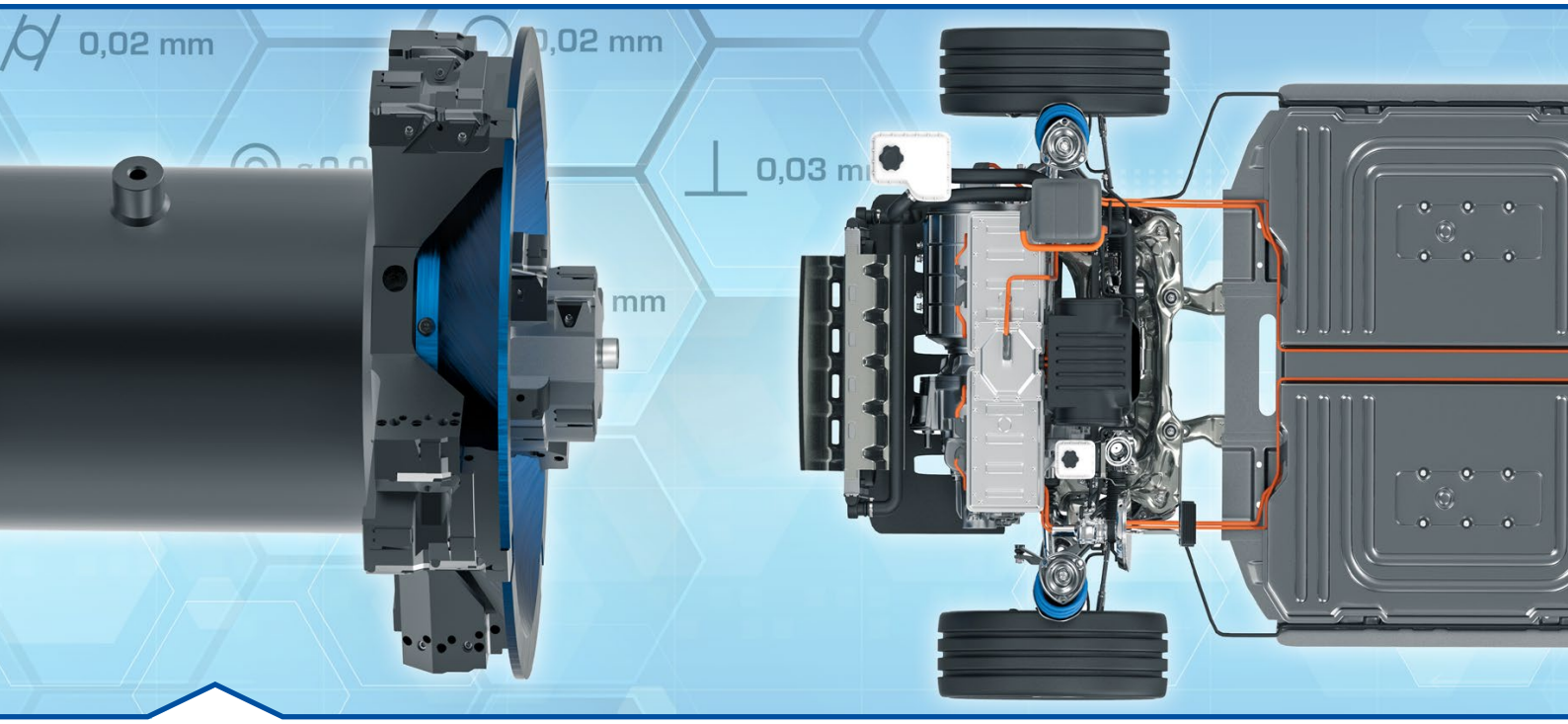


Your technology partner for cost-effective machining

ELECTRIFIED MOBILITY

Markets and sectors

MAPAL has developed an in-depth understanding of almost all processes and applications in machining manufacturing through many years of close cooperation with customers. The areas of application for MAPAL machining solutions extend across various sectors.

MAPAL has been developing innovations to meet the challenges of the automotive industry and large-scale production for a long time. These innovations are successfully used by reputable manufacturers and their suppliers in the chassis as well as in the powertrain sector and in electric mobility.

MAPAL is an accredited partner to the aerospace industry and sets trends and standards in manufacturing and machining technology with reliable solutions. MAPAL also offers a comprehensive product range for the new area of expertise tool and mould making.

Germany
Headquarters of the group of companies

Close to the customer – globally

The close dialogue with customers and thus the early recognition of technological requirements and approaches for innovations are essential pillars of the MAPAL company policy. As a result, MAPAL is directly represented with production and sales branches in 25 countries. This ensures close proximity, personal contacts and long-term partnerships.

In addition to the main production facilities in Germany, local production facilities in strategically important markets worldwide guarantee short delivery times. They are responsible for the manufacture of selected products as well as for reconditioning, repairs and repeat orders for the local market.

In addition to its own branches, MAPAL products are available through sales agencies in a further 19 countries.

No. 1
Technology leader for the machining of cubic parts.

Subsidiaries offering production, sales and service in
25 countries.

Yearly investment in research and development amounting to
6% of turnover.

Over
450
technical consultants in the field.

More than
300
apprentices worldwide.

Our biggest asset: More than
5,000
staff worldwide.

MAPAL sectors

1 Electric mobility
2 Automotive
3 Aerospace
4 Fluid power
5 Energy production
6 Medical technology
7 Die & mould
8 Shipbuilding
9 Rail transport

Electrified mobility – tool solutions for every concept

Mobility is changing – the goal is a CO2-neutral future

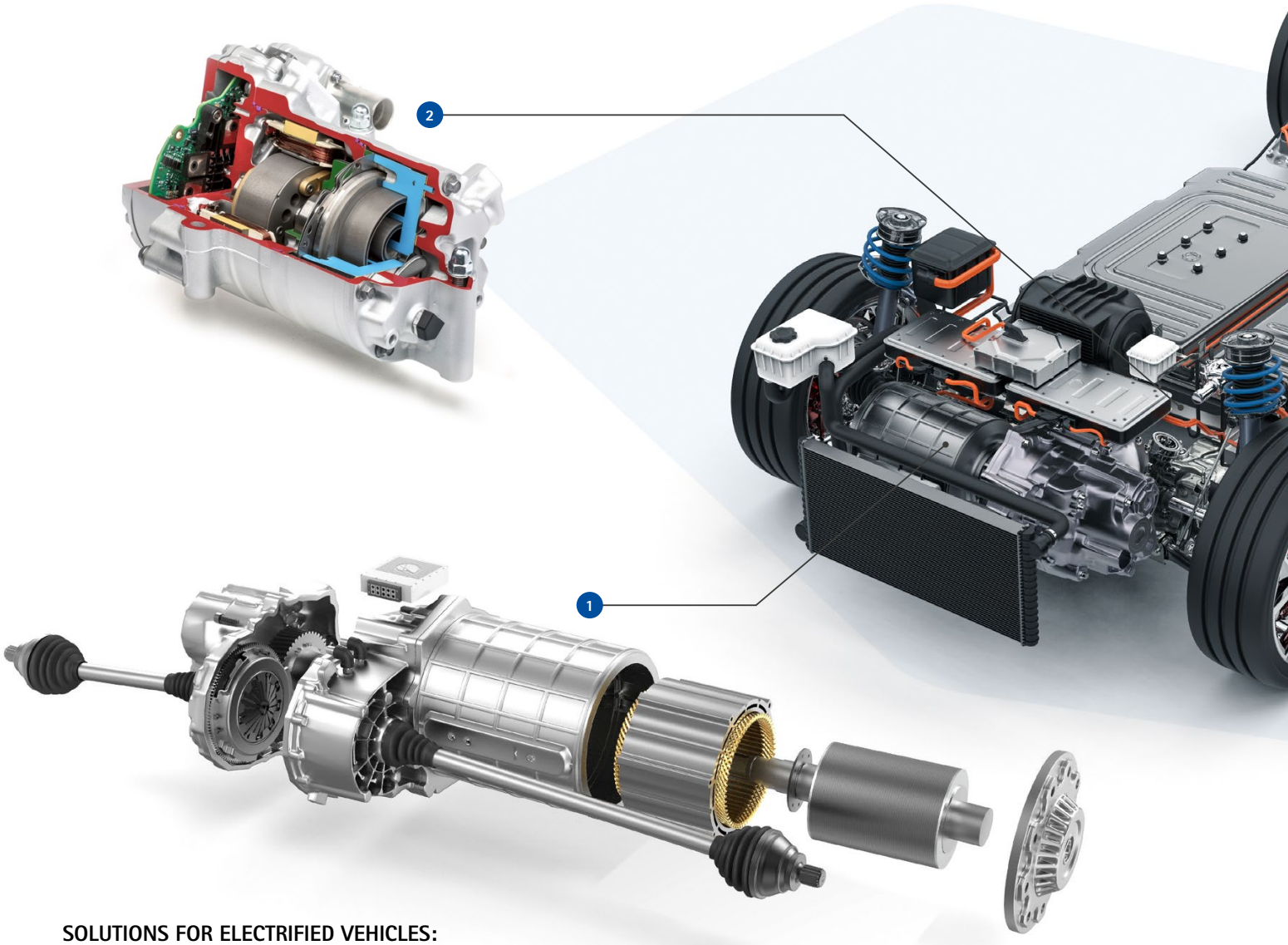
Mobility is changing, with a focus on a carbon-neutral future and sustainability. To meet this objective, the automotive industry is working on alternative drive concepts. The electric drive is increasingly replacing the combustion engine. However, this transition won't happen overnight. Some parts of the conventional drive are being further developed and the share of hybrid drives is increasing. At the same time, the production of battery-powered electric vehicles is increasing rapidly and has already almost reached same the production volume as conventional drives.

As a supplier of cutting tools for the automotive industry, MAPAL incorporated the topic of sustainability into the company's strategic orientation at an early stage. The company has transferred its expertise in machining the conventional power train to the parts to be machined in electrically powered vehicles. Only through efficient tool solutions for productive series processes can the change be shaped successfully and sustainably. MAPAL plays an important role in overcoming the challenges of e-mobility and contributing to the environmentally friendly mobility of the future.

CONTENTS

Scan the QR code for more information

New systems and parts for electrified mobility



SOLUTIONS FOR ELECTRIFIED VEHICLES:

1

Electrified drives
(Hybrid and fully electric)

High-precision with large diameters
Different electric motor housings are used in vehicles with electric drives. You can differentiate between three basic types of construction. MAPAL offers innovative tool solutions for machining tasks with the housing types.

>> More from page 8

2

Electrified auxiliary units
(Thermal management)

Spiral shapes with tolerances in the µm range
Not only the drive and energy storage systems are affected by the electrification of vehicles, but also some auxiliary units. An example of this is the electric refrigerant compressor (scroll compressor).

