

Opening up new fields
of application.

Wire erosion – an essential
technology.

Friedrich Daniels Medical

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Opening up new fields
of application.

HFU – KSF Tuttlingen

44

A massive
difference.

K-L Präzision Falk Lange GmbH

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in the Bavarian Forest.

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Legal notice

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Editorial



Hans-Jürgen Pelzers

“**Style** is the proper omission of the inessential.”

Anselm Feuerbach

Electrical discharge machines in high tech

Precision and style are two factors for success. If you want exposure with an accuracy of 20 nanometres, you need to start with an outstanding electrical discharge machine. At GEWO, the requirements for the manufacture of assemblies for extreme ultraviolet radiation (EUV) are at the limit of what is technically feasible (page 26).

The higher the frequency, the smaller and therefore more precise the components have to be. This principle is heeded at Rohde & Schwarz in their efforts to supply customers all over the world through their locations in 70 countries – a feat made possible by the 50 employees in the toolshop in Teisnach (page 6).

The latest news from the Institute of Precision Machining in Tuttlingen comes from the professor himself – starting on page 44.

Best regards

Hans-Jürgen Pelzers

from the Technology Centre in Ratingen

News



Gaining a competitive edge with automation solutions

At SPS 2019 in Nürnberg, Mitsubishi Electric's motto will be 'Your solution partner for smart manufacturing'. On the stand the company will be demonstrating its latest range of automation products and technologies that give users a competitive advantage.

The solutions on show will include Predictive Maintenance, Time-Sensitive Networking (TSN) and increasingly collaborative robotics – all of which are designed to improve production. Help in handling big data using edge computing will feature prominently, in addition to the wider application of AI for improved machine and systems intelligence.

Enjoy your read of this issue!



Mitsubishi Electric develops world's first metal corrosion sensor designed for mounting on printed circuit boards

Mitsubishi Electric Corporation announced that it has developed what is believed to be the world's first* compact metal corrosion sensor small enough to be mounted on printed circuit boards. The new sensor utilises metal corrosion monitoring technology developed by Mitsubishi Electric that detects the degree of corrosion of metal components caused by corrosive gases such as sulfur compounds in the atmosphere. The deployment of multiple sensors with different levels of corrosion resistance allows the degree of corrosion to be detected in stages, helping to prevent equipment failure. Mitsubishi Electric plans to deploy the new technology across its own industrial equipment portfolio.

* According to Mitsubishi Electric research as of 4 September 2019

Smart automation solutions for machine tools enable increased productivity

In an increasingly competitive marketplace smarter machine tools can offer big advantages to production facilities such as increased flexibility, efficiency gains and reduced down-time. At EMO 2019 Mitsubishi Electric showed how these goals can be met with connected production systems, intelligent control systems, Edge Computing and partner solutions. Faster time to market and increased production flexibility can be achieved using Mitsubishi Electric's M8 Series CNC controllers with Direct Robot Control (DRC) functionality. Mitsubishi Electric robots and models from KUKA will work seamlessly with DRC enabled controllers from Mitsubishi Electric.

changes.AWARD 2019: And the winners are...

Memorising content quickly and easily in deep sleep, an automatic ticket system for public transport, glasses that detect eye diseases, and an app that connects people via neighbourhood services – these are the winning projects of the changes.AWARD 2019. The fourth changes.AWARD on Sunday, 07.07.2019, ended with the award ceremony at the Cromford-Parkfest. This year the project topics were concerned with the subject of "Society 5.0". All 12 participating groups successfully addressed this challenging issue. In the final on 27.06.2019 they presented their business plans so professionally that it was by no means easy for the jury to select the first three places. So there are two third places this year.



THE CHANGES.AWARD MOVIE

Scan the code now and watch the film!

www.changes-award.de

55 metres
of grounded
technology

Rohde & Schwarz transmitters
and measuring techniques are
used all over the world – as
here on the Wendelstein in the
Bavarian Alps.

Global player.



Rohde & Schwarz GmbH & Co. KG

Oscillations for the world

in the Bavarian Forest.

Teisnach, picturesquely situated in the Bavarian Forest with a population of roughly 3,000, is one of the high-tech centres in the region. The Rohde & Schwarz technology group is one of the key contributors to this with its Teisnach plant. Since 1969, the plant has been responsible for the prefabrication of the global player's products. Today, the company produces complex systems, numerous electromechanical assemblies and custom-made items. Last year, two Mitsubishi Electric EDM machines from the MP Connect series joined the precision production activities of the plant's toolmaking department.

With its industry-leading technological expertise, Rohde & Schwarz is working energetically on the future of communication, information and security.

The independent group develops, manufactures and sells a wide range of electronic capital goods to industry, infrastructure operators and sovereign customers. The company is one of the technology or market leaders in all of its fields. Rohde & Schwarz concentrates on the areas of mobile radio and high-frequency measurement technology, and broadcasting and media technology. Air traffic control and radio communication, cyber security and network technology also enjoy high priority in the Group.

In fiscal 2017/2018, Rohde & Schwarz generated sales of EUR 2.04 billion. The company owes this success to its 11,500 highly skilled employees in over 70 countries. As the largest employer in the Teisnach region, the Group employs around

1850 skilled workers at its plant there and allocates more than 74,000 square metres to production. Since its foundation in 1969, the Teisnach plant has been responsible for the prefabrication of products. "In addition, we also manufacture among other things electromechanical assemblies, custom-made items and radio communication systems," explains Andreas Bauer, head of toolmaking at Rohde & Schwarz in Teisnach. It is also home to the manu-

facture of radio and television transmitter systems, body scanners, micromechanical precision parts, antennas, printed circuit boards, housing parts and hollow waveguides.

"Over the past five years, we have developed the Teisnach site into a contract manufacturer with

The reference receiver for broadcast signal analysis is one of many Rohde & Schwarz products.



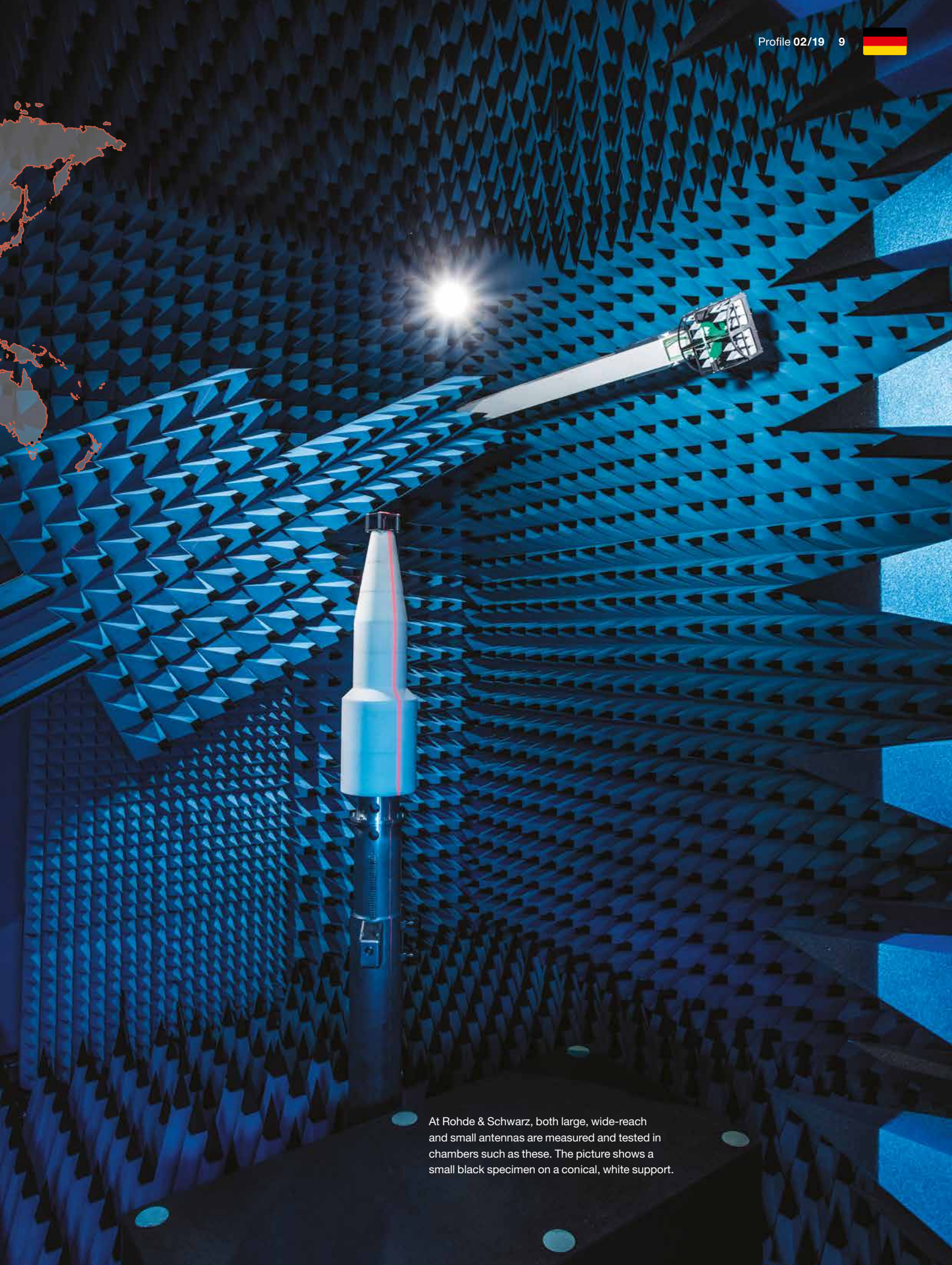
Global player

Rohde & Schwarz is a high-tech company that thrives on innovation. The company has a tightly meshed sales and service network and is present in more than 70 countries, mainly through its own subsidiaries. Exports account for around 85 per cent of its sales. The company is headquartered in Munich and has strong regional offices in Asia and the USA.

