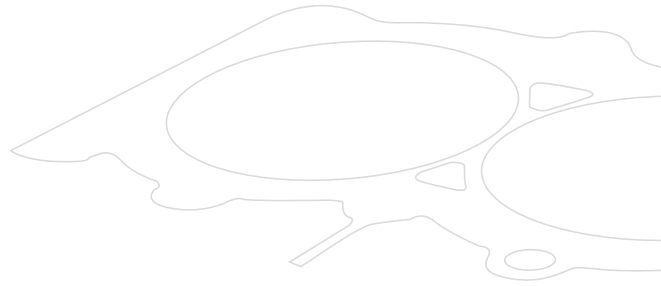




Excellence in motion. Future in mind.



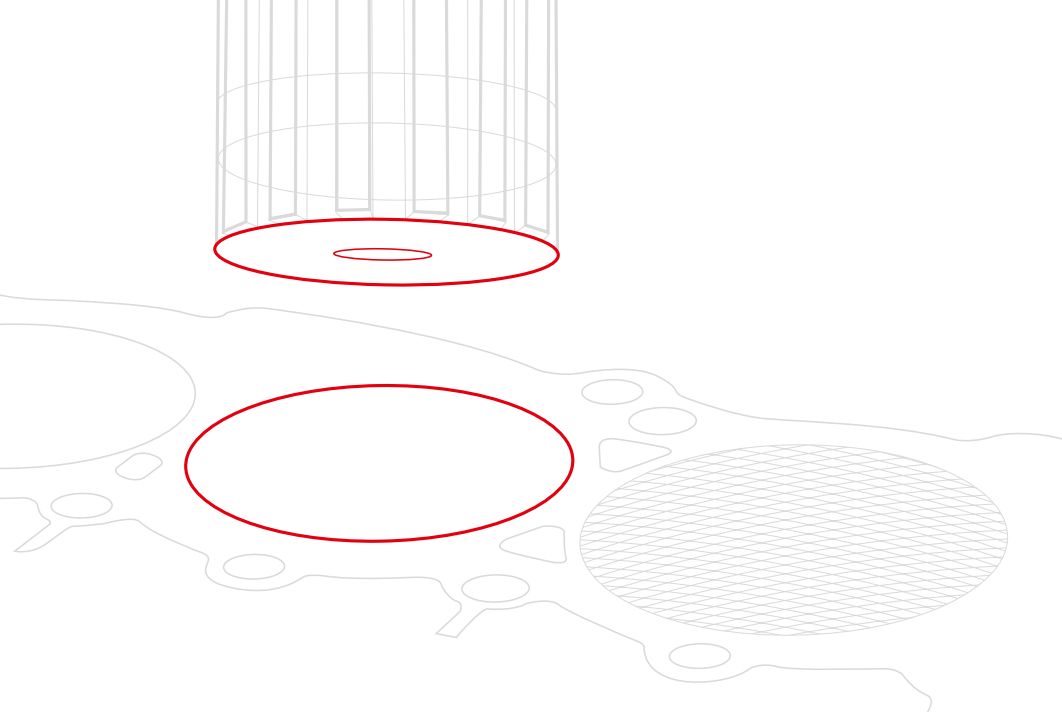
## *Our Introduction*



Specializing in powertrain production technologies, we are a globally operational machine tool company that combines tradition with innovation.

We are your reliable partner in finding innovative solutions to meet current demands and future challenges. We promise to provide our customers everything from one source, offering individual system and process solutions. We support our customer base





worldwide with excellent training opportunities by the Gehring Academy, as well as options for modernization and comprehensive service and support that characterize our total customer care philosophy.

Our experience as the global market leader allows us to critically reflect on conventional solutions and break new ground. This is how Gehring has succeeded in developing innovative technologies for more

than 90 years. Our clients benefit from our honing and laser technologies as well as our production processes for electric motors. We utilize pioneering technologies to create solutions for conventional and electric powertrains.

With form honing technology, we present the ideal solution to meet current regulations for CO<sub>2</sub> emissions. With our experts, we assist you in reaching your

individual goals worldwide. The successful and smooth interaction of the entire Gehring Group allows us to guarantee worldwide performance of outstanding quality. This is what our corporate statement “ONE Gehring” stands for.





## *ONE Gehring*

With our corporate statement ONE Gehring, we strengthen the internationalization of our business fields for our customers, partners and suppliers. With the quality benchmarks *global performance, best practice orientation, resource efficiency as well as commitment and experience,*

we illustrate our superior values. We offer our customers globally focused solutions, application-relevant technologies, ideal cost and resource management and excellent service partnerships.





## *Corporate Culture*

Our success is first and foremost due to our employees, who constantly commit themselves with expertise, passion and creativity to our company's benchmarks and our customer's interests. This is also why we invest in our employees' personal and professional development - be it through long-term training programs, courses tailored for experienced staff, or by applying modern management and leadership concepts.

One of our priorities is to be an attractive employer. A low labor turnover and a strong sense of identity among our employees makes this all the easier for us.

We are determined to work hard for open and proactive communication, mutual trust and the courage to strike new paths - day by day. For our customers, our self-image and our future.



*Global  
performance*





## *Corporate Identity*

Gehring stands for the productive connection of experience and innovation. Our company history of 90 years and our passion to embrace change account for our performance. As we trust in our competence, we are determined to continuously challenge conventional thinking.

## *Our Promise*

Outstanding performance  
Customer focus  
Sustainability

## *Our Values*

### *Customer focus*

Our customers' interests are at the core of our efforts. We therefore base our actions on their operational goals.

### *Performance*

We are primarily characterized for our performance. We continuously check ourselves and strive for constant optimization.

### *Responsibility*

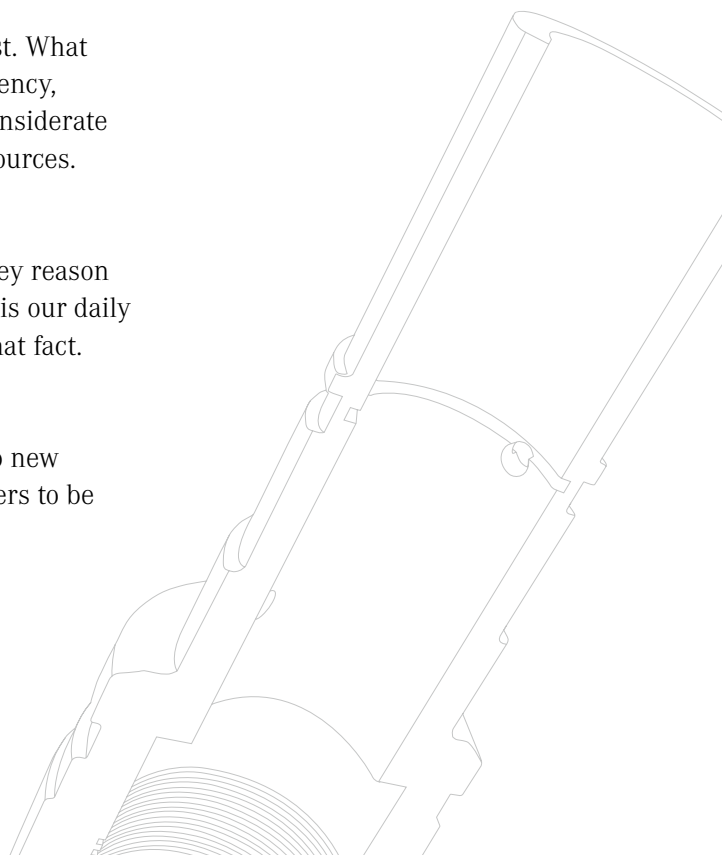
We create values that last. What we do is shaped by efficiency, sustainability and the considerate handling of valuable resources.