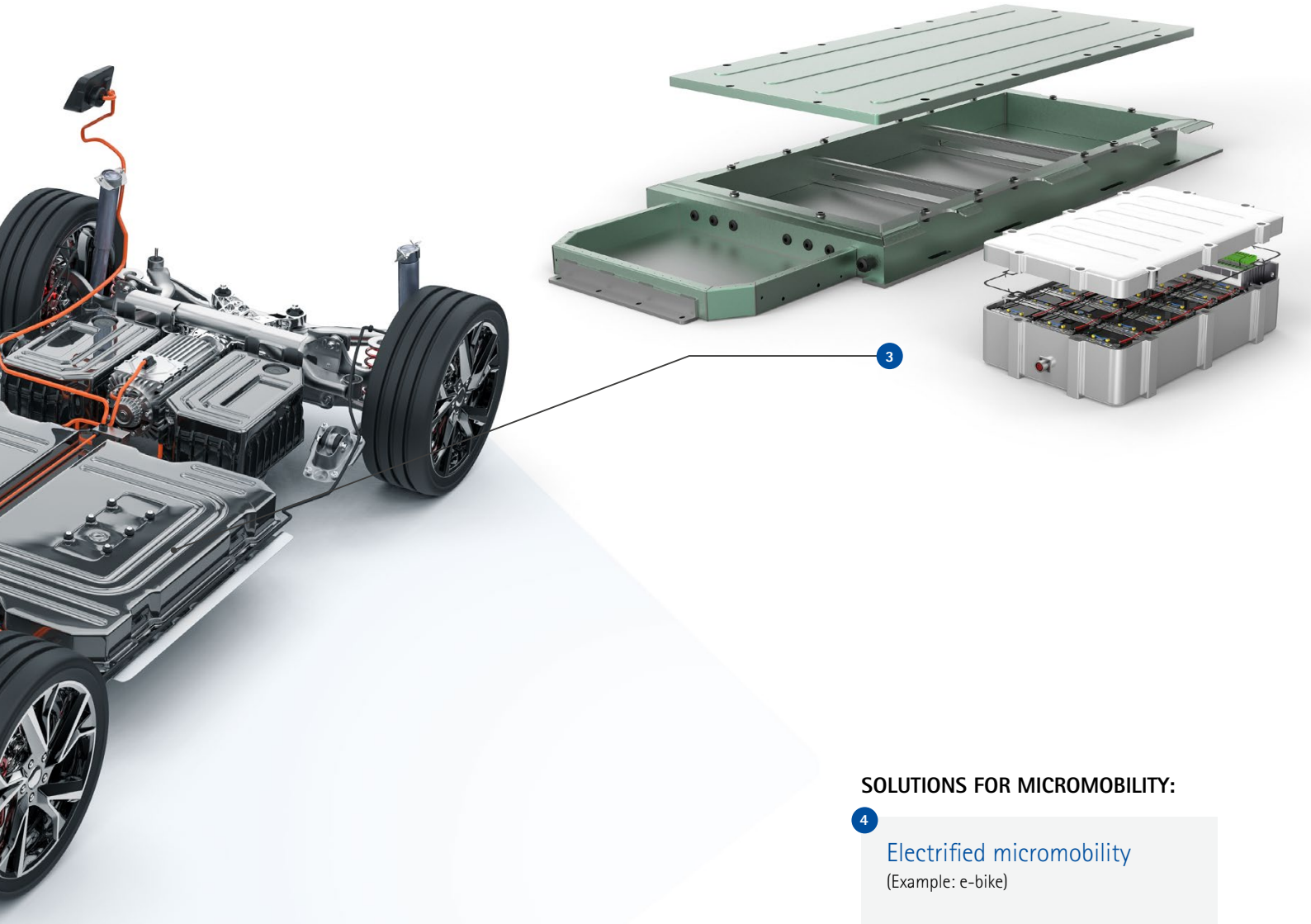
>> More from page 22

3

Energy supply
(Storage, control, charging)

Machining complex, thin-walled housings vibration-free
MAPAL offers the appropriate tools with the optimal machining strategy for the various housing variants for batteries and power electronics. The powerful tool portfolio includes PCD and solid carbide tools.

>> More from page 24



3

SOLUTIONS FOR MICROMOBILITY:

4

Electrified micromobility

(Example: e-bike)

High-precision even on a small scale
The very thin-walled housings made of aluminium or magnesium must be manufactured with tight shape, running and position tolerances. The high precision guarantees the tangible comfort of the drives for e-bikes.

>> More from page 28

4

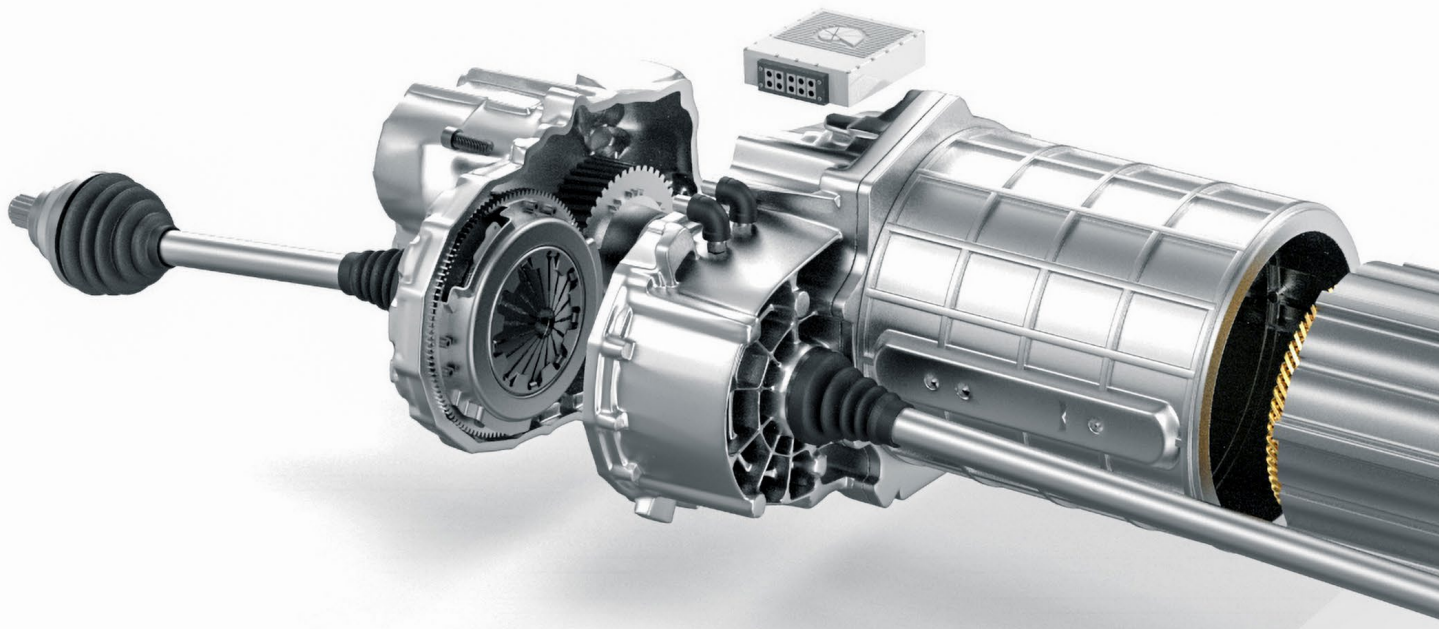
Electrified drives

Automobile manufacturers and suppliers are facing new challenges when it comes to components for electric motors. The example of the housing of an electric motor shows how big these challenges are: Compared to a transmission housing, this has to be manufactured within significantly tighter tolerances, since the accuracy has a decisive influence on the efficiency of the motor.

In addition, due to the special structure, such as integrated cooling channels, the electric motor housing is usually significantly thinner than a transmission housing. In addition, bearing bushes made of steel materials are pressed into some of these housings. Special protection shields in the tool ensure that steel chips do not come into contact with the aluminium surfaces during processing and damage them.

Required dimensional tolerances

0,02 mm	ø 0,05 mm	0,05 mm	0,02 mm	0,03 mm



BASIC – PERFORMANCE – EXPERT

Always the right solution!

Basic SOLUTION — Flexible and cost-effective tool solutions for small series

Adjustable tool solutions enable flexible processing, which is particularly relevant for small series and prototypes due to changing requirements. MAPAL offers simple, flexible and cost-effective tool solutions for this – optimally set up for all requirements

Performance SOLUTION — Weight-optimised tools for series production with hollow shank taper A63

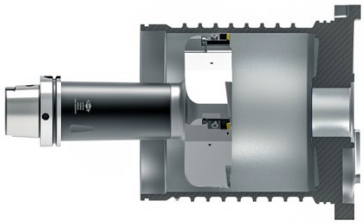
Continuing to use existing machines saves time and money. MAPAL has the necessary know-how to support its customers in the reliable conversion for series production – individually customised to their needs. The Performance solution enables reliable implementation that takes the existing limiting factors (tool weight, machine performance, installation space, etc.) into account.

Expert SOLUTION — Highly productive tools for large-scale production

MAPAL takes on the planning of complete workpieces and implements a safe process for large-scale production. Customers can concentrate on their core competences – quickly, flexibly and transparently. Highest level of productivity with maximum quality demands are the priority.

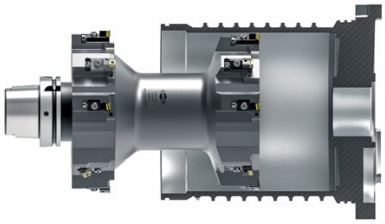
Basic procedure for machining electric motor housings

The machining process as well as the tools are designed individually depending on the measurement situation, machine park and clamping setup. In this way, the cutting forces applied to the component are kept as low as possible. In addition to the requirements of the component, in most cases the performance of the processing machine is decisive for the design of the tools.



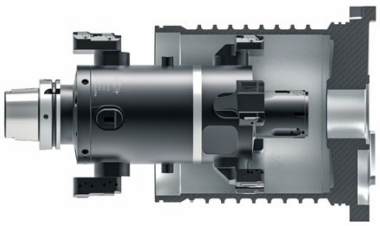
1. Pre-machining

The use of an ISO boring tool is particularly suitable for pre-machining. This method allows high cutting speeds and feed rates to remove material quickly and economically. Under specific conditions, for example with precisely pre-cast parts and corresponding machine conditions, the first roughing operation can be omitted.



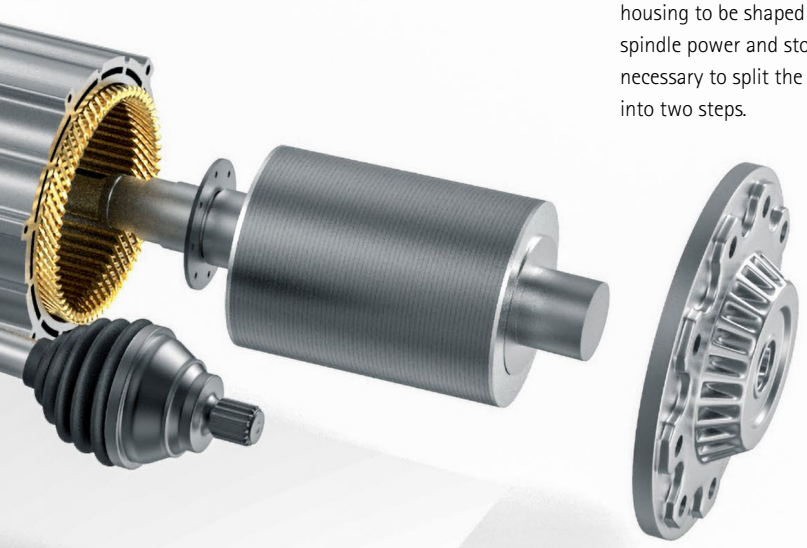
2. Semi-finish machining

During semi-finish machining, the complex contour train of the electric motor housing is prepared. This is done in such a way that the complete contour with chamfers and radial transitions are produced in the required quality during finish machining. This step allows the housing to be shaped optimally. Depending on spindle power and stock removal, it may be necessary to split the semi-finish machining into two steps.