Business fields

- Test and measurement
- Broadcast and media
- Aerospace | defense | security
- Networks and cybersecurity

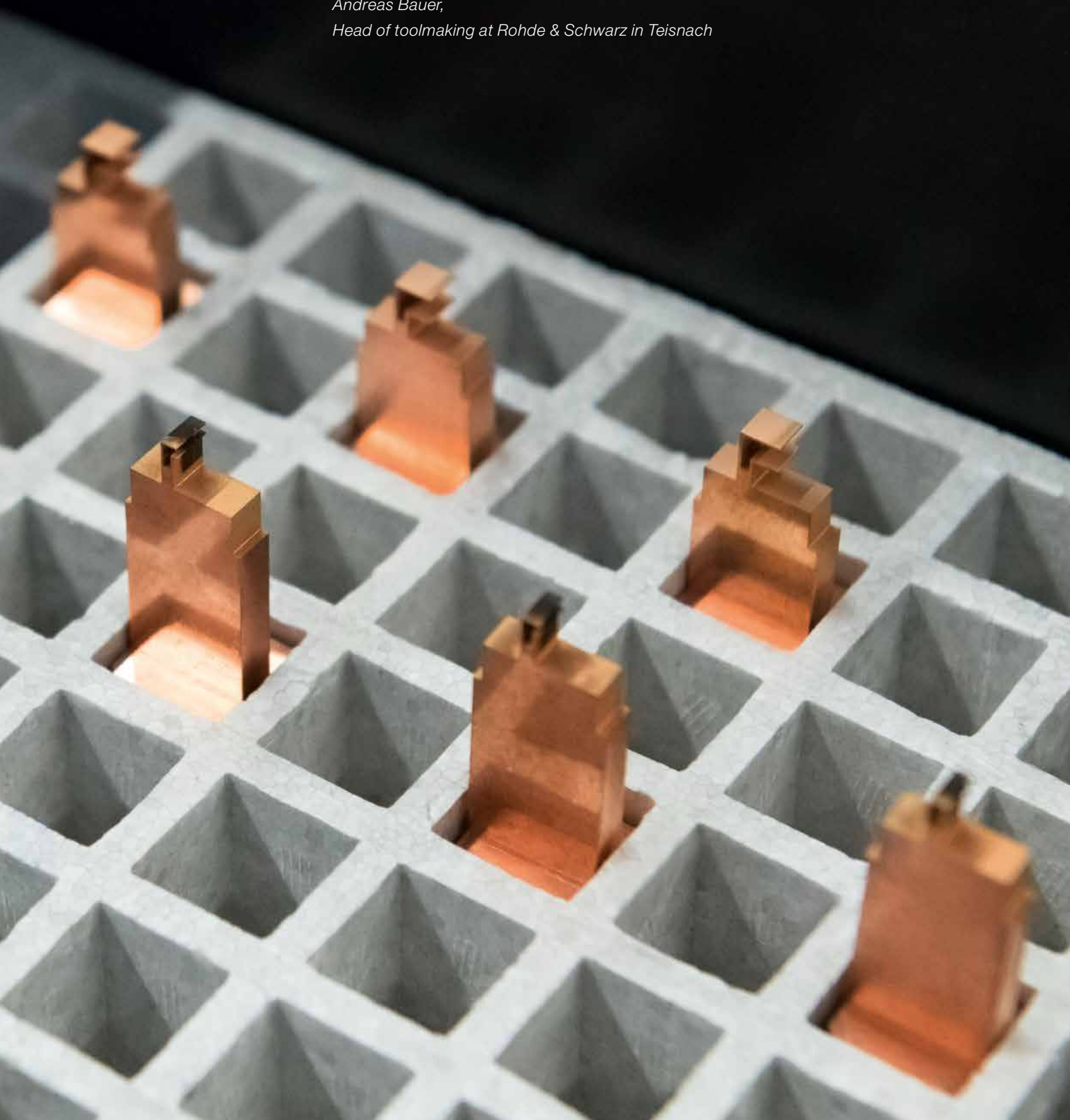
Technology and market leader.



At Rohde & Schwarz, both large, wide-reach and small antennas are measured and tested in chambers such as these. The picture shows a small black specimen on a conical, white support.

We have developed a comprehensive conception of quality. This also means that our quality testing accompanies all phases from procurement to production and documents them precisely.

*Andreas Bauer,
Head of toolmaking at Rohde & Schwarz in Teisnach*



Comprehensive know-how.

expertise in the complete field of mechanical and electronic component production,” adds Christian Ebner from toolmaking in Teisnach. Since 1991, the plant has also been offering production services to external customers. Teisnach’s broad portfolio includes product development and design, software development, purchasing and logistics, and cutting and non-cutting machining as well as the assembly of mechanical assemblies, mechatronic systems and special machines. In addition, the specialists in Teisnach also perform high-quality surface finishing.

“We have developed a comprehensive conception of quality. This also means that our quality testing accompanies all phases from procurement to production and documents them precisely,” says Bauer. This understanding of quality is also reflected in the company’s environmental policies. Water is not simply disposed of, but efficiently purified with a computer-aided water treatment system that guarantees the highest wastewater purity in every situation.

The company shows huge commitment in its training activities. More than 100 young people are currently undergoing training, primarily in technical professions such as industrial mechanic, electronics technician and electrician, or combined courses of theoretical study and work experience.

Tools for internal and external customers

“The bulk of what we make is used in Rohde & Schwarz’s production activities, so we can only devote 20 to 30 per cent of our capacity to external orders,” Bauer explains. “But external customers are important to us. We always seek the challenge of the marketplace. Only then can we see whether we are competitive. And only then can we achieve the optimum for our company.”

Toolmaking enjoys high status at Rohde & Schwarz and is performed in several plants. Teisnach is a toolmaking centre. Of the approximately 100 toolmakers in the group, 50 work in Teisnach. “This is

where most of the technologies are located,” Bauer reports. “It is important for our work that we can quickly serve the various departments within the Group. And this is why our department is equipped with a wide range of technologies.”

Microtechnology specialists

A number of Rohde & Schwarz products require very small and very precisely machined injection-moulded parts, which are developed and manufactured in the Teisnach plant. This also includes the fabrication of all the required injection moulds. “Since 2011, we have been involved in micro-injection moulding,” Bauer explains, “and have been working consistently in this area and built up extensive know-how. Most of the applications for these products at Rohde & Schwarz are in high-frequency technology. “The higher the frequencies, the smaller the components, and the smaller the components, the smaller the manufacturing tolerances,” Ebner

Facts & figures

Founding year

1933



11,500

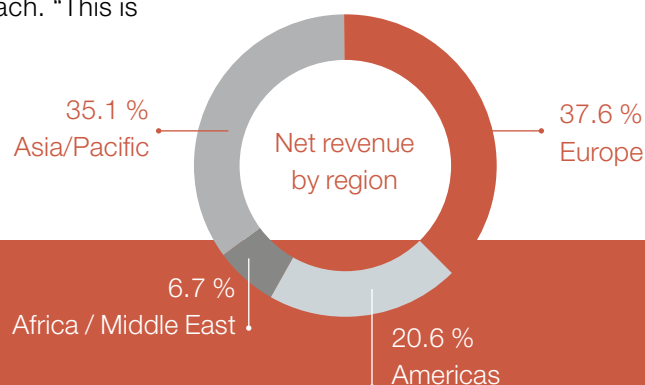
employees worldwide
Rounded values as of
30 June 2018

7,000

employees of them in Germany

1,850

employees of them at
the Teisnach plant



Net sales
in fiscal 2017/2018

EUR 2 billion



The two Mitsubishi Electric machines in the EDM section of the toolshop

With these two precision machines, we can operate with high process security in this area, and they give us the necessary flexibility.

*Andreas Bauer,
Head of toolmaking at
Rohde & Schwarz in Teisnach*

notes. "Since we manufacture micro-injection moulds, we are also very heavily involved in the machining of high-precision moulds and tools and in the field of micro-erosion technology.

One area firmly anchored at the Teisnach plant is the manufacture of punching and bending tools. The toolmakers specialise in machining sheet metal with a thickness of just a few tenths of a millimetre. "Forming processes for materials over a millimetre thick," Bauer explains, "are the absolute exception in Teisnach."

In-house specialists

Vertical integration at Rohde & Schwarz is very high because the company prefers to have specialists in-house for special manufacturing processes. This way you always keep a check on costs. "Of course, we also attach importance to reacting quickly and flexibly internally," Bauer continues.

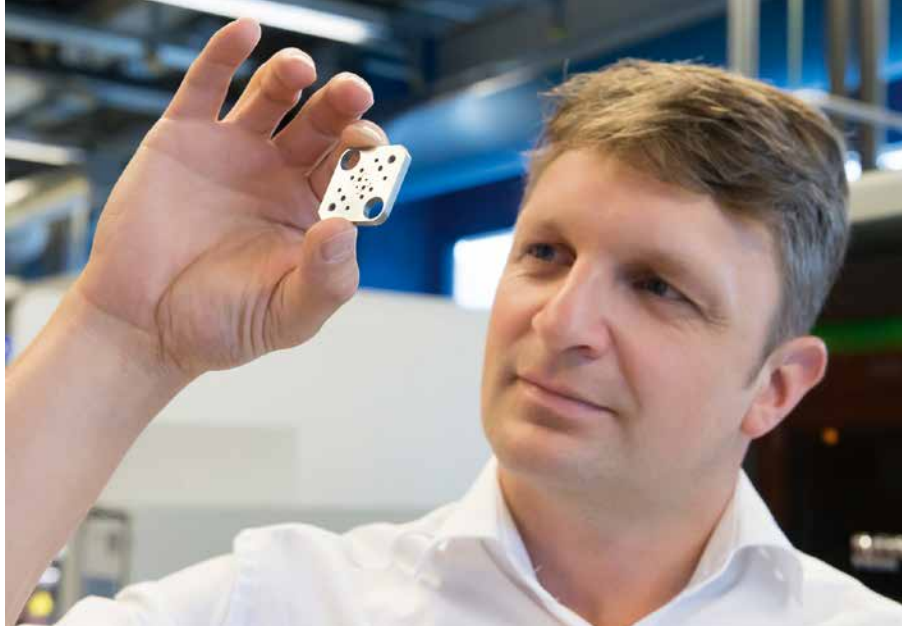
With 50 employees, the toolshop in Teisnach is of a manageable size. "To maintain a high degree of flexibility, we are constantly re-organising our operations. This is also one reason why we keep toolmaking



Body of an HF assembly – produced on the MP1200 from Mitsubishi Electric

here a little separate and autonomous."

Five wire EDM machines are in operation in the toolshop in Teisnach, mainly in the production of punching, bending and extrusion tools. The two new Mitsubishi Electric



Andreas Bauer inspecting an intermediate ejector plate.

MP1200 Connect and MP2400 Connect machines are mainly used for stamping and bending. "With these two precision machines, we can operate with high process security in this area, and they give us the necessary flexibility."

Team decision-making

"Last year we were faced with a change in our wire EDM machines. We took a close look at the main suppliers and drew up the requirements profile with our entire team," Ebner reports. "It was important for us to make a joint decision in which all the pros and cons and the sustainability issues were examined. And the price-performance ratio was also of course a crucial factor. We paid visits to users and compared the technical data until we were convinced that Mitsubishi would be able to supply us with good and operational machines. Only then did we take the plunge. We've been using the two Mitsubishi machines in our toolshop for about a year, and we are still very happy with them and have no regrets."

Toolmaking 2027

"We drafted our 2027 toolmaking strategy back in 2017, venturing a look ahead to 2027," Bauer reports. "We coordinated our strategy with plant management. Last year we took the first big step and invested around EUR 2,000,000, among other things in two Mitsubishi systems. In doing so, we gave new impetus to micro-erosion, micro-milling and micro-drilling."

Another goal is efficient production planning, which will make our working methods more efficient. We also want to optimise our communication so that the right information is always available in the right place."

Rohde & Schwarz GmbH & Co. KG

Core business

Rohde & Schwarz develops, manufactures and markets a wide range of electronic capital goods for industry, infrastructure operators and sovereign customers.

Employees

11,500

Executive board

Christian Leicher (President & CEO)
Peter Riedel (President & COO)

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Elaborate eightfold mould for the injection-
moulding of rubber components

Flexibility in the face of constant change.



Reliable and exact.

Precision mechanics specialist
relies on Mitsubishi Electric.

Markets and technologies are subject to constant change. Only those who are willing and able to adapt to changing requirements and acquire new skills in good time will survive. AMB near Paris is no exception. In the face of shrinking demand for rubber injection moulds, the company has been adding precision prototypes and mechanical components for a wide variety of industries to its portfolio. What experience has it acquired in this context with Mitsubishi Electric electrical discharge machining systems?