### *Teamwork*

Our employees are the key reason for Gehring's success. It is our daily mantra to reflect upon that fact.

### *Innovation*

We continuously develop new solutions for our customers to be always one step ahead.



## History

**1926**

Foundation of Gehring in Naumburg/Saale by C.W. Gehring. The company started with the repair of engines and the first mass production of honing tools.

**1938**

Production of the first six-spindle honing machine with combined drive in the spindle case.

**1941**

The first Gehring honing machines with hydraulic stroke drive, central lubrication, and oil processing are built.

**1943**

Patent registration of a hydraulic gauging system.

**1948**

Establishment of the new "Maschinenfabrik Gehring" in Ruit near Stuttgart.

**1960**

Plateau honing on combustion engines is introduced.

**1961**

First honing machine with pneumatic in-process gauging system is built.

**1966**

Honing tools with direct coolant are introduced.

**1975**

Introduction of Gehring-Cylindromatic.

**1977**

First mass production of diesel injection pump parts with cylinder form quality  $< 1 \mu\text{m}$ .

**1979**

Foundation of the diamond and CBN-stone production plant DIATO.

**1989**

Gehring presents the first NC controlled honing machine at the Int. Machine Tool Exhibition EMO.

**1992**

Introduction of laser technology and laser honing for combustion engines.

**2006**

Development of the lifehone machine series for small diameters.

**2007**

Introduction of position honing. Development of the powertrainhone machine series.

**2010**

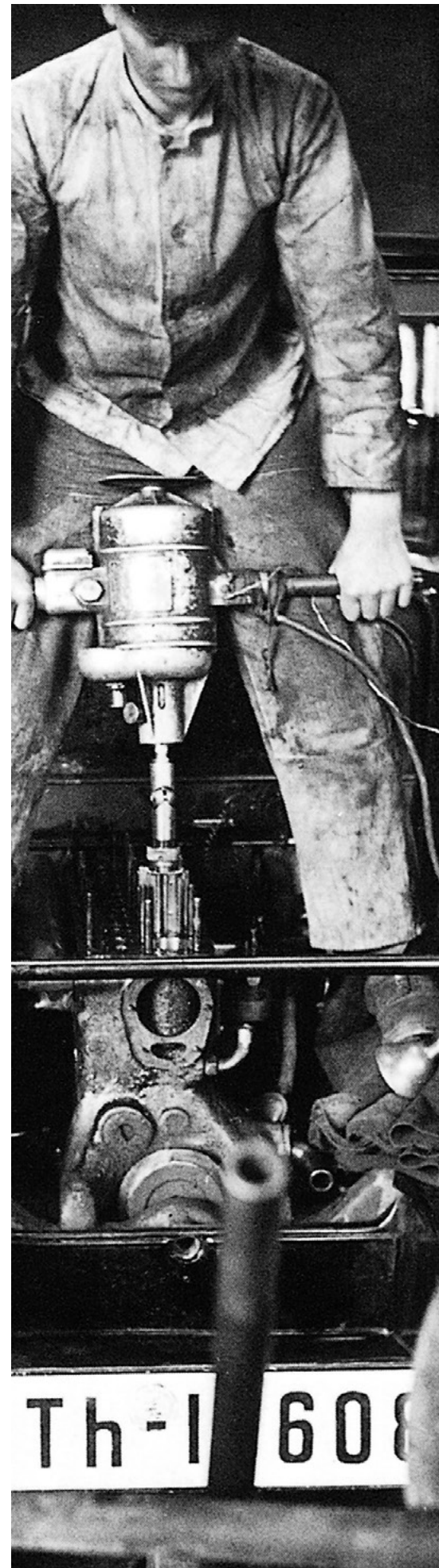
Introduction of form honing. Honing with diameters of  $\leq 0,8 \text{ mm}$  goes into mass production.

**2016**

Gehring celebrates its 90<sup>th</sup> year anniversary. Foundation of the Gehring Academy.

**2018**

Gehring joins forces with copperING, specialists in the production of electric powertrains.







## *Our Customers*

We are proud that our achievements have satisfied customers from the entire metal working industry worldwide.

Examples:

### *Automotive industry*

Audi  
BMW  
Changan  
Chery  
Daimler  
FAW  
Fiat  
Ford  
General Motors  
Great Wall  
Hyundai  
Opel  
Peugeot  
Porsche  
Renault  
Scania  
Volkswagen  
Volvo

### *Their suppliers*

Bosch  
Continental  
Federal Mogul  
Mahle  
Shanghai Gear  
Valeo

### *Manufacturers of construction equipment and utility cars*

Caterpillar  
Cummins  
Doosan  
Liebherr

### *Machine and tool making*

Comau  
GROB  
MAG  
Oerlikon

### *Manufacturers of hydraulic and pneumatic parts*

Beijing Huade  
Bosch Rexroth  
Linde

### *Aerospace technology*

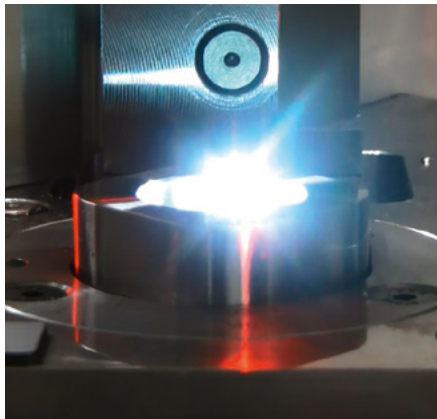
Hindustan Aeronautics  
Magnaghi Aeronautica  
Messier-Bugatti-Dowty

### *Ship building*

Jürgensen  
MAN Augsburg  
Wärtsilä



## *Honing Technology and functionally optimized Surfaces*



Honing as a metal-cutting fine machining procedure is applied primarily for bore honing in order to improve size and form accuracy and optimize tribological characteristics. The primary goal is to reduce friction. By reducing the energy consumption, material usage and production and maintenance requirements of our honing technology, we can make a major contribution to the preservation of energy and raw material resources – one of the central focuses of our „ONE Gehring“ corporate statement.

For more than 90 years, we have followed our vision to develop innovative technologies to be able to quickly and professionally react to new requirements. In this regard, our form honing technology is paving the way to lower emissions,

making us a reliable partner in our clients' implementation of international regulations to reduce carbon footprint.

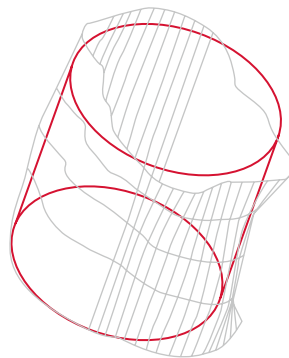
We provide our clients with innovative laser applications. Laser roughening technology is used in the pretreatment stage of thermal coating processes and ensures the reliable function of cylinder surface coatings. Laser structuring increases static friction and thereby guarantees the torsional resistance of components such as cams on a camshaft, as well as the frictional connection in central compression joints.