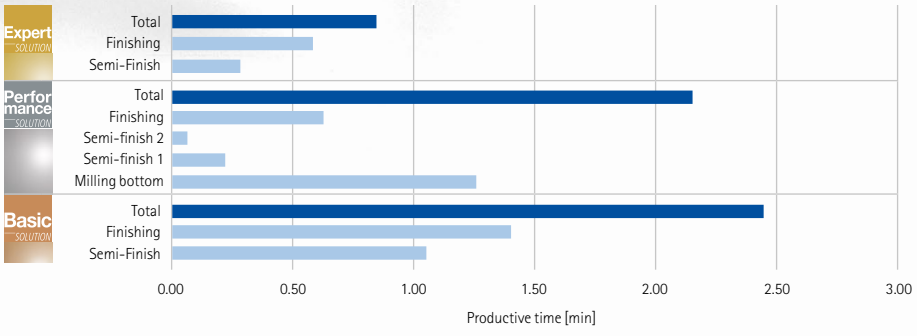


3. Finish machining

In the final step, the stator drilling is precisely machined with a fine boring tool that has finely adjustable indexable blades and guide pads.



Basic | Performance | Expert – Comparison of productive times

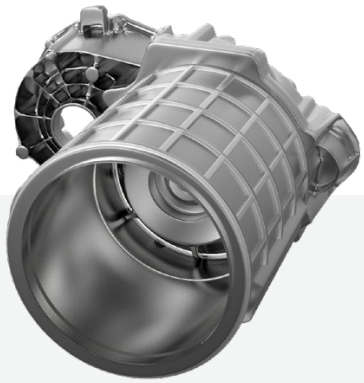


The various solution levels differ in terms of the achievable productive times.

An overview of the solution packages can be found on page 17.

Machining requirements and features of different housing types

Highly integrated electric motor housing



Description:
Highly integrated, complex housing with stator mount, transmission mount and connection for the power electronics. High functional integration saves assembly costs. Compact design. Complex cast housing as a result.

FEATURES

- Stator incorporated directly in the housing or via a stator carrier / cooling jacket
- Stator bore with stages and flat surfaces as functional surfaces
- A bearing bore of the rotor is integrated coaxially with the stator bore in the housing
- Positioning of the second bearing cover via dowel pins or fitting surfaces; second bearing bore must be coaxial
- Bearing bores of transmission stages integrated in the housing; high concentricity and positional accuracy are required
- Cooling channels partially integrated in the housing
- Complex cast aluminium housing

MACHINING REQUIREMENTS

- Elaborate contour trains with several diameter levels (→ high cutting forces and large machining volume)
- Mixed processing (→ chip separation / removal)
- Interrupted cuts (→ contacting, cooling circuit)
- 15° to 30° flat lead-in chamfers (→ flow chip formation and high radial forces)

Pot-shaped electric motor housing

Description:
To reduce the complexity, in particular to implement a simpler construction of the cooling jacket, pot-shaped or bell-shaped housings or stator supports are used.

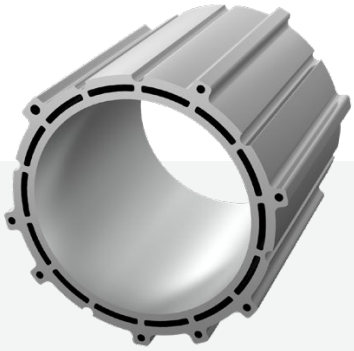
FEATURES

- As an intermediate housing for integration in the overall system
- Stator bore with stages and flat surfaces as functional surfaces
- A bearing bore of the rotor is integrated coaxially with the stator bore in the housing
- Positioning via fitting surfaces on the outer surface
- Cooling channels as ribs on the outside
- Thin-walled, susceptible to vibration
- Tension problematic

MACHINING REQUIREMENTS

- Extremely thin-walled parts (→ a_p corresponds to wall strength)
- Outer cooling ribs must be machined
- Pot or bell shape (→ promotes vibrations, special clamping concepts and vibration dampers)
- 15° to 30° flat lead-in chamfers (→ flow chip formation and high radial forces)

Tubular
electric motor housing

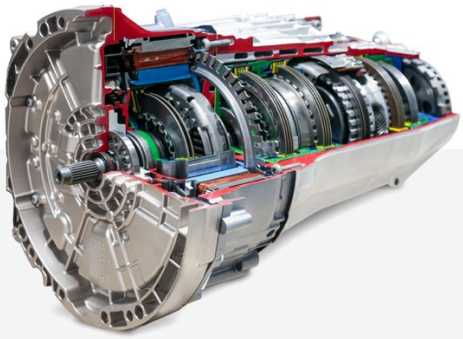


Description:
The simplest design of motor housings is tubular. The length of the housing and thus the electrical machine can be varied comparatively easily for different powers. As a result, the installation effort increases due to the low level of functional integration.

FEATURES
- No rotor bearing bores integrated in the housing
- Two bearing covers to hold the rotor
- Positioning of the two bearing covers over fitting surfaces for coaxiality of the bearing points
- Minimal complexity
- Practically rotationally symmetrical
- Thin-walled, susceptible to vibration
- Tension problematic

MACHINING REQUIREMENTS
- More stable components usually with an internal cooling structure
- Extruded profiles also possible (AlSi1 → flow chips)
- Without clamping straps (→ special clamping concepts)
- Partly with fits on both sides in IT6 tolerance

Hybrid transmission housing and hybrid module/intermediate housing



Description:
Integration of the electrical machine into the existing transmission architecture using disk-shaped hybrid modules or intermediate housing. Space-neutral structures are also implemented with partially pot-shaped housings as slide-in parts.

FEATURES

Hybrid module/intermediate housing
- Mainly incorporation of the stator
- No rotor bearing with disc shape
- Rotor bearing integrated with pot shape

Hybrid transmission housing
- Extreme length-diameter ratios
- Thin-walled, susceptible to vibration
- Elaborate contour trains
- Interrupted cut

MACHINING REQUIREMENTS

Hybrid transmission housing
- IT6 tolerance
- High demands on coaxiality and stage dimensions
- Restricted maximum weight and moment of tilt

Expert SOLUTION

Solutions for electric motor housings

Series solution with HSK-A100

Highly productive for large diameters

- Three stage process (pre-, semi-finish and finish machining)
- Large machining diameter > 220 mm
- The highest levels of performance and precision
- Ideal process for large quantities and short cycle times

1. Pre-machining

Efficient roughing with high cutting depth

ISO BORING TOOL IN ALUMINIUM DESIGN

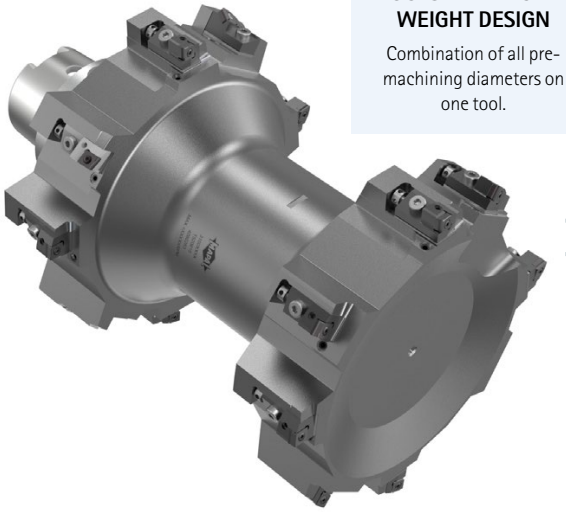
- PCD-tipped indexable inserts
- ISO cartridges
- Designed as single or multi-stage

2. Semi-finish machining

Contour-forming to approximate the final contour

TOOLS WITH LIGHT-WEIGHT DESIGN

Combination of all pre-machining diameters on one tool.

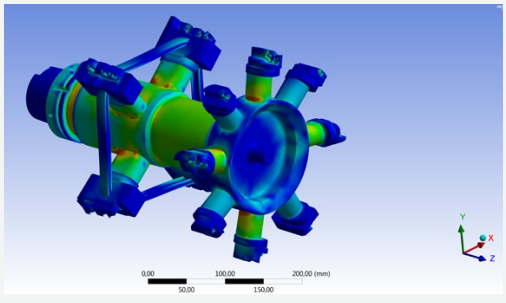


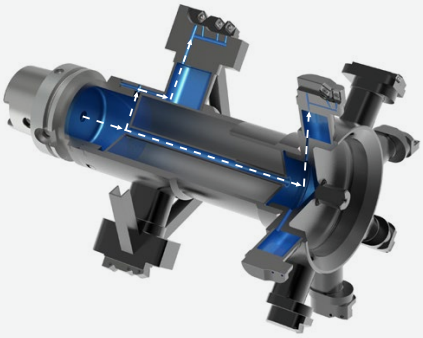
PRECISION BORING TOOL

- PCD-tipped indexable inserts
- Design as welded construction or with tool body made of aluminium

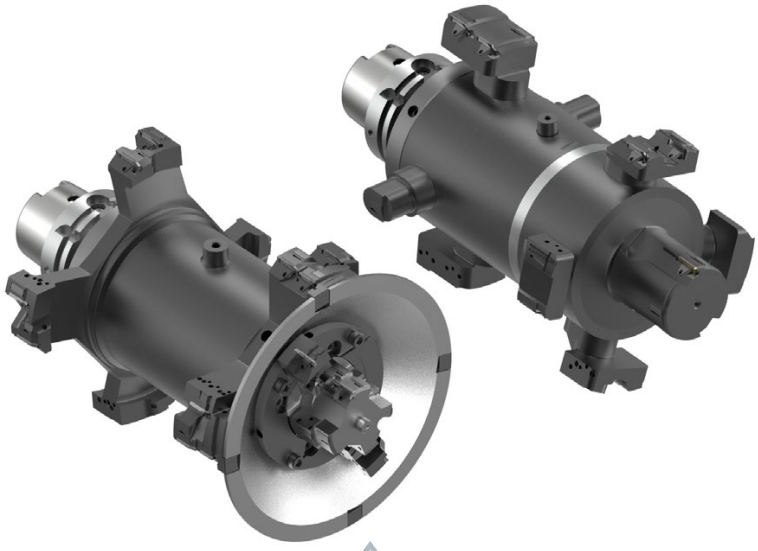
Individual tool design for specific requirements

- Simulation of the cutting force components
- Calculation of weight and moment of tilt
- FEM calculation of the natural frequencies of the system and the flexibility under axial force / torsional load
- Calculation of coolant distribution and volume flows





PATENT PENDING



3.1 Finish machining

Innovation for the highest precision

FINE BORING TOOL IN LIGHTWEIGHT CONSTRUCTION MADE OF STEEL WITH PROTECTION SHIELD FOR MIXED MACHINING OF THE BEARING BORE

- PCD-tipped indexable inserts for aluminium housing
- Cermet indexable inserts for machining of steel bearing bushes
- Finely adjustable and temperature stable
- Guide pad technology

In detail:
With the help of a special chip guiding stage, the appropriate coolant supply and open chip flutes, the steel chips are reliably removed to the front. The aluminium chips, on the other hand, are removed to the rear by a specially designed backwash. In order to ensure that no steel chips get into the aluminium area, the tool is equipped with a so-called protection shield, which ensures that the steel chips stay in the front area.