2-cavity rubber mould – erosion finish



"We have developed from a maker of rubber moulds into a precision mechanics specialist in high-accuracy prototypes and mechanical components," explains Jacques-Henri Miguet, second-generation managing director of AMB in La Ferté Alais (France). For its original main business – complex moulds for the production of rubber parts by injection moulding – demand has declined steadily over

the decades, which is why it is now the last company in a large area to produce such moulds at all. Although it continues to successfully serve this market, its main focus is now on numerous top industries such as aerospace, automotive, shipbuilding, the oil industry, motor sports and electronic/electrical engineering. For these it produces complex, high-precision machined prototypes and mechanical components, in anything from single items to mid-size series. It machines all common metals such as steels with hardnesses up to 62 HRC, aluminium, titanium, bronze and brass as well as numerous important plastics. For this purpose, the company certified to ISO 9001:2019 is fully equipped with modern, CNC-controlled machines such as HSC milling centres and turning/milling centres, wire EDM and die-sinking EDM systems, and 2D and 3D laser engraving machines. The firm achieves machining accuracies in the range of 10 µm and assures quality with a range of modern measuring systems.

From a mould maker to a precision mechanics specialist.

Emphasis on advice and service

“For such orders, advice and assistance in improving the geometry are an integral part of the services we provide,” Miguet adds. This was already an essential part of the package of services for rubber moulds, since here it was not only a matter of the geometry, but also of the process-related design of the moulds, e.g. with regard to their heat management. In such cases, it is sometimes necessary to go with the customer to his own buyers so as to jointly arrive at optimal, reliably controllable solutions. In this context, the business has established a network of expert contacts in the field of rubber materials and their processing so that they can draw on the specialist best suited to the respective task for the customer. This lively tradition of advice and assistance for the customer is also practised with other technologies. At the same time, the employees in production undergo regular training so that they always have full mastery of



The Mitsubishi Electric EA8S die-sinking EDM system that went into operation at the same time as the MV1200R

Our Mitsubishi wire EDM machine works perfectly and delivers everything we expected of it.

*Jacques-Henri Miguet,
Managing Director at AMB*

Component produced by wire cutting



The MV1200R wire EDM system now in use at AMB for three years

the latest technology. This results in manufactured parts of superior quality and precision.

Why Mitsubishi Electric for electrical discharge machining?

"In 2016, we started looking for a new wire-cutting machine because the existing machine from another manufacturer was unreliable and caused excessive maintenance costs," Miguet reveals. Initially there were discussions with three different suppliers, but the choice quickly narrowed down to the Mitsubishi Electric MV1200R offered by Delta Machines. One important reason for this was that the system accommodates a working height over 200 mm.

The decision in favour of Mitsubishi Electric was swayed in part by its holding of its "French Days" open day in Germany, during which visitors could witness the system in action, ask any questions they wanted and view the parts produced with it. In the end, the quality of the advice received was what clinched the decision in favour of Mitsubishi Electric. Ultimately a wire EDM system type



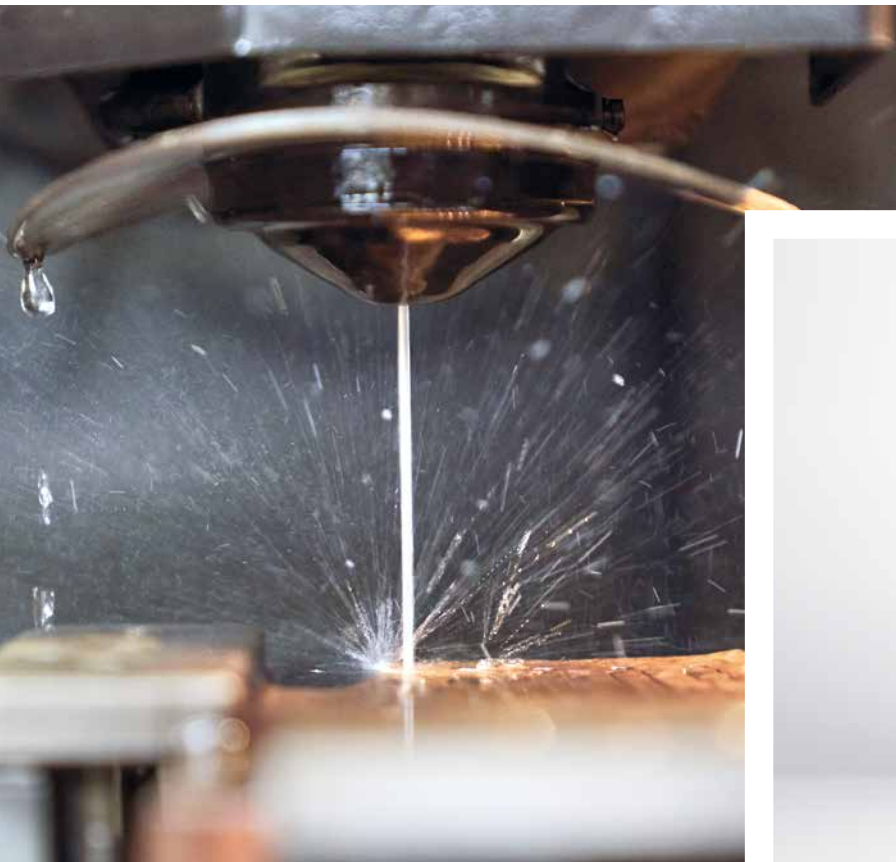
Michel Rouhaud on "his" MV1200R

MV1200R was purchased along with an EA8S die-sinking EDM system.

Experience with the MV1200R

"Our Mitsubishi wire EDM machine works perfectly and delivers everything we expected of it," says Miguet.

Automatic wire threader of the MV1200R



Part wire-eroded because of its 60 HRC hardness



Machines running around-the-clock.

If I should ever need another EDM system, I know exactly who to contact.

*Jacques-Henri Miguet,
Managing Director at AMB*



The training, which was spread over two courses 2–3 months apart, was very satisfactory, and his staff was soon well able to handle the system. The machine is programmed using NC software written externally with Mastercam CAM. The MV1200R achieves an accuracy of 1/100 mm when used with wire diameters from 0.1 to 0.25 mm, usually with two passes to achieve the best possible quality. In 2-shift operation and with an average spool life of 20 hours, jobs can usually be planned so that the next change falls within an employee's working hours and the machine runs largely around the clock. In this context, the automatic re-threading of the wire

after a breakage, even in the narrowest kerfs, is also very useful. The system is outstandingly maintained by the employee entrusted with it and has been running continuously and trouble-free in the three years since commissioning, and no wear worth mentioning has arisen. The cost of consumables such as filters is in the expected order of magnitude, and cooperation with Delta Machines has gone very smoothly during this time. "If I should ever need another EDM system, I know exactly who to contact," says Miguet, summing up his experience.

AMB Ateliers Mécanique de Baulne

Founding year

1980

Managing director

Jacques-Henri Miguet

Employees

17

Core business

Precision mechanics, prototypes,
mould making

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Wire erosion – an essential technology.

Specialists in EDM evolve into full-range suppliers of medical instruments

Easy access to the market.



Friedrich Daniels Medical GmbH has been operating in the Swabian town of Aldingen for a few months now. In the medical technology sector, this has been for many years a familiar name from a company based in Solingen, and this is something entrepreneurs Robert Keller and

Andreas Wenzler wanted to exploit. As Keller reports, the participation of the Solingen medical technology manufacturer in the recently founded company has opened up direct access to customers. "Via our head office in Solingen, we are already listed as a qualified supplier for many

potential customers. And this greatly simplifies access to the market we focus on," he adds.

Successful team of medical technology and production experts

Keller and Wenzler moved into the

modern new building in Aldingen in spring 2019 after only six months for construction. It provides over 1,000 m² of space for production and 250 m² for administration. Within a very short time, production capacity utilisation was high. The company had previously been based in Gosheim for more than two years, but the production site there did not offer any scope for expansion. Keller says: "We're obviously the ideal team for persuading customers of our comprehensive services, and this is probably why our company has grown so quickly and successfully." He and his partner started in 2017 by themselves, and today they already employ 15 specialists. The two of them met at handball – a real team sport. Keller had already had several decades of experience of EDM and had been highly successful with his old company Keller Erodieretechnik in neighbouring Gosheim. The other, Andreas Wenzler, had been a technical business economist specialising in medical technology for several years. So that he could embark on his own career, he refused to take over a long-established family business as planned, de-

ciding instead to start something of his own with his newly found partner. With their previous knowledge and excellent contacts in the industry coupled with their new location in the south-west German medical technology region around Tuttlingen, the two team players see themselves well positioned.

Development and production expertise

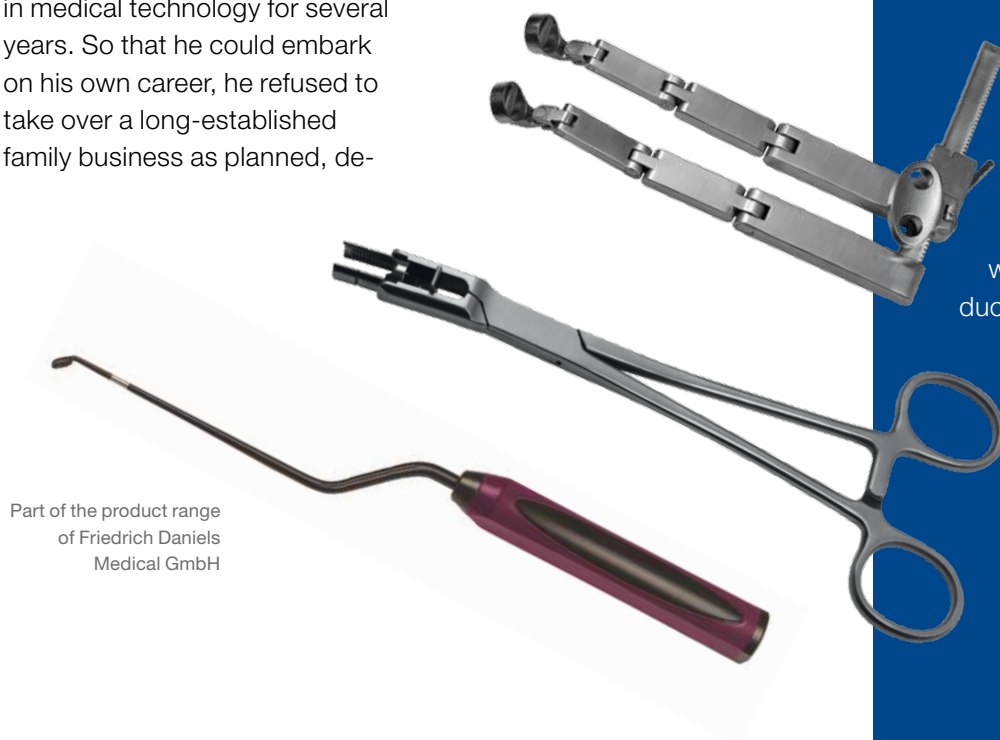
At their newly founded business, they have all the machining processes at their disposal – turning, drilling, milling, grinding and eroding. More than 20 machines are already in operation in the new production building in Aldingen, along with several skilled design engineers and CAM programmers. Keller and Wenzler thus see themselves well equipped to act increasingly as full-range suppliers of medical instruments. Wenzler is familiar with the demands and wishes of medical professionals and manufacturers who have been established in



Profile of Robert Keller

Robert Keller, one of the current managers of Friedrich Daniels Medical GmbH in Aldingen, has followed the technology of eroding from the very beginning. He first came into contact with the process in the 1980s during his training as a toolmaker at a Black Forest watchmaker's. Later, he worked in stamping and toolmaking and was able to significantly expand his knowledge of sinker and wire EDM. At his design office for toolmaking and at his later company Keller Erodieretechnik, he was also mainly concerned with this specific machining process. He is keen to point out that he is largely self-taught. He has also attended numerous further training courses at industrial institutions and machine manufacturers and finally passed the examination to become an industrial foreman.