## *Our Technologies*

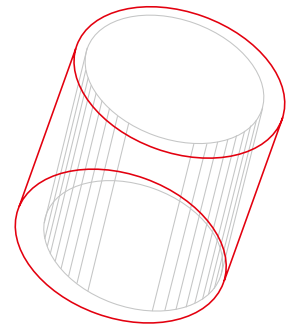
It is part of our corporate culture to be technologically one step ahead. Only with trendsetting techniques, versatile process solutions and the constant development of new ideas, can we meet our customers' demands. Outlined below are several examples of the technologies developed by us.



*Form honing*

With form honing technology, we offer the ideal process to successfully meet current regulations for CO<sub>2</sub> emissions. Form honing simulates the deformation of cylindrical shapes of combustion engines during honing, which results in a nearly cylindrical shape under operating conditions. This influences the emissions, oil and fuel consumption. Cast-iron as well as thermal spray coated cylinder bores can be form honed.

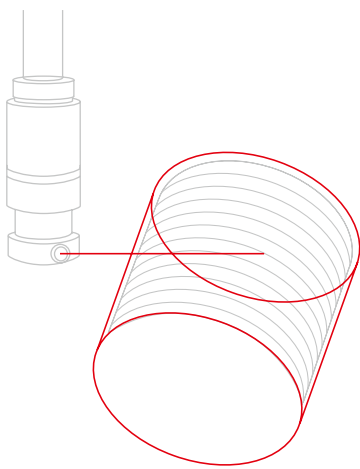
Apart from *form honing light*, which can easily be integrated in conventional honing systems, Gehring additionally presents an innovative technology called *form honing professional*, which is characterized by allowing free form shape optimization.



*Position honing*

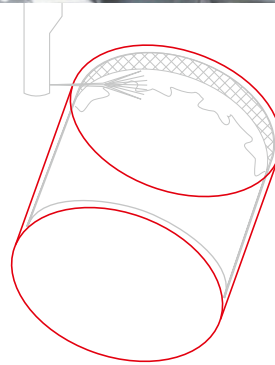
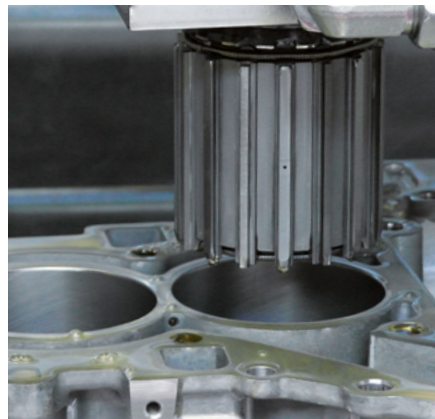
Position honing aims at shortening the process chain of cylinder block production without reducing the final quality. Position honing combines fine boring and rough honing in one step, improving not only size, form and surface accuracy, but also positional accuracy such as perpendicularity and bore position. Position honing is especially advantageous for thermal coated cylinder bores.

With regard to the positional accuracy and tool life, position honing is superior to fine boring because of cost and quality reasons: The results are lower investment for the finishing process and lower unit costs.



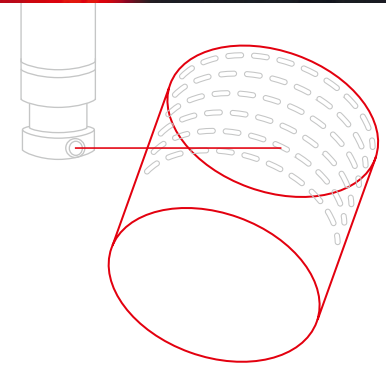
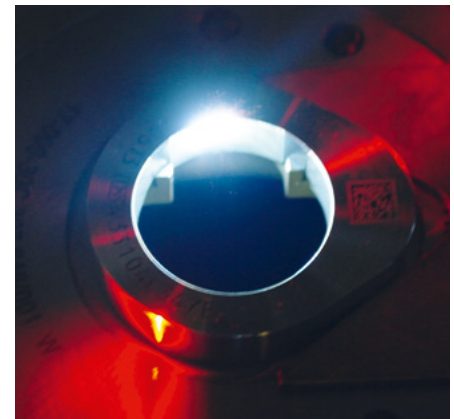
### *Laser roughening*

Laser roughening is an innovative and economical process for modern series production of cylinder crank-cases. As a pretreatment for the process of thermally coating cylinder bores, the surfaces are roughened using a laser. Provided appropriate parameters have been selected, this results in the formation of the profile roughness best suited to the function – in the case of both aluminum and cast iron. It is only the overall effect of the adhesive pull functions that creates a high adhesion strength. This is particularly significant for the motor function of the coating. The major benefits of laser roughening are the high adhesive properties, the high level of flexibility and the low process costs. These process advantages have been evidenced in large-scale series production.



### *Nano honing*

Gehring has extensive expertise in the „laser roughening, coating and honing“ process chain. Lowering costs while increasing functionality – that is our goal when it comes to optimizing cylinder surfaces for combustion engines. Alongside mechanical roughening processes, laser roughening has also proven its worth in series production. This process can be adapted to work with all the conventional coating processes. A basic profile is created, which exhibits a very high adhesion strength for the connective coating. The coating process is followed by position honing or rough honing. The following finish honing process of the coated bore also serves to optimize the tribological properties of the cylinder surface.



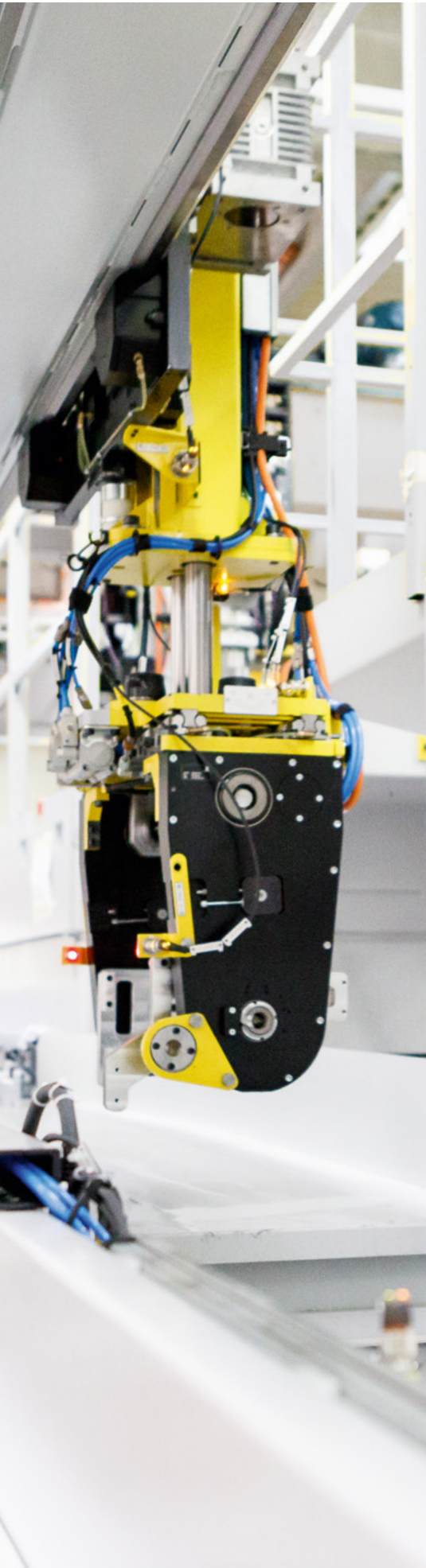
### *Laser structuring*

Laser structured surfaces enhance static friction and serve as absorption of torques and shear forces. Elevated micro structures achieve a rigid connection of components. Friction based connections with laser structured surfaces are applied, for example in crank bores on connecting rods, cast cams and spur gears.