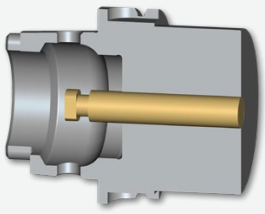
3.2 Finish machining

Flexible machining of the inner contour

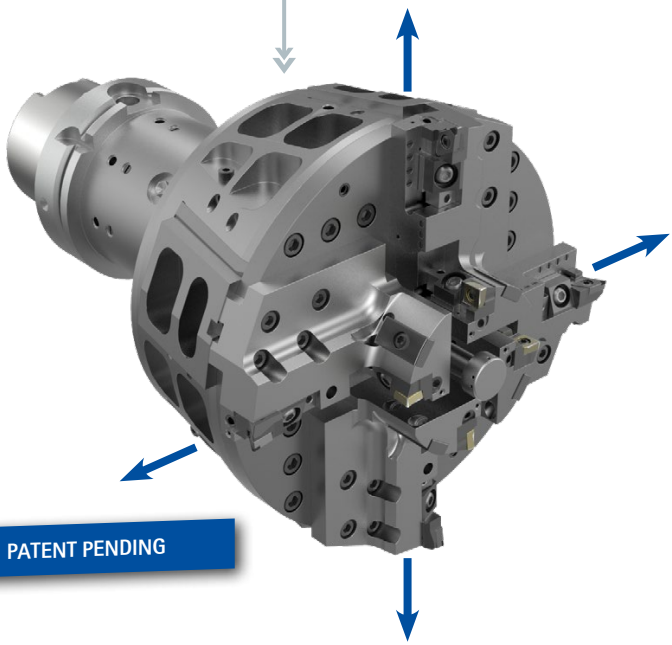
ACTUATING TOOL FOR U-AXIS SYSTEMS

- Suitable for machining of housing variants
- To compensate for insert wear

In detail:



U-AXIS
(rotary / translational)
The movable slides are moved via the U-axis (pull or rotating rod) of the processing machine and controlled via the machine control and set via the machine's NC control. This is a fully integrated NC axis that can be used for contour machining.



PATENT PENDING

Performance SOLUTION

Solutions for electric motor housings

Series solution with HSK-A63

For medium and small diameters

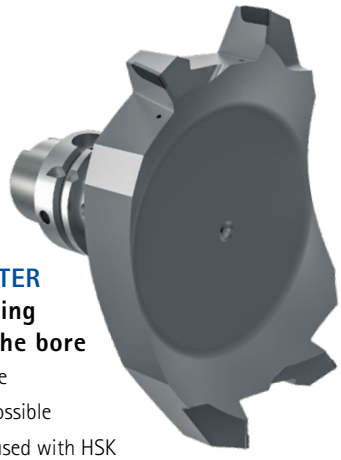
- Specially light tools required
- Diameter of the stator bore < 220 mm recommended
- Tools adapted to less performance and space available
- Also suitable for reconditioning existing machines and systems

1. Pre-machining

HELIX MILLING CUTTER WITH ISO INDEXABLE INSERTS

Flexible for different diameters

- Coated ISO indexable inserts made of carbide or PCD-tipped indexable inserts
- Reduced cutting forces
- Standard product
- HSK extension for different machining depths

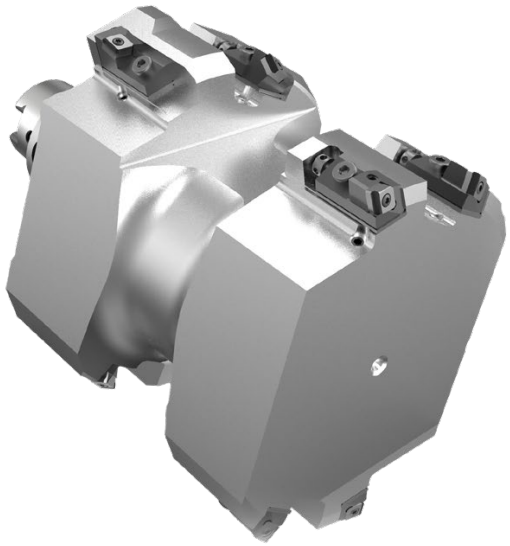


PCD FORM CUTTER

Contour machining the bottom of the bore

- Brazed cutting edge
- Special contours possible
- Can optionally be used with HSK extensions

2. Semi-finish machining



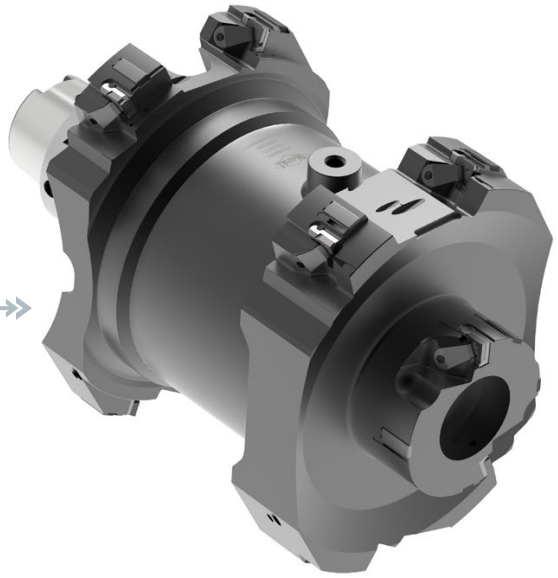
PRECISION BORING TOOL

Single-stage or multi-stage

- ISO cartridges
- PCD-tipped ISO indexable inserts
- Tool body made of aluminium

SEMI-FINISH DOUBLE-STAGE OR SINGLE-STAGE

The right solution depending on part size and machine conditions.

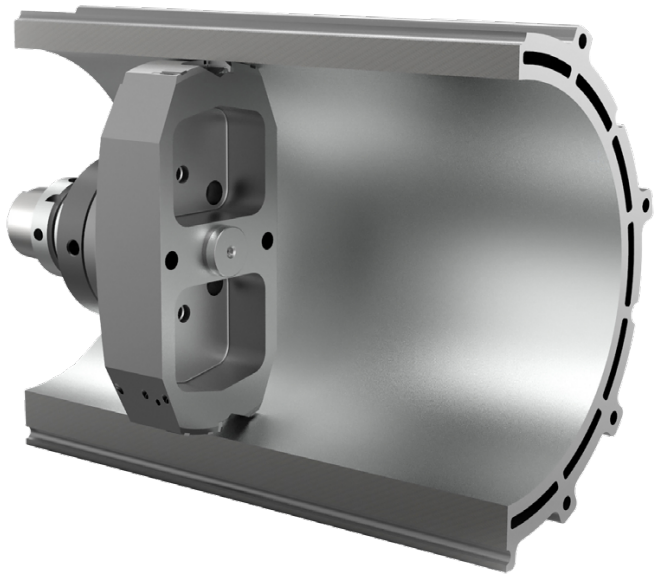


3. Finish machining

MULTI-STEPPED FINE BORING TOOL IN LIGHT-WEIGHT CONSTRUCTION MADE OF STEEL

Finishing of all functional diameters

- PCD-tipped indexable inserts
- Cermet indexable inserts for machining of steel bearing bushes
- Finely adjustable and temperature stable
- Guide pad technology with EA system



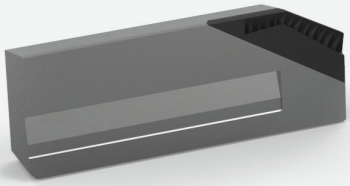
COMPACT FINE BORING TOOL WITH GUIDE PADS

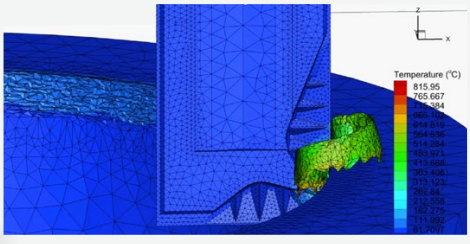
Finishing of individual diameter steps

- ø 210 mm
- PCD-tipped indexable inserts
- Finely adjustable
- Guide pads made of PCD
- Tool shape adapted to magazine changer

Process reliability through chip control – chip guiding stage for the fine machining of AlSi alloys

MAPAL has developed a new chip breaker to ensure defined chip breaking when boring and reaming with PCD aluminium with a low content of silicon. Its special topology, which was developed with the help of 3D simulations, ensures a defined chip breaking and thus short chips. Defined chip breakage and a defined chip shape are guaranteed even with low feed rates and low allowances. This ensures the highest performance and process reliability.





Basic SOLUTION

Solutions for electric motor housings

Prototype, pre-series and small series construction

Simple, flexible and cost-effective tool solutions

- Machining on existing machines
- Standard tools or simple custom tools
- Compromise solutions → small machine – big tool
- Cycle time is not the focus
- High flexibility is what is wanted
- Universal application
- Contour independent

1. Pre-machining

Flexible for different diameters

2. Pre- and finish machining

With standard tools

HELIX MILLING CUTTER WITH ISO INDEXABLE INSERTS

- Coated ISO indexable inserts made of carbide or PCD-tipped indexable inserts
- Reduced cutting forces
- Standard product
- HSK extension for different machining depths

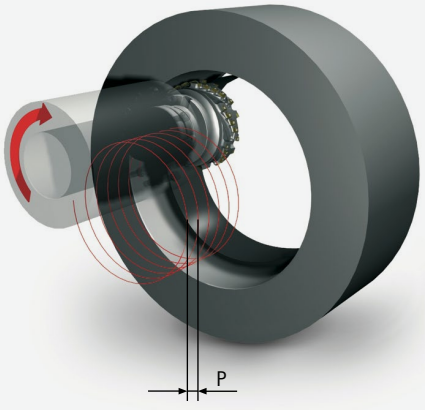
MODULE BORE – HIGH LEVEL OF FLEXIBILITY DURING BORING AND FINE BORING

- Pre- and finish machining system
- Modular construction
- Standard range from ø 87 mm – 1000 mm
- Fine boring cartridge adjustable in the µm range
- Easy to handle

Helix milling – helical angled entry

The helical angled entry is an alternative to boring. This involves a circular movement with simultaneous axial feed. Due to the larger machining path, the machining time is longer compared to boring. However, the cutting forces that occur are significantly lower, which means that the stator bore can also be machined on machines with low torque and low power. In addition, the use of a helix milling cutter enables pre-machining with different diameters.