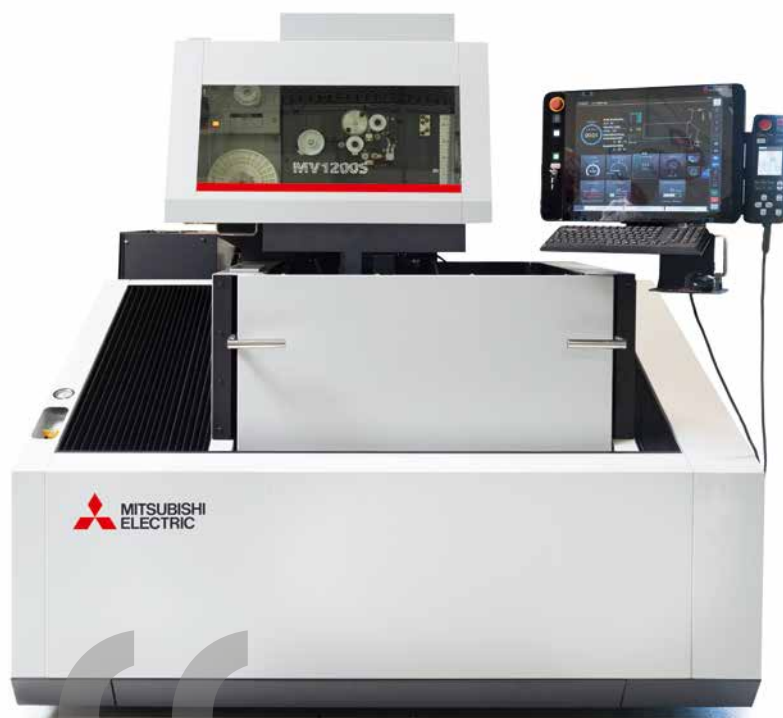
Throughout his professional career, Keller has seen himself as a practitioner. Even today, he says, he enjoys working at the machine. In this way, he can maintain and further develop a feeling for which workpieces can be produced under which conditions – using wire EDM, for example.



Part of the product range
of Friedrich Daniels
Medical GmbH

medical technology for many years in Tuttlingen. He has excellent contacts with the specialists, which allows him to participate in innovative projects from the idea through to the finished product. The company mainly focuses on instruments for surgical procedures and orthopaedic treatment of the spine. As a specialist in machining and specifically in EDM processes, Keller uses his comprehensive knowledge to ensure that the company can also cost-effectively manufacture difficult parts and components for medical instruments with high productivity.

Keller regards the wire EDM production process as one of the business's essential core competences. "This is the only way to produce the intricate and sometimes complex contours required especially for components for instruments and accessories in medical technology," he explains, adding: "This also applies particularly to the corrosion-resistant and high-tensile steel alloys used in medical technology." In Aldingen, the experts produce numerous components for medical instruments, using such materials as steel grade 1.4307, a corrosion-resistant chromium-nickel alloy.



This wire EDM machine is highly productive, accurate and dependable.

*Robert Keller,
Manager at Friedrich Daniels Medical*

Proven technology from Mitsubishi Electric

His excellent experience with Mitsubishi Electric wire EDM machines at his old company specialising in spark erosion goes back to 2003. He has experience of the FA10, FA20 and

BA8 machines. These, he confirms, have proven themselves over many years. "These machines have always been robust and reliable. I was also impressed by the comprehensive advice provided by the eroding specialists at Mitsubishi Electric. The



Cutting punch for toolmaking



Robert Keller proudly presents his SX20 wire EDM system.

MV1200S NewGen wire EDM with its state-of-the-art D-CUBES CNC control in May 2019. The programmers and machine operators took only little time to familiarise themselves with the innovative technology, Keller reports. The app-like operating and programming interface on the touch screen is much appreciated particularly by young professionals who are already familiar with this operating philosophy from their smartphones and tablet PCs. They appreciate the intuitive and simple operation. "However, it is also possible to select the user interface of the previous Advance Plus control system, which allows the new MV1200S NewGen to operate

competent and always accessible service was another reason why I consistently chose machines from the Japanese manufacturer." Keller proudly shows one of his trusty wire EDM machines, an SX20. "Since its initial installation and commissioning in 1996, it has been working dependably and with high precision. It has survived the move to today's production site without any problems and will hopefully continue to perform well for a few more years", Keller stresses. "That says a lot about the outstanding quality of these machines, I believe."

Keller has based his decision for further

investments on this positive experience. To expand production capacity, he purchased a



In the quest for μm precision

Productivity, high precision and dependability.

Friedrich Daniels Medical GmbH

Founding year

2018

Employees

15

Managers

Robert Keller,
Andreas Wenzler

Core business

Development and production of medical instruments and devices as a certified full-range supplier as well as EDM services on a contract basis

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very flexibly. Existing CNC programs can also be used on the MV1200S NewGen by operators who previously worked exclusively at the proven machines," says Keller. The fourth, rotary axis also contributes to the flexible use of the MV1200S NewGen, enabling it to fully machine all conceivable geometrical details on a workpiece in several planes.

Networking for Industry 4.0

Programming in Aldingen is conducted almost exclusively at CAM workstations from DCAM. The data is digitally transmitted straight to the EDM systems via the company network. The newly founded business is well on its way to Industry 4.0, Keller notes. The new building offers ideal conditions for directly networking all machines, CAD-CAM systems, and production planning and monitoring. It goes without saying that the processes in production are validated and largely certified. "This is the only way can we become a competent component supplier to medical technology. The components and instruments we develop and manufacture are approved for use in medicine – in surgery, for example," says Keller.



Learning the ropes the fast way with the new D-CUBES control

Production under contract to continue

With his comprehensive array of EDM systems, Keller intends to continue the contract manufacturing of customer-specific components, making a further commitment to this with the recently purchased MV1200S NewGen. "This wire EDM machine is highly productive, accurate and dependable," he says. The company in Aldingen therefore has sufficient capacity to punctually complete outside contracts at short notice.



The modern new building in the Swabian town of Aldingen was moved into in spring 2019.

**“Precision is
our strength.”**

Demand for EDM
processes results in
strategic decisions.

With great entrepreneurial intuition, GEWO Feinmechanik GmbH has successfully established itself with the manufacture of precision parts with high innovative elan. The increasingly high standards demanded of accuracy, quality and surface finish on increasingly complicated workpieces as well as growing order volumes in the production of such precision parts have called for the machine park to be gradually extended to include electrical discharge machining systems.

Founded in 1981 as an unlimited company by the couple Georg and Marianne Woitzik, the company history of GEWO Feinmechanik GmbH from Wörth/Hörlkofen near Erding shows a rapid advance to today's high-tech company. From the first apprentice in 1982 to today's workforce of more than 400 employees and the recent expansion of the production area to over 16,200 m², growth has been steady. The family-run business continues to specialise in the complex manufacture of elaborate components for the semiconductor industry, aerospace, automotive, medical technology and research. GEWO generates

most of its sales with clients in Germany. However, the continuously evolving sales network has also gained a foothold in other European countries and Japan. In 1999 the owner's older son Stefan joined the company, followed by his younger one Andreas in 2000. Stefan took over the technical management in 2011 and Andreas has held the position of sales director since 2014. After the economic crisis in 2009, the company quickly returned to growth, and a second plant was opened in the immediate vicinity in 2013. For reasons of internal logistics, about 10 per cent of the milling machines initially remained

in Plant 1 so that the parts turned there could be supplied to the milling process without the need for time-consuming transport. When these machines were also transferred to Plant 2, this freed up further space for expansion and greater overall flexibility.

To punctually supply its customers with high-quality and extremely precise components and assemblies, GEWO has a large number of wide-ranging machines at its disposal. The company has to machine a broad spectrum of materials: titanium, stainless steels, various other steels, special alloys such as MU metal,

Corporate history

1981 Founding of GEWO Feinmechanik GmbH. Big-name customers like Siemens and Agfa were regular customers right at the outset.

1982 The first apprentice is taken on.

1986 Purchase of a 3100 m² site and construction of a new company building with roughly 1100 m² of floor space

1994 Takeover of laboratory equipment specialist H. Hölzel GmbH

2000 Increase in the workforce to 70 employees

2004 Extension of milling capacity to include the Matec 30P machining centre

2009 135 employees now work for GEWO. Production covers 6,500 m².

2010 Takeover of Richard Staab GmbH & Co. inclusive of the entire workforce

2011 30th company anniversary

2013 GEWO employs 250 people.

2013 Commissioning of Plant 2 with 10,000 m² for production

2014 Brothers Andreas and Stefan Woitzik have been running the business since June 2014.

Permenorm, brass and copper as well as plastics and ceramics. In addition to the multitude of CNC machining centres with multi-axis milling machines, numerous CNC lathes, eroding, grinding, polishing and drilling machines as well as saws, there are also various systems for cleaning parts. Turning operations range from the production of precise 0.3 mm bores to reliable turning in diameters of 700 mm.

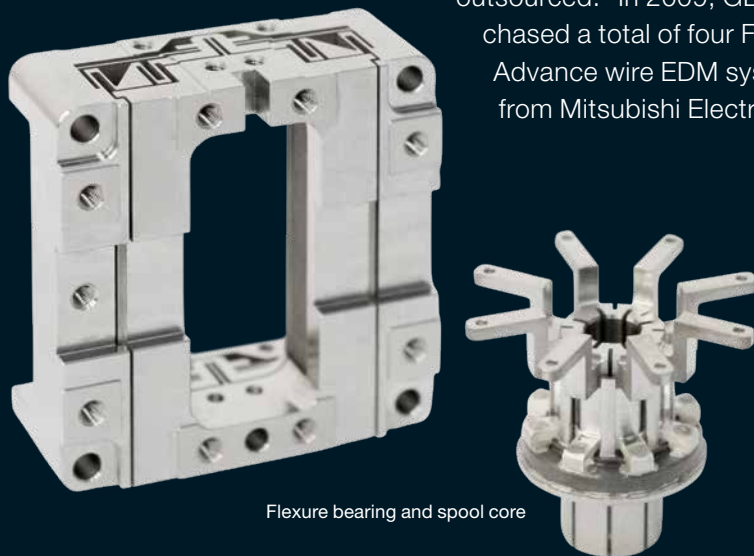
In the milling sector, the company machines components that require a working range of 3000 x 3000 mm and also produces tiny bores in the order of 89 µm. For its spark erosion activities, it has several wire-cutting machines and a die-sinking machine from Mitsubishi Electric. Here, a 6-axis robot supports the production of single parts and small series.

The company's fields of activity also extend to the professional integration of electrical/electronic and pneumatic units and the installation of drives and sensors. ESD (Electro Static Discharge) workstations are available for the fitting of sensitive electronic components. Furthermore, ISO Class 5 clean-rooms facilitate largely dust-free assembly. The quality

of cleaning is assured by a variety of cleaning and testing methods such as the water break test, particle measurement and residual gas analysis. In addition to the manufacture of high-precision products, GEWO also invests heavily in quality assurance, which enables it to meet the exacting demands of its customers, particularly in the semiconductor industry.

