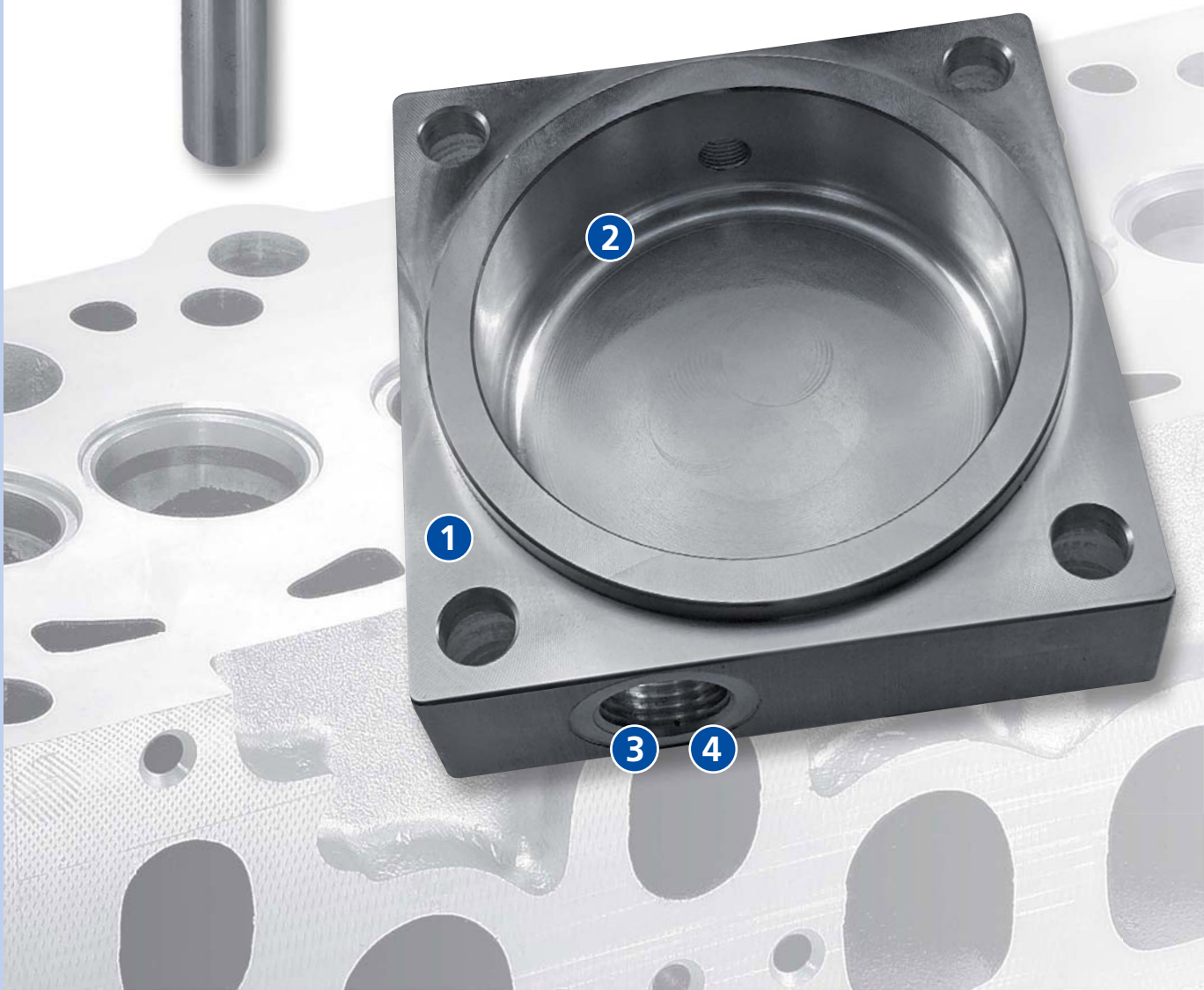
Cylinder base (pneumatic part)

Pneumatic cylinders are components that move using compressed air. They are widely used in automation technology / factory automation.

The cylinder base is the lower part of a pneumatic cylinder.

3 Solid carbide step drill

- Multitool for multiple processes in one operation
- 2 straight coolant holes
- Special surface treatment HSF



4 Solid carbide thread milling cutter

- For a large diameter range with the same pitch
- Internal coolant exiting in the flutes
- Adapted cutting edge geometry

2 HAM 40-5490 Alu HPC end mill

- Special geometry for smooth running and very little vibrations during machining
- High chipping volume
- Special rainbow-coloured carbon coating

1 HAM 40-7640 PCD arbor milling cutter

- Highest possible productivity
- Optimal surface quality and long tool life
- Internal coolant

Titanium

Titanium

- Aerospace
- Medical engineering
- Motor and racing sports

Titanium

Almost as light as aluminium but stronger than steel – these are the properties of titanium.
Titanium is approximately 30 times more expensive than high-quality steel alloys. The complex manufacturing process makes it so expensive.

The strength properties are in the range of tempered steels. Depending on the alloy, the tensile strength is in the range of 300 to 1150 N/mm^2.

The material titanium is being used more and more in a wide variety of industries. But processing this material also has its difficulties.