Pitch (P):
The pitch (P) corresponds to the axial infeed per revolution. This depends on the workpiece, tool length, workpiece material and machine.



Solution packages for stator drilling

Basic – Performance – Expert for internal machining

Expert SOLUTION

Series solution with HSK-A100 Highly productive for large diameters

- Three stage process (pre-, semi-finish and finish machining)
- Large machining diameter > 220 mm
- The highest levels of performance and precision
- Ideal process for large quantities and short cycle times

Performance SOLUTION

Series solution with hollow shank taper HSK-A63 / HSK-A100 Process-reliable solution with adapted performance and requirement spectrum

- Three stage process (pre-, semi-finish and finish machining)
- Specially light tools
- Large parts on compact machines
- Optimal solution for small and medium quantities

Basic SOLUTION

Prototype solution with standard tools

- Modular construction
- Fine boring cartridge adjustable in the µm range
- Easy to handle
- Multi-stage process
- Ideal for large diameter variation

Solutions for electric motor housings

External machining

Highly productive for large diameters

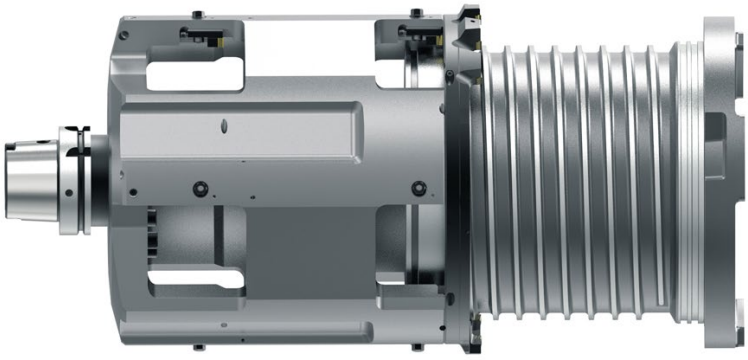
External machining of stator housings for electric motors is a demanding task. These housings, which often come in tubular or pot-shaped designs, are crucial for the efficiency of the electric motor. Several challenges have to be overcome during the process. The thin-walled aluminium housings with integrated ribs for the cooling circuit require the highest precision in terms of diameter accuracy, shape and position tolerances. The concentricity between different diameters is of huge importance.

1. Pre-machining

HELIX MILLING CUTTER WITH ISO INDEXABLE INSERTS

Roughing of outer diameter and surface

- Coated ISO indexable inserts made of carbide or PCD-tipped indexable inserts
- Reduced cutting forces
- Standard product
- HSK extension for different machining depths



ISO BORING TOOL

Roughing of outer diameter

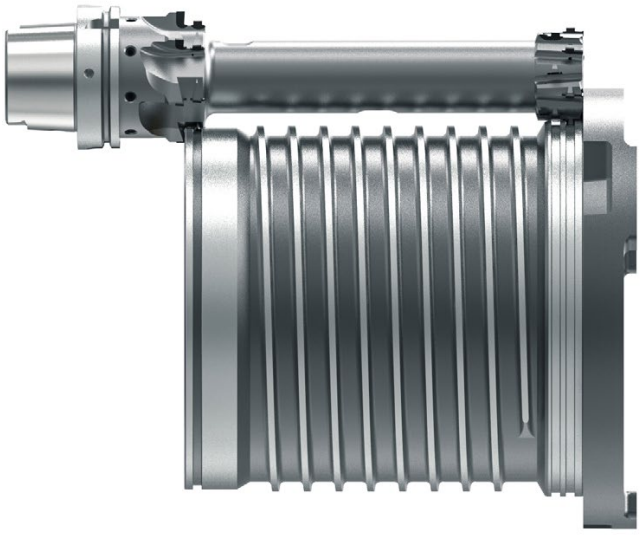
- Multi-stage bell tool for external machining
- ISO indexable inserts

MILLING CUTTER WITH ISO INDEXABLE INSERTS

Roughing the sealing groove

- Coated ISO indexable inserts made of carbide
- Optionally with vibration damper
- Effective roughing of the sealing grooves

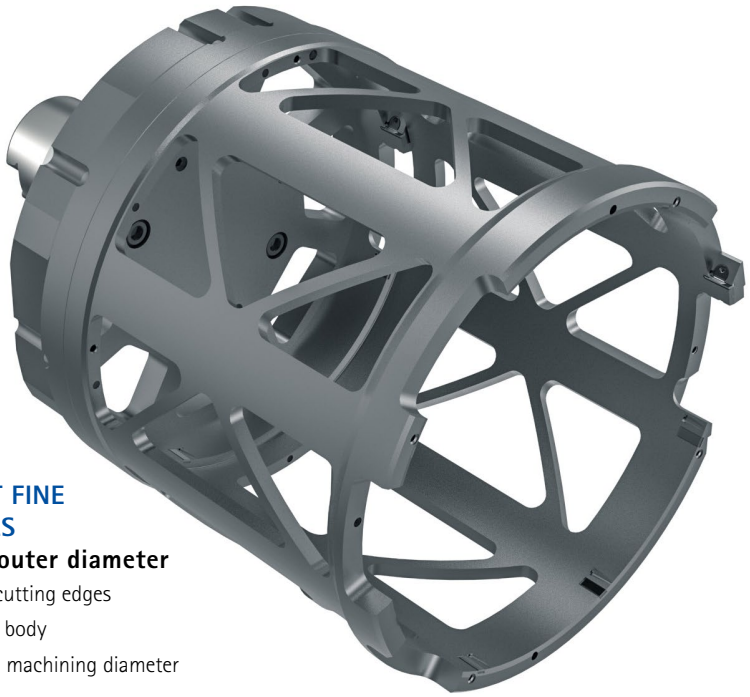
2. Finish machining



PCD MILLING CUTTER WITH SPECIAL CONTOUR

Finishing the sealing groove

- PCD form cutting edge
- Perfect geometry of the individual recess contours
- Optionally with vibration damper
- Finish machining of all recesses in a single cut



LIGHTWEIGHT FINE BORING TOOLS

Finishing the outer diameter

- Adjustable PCD cutting edges
- Lightweight tool body
- Up to Ø 260 mm machining diameter

Complete process for pot-shaped stator housings on machining centre:

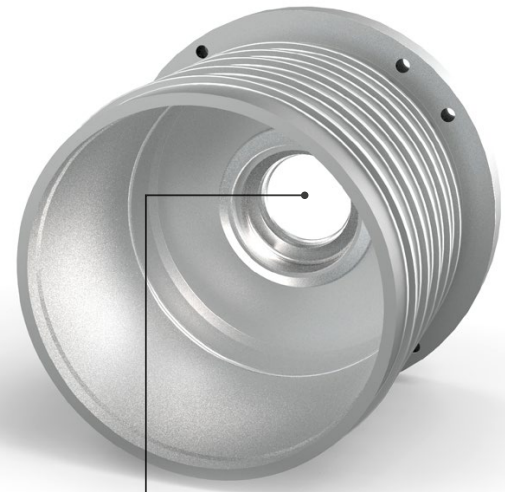
Internal machining is extremely efficient and precise with the help of the drilling tools. Furthermore, the innovative solution for machining centres allows the outside to be machined in the same clamping setup without reclamping. This offers a seamless opportunity for customers making the transition to e-mobility, using their existing machinery with a focus on machining large cubic aluminium housings.

Solutions for electric motor housings

Bearing and position bores

With maximum concentricity and roundness

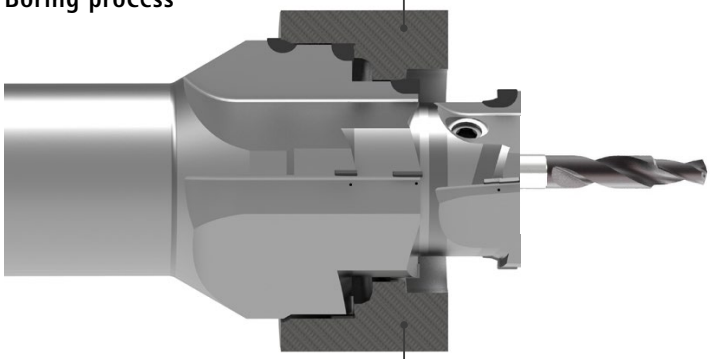
A constant air gap between rotor and stator is crucial for the functioning and efficiency of the electric motor. In addition to the coaxiality of the bearing and stator bores, the roundness and cylindrical shape of the bearing seat are decisive for this. In order to meet the high coaxiality demands, it is advantageous to machine the bearing seat in one clamping setup (retraction machining). In the case of tubular or pot-shaped housing, there is at least one bearing point in a separate bearing cover, which is positioned on the electric motor housing via position bores or fitting surfaces.



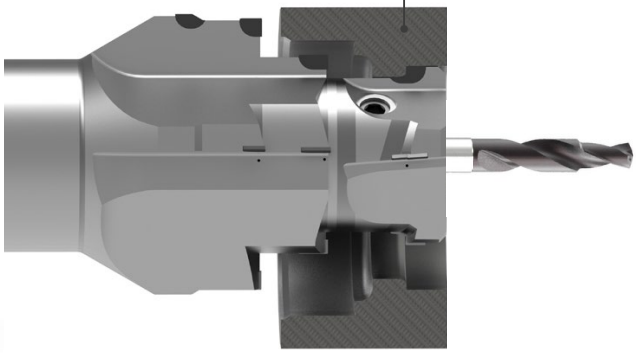
1. Pre-machining

Boring of bearing and position bores

Boring process



Circular milling



ISO BORING TOOL

- Multi-stage boring tool with solid carbide step drill
- PCD-tipped ISO indexable inserts

PCD BORE MILLING TOOL

- Multi-stage bore milling tool with solid carbide step drill
- Boring and circular milling with a single tool
- Brazed PCD cutting edge

2. Finish machining

MULTI-STAGE ISO CIRCULAR MILLING CUTTER WITH INTEGRATED BORING STAGE

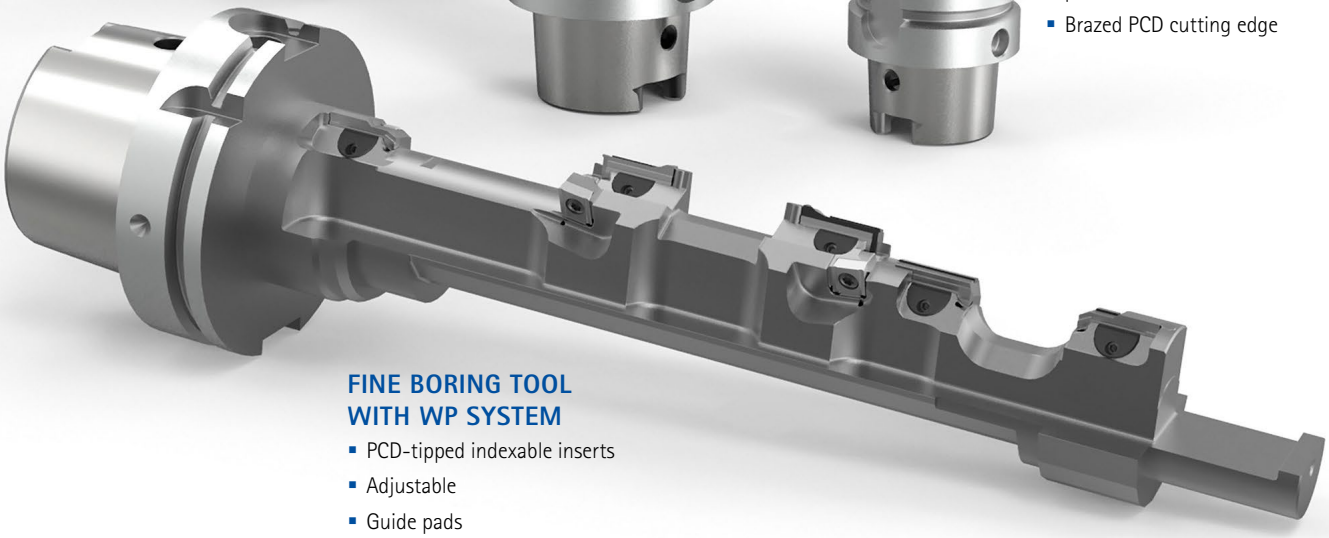
- Boring of the bearing bore
- Finishing of face surfaces and radial recess