Wire EDM machines in continuous use

"We used the period during the tense economic situation in 2009 to become more familiar with the possibilities of EDM technology. This was particularly because we had increasingly recognised a growing need for eroding processes. The components concerned are ones with intricate contours, tapers, penetrations, corners and the tiniest radii that require high-precision dimensional accuracy with special surface finishes. This is where EDM has clear advantages over conventional machining," Stefan Woitzik reports. "Until then, we had outsourced all such tasks. But we are now successfully handling this form of machining ourselves. Nevertheless, some parts are still outsourced." In 2009, GEWO purchased a total of four FA20S Advance wire EDM systems from Mitsubishi Electric on the



Flexure bearing and spool core

Generation change for wire-cutting machines.

strength of their outstanding price/performance ratio. Their capacity utilisation was gradually raised to an effective level. After the generation shift of wire-cutting machines to the MV series, the machine park was supplemented with three MV1200R machines.

The new generation brought with it significant advances thanks to such additional functions as enhanced machining precision by means of tubular direct drives and further improvements in process reliability, and reductions in machining cycles and energy consumption. Corner precision of $\pm 1 \mu\text{m}$ and circular shape deviation of less than $2 \mu\text{m}$ are now possible. The improved generator performance permits higher productivity. For example, Ra values of $0.45 \mu\text{m}$ can now be achieved with three cuts and $0.28 \mu\text{m}$ with four. "In addition, the automatic wire threading already available on the FA20S machines is now noticeably more efficient thanks



Stefan Woitzik talking to Josef Lanzinger

to an improved parameter setting," Josef Lanzinger, EDM department manager at GEWO, notes. "In general, wires with diameters of 0.1 to 0.3 mm can be used. But with the new generation we can also use

molybdenum wire with diameters of 0.1 to 0.2 mm. These wires are used to prevent copper and zinc contamination of the component." The MV1200R machines have a work table measuring 640 x 540 mm

On course for growth with innovation

Lithography optics with extreme ultraviolet light (EUV) already permit the exposure of structures in the order of less than 20 nanometres. Reaching market maturity in 2017, the associated EUV technology opened up a forward-looking market segment for GEWO. This new technology is important for chip manufacturers and users because it benefits home electronics, medical technology, autonomous driving, robotics and artificial intelligence. GEWO Feinmechanik GmbH manufactures precision parts for the semiconductor industry on behalf of Zeiss. For another customer it manufactures electron beam columns for the control of pixel errors in LCD televisions, monitors, notebooks and mobile phones. These are used for the control of pixel errors in LCD televisions, monitors, notebooks and mobile phones.

In 2016, the GEWO 3D division was established for the development and marketing of special 3D printers. These printers are designed for additive manufacturing in the high temperature range of over 200 degrees for plastics such as PEEK. This high-performance material is noted for its chemical resistance, low moisture absorption and high durability and strength. GEWO 3D printing technology enables extremely high reproducibility of the printing process, super-high 3D printing temperatures for the processing of high-performance plastics and up to 10 times the printing speed of similar 3D printers. The 2nd generation of the GEWO 3D printer was unveiled at formnext in Frankfurt in November.

and can accommodate workpieces with max. dimensions of 810 x 700 x 215 mm and a max. weight of 500 kg. Travel (X, Y, Z) is 400 x 300 x 220 mm.

High EDM efficiency thanks to robotic assistance

Since 2016, a PCam robot, three MV1200Rs and one FA20S, a coordinate measuring machine and a cleaning system have been operating very impressively in the EDM department. The 6-axis robot loads the various wire EDM machines with blanks and unloads the finished parts as well as manipulating clamping elements from a rotary magazine. It very effectively supports the

production of unique and series parts. The automation solution plans jobs, controls processes and activates machines. "With the PCam automation solution and the integration of our ERP system, we can machine components very efficiently on our Mitsubishi EDM machines. Via the plant's own machine network, the machines receive the required order data, 3D data and the generated NC programs from the CAD/CAM software PCam/Wire," says Stefan Woitzik, drawing attention to the EDM automation cell. "In line with Industry 4.0, we succeeded in networking all the machines in our company by 2013. This means, for example, that malfunctions such

as faulty processes or stoppages can be recorded and reported immediately. This was done initially via the telephone system and later via an SIP client." These Session Initiation Protocols are based on voice-over-IP. The content is sent in individual data packages via the Internet or intranet.

In the event of a malfunction, a message flashes up immediately on the machine display. An additional window provides the operator with a problem analysis as well as information on action to be taken. Configurable machining parameters can be used to graphically display information on the status

Training programme for nurturing young talent

"Admittedly, our training programme in the fields of precision mechanics, mechatronics, information technology, industrial clerks, etc. is not entirely altruistic in its systematic advancement of the young generation in the company. Study coupled with practical experience is also available. In September 2019, we were pleased to admit 24 new trainees," says Stefan Woitzik, explaining the training offer to encourage continuous growth of the workforce.

"The majority of the trainees stay at the company, with some going on to further training to become master craftsmen or technicians or studying for a bachelor's degree. We are fortunate in also being able to recruit managers from this group."



Significant boost to quality.



Head of EDM Josef Lanzinger setting up an MV2400

and production times of machining operations, as well as the consumption of operating resources and maintenance requirements. In addition, there is an oversized and clearly visible display for the convenient monitoring of all EDM systems. For each machine, a three-colour status indicator lights up in green to indicate that everything is running smoothly or flashes in red to indicate a malfunction. Furthermore, the screen permits the identification of all relevant order data, machining processes, runtimes and production statuses at a glance.

MV2400R EDM systems also assist the machining of larger workpieces

In the wire EDM sector, GEWO was prompted by customer enquiries to conclude that it would have to accommodate larger components, some of which required multiple machinings. So it was an obvious step to take a closer look at the per-

formance profile of the larger Mitsubishi Electric MV2400R machines. These wire EDM machines make it possible to clamp 1050 x 800 x 295 mm components and machine them in the 600 x 400 x 300 mm range. In principle, they offer the familiar range of functions, performance and accustomed operating comfort of the MV1200R. These easily underestimated factors along with the positive experience gained in terms of safety and availability resulted in the installation of two further MV2400R Connect wire EDM systems in 2018.

The innovative Tubular Shaft Motor drive of all MV wire-cutting systems goes a long way towards enhancing the quality of the machined workpieces. This is because the linear technology employed uses magnetic motors to ensure that the motions of the axes are adapted and completely cogging-free, so responsive control behaviour yields

precisely controllable processes and positioning. This in turn results in highly precise wire guidance with clean cuts. The intuitive operation of the wire EDM machines proves to be highly convenient with the Natural User Interface. Operating staff are supported by input masks, 3D views and assistance on the machine's 19" touch screen. This facilitates workpiece set-up, measuring the workpiece surface using a probe and automatically adapting the angle of the wire to the position of the machined component. Even complicated machining steps can be controlled in 3D.

An initial interim balance has revealed a reduction in machining times, in operating resources such as erosion wire, deionising resin and filter cartridges, and in energy consumption. If, for example, machining does not take a whole night in an unmanned shift, the machine switches all standby systems to sleep mode on completion. This process complements the already lower energy consumption due to the new generator technology.

Die-sinking EDM now on-site

In October 2018, the GEWO machine park was extended to include an EA12S die-sinking system from Mitsubishi Electric. It is capable of accommodating components weighing up to 1000 kg with maximum dimensions of 900 x 650 x 350 mm and performing machining operations in the 400 x 300 x 300 mm range. "Although we still had a 40-year-old die-sinking EDM machine at our disposal, it was technologically outmoded and was only taking up space. Although we considered farming out this type of

machining, in the end we decided to purchase a new machine for die-sinking EDM. An important requirement was that die-sinking was also very effective in removing seized tapping bits or broken drill bits. In this way, production proper can be resumed without delay," Lanzinger comments. To boost the productivity and flexibility of the machining sequences on the machine, a 20-fold electrode changer is used. In addition, a C-axis is available, which can be freely programmed for simultaneous operation as well as for rotary operation, while permitting highly precise electrode positioning. For certain requirements, such as deflection, the C-axis makes it possible to position

the electrodes exactly at the side. In addition, the same electrode can be used to access the component from different sides.

"Our investment decisions and expectations of the performance and stability of the eroding machines have been vindicated. This was true of the FA20S and is now also the case with the machines from the MV series and the EA12S. They help to boost our productivity, technological competence and competitiveness, and ultimately savings. Maintenance costs are low and the availability of the eroding machines is very high. Over the years, situations where a machine stopped for unknown reasons overnight or at weekends have arisen perhaps two or three times. But downtime has been minimal," Stefan Woitzik reflects. "Successful implementation has been assisted

by the constructive support of Mitsubishi Electric's experienced process technicians and engineers. We are very confident about the future. Because with our expertise gained from the constantly new challenges of the European market, we are also well positioned on the global market. "

The story continues ...

In the next issue, read the success story 4.0 about **wire EDM towards full automation.**



Josef Lanzinger at the EA12S die-sinker

Interview Stefan Woitzik



GEWO Feinmechanik GmbH

Founding year
1981

Employees
400

Managers
Stefan Woitzik,
Andreas Woitzik

Core business
Precision apparatus, optical and
machine component manufacturing

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How did you start your career?

I grew up surrounded by metal swarf, because my parents got the business started with their first machines in the cellar and the garage. I have always really enjoyed working with metal.

I started my training as industrial mechanic for devices and precision mechanics after finishing school.

How did you earn your first money?

Helping out in my parents' business before training.

What do you like most about your job?

I am always having to deal with new and interesting projects, so I can always learn new things and put myself to the test on a daily basis.

What are the biggest challenges in your sector?

We want to and have to continue to develop so that we can hold our own in the marketplace in terms of price and quality.

How do you see your company in the market?

Our strengths are our high vertical integration as well as cleaning, residual gas analysis and subsequent cleanroom assembly.

What makes you successful?

We carefully analyse and evaluate all our projects. This makes it possible to minimise problems and achieve efficient processes with high quality.

What mistakes can you most easily forgive others for?

It is important to admit to making mistakes and to not conceal anything. It is then easier to correct the mistakes.

What is different about what you do today compared to five years ago?

Projects are getting bigger and bigger. More employees are therefore involved in the teams, and I delegate more tasks and responsibilities.

How do you recharge your batteries outside work?

With my family and children as well as cycling outdoors and climbing.


Mitsubishi Electric



Fast track to individualisation.

Industry 4.0 is a big talking point. But what does it really entail? The idea is that, as a benefit for the customer and consumer, the individualised product should be available within minimum delivery time. Although it requires, on the one hand, great efforts on the part of industry, it nevertheless opens up undreamt-of opportunities for internationally competitive production at a cost-intensive location such as Germany.

Fast and cost-effective production of single items.



The point of digitisation is to enable companies to become more efficient, flexible and productive. And this will also be absolutely necessary from now on. This is because consumers increasingly expect to receive a product tailored precisely to their needs and preferences within the shortest possible time – something barely achievable with the currently widespread methods of industrial (mass) production.

That's why experts all over the world are working to largely optimise processes in industrial companies along the same lines as in the retail sector. A product's route from the order to design and pro-

duction through to delivery is to be digitally served, controlled and monitored. In this country, strategies of this kind are referred to as Industry 4.0 and are designed to enable companies to manufacture individualised single items just as quickly and economically as the mass products common today.

This requires a comprehensive strategy. All processes in all organisational areas of a company have to be optimised and digitised. This begins with the design and engineering of the products, and to this end engineers and technicians work with a variety of computer-aided technologies. These cover the

design and detail engineering (3D-CAD), the calculation and design of strength as well as static and dynamic behaviour (CAE, FEM calculation), the programming of the production equipment (CAM), the planning and preparation of production (PDM) and the test and measurement procedures for quality assurance (CAQ). These extensively digitised processes are networked with each other, resulting in a comprehensive digital model of the product being manufactured. Consisting of a multitude of important data and information, this model is also known as the 'digital twin'. The product initially exists only virtually, although all of its properties and characteristics are already known. So the consumer can already see his product – in a three-dimensional virtual realm – even though it has not yet been manufactured. In this digital model, features can still be varied flexibly and at short notice, enabling the product to be adapted to individual wishes and requirements in this way. The resultant data model can be used in the digital environment to quickly and reliably derive all instructions and process specifications for subsequent production.