### *Laser honing*

Laser honing reduces friction and wear in cylinder bores of combustion engines. This method has already been proven in worldwide mass production of diesel and gasoline engines.





## *Products and Services*

For modern production systems, the greatest challenges are no longer reduced to providing and optimizing single machines. In fact, it is the entire process chains that has to be optimized through the interaction of networked production elements. We therefore act as a supplier for solutions with robust and highly productive processes. With our know-how, we support our customers in all stages from planning to production to modernization.

Our one-stop range of honing systems comprises of pre-control stations and traceability devices (e. g. based on RFID) as well as honing and post-gauging machines up to automated linkage - everything from one source. We coordinate all elements of the system according to our customer's

application specifications. We use well proven Gehring components such as gauging units, conveyors and gantry solutions for the creation of our honing systems.

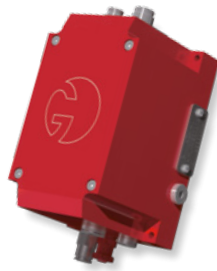
### *Automation*

With our Gehring automation systems, we provide you with the complete production line from one single source. The Gehring automation systems includes part transport, emptying, loading and unloading systems.





## Tools and Components



*Digital Transducer*

Multichannel measuring and simple calibration for specific parts. Via electrical signals, the transducer transfers the pneumatic measuring results of the gauge plug directly to the gauging computer.



*Gauging Mandrel*

Precise and accurate standardized measuring tool for bore control, which is characterized by high robustness of pneumatic measuring systems, an outstanding measuring accuracy and a hard TiN-surface.



*Tools L Series*

Specifically designed for honing of high-precision bores in a diameter range of 3-15 mm. With the L series, shape and dimensional tolerances  $< 1 \mu\text{m}$  can be realized.



*Tools PT Series*

As the typical tool for the machining of cylinder surfaces, the PT series is suitable for the machining of bores with 68-110 mm diameter.



*Tools TN/TS Series*

Multiple-stone honing tools of the TN/TS series are used for the honing of bores with a diameter range of 5-1,000 mm. Enables the honing of through holes and blind bores.



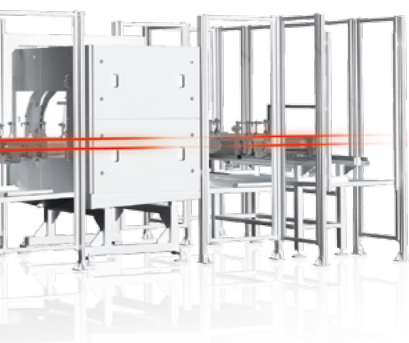
*Abrasives*

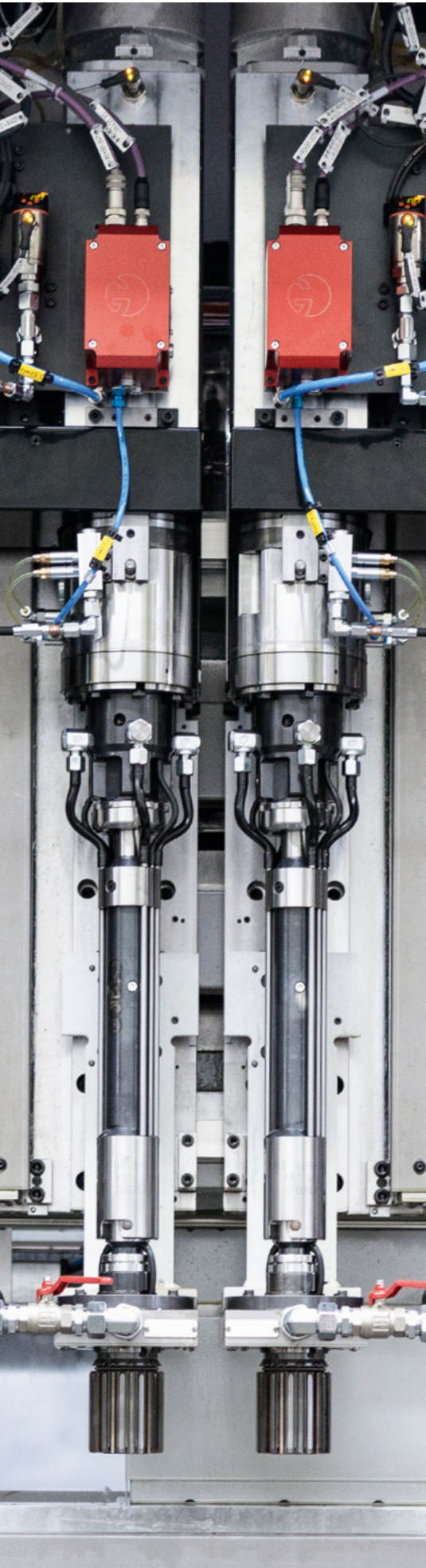
Synthetic diamonds or cubic boron nitride (CBN), both available in various grit sizes and crystal types.



*Gehring Honing Control*

Specifically developed control system by Gehring that fulfills high standards for processes and realizes an optimal interplay between the individual system components.





## Machines and Systems

### *powertrain*hone

The powertrainhone series is primarily used in the automotive sector. Main applications are honing of crankshafts and cylinder surfaces of motor blocks. The efficiency of combustion engines can be increased via the surface and geometrical design of cylinder bores.

Specially designed process chains and honing systems allow for the manufacturing of geometrical tolerances within the range of a few micrometer with an accurately defined surface profile. Thus form honing e. g. with widened bore bottom size for friction reduction can be controlled.

Our modular series offer a wide range of solutions for production scenarios due to the layout possibilities with several working areas and scalable numbers of spindles. Our transfer lines are a conventional and interesting alternative for large volumes with little variation of type. Our solo-hone is defined as a solution for smaller production quantities and thanks to its easy and flexible operation, it is the ideal solution for job honing.



### **lifehone**

With the lifehone series, manifold pneumatic and hydraulic components, valve blocks and injection pumps right up to the point of connecting rods and cams are honed. The modular machine structure for vertical and horizontal honing centers as well as for transfer lines offers customized configurations of the single working and function stations as well as the part transport. Specific highly productive solutions for gear machining including multi-spindle honing centers for gear wheel, sun and planetary gears complete the lifehone series.