FINE BORING TOOL WITH WP SYSTEM

- PCD-tipped indexable inserts
- Adjustable
- Guide pads
- Integrated retraction machining

PRECISION BORING TOOL

- Multi-stage combination tool with brazed step drill
- Finishing of bearing and position bore
- Brazed PCD cutting edge



FINE BORING TOOL WITH WP SYSTEM

- PCD-tipped indexable inserts
- Adjustable
- Guide pads
- Integrated retraction machining

Sealing and contact surfaces

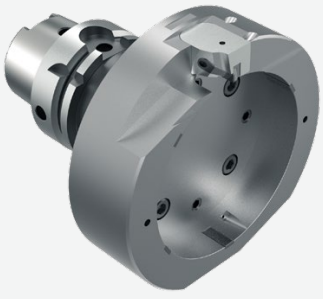
FACE MILLING CUTTER WITH PCD MILLING INSERTS

- Creation of defined surface profiles for sealing and contact surfaces (e.g. cross-cut structures)
- Surface finish $R_z < 1$

MONOLITHIC FACE MILLING CUTTER WITH PCD MILLING INSERTS

- Long overhangs make it possible to work on hard-to-reach areas

External machining of the bearing bore



EXTERNAL REAMER WITH EA SYSTEM

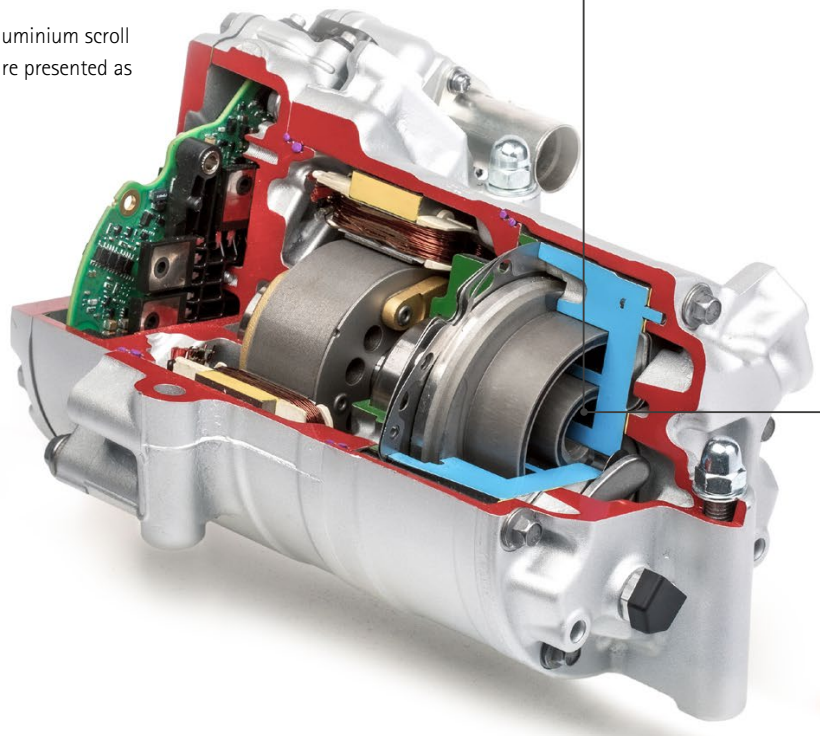
- External machining of the bearing bore

Electrified auxiliary units

As a result of electrification in the automotive industry, more and more drive tasks of the internal combustion engines are being performed by electrified components. By electrifying the auxiliary units, these components can be used as required and depending on the load, and thus contribute to reduced energy consumption. They stand out thanks to their high reliability and low noise emissions as well as excellent energy efficiency.

An example of this is the scroll compressor, which is used as an electric refrigerant compressor in thermal management.

Three specific machining operations on an aluminium scroll compressor for use in an electrified vehicle are presented as examples.

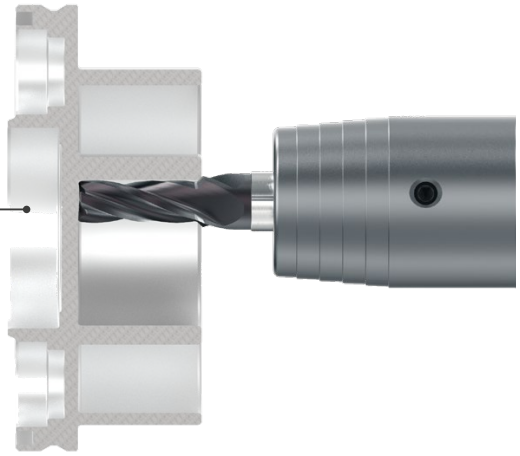


FEATURES

- Core pieces orbit and fixed scroll
- Geometric accuracy and connection is paramount
- Exact positioning of the spirals to each other

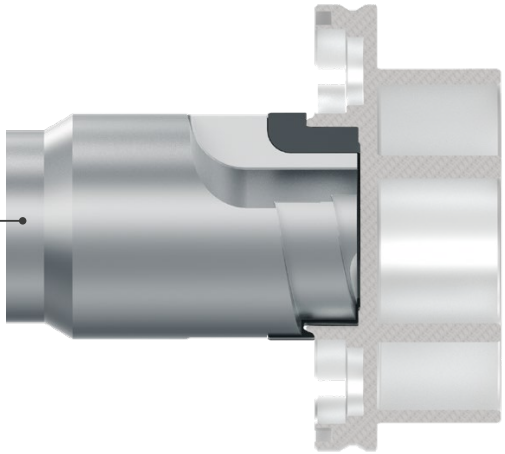
MACHINING REQUIREMENTS

- High degree of shape accuracy of the spirals (≤ 20 µm)
- High perpendicularity of flanks to base surface (≤ 20 µm)
- Parallel alignment and flatness of ≤ 10 µm
- Surface roughness (R_z) in the single-digit range
- Perfect interaction between machine and tool



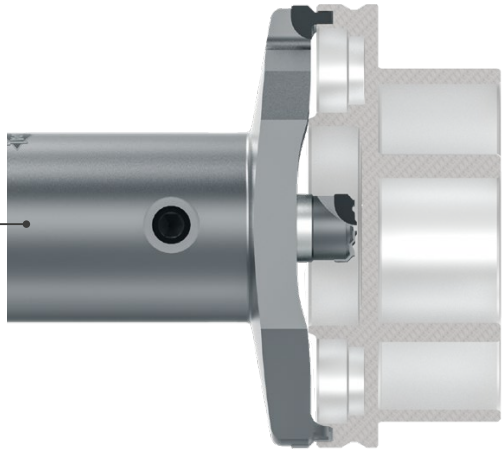
1 HIGH PRECISION SPIRAL SHAPES

- Pre-machining and finish machining with solid carbide milling cutters
- Extremely sharp cutting edges ensure high dimensional accuracy



2 PRECISE BEARING BORE

- Pre-machining is carried out by circular milling with a triple-fluted PCD milling cutter
- Finish machining with double edge PCD boring tool with two stages and distribution of the cut to reduce the cutting forces



3 RECESSES FOR SEALING ELEMENTS

- Pre-machining and finish machining of the recesses is carried out with double-edged PCD boring tools
- Combination tool enables the machining of the connection bore
- Distribution of the cut reduces cutting forces and ensures optimal chip formation

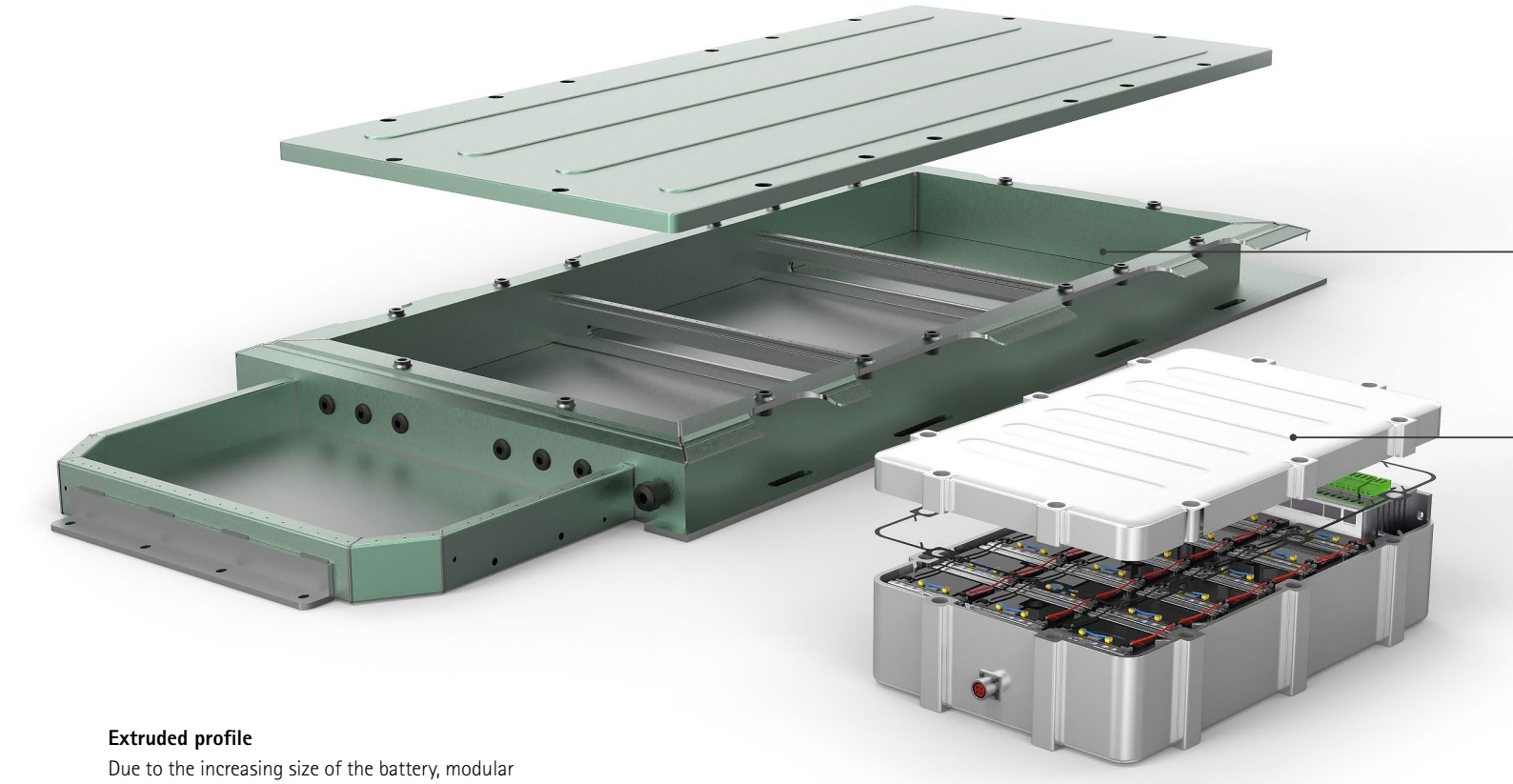
MAPAL offers the complete process for machining scroll compressors from a single source.