Machines and workstations comprehensively networked for data communication accelerate the subsequent production processes. Single items can be produced with ease. This is because the machines and the specialist personnel each receive the very latest data on the manufacture of the various personalised items without delay, along with all the information on

the tools and auxiliary equipment required. These data are available at terminals and computer controls. For the production steps already accomplished, operators and machines each report data on operating states and results back to the central production planning and monitoring system. Thus, the path from the individual component to the fully assembled product can be tracked at any time using the digital information. The data collected are also analysed by specialists, and future production processes are continuously optimised on the basis of the findings. Finally, quality assurance records the real data of the entire product at measuring and test benches. Quality assurance is also integrated into the networked structures and receives specifications from design and engineering, which it compares with the actual values generated by the inspected product. In this way, each manufactured product receives an individual data record as a stamp and lifelong identification mark, as it were.

The manufactured products themselves will also benefit from digitisation, if

Digital twin



Machines and workstations comprehensively networked for data communication accelerate the subsequent production processes.

Finished product with individual data record.

available, and are endowed with abilities that were previously considered unthinkable. This applies in particular to individualisation. With the aid of software functions, a multitude of functions and features can be introduced with minimal effort. Household appliances and similarly complex products, for example, will monitor their own operating states at all times with the aid of sensors. Using extensive data communication, e.g. via the Internet, these sensors transmit the data to the user and to the manufacturer. On the latter's site, specialists – and in the future also automated algorithms – will use this information to identify

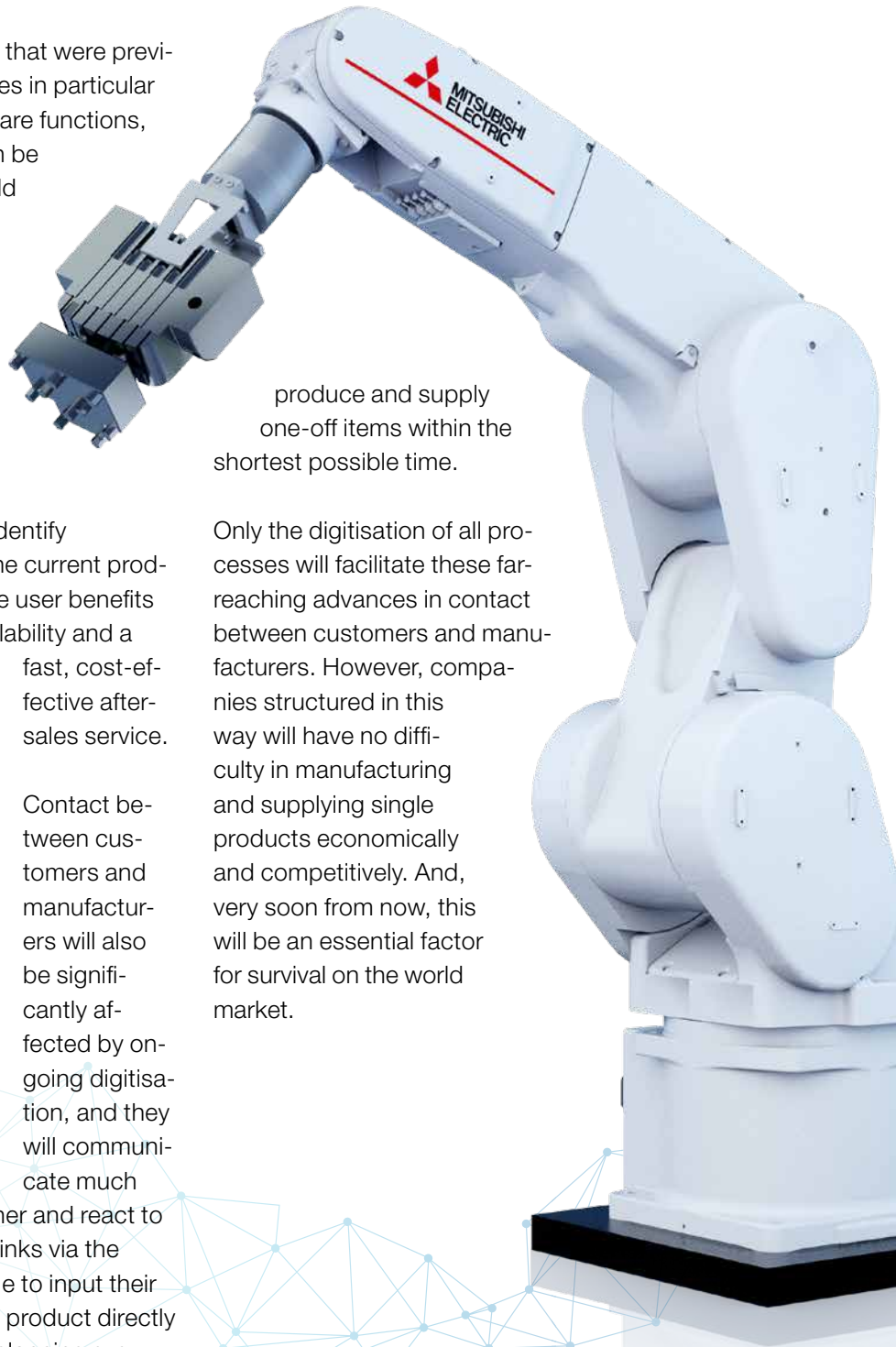
and analyse the current product status. The user benefits from high availability and a fast, cost-effective after-sales service.

Contact between customers and manufacturers will also be significantly affected by ongoing digitisation, and they will communicate much

more efficiently and flexibly with each other and react to changing wishes. For example, utilising links via the Internet, users and customers will be able to input their information on the desired individualised product directly into the product design and production planning systems. Using the data digitally generated by the manufacturer – the digital twin – they can then view the desired product a very short time later and place their order for it. Thus, to a large extent, it will be possible to flexibly manufacture individualised products. Thanks to sophisticated algorithms and production planning software, manufacturers will be able to specify the exact delivery date as soon as the order is accepted. As a result of digitised production processes, they will then be able to

produce and supply one-off items within the shortest possible time.

Only the digitisation of all processes will facilitate these far-reaching advances in contact between customers and manufacturers. However, companies structured in this way will have no difficulty in manufacturing and supplying single products economically and competitively. And, very soon from now, this will be an essential factor for survival on the world market.



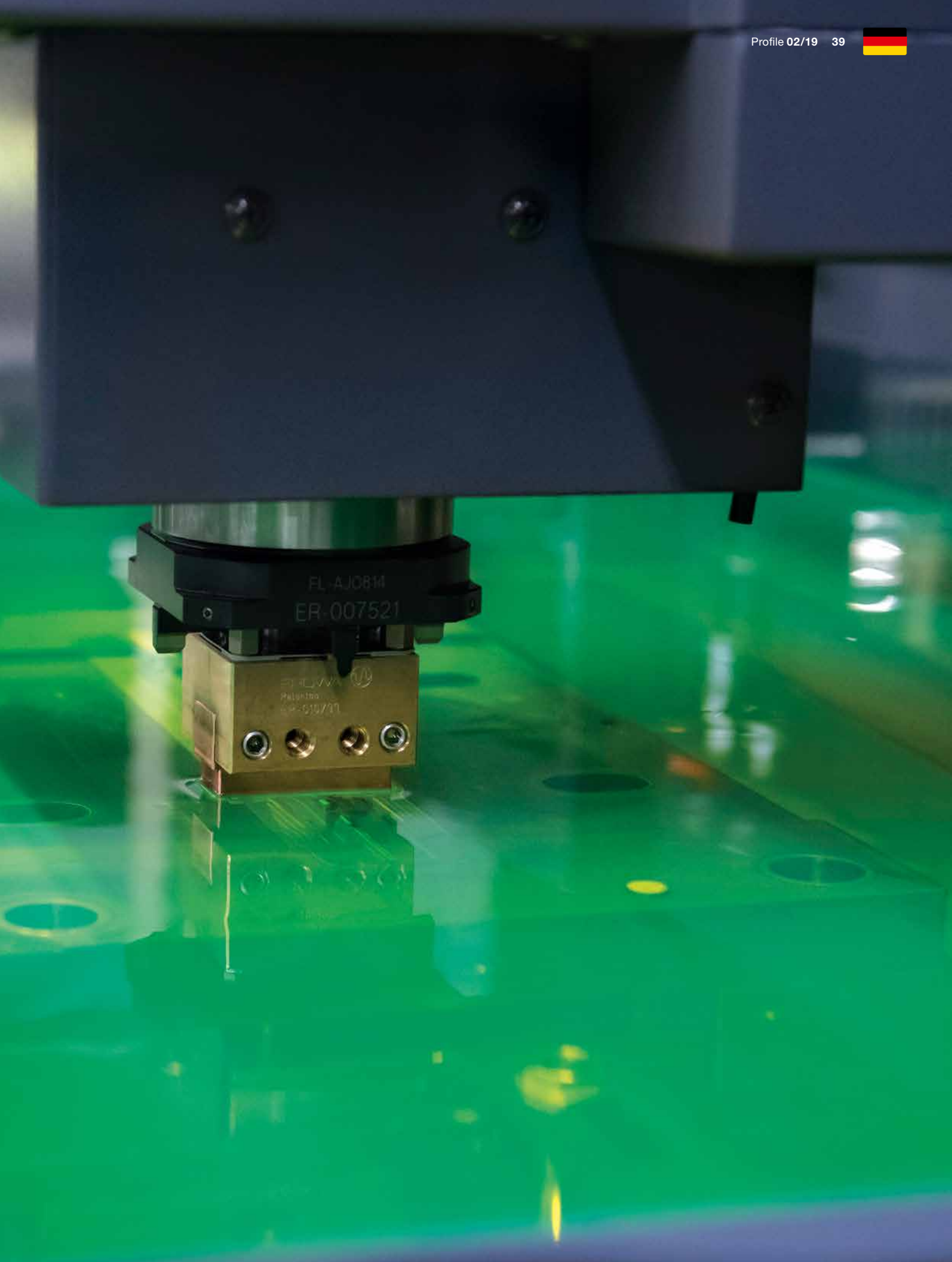
HIMATEC GmbH & Co. KG

Machines are an investment in the future.

HIMATEC – a family business that aspires to quality.

Modern technology, highly skilled employees and a clearly defined corporate strategy are the cornerstones of the success of HIMATEC GmbH & Co. KG. “We don’t talk about quality, we produce it,” co-manager Severin Himmler explains. “That was the guiding principle of our parents, who founded the company in 1985, and it is still our aspiration today.” Since its foundation, HIMATEC has developed steadily, employing around 45 people and specialising in the manufacture of single and series parts, fixtures, test benches and assemblies. So that it can meet its wide-ranging requirements, HIMATEC relies on advanced, forward-looking technologies and machines. In 2018, for example, the company completely replaced its EDM equipment, commissioning four new Mitsubishi Electric eroding machines and a start-hole drilling machine.

With the latest technology into the future.