### **deephone**

Parts with lengths or diameter which range up to a few meters can efficiently be machined in high-quality on machines that belong to the deephone series. Main applications are found in the aviation, energy and food industries. The horizontal honing machines of

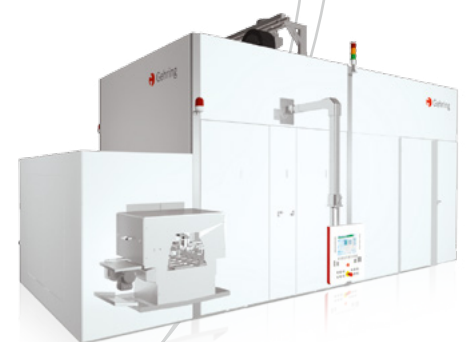
the GNM section can be adapted to the respective part with a length up to 10.000 mm. A broad range of machining tasks can also be carried out by different vertical honing centers.



### **laserstructure**

Structured surfaces can help to increase the torque transferable between two parts. Our series of laser structuring machines use laser technology to structure, for example, connecting rod bore holes in order to improve the torsional resistance of bearing shells.

The laser roughening process is controlled by the innovative rotating optical system and is used as a pretreatment in thermal coating processes. Thanks to the compact design of our machines, two identical cylinder bores can be machined in a crankcase at the same time.







## *Engineering Solutions*

Honing and laser processes are subject to complex influential factors, which require a high level of expertise to be fully understood in numerous applications - expertise which we have built up over more than nine decades. We are happy to share our knowledge with our customers and support them with the installation of new processes, the introduction of innovative technologies and the determination of new specifications in the manufacturing of complex components. We offer:

- Honing in various forms
- Laser structuring
- Laser-based and mechanical roughening processes
- Coating technologies

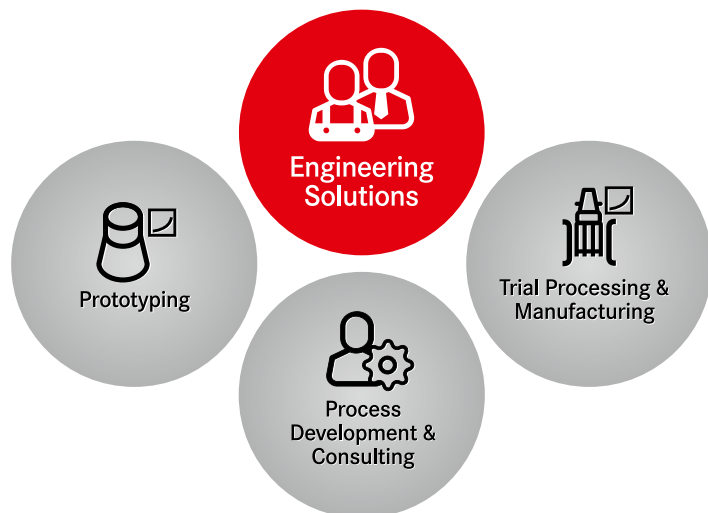
### *Process development and Technology support*

Our experts assist you in defining the correct process chains and parameters and advise you regarding the optimal part properties relevant to the manufacturing technology being used. We want our customers to successfully achieve the absolute optimum in terms of product and production properties.

### *Honing trials and job honing*

We offer our customers the option to perform honing trials as we want to guarantee high assurance in the process control.

We can process your prototype jobs for small and medium size quantities offering you a temporary, economical and feasible addition to your production capacity.





## Digital Solutions

Our “Digital Solutions“ business segment enables us to apply new possibilities of IT networking in order to increase the efficiency of our honing systems. Our objective is to increase the efficiency of our production systems by providing solutions in the fields of customer platforms, maintenance and repair, and production analytics.

With these solutions, we improve the access to system specific and customer specific information. The underlying causes of production system bottlenecks are identified by means of targeted analysis of productive data, and machine downtime is also reduced.

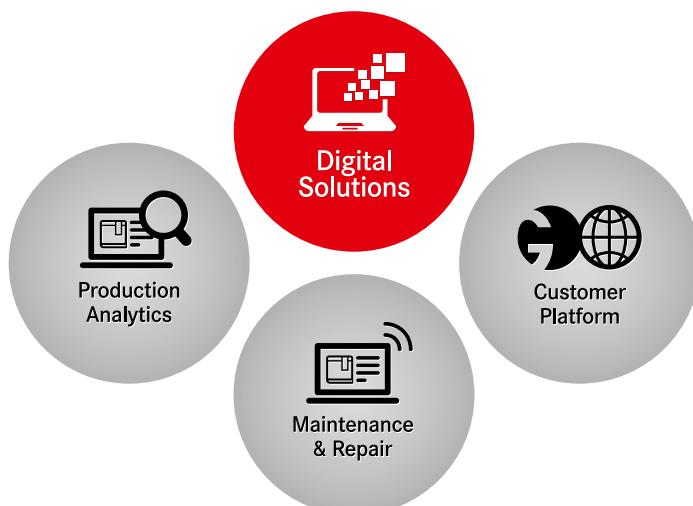
For our customers, we want to provide general starting points for bench marking in the field of Digital Solutions.

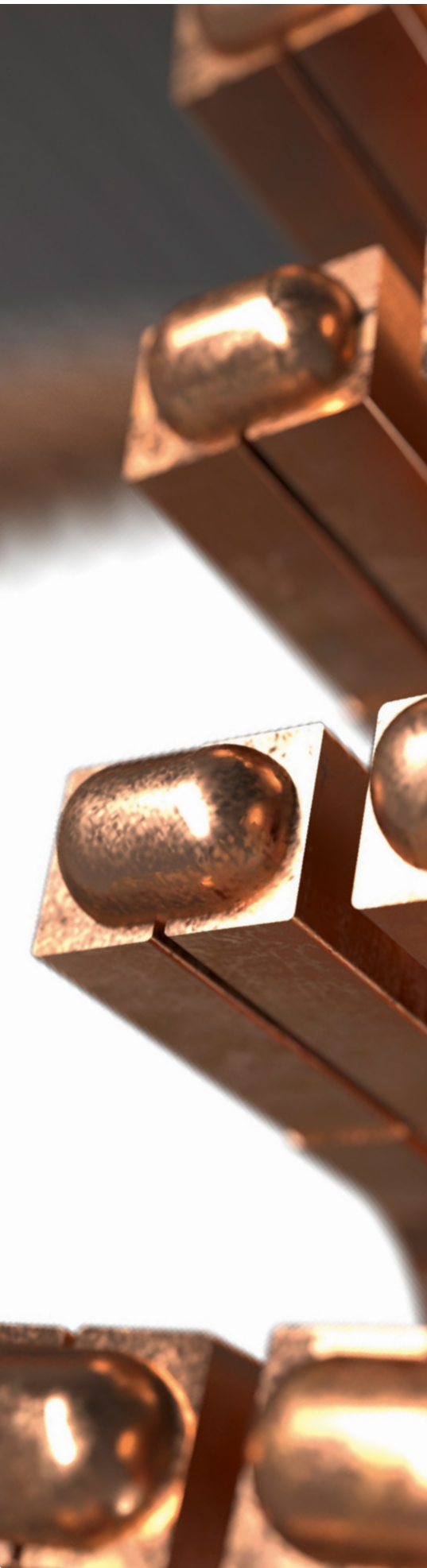
### *Connectivity and augmented reality*

We enable our customers to be directly and conveniently supported by Gehring experts anytime through our Gehring Connection Box. The box allows for a secure and reliable access to your machine. Thanks to VPN and LTE/UMTS, Gehring’s Service team is able to provide remote support at any time. Our clients retain complete control of their data and our augmented reality solutions simplify the support process.