Energy supply housing

Different housings are used to protect electronic parts, such as battery systems or power electronics, from external environmental influences and to attach the parts to the interior in order to ensure that they function properly during vehicle operation. The requirements for the housing depend on the electronic system and drive concept. Different materials and manufacturing processes are currently used.

FEATURES

- Unstable, thin-walled components (susceptible to vibration)
- Construction as a cast tub or as a frame construction made of hollow profiles
- Partly low-silicon aluminium
- Extensive (2 x 3 m)
- Mainly drilling and milling operations and threading
- Accuracy and surface requirements for cable bushing and cooling connections



Extruded profile

Due to the increasing size of the battery, modular concepts for different performance classes and ranges are used. For this reason, extruded aluminium profiles are welded to form a housing.

MACHINING REQUIREMENTS

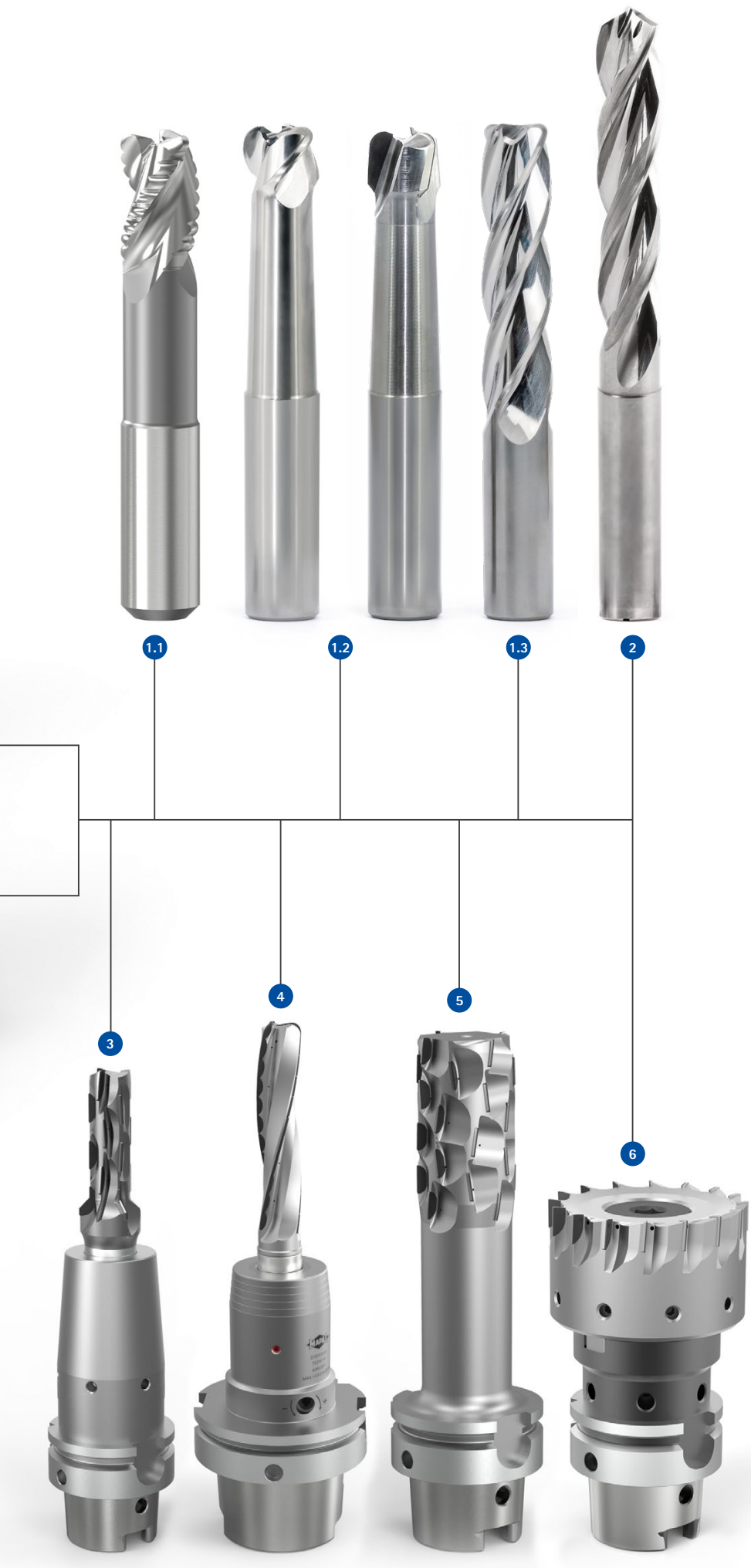
- Thin material with several layers
- **Drilling:** Vibrations and burr formation. Ring formation on the tool
  → Helix milling/orbital drilling prevents burr formation and rings
- **Milling:** Thin material tends to vibrate
  → Less vibration through optimised cutting-edge geometry

Die-cast housing

Die-cast aluminium housings are mostly used to accommodate power electronics or smaller battery systems for hybrid vehicles. The complex housing structures are designed with integrated cooling channels.

MACHINING REQUIREMENTS

- Milling of sealing surfaces (in some cases special surface requirements)
- Drilling of core holes (> 50 holes per component)
- Milling of mounting surfaces for electronics and battery cells with long tool overhang



1 STANDARD RANGE FOR THE MACHINING OF STRUCTURAL PARTS

- Highly positive cutting edge geometry
- Reduced cutting forces
- Low vibration cut

1.1 OPTIMILL-ALU-WAVE

- Low vibration roughing with deep cutting depth

1.2 OPTIMILL-SPM

- Ideal for making openings or pockets
- Solid carbide design or with brazed PCD cutting edges

1.3 OPTIMILL-SPM-FINISH

- Finishing of great depths in one go
- Strong performance with high wraps

2 TRITAN-DRILL-ALU

- Creation of core holes
- Three cutting edges for the highest feed rates
- Highest positioning accuracy through self-centring cross cutting edge

3 PCD MILLING CUTTER WITH ALTERNATELY ARRANGED CUTTING EDGES

- Low cutting forces over the entire machining depth

4 SPIRALLED PCD MILLING CUTTER

- Finishing of thin-walled structures

5 PCD HELIX MILLING CUTTER

- Trimming with a large cutting depth

6 PCD FACE MILLING CUTTER

- Face milling for a cutting depth of up to 10 mm
- Creation of defined surface profiles for sealing and contact surfaces

Solutions for battery housings

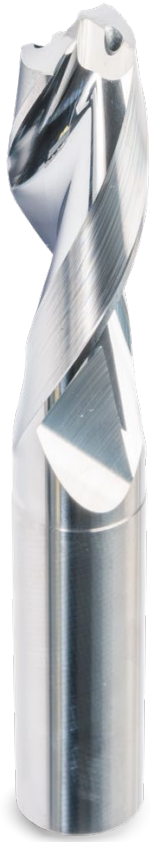
Complete machining of battery frames

Machining thin-walled frame profiles without vibration

- Drilling with short cycle time
- Milling with perfect chip control
- Machining different diameters with a single tool
- Milling stepped bores
- Reduction of vibration
- Face milling surfaces

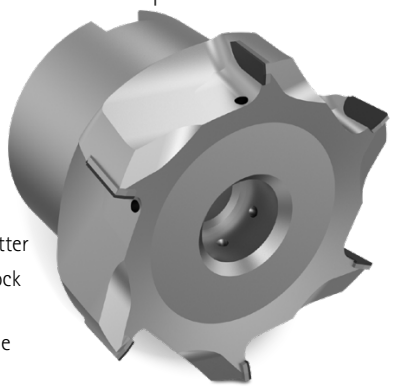
TRIMMING POCKETS AND SURFACES

- OptiMill-SPM-Finish finishing milling cutter
- Finishing for the best surface quality and optimal vibration control



DRILLING WITH LOWER CYCLE TIME

- MEGA-Drill-Alu solid carbide drill
- Focus on chip formation
- Effective drilling processes with a larger number of equal diameters



ROUGHING AND FINISHING OF FACE SURFACES

- FaceMill-Diamond-ES PCD face milling cutter
- Machining face surfaces with different stock removal using a single tool
- Roughing and finishing operations possible

MILLING VARIOUS DIAMETERS

- OptiMill-Diamond-SPM PCD milling cutter
- Circular milling operations of various diameters and surfaces
- Less tool changes thanks to flexible tool deployment

ROUGHING POCKETS AND SURFACES

- PCD milling cutter for flexible machining of various features
- Part-dependent diameter selection enables effective machining with regard to cycle times
- Vibration control thanks to the alternating arrangement of the PCD cutting edges

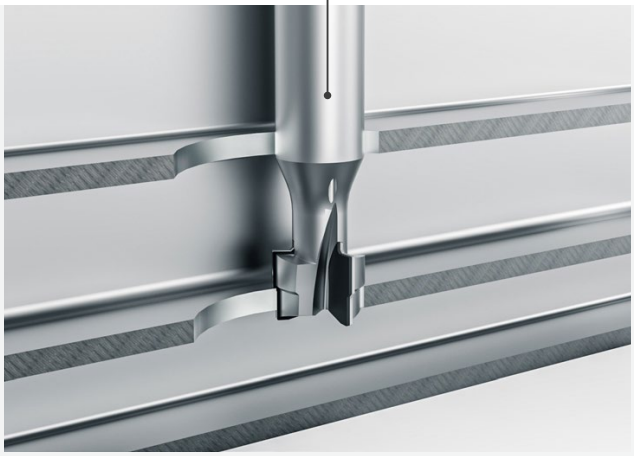
MILLING MULTI-STAGE BORES

- Circular milling operations of various diameters
- PCD circular milling cutter with several machining characteristics
- Machining stepped bores from one side

Milling instead of drilling

The approach of milling instead of conventional drilling is proving to be groundbreaking in component machining, especially in the context of electric mobility. This strategy presents not only increased process stability, but also a reduction in machining times. Thanks to specialised milling tools, flexible adaptation to different bore diameters and materials – such as long-chucking aluminium – is possible.