For HIMATEC co-managers Daniel and Severin Himmler, everything revolves around quality. In doing so, they define the term quite broadly rather than reducing it solely to product quality. Reliable delivery and good customer relations are also important to them. And their success speaks for itself. Today, around 45 skilled employees work at the company headquarters in Berg near Neumarkt in the Upper Palatinate. These are the sought-after specialists when it comes to the manufacture of single and series parts, fixtures and assemblies. HIMATEC also develops and produces high-quality injection moulds and measuring devices for the plastics industry in the medical, automotive and electronics sectors.

“We manufacture assemblies and complex individual parts in different batch sizes,” Severin Himmler explains. “Our customers appreciate our flexibility and above all our high vertical integration. With our comprehensive machine park, we cover all the machining operations required in our machine manufacture and toolmaking.” The manufacturing processes available include CNC milling as well as turning, wire-cutting, die-sinking, grinding and much more besides.

The automated 5-axis simultaneous milling and turning centres with a large variety of workspaces are especially important for the company. “However, machines only do a good job if they are properly operated,” Himmler explains. “It is our employees, with their commitment and know-how, who deliver quality.”

35 years of machine manufacture

It all started classically in a garage. Armed with plenty of ideas, a milling machine and a saw, Erhard Himmler and his wife founded Erhard Himmler Maschinenbau in 1985. This was followed by rapid growth. Only four years after its foundation, the first extension building for production went up. Today, some 35 years and 3 extensions later, the founder’s sons Daniel and Severin have now taken over the reins of the company. “Our customers appreciate our wide range of machining options. As a contract manufacturer, we cover all milling, turning and eroding processes as well as assembly and toolmaking”, says Severin Himmler listing the various activities. “Our customers get everything from a single source. We have the entire machining process in-house and therefore under our control. This means we also have direct control over

deadlines. Compliance with delivery deadlines is a central issue and is just as important today as the price.”

Specialists in complex tasks

HIMATEC has a huge product range. In addition to the production of highly complex individual parts and

The entire machining process on site.

injection moulds, this also includes automated mass production inclusive of various surface finishes and assembly work. "We can machine almost all materials, from stainless steels, aluminium and tool steels to the various plastics predominantly used in electronics," Himmler explains. "In production we have a broad set-up and supply prototypes and/or one-offs, and anything from small series up to series of up to 5000 items."

Advanced equipment

For the two managers, the business's advanced, forward-looking equipment forms the basis for their success. They invest in it regularly so as to keep their machine park constantly up to date. This also entails the replacement of older machining centres and ongoing automation. With each investment HIMATEC hopes to appeal to and attract new customers. "The technologies that will be important for us tomorrow depend on our customers' requirements," Himmler explains. "But we're always ready to develop further and go new ways."

A major investment was due for HIMATEC in 2018. So they can continue to offer their customers the immaculate processing of tools and moulds with state-of-the-art EDM equipment, the company replaced both the

die-sinking and wire-cutting EDM machines.

Practically fail-safe and consistently precise

The two new Mitsubishi Electric EA12S and EA28V Advance die-sinking EDM machines and two Mitsubishi Electric MV1200S NewGen and MV2400S NewGen wire-cutting EDM machines went into operation in 2018. "We rounded off our investment with a new start-hole drilling machine," explains Himmler. "When investing in our machine park, we always compare the offers of all manufacturers very closely and examine the data in detail. When we invited tenders for five systems, we studied the market very closely and evaluated the performance, prices and service of the major manufacturers."

The comparison went quite clearly in favour of Mitsubishi Electric. One of the decisive factors was the company's very positive experience with Mitsubishi Electric eroding technology. Himmler has been particularly impressed by the virtual fail-safety as well as the consistent precision and simple handling of Mitsubishi Electric machines, as demonstrated over two decades. "Of course, price is also an important criterion, but not the only one," explains Himmler. "It's the

overall package that counts. We can only operate profitably



Five Mitsubishi Electric machines, comprising two wire-cutting machines, two die-sinking machines and one start-hole drilling machine, can be found at HIMATEC.

We can only operate profitably with a machine park that is capable of meeting current and future requirements. A bonus in Mitsubishi Electric's favour is the machines' robust standard equipment.

Severin Himmler, manager at HIMATEC



with a machine park that is capable of meeting current and future requirements. A bonus in Mitsubishi Electric's favour is the machines' robust standard equipment."

Dependably through the night

For production to be cost-effective, a process-safe unmanned third shift is required. Automatic wire threading is crucial here, because a wire can also break. This made a reliable threading system essential for HIMATEC. "We knew that the system worked," explains Himmler, "but we were a little sceptical about the heights given by Mitsubishi Electric at which the wire is safely threaded into the kerf. "After a year in operation," the managing director continues, "we have not yet been able to challenge the machines at all the heights, but we have gathered plenty of experience and know that the system is

working to our complete satisfaction." For the company, this means a boost to process reliability. "This is the only way we can perform several tasks in a single clamping," Himmler stresses, "and have long-running jobs reliably performed at the weekend."

Machinery and manufacturing processes

- **CNC milling:** 5-axis (partly simultaneous plus automation)
- **CNC milling:** 3-axis (including automation and a fourth axis)
- **CNC milling:** 3-axis large-format (base plates, turntables, etc.)
- **CNC turning:** with a Y-axis, sub-spindle, bar loader and gantry loader
- **EDM:** wire-cutting / die-sinking / drilling
- **Measuring:** air-conditioned measuring room with coordinate measuring machine
- **Others:** grinding / sawing / sandblasting / etc.

HIMATEC GmbH & Co. KG

Founding year

1985

Managers

Daniel Himmler, Severin Himmler

Employees

45

Contact

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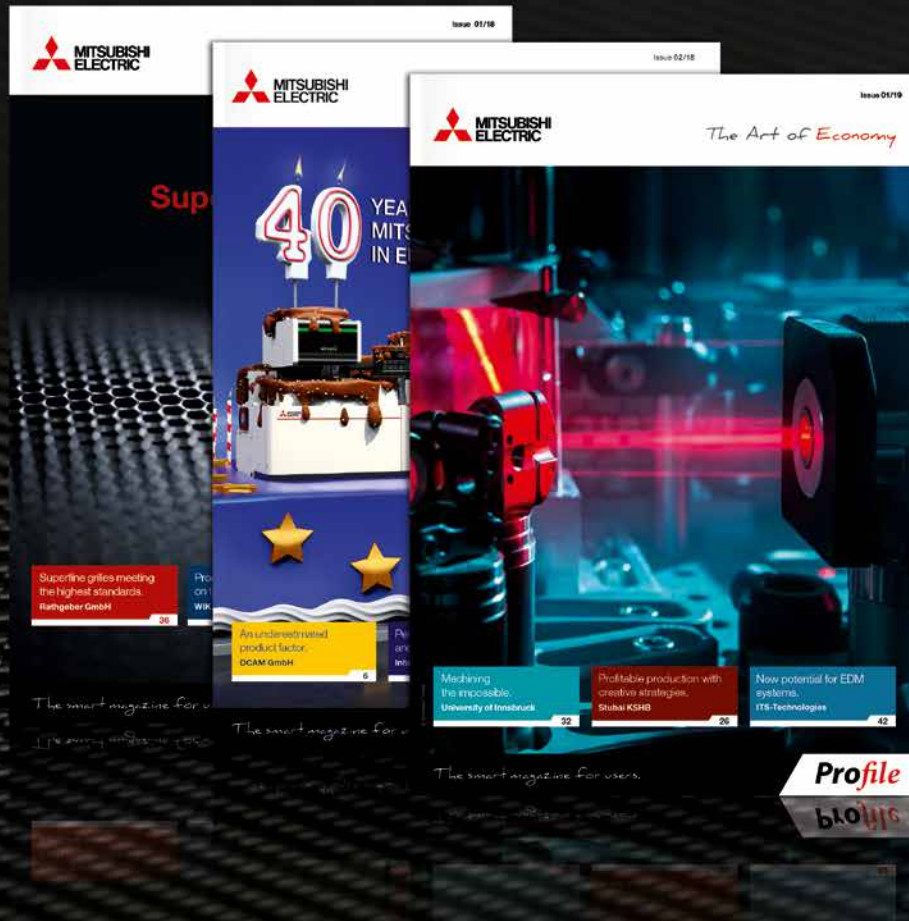
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From practitioners for practitioners.



Focus on grinding processes.

HFU – KSF Tuttlingen

Opening up new fields of application.

At the Institute of Precision Machining in Tuttlingen, Germany, scientists are developing process-safe methods for the wire-cutting of micro-profiles in metal- or resin-bond grinding wheels and pins with high repeat accuracy.

Scientists at the institute in Tuttlingen have been working primarily on grinding processes since 1997. Prof. Dr.-Ing. Bahman Azarhoushang was appointed its head in 2013, expanding its fields of research and giving the institute its current name of Institute of Precision Machining. Since then,

the now 14 scientific staff (including 8 doctoral postgraduates) and around 150 students in Tuttlingen have also been working on turning, milling, drilling and electrical discharge machining. However, the emphasis continues to be on grinding processes. The institute is sup-

ported by two work groups comprising 35 companies – mainly manufacturers of grinding machines and grinding tools and users. The scientists in Tuttlingen maintain their leading role beyond the region in their research into machining processes with special research focuses.

Skills for machining

The Institute of Precision Machining is part of Furtwangen University (HFU), which in turn has evolved out of Furtwangen University of Applied Sciences. At the institute, scientists and students are concerned with the three production areas of grinding technology and precision machining, machining technology, and laser technology and EDM. Application-driven and in some cases on behalf of machine manufacturers, toolmakers and users, they research the machining of difficult-to-machine materials as well as innovative processes for non-conventional machining, such as hybrid machining and additive manufacturing. In doing so, they concentrate, among other things, on micro-structures and high-productivity processes such as high-performance and high-speed machining. They develop processes, tools and process monitoring. They also hold specialist conferences and workshops so that their specialist knowledge and the developed technologies can be transferred directly to production at toolmakers, machine and measuring instrument manufacturers, and users. They also assist interested parties individually with studies, research and plans for the launch of innovative manufacturing processes.

As institute head Azarhoushang explains, these include above all processes for high-performance machining, micro-machining and non-conventional machining. The latter include laser- and vibration-assisted turning, micro-milling and micro-grinding. In conjunction with about 25 bachelors' and masters' theses, students and postgraduates develop and pilot innovative, application-driven manufacturing processes. To verify their theoretical predictions in practice, they have a lavishly equipped workshop comprising turning, milling, grinding and EDM machines, including, for roughly the last two years, a wire-eroding system from Mitsubishi Electric.

Demand for sharp, micro-profiled grinding wheels

At the request of the automotive industry, toolmaking and medical technology, the scientists in Tuttlingen are currently working on special profiling and dressing processes for grinding wheels. Their aim is to create precise, intricate and difficult-to-produce geometries in grinding wheels. It is not yet possible, Azarhoushang explains, to realise concave micro-geometries in metal- or special resin-bond grinding wheels in particular.

All currently familiar dressing and profiling processes have so far failed, be it with diamond, SiC or corundum dressing rolls or wheels. During dressing, either the bond of the grinding tools (diamond rolls) smears or the bond is reset by the process, causing individual abrasive grains to be torn out of the bond. The result is a smooth and at the same time not precisely pre-deter-

minable surface. Profile geometries smaller than the bonded grain size cannot be generated with contour accuracy. In addition, the bond of grinding tools made of hard cutting materials, such as diamond and high-strength bonded CBN in particular, cannot be reset in a controlled manner using conventional methods. However, this is absolutely necessary if the grinding wheels are to be resharpened again and again. Only then can they efficiently remove material from the surface of the workpieces being ground.