Titanium tends to work hardening when milling or turning, which means: if the friction on the cutting edge becomes too high, the beginning of work hardening can cause the tool to become dull.

Therefore, when milling or turning titanium, you need sharp and heat-resistant tools, the right cutting parameters and optimal chip formation.

Machining titanium is an important process in metal working, as titanium is used in many industries due to its excellent properties.

Titanium is a light, yet very strong metal with high corrosion resistance. It is also biocompatible, making it an ideal material for medical implants.

However, machining titanium is a challenge because the metal has high strength and hardness. It requires special tools and techniques to machine titanium efficiently.

One of the most common methods is metal cutting, in which the metal is shaped into the desired shape using cutting tools.

Turning titanium involves using special carbide or ceramic tools to cut the metal.

Due to the high heat generated when machining titanium, it is important that the tools have good heat resistance. In addition, the cutting speed and feed must be carefully selected to avoid overheating the workpiece.

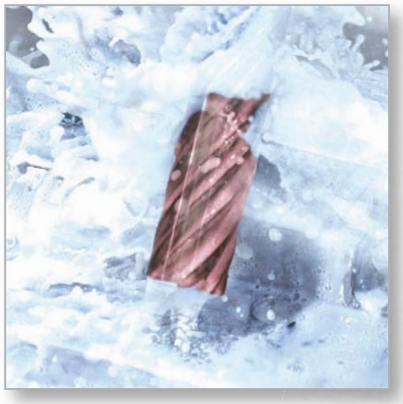
Special end mills are also required when milling titanium. Solid carbide cutters with high cutting edge stability and good heat resistance are particularly suitable for this.

Cooling the workpiece and tools is also important to prevent overheating.

Machining titanium also requires good lubrication to reduce tool wear and improve the surface quality of the workpiece.

Special cooling lubricants are used here that have a good lubricating effect and high cooling performance.

Machining titanium is a challenging task due to the metal's special properties.



Titanium work piece

A wide variety of processes was carried out on this component,
holes, threads and fits were made.

The component was edged with the titanium milling cutters, full-cut grooves were made and additional pockets and cutouts were added using trochoid volume machining.

3 HAM 40-1880 Engraving bit

- Centre cutting
- Special tool for engraving and copying

5 HAM 50-1080 Reamer

- Unequal division
- Short bevel
- Manufacturing tolerance as specified acc. DIN 1420

1 HAM 40-3001 Titanium end mill Z = 3

- Central internal cooling for maximum performance
- Very smooth running and low-vibration machining
- High chipping volume (up to 1,5 x D)

4 HAM Titanium drill

- Special chip flute geometry
- Internal coolant
- Special ground for machining titanium

2 HAM 40-3011 Titanium end mill Z = 5

- Central internal cooling for maximum performance
- Max. chipping volume at high surface quality
- Special surface treatment

Honeycomb

Honeycomb

- Aerospace
- Automotive
- Furniture industry

Honeycomb

Honeycomb is a material that takes its name from the structure of a honeycomb hive. It consists of a large number of hexagonal cells that are connected to each other.

These cells are usually made from a lightweight yet sturdy material such as aluminium, plastics or stainless steel.

The special structure of the honeycomb gives it some unique properties. On the one hand, it is very light because most of the material consists of air.

This makes it ideal for applications where low weight is of great importance, such as in aircraft construction or in the production of lightweight walls.

In addition, honeycomb is also very stable and resilient. The hexagonal shape of the cells ensures an even distribution of forces, giving the material high compressive and bending strength.

This makes it ideal for applications where high stability is required, such as in the automotive industry or construction.

Another advantage of honeycomb is its good sound insulation. The air in the cells acts as an insulator and absorbs sound, which can effectively reduce noise.

This makes the material particularly suitable for use in acoustics, for example in concert halls.

Honeycomb is also a very versatile material as it can be easily molded into different shapes and sizes. It can be manufactured in plate form or as a three-dimensional structure, depending on the requirements of each application.

It can also be combined with other materials such as glass fibres or resins to further improve the properties.

Overall, honeycomb is an extremely useful material with a variety of uses. Its lightweight, strong and sound-absorbing properties make it a popular choice in various industries.

Typical honeycomb panel options

Cover layers:
- Aluminium
- Stainless steel
- High pressure laminate
- G10 fibre glass
- Glass / epoxy / Prepreg

Cover layer finishes:
- Epoxy primer
- Mill finish
- Powder coating

Honeycomb cores:
- Aluminium
- Stainless steel
- Kevlar
- Nomex
- Polypropylene
- Polycarbonate

Adhesives:
- Hardened epoxy resin
- Modified epoxy film adhesive

Honeycomb work piece

Grooving, hemming, pocket milling and drilling show completely different challenges in materials such as honeycomb.

With the special tools for lightweight materials, a wide range of processing operations can be mastered.

1 HAM 30-1320

- Special point ground for fibre compound materials
- Periphery cutting edge in sickle design
- Especially for thin-walled components

2 Solid carbide special router

- Special spiral teeth
- Right hand cutting

3 Solid carbide end mill up-/downcut

- Diamond coated
- Special cutting edge geometry

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