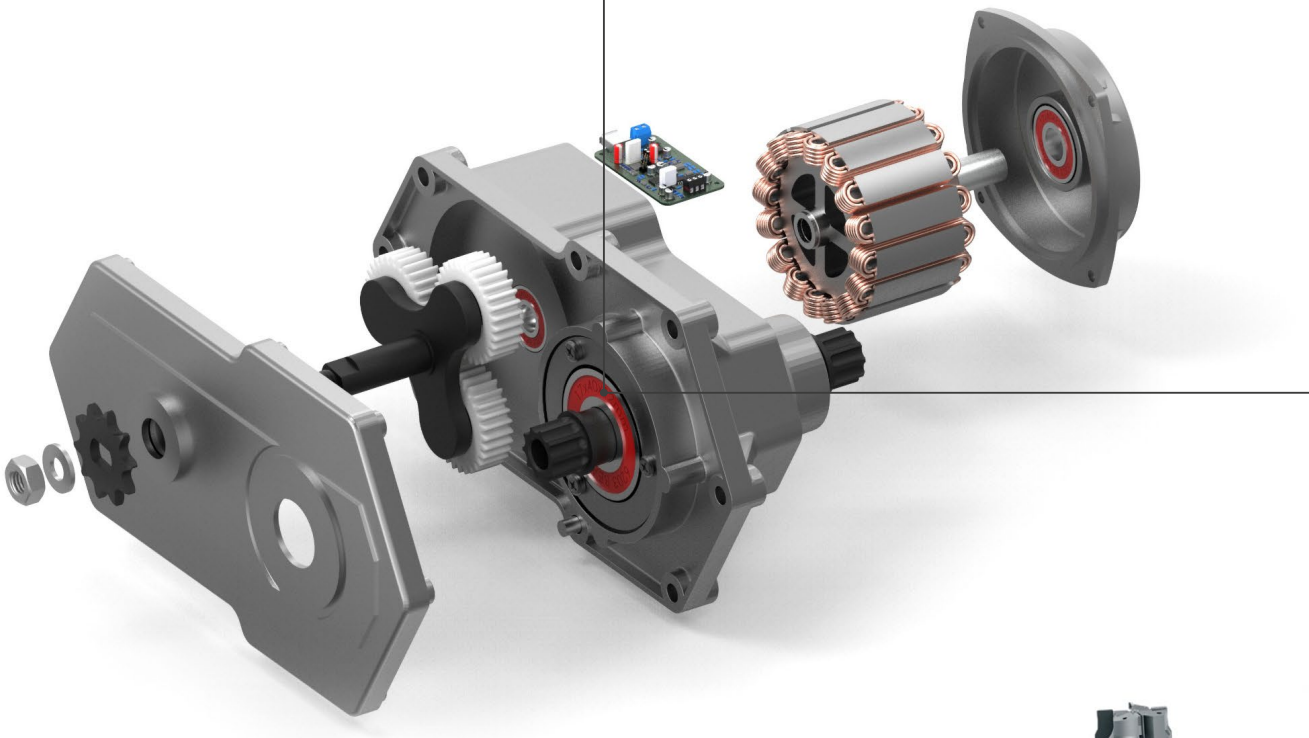
After successful tests, as demonstrated by MAPAL, this approach breaks with old conventions and opens up potential for improved production times and quality. Milling as an alternative to drilling is becoming increasingly important, especially when manufacturing parts for electric vehicles, such as battery housings and welded structures.



Small motor housings using the example of an e-bike drive

Electrified mobility has long since found its way into everyday life. The general public was first introduced to electric drives on bicycles. The motor housings, among other things, pose a challenge in their production – they have to be small and light and at the same time highly accurate.

Over the past decades, MAPAL has gained extensive experience in the machining of small motor housings made of both aluminium and magnesium, for example housings for chainsaws, mopeds or lawnmowers. However accuracy requirements have increased yet again with electrification.

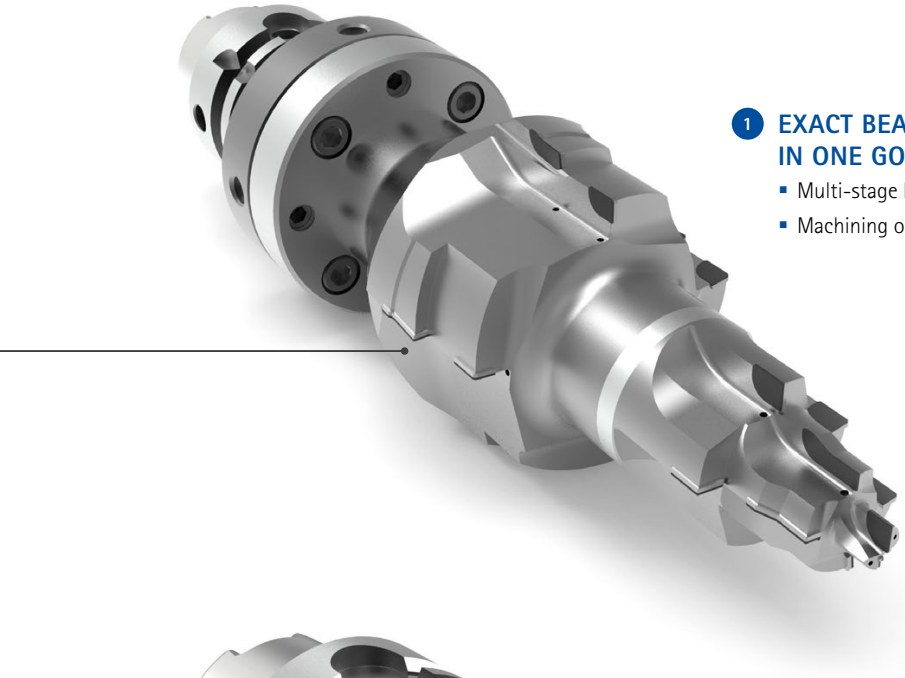


FEATURES

- Two-part or three-part (housing and cover)
- Die-cast housings made of aluminium or magnesium
- Unstable, thin-walled components (susceptible to vibration)
- Multi-stage contour trains
- The geometrical and dimensional requirements are high (shape, running and position tolerances)

MACHINING REQUIREMENTS

- Roundness < 0.01 mm
- Diameter tolerance IT7
- Average roughness depth R_z < 10 µm



1 EXACT BEARING AND POSITION BORES IN ONE GO

- Multi-stage PCD combination tool
- Machining of bearing and position bores in one go

2 DRILLING AND MILLING COMBINED IN ONE TOOL

- Multi-stage PCD bore milling tool
- Drilling stage for bearing and position bores
- Milling stage for finishing seal grooves

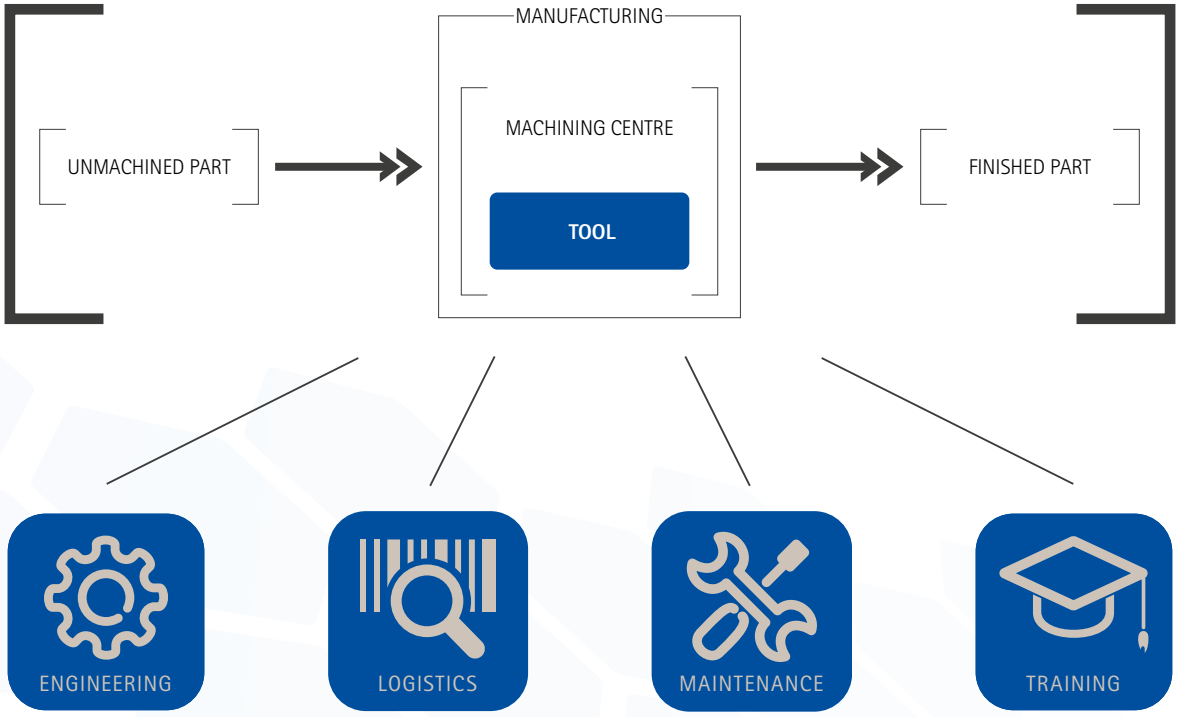
MAPAL offers an all-round package for the machining of small housings made of aluminium or magnesium.
First and foremost, PCD and solid carbide tools are ideal for machining both materials. Depending on the requirements and complexity, MAPAL will design the best concept including all tools and chucks. Combination tools, each covering several work steps, make the process more economical.

Individual, needs-based service

MAPAL's roots lie in the manufacture of custom tools. The focus is therefore always on holistic advice and support for machining tasks and processes.

MAPAL provides support in all phases and areas of production with an extensive range of services. Regardless of whether a new production facility is to be set up, processes are to be optimised, new technologies to be introduced, machines to be converted to new components, the tool inventory to be optimised or the know-how of employees to be expanded.

CUSTOMER MAPAL



With the engineering service module, MAPAL guarantees fast, precise and safe manufacturing. Further savings potential can be tapped in the area of logistics and maintenance. And in the area of training, MAPAL ensures that the specialist know-how it has gathered is transparently and completely available to the customer – this gives customers a decisive lead over their competitors.

All of the services offered by MAPAL focus on optimal processes and comprehensive support on the way to Industry 4.0. The goal is to always significantly assist the customer in achieving smooth, productive and economical manufacturing.

ADVANTAGES

- Solutions for complete workpieces including tools, devices, NC programs and commissioning
- Complete process design and implementation from a single source
- Fast and flexible on-site support worldwide
- Efficient and cost-optimised tool technology
- Optimum coordination of tool, workpiece, equipment and machine
- Highest product quality, process reliability and cost-effectiveness right from the start
- Fast throughput from planning to implementation with maximum planning security

Discover tool and service solutions now that give you a lead:

BORE MACHINING

REAMING | FINE BORING

DRILLING FROM SOLID | BORING | COUNTERSINKING

MILLING

CLAMPING

TURNING

ACTUATING

SETTING | MEASURING | DISPENSING

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