### *Platform support*

We offer platform solutions with our IT specialists in order to offer a broad range of networking options to our customers. Hereby, we can define high standards of cyber security and cyber safety.



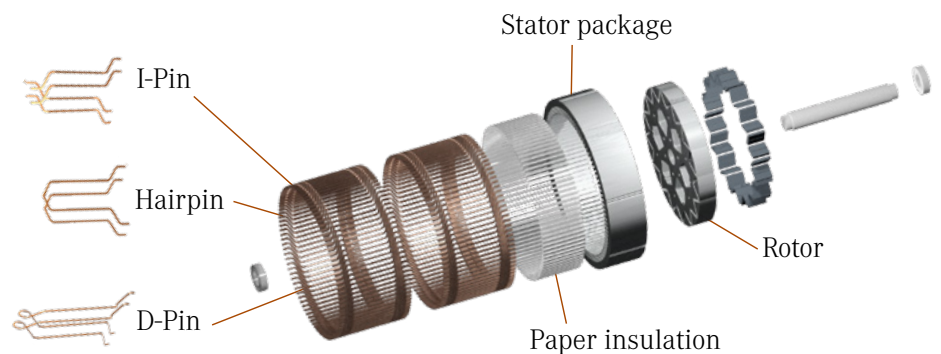


## *copperING - the hairpin technology specialists*

copperING is a pioneer of technologically innovative approaches and has extensive experience as a production technology manufacturer operating in the field of electric powertrains. The company's main focus lies in the fundamental processes involved in manufacturing stators and rotors for traction drives, the likes of which are used in the traction drives of electrified vehicles.

The company specializes in production technology for the manufacture of electric motors, based on I-pin, hairpin and D-pin technologies. These designs combine the efficiency of electric motors with high automation capabilities and process reproducibility - all of which are key requirements for series production in the automotive industry.

With standalone made-to-measure solutions for stator prototype development and small-scale series production, as well as fully automated new system solutions for electric motor production lines, copperING's product portfolio complements that of its new partner Gehring. The Gehring group therefore offers the full gamut of technologies for vehicle drives - from conventional solutions to hybrid technologies and even integral electrification.





## *Engineering Solutions for the development of electric motors*

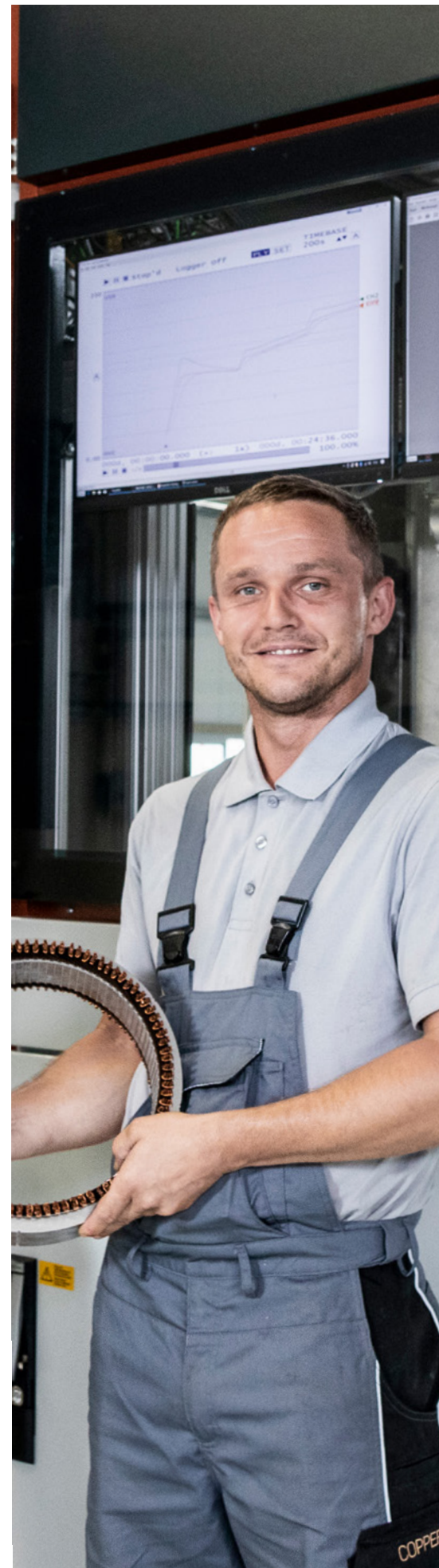
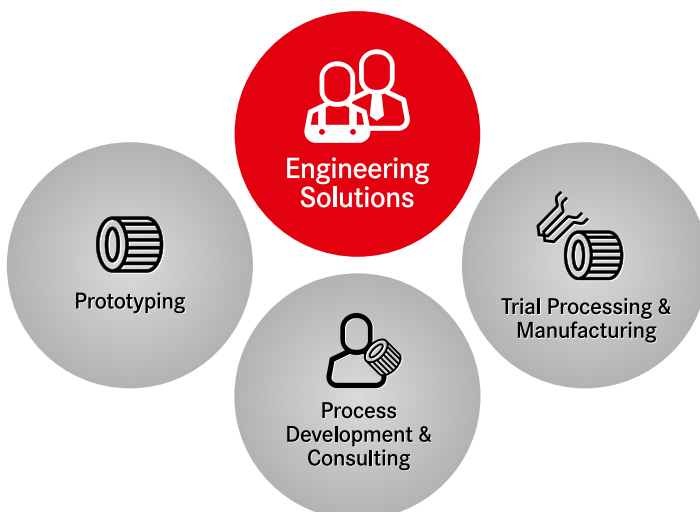
Developing electric drives and producing electric motor prototypes takes extensive knowledge of the interplay between individual production steps. We pass this knowledge on to our clients and support them from initial product development through to prototyping and all the way to series production.