Wire EDM cuts defined geometries

First tests only a few years ago showed that it is possible to wire-cut even extra-hard grinding wheels. Azarhoushang explains: "We have taken up this approach at the institute and consistently pursued it further. The micro-profiling of high-strength grinding wheels can yield economic advantages particularly for regional industry."

The institute has invested in a precision wire EDM system from Mitsubishi Electric. This machine was chosen, Azarhoushang continues, because of the machine's comprehensive equipment, the main reason being the integrated V350 generator, the heart of the wire EDM machine, which is particularly suited to machining diamond and CBN grinding wheels. He was also impressed by the sound advice and service he received. "We also have the impression that Mitsubishi Electric is particularly interested in innovations and forward-looking applications for its wire EDM technology." He and his colleagues opted



The MP2400 Connect at its workplace

We also have the impression that Mitsubishi Electric is particularly interested in innovations and forward-looking applications for its wire EDM technology.

*Prof. Dr.-Ing. Bahman Azarhoushang,
Head of Institute of Precision Machining*

for the MP2400 Connect also because of its large workspace ideal for the processing of large grinding wheels. In addition, the wire EDM is equipped with a fine-finishing generator and a rotary axis. This enables the scientists to generate highly complex profile geometries on grinding wheels and pins.

They have been running the machine for about five months now. Using HSK tool holders, they clamp the grinding wheels requiring processing on the machine. The pa-

rameters for wire eroding are first retrieved from the assistance system integrated in the controller. This considerably simplifies programming and operation, Azarhoushang

says, especially for students and postgrads who usually work only briefly and occasionally at the machines. This also applies to the current control system with its large



Dressed by wire EDM – the wheel still on the EDM system



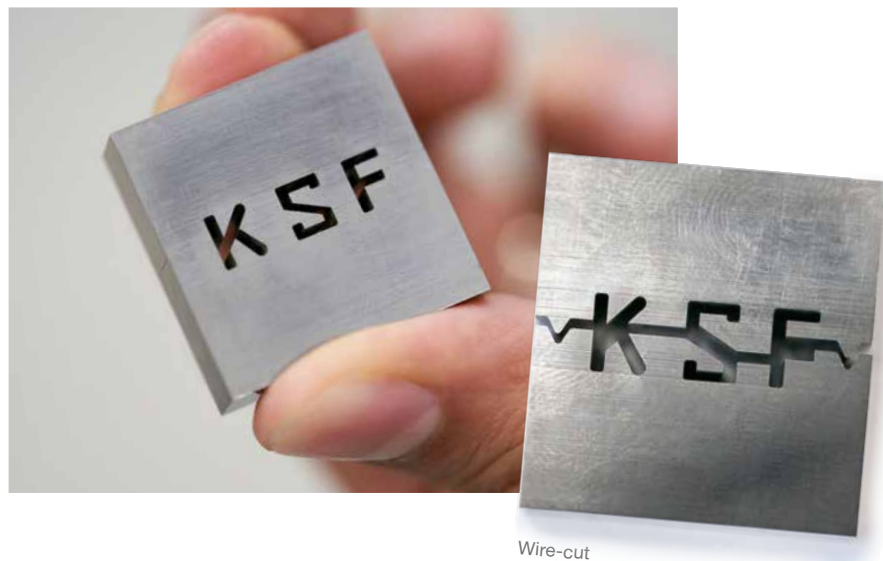
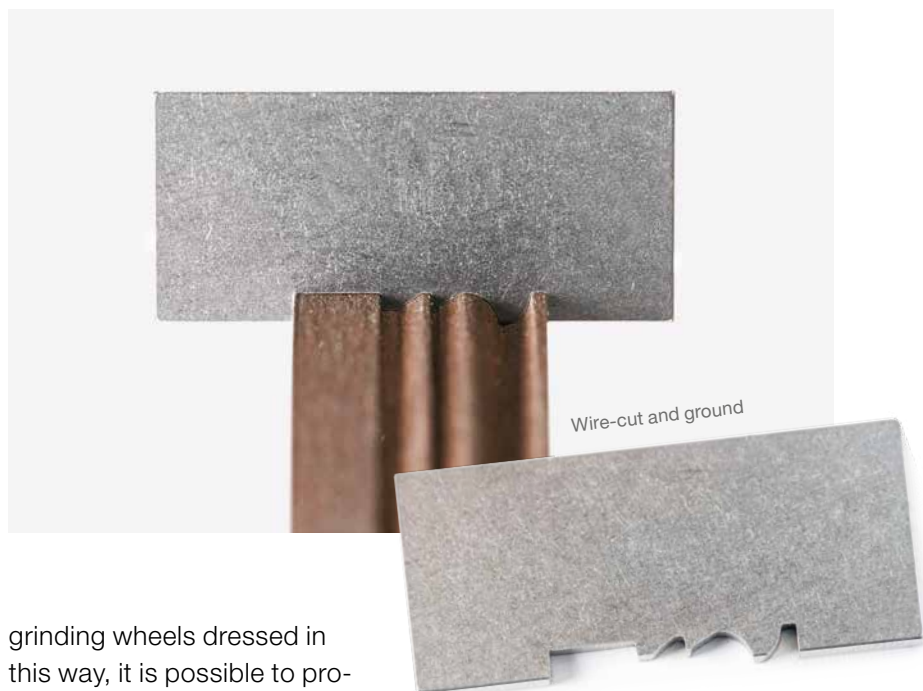
Dr Zahedi and Mr Khosravi
(postgraduate) at work

monitor and touch screen, which is operated using an app similar to those on smartphones.

Reliable profiling of high-strength grinding wheels

In their research and development work to date, the specialists in Tuttlingen have already identified numerous parameters for the dressing of profiles and micro-profiles in extremely hard grinding wheels. Azarhoushang explains: "In wire EDM, the wire cuts the profile with precision. Only the bond of the grinding wheels is removed, causing abrasive grains outside the produced profile to drop out, with the abrasive grains left on the grinding wheel surface protruding in a perfectly sharp condition. This enables even small profiles to be produced with repeat accuracy, while the

grinding wheels dressed in this way, it is possible to produce workpiece geometries that were previously impossible. Profiling and dressing by wire erosion thus also open up totally new production applications."



generated profiles are sharp as well. The grinding wheel is incisive and achieves high removal rates, removing material from the workpieces in a much more productive and, above all, precisely predictable manner. This proves to be highly beneficial for manufacturing companies. With

Process-safe micro-profiling

Depending on the diameter of the cutting wire, wire EDM can also be used to reliably generate highly intricate profiles, such as tooth profiles only a few tenths of a millimetre high

with almost any tooth flank contours. The innovative wire EDM dressing process is thus proving to be of great advantage to manufacturing companies. Numerous industrial users, especially in toolmaking, medical technology and microelectronics, Azarhoushang claims, are now interested in this technology. But he adds that for the application of the process in industrial series production, a large number of parameters and interrelationships between bonds, hard materials (grain size, concentration and grain type) and erosion parameters already work very well, although parameters optimised for special, newly developed bonds and hard materials still have to be determined. In his opinion, Mitsubishi Electric's wire EDM machines at the institute in Tuttlingen are able to do this quickly, easily and above all reliably. Once parameters are considered optimal, they are simply stored in the database integrated in the CNC control.

Machining a much larger range of workpieces.

With grinding wheels dressed in this way, it is possible to produce workpiece geometries that were previously impossible. Profiling and dressing by wire erosion thus also open up totally new production applications.

*Prof. Dr.-Ing. Bahman Azarhoushang,
Head of the Institute for Precision Machining*



Calculating parameters and simulating processes

In addition, the scientists are developing and refining suitable CAD/CAM software that makes the wire-cutting of profiled grinding wheels even easier to program and simulate than before. "With a sufficient bank of data, it will be possible in future to more precisely pre-determine the

appropriate strategies and the machine and process parameters for the required accuracy and surface quality. In addition, it will also be possible to simulate the machining process as a means of detecting collisions and impracticable profile geometries in advance," says Azarhoushang, looking ahead to the near future. At the research institute

in Tuttlingen, wire EDM machines from Mitsubishi Electric are making a major contribution to enabling production businesses to process a much wider range of workpieces with much higher productivity by using precisely profiled, strong and extremely hard grinding wheels.

Furtwangen University



The institute at its new location in Tuttlingen

Institute of Precision Machining

Head

Prof. Dr.-Ing. Bahman Azarhoushang

Employees

14 research assistants including 8 doctoral postgraduates, and 150 students

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K-L Präzision Falk Lange GmbH

A massive difference.

K-L Präzision Falk Lange GmbH has two oil-bath wire EDM machines in operation. This enables the company to machine in the μm range precision parts that can only be produced with great difficulty using other processes – and whose quality offers customers genuine benefits.

Consistently further developed.



K-L Präzision supplies tools and components to customers in medical technology, to automotive suppliers and aerospace industries.

“Never rest on your laurels, and always stay one step ahead” – this is how Falk Lange described his motivation as an entrepreneur when Profile magazine first visited him in Nideggen in the Eifel region in early 2016. His company K-L Präzision Falk Lange had already made a name for itself at that time with precision mechanical parts far beyond its immediate region. It supplies customers in medical technology, automotive suppliers and the aerospace industry with tools and components in the μm range – K-L Präzision products are even shipped to the USA.

Superlative precision times two

The trained toolmaker has remained true to his motto and has consistently developed his company further in re-

cent years. In the meantime, a second shop, where Lange stores the materials for his precision parts, has been erected on the 20,000 square metre company premises. He has used the vacated space in the first hall to further extend his machine park of EDM systems, machining centres, surface and cylindrical grinding machines, and lathes – he has almost doubled it in size since 2016. Twelve machines from Mitsubishi Electric alone are in operation, the MX600s being the flagships among them: “We are one of the few companies in Europe that has two oil-bath wire EDM machines,” Lange stresses, not without pride.

The challenge of special materials

“We didn’t actually plan to buy the



K-L Präzision has a total of twelve Mitsubishi Electric machines, including two oil-bath MX600 machines.

MX600s at all," Lange admits. He had already seen the machine at the AMB trade fair, but had not given it any further attention. "Of course, I knew about die-sinking in an oil bath, but not about wire-cutting. I actually asked myself what the point of it was." Today he can only smile about it, because a research contract from RWTH Aachen University ultimately showed him what wire-cutting in an oil bath is capable of. "At the time we were awarded a contract to manufacture high-precision components for an aerospace project." The parts were made of a very special material, although Lange is not allowed to disclose any more details for reasons

of secrecy. What we can say is that Lange was able to produce the components as desired on his existing water-bath wire EDM machines. But afterwards, difficulties arose in the parts' use – the edge layers that developed during EDM in a water bath proved to be problematical. Lange then discussed the problem with Lutz-Roger Neuendorf, the responsible sales manager at Mitsubishi Electric: "We examined the issue in detail," says Lange, stressing the competence of the Mitsubishi team with whom he has been working for many years. "Together, we came up with an oil-based wire EDM solution with the MX600."

K-L Präzision Falk Lange GmbH

Founding year

1998

Managing Director and owner

Falk Lange

Employees

10

Core business

Tool- and mould-making, precision parts production and the manufacture of small machines

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Eliminating microcracking and corrosion

Wire EDM with oil as the dielectric prevents the workpiece corrosion that can occur in a water bath. In addition, smaller spark gaps are possible, facilitating the machining of even more intricate parts.

Above all, however, it is the nPV generator of the MX600 that ensures gentle energy input into the workpiece. In total, the same amount of energy is used for machining the material as for wire eroding in a water bath, but broken up into several short discharges. By applying lower energy per pulse at