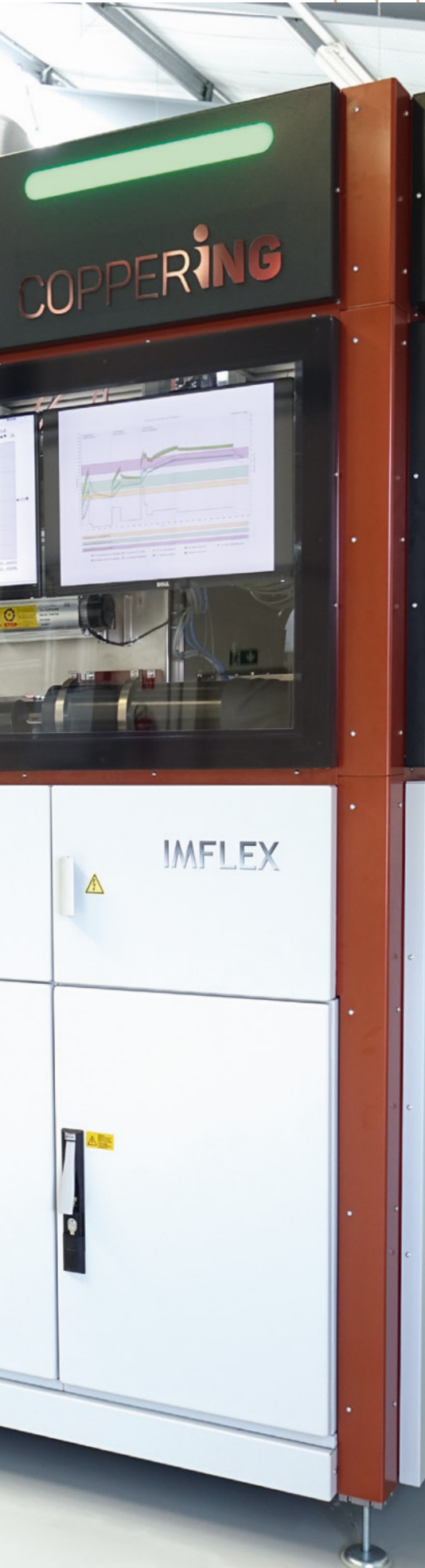
### *Design of electric motors*

A high level of customer support, from the very outset of development, is what stands us out from the crowd. While a product is being developed, we incorporate our knowledge precisely where it is needed and assist in the design process, always keeping in mind a high level of production compliance. Investigating different concepts and production processes aids decision-making and makes the transition into series production easier.

### *Prototype production*

The creation of sample electric motors for proof of concept and for test applications during product development is essential. Simultaneously developing product and production processes together with our clients and identifying critical attributes or interactions with production tolerances provides a level of quality assurance before series production even begins, and aids the structural setup of the production lines.

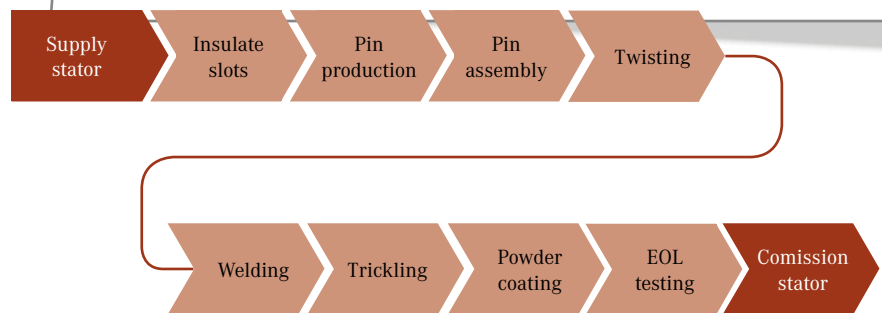
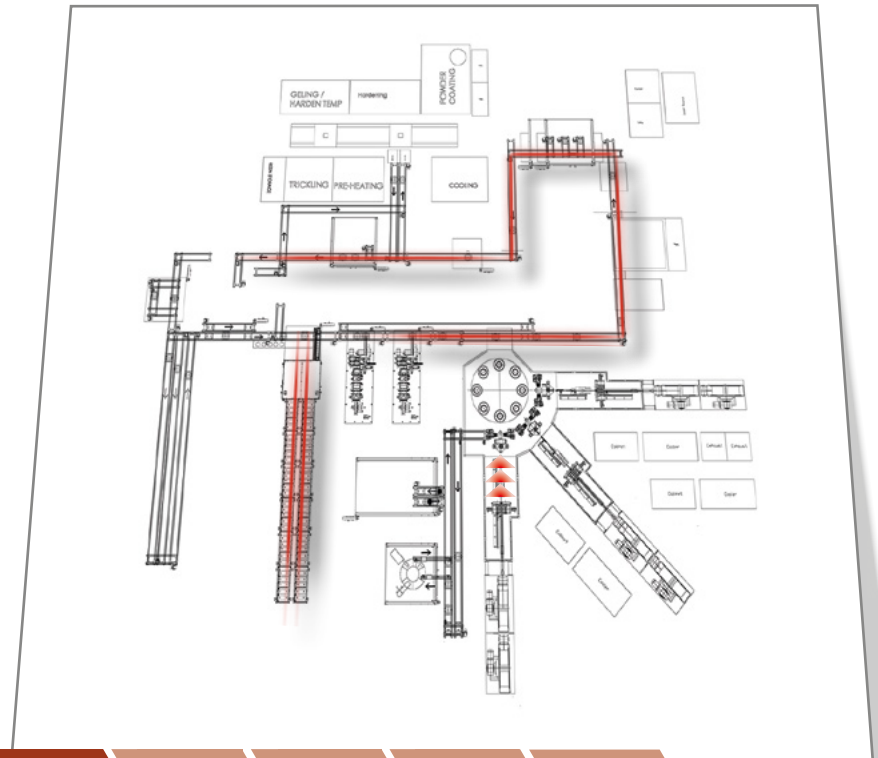




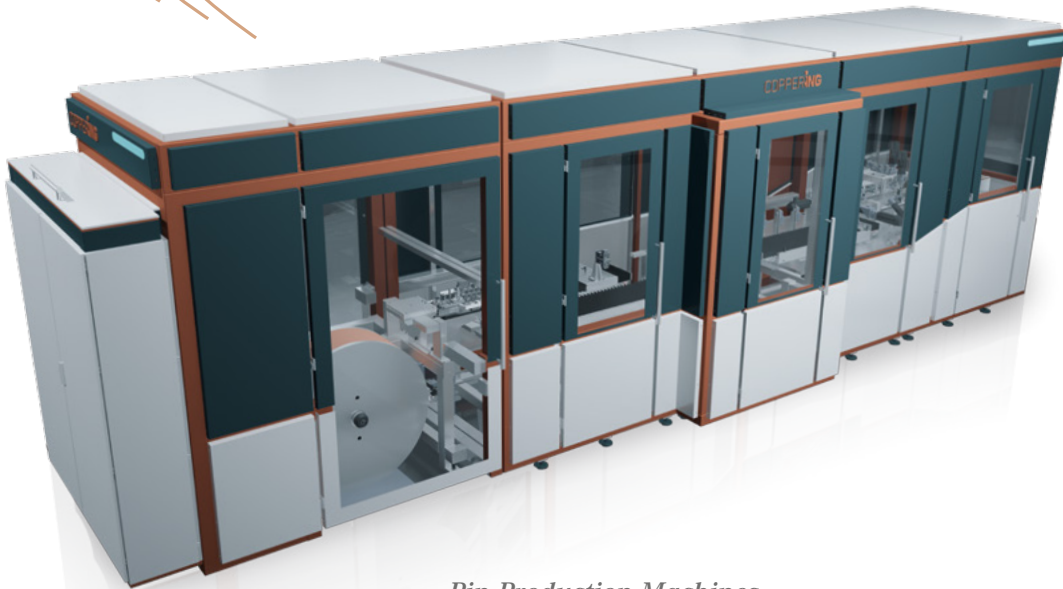
## Turnkey Solutions

We provide complete system solutions and production lines for the manufacture of electric motors. From producing pins to inserting pins, from twisting and welding pin ends through to impregnating the stators using trickle and powder coating methods, we have every step covered - and all from a single source. The integrated automation guarantees a steady flow of stators along the line.

With the benefit of modern simulation procedures and proven skills in project management, we are the go-to partner when it comes to designing new production lines for high productivity. By pooling together all our skills and our extensive knowledge of the individual production steps, and by providing a direct point of contact, we simplify and optimize the execution of project for our clients.







### *Pin Production Machines*

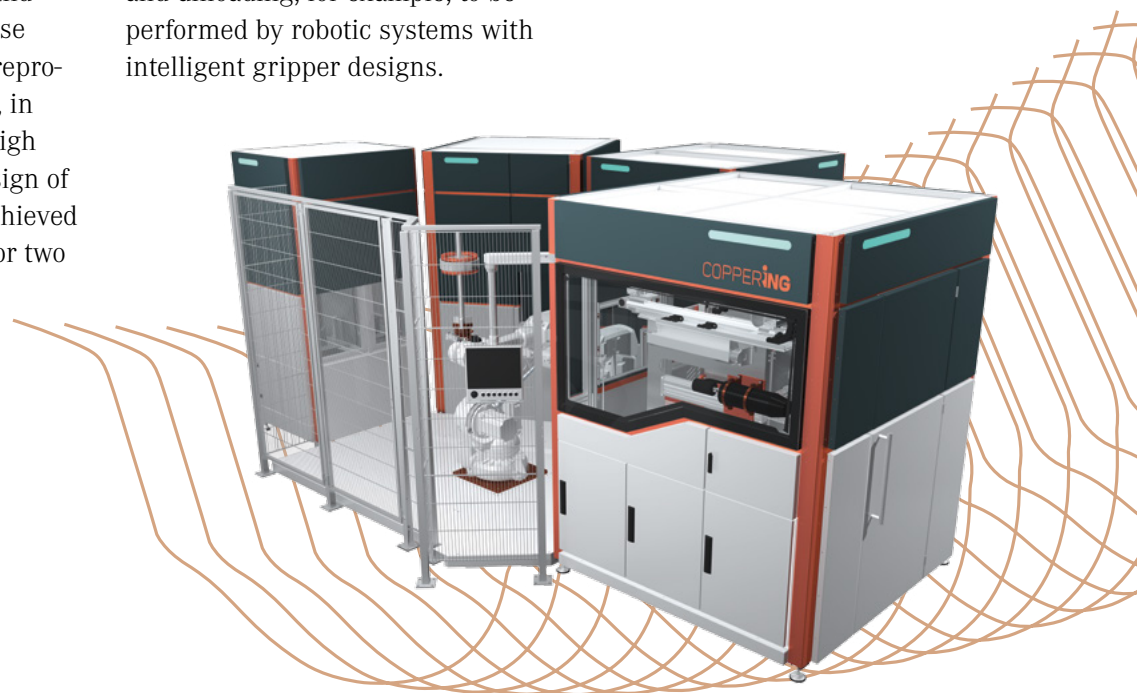
The patented planetary gearing of our pin production machines makes the individual pins ultra flexible. Thanks to the programmable axles, these can be bent into virtually any shape. To increase productivity, we can bend up to two units at the same time. Two grippers ensure wire is fed at a fast and constant speed,

while the automated spool changer means production does not have to be interrupted. Cutting and chamfering within one processing step reduces the cycle time and makes pin insertion and pin welding easier.

### *IMFLEX Impregnation Machines*

Our patented process for heating stators directly by means of induction makes for a short cycle time and a compact machine. The precise temperature control ensures reproducible thermal behavior and, in turn, reliable processes and high quality. Depending on the design of the stator, the setup can be achieved by means of trickling on one or two sides. The automation of the

separate steps is designed in an efficient manner, allowing loading and unloading, for example, to be performed by robotic systems with intelligent gripper designs.





## Total Customer Care

*360-degree support – we meet your individual requirements*

A high performance product needs assistance that is of high quality during the entire life cycle and in all aspects of the production cycle. Our Total Customer Care can support you with any of your concerns.

### *Academy*

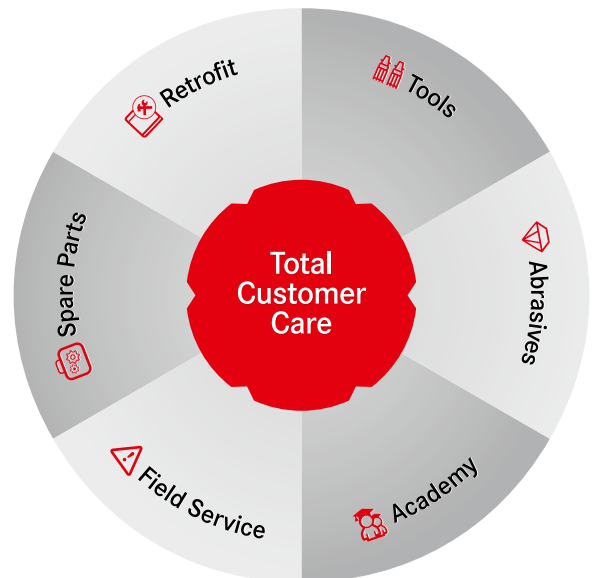
Only with highly qualified operational and maintenance personnel, can ideal manufacturing quality be achieved. In order to guarantee this, we have developed comprehensive training programs which meet your individual requirements. Our academy is certified by the TÜV testing body and provides training to our clients and our employees alike.

### *Spare Parts*

For today's production scenarios, it is essential to have a broad and easily accessible range of spare parts available. Our experts can advise you about onsite stocking and component availability. That is how we guarantee that machine downtime can be reduced to a minimum.

### *Refurbishing and updating*

The processes of machining new workpieces or changing production concepts call for production systems with modern components. Together with our clients, we devise suitable concepts and make their machinery ready to handle new tasks.



## Global Presence

### *Tools and Abrasives*

The choice of tools and abrasives used is of considerable importance for the success of processes and the resulting quality achieved. Right from the initial equipment purchase and during the entire life cycle, we offer technical consulting and hardware from one source – because quality and costs matter. From the maintenance of tools, repair, supplementary delivery of defined abrasives or technical consulting on process- or tool life optimization – Gehring provides everything from one source. We are now online too: [www.webshop-gehring.com](http://www.webshop-gehring.com)

### *Service & Hotline*

We are happy to assist you with any problems and issues that might arise. Our hotline provides direct support for systematic troubleshooting. Our global team of experienced service technicians can support you at your site for both preventative maintenance and production problems. Due to our global presence and expansive service network, we are always closely available and ready to help you.

With an active presence on three continents and a total of 14 subsidiaries, we are well-positioned and well-equipped for the increasingly global nature of our industry. In addition to that, our agents are available worldwide to competently assist you with any issues and concerns.

### *Gehring locations*

- Ostfildern (Germany)
- Naumburg (Germany)
- Bridgnorth (UK)
- Paris, (France)
- Farmington Hills (USA)
- Livonia (USA)
- Silao (Mexico)
- São Paulo (Brazil)
- Shanghai (China)
- Bangalore (India)

### *copperING locations*

- Wernigerode (Germany)
- Nuvolera (Italy)





*Time to exchange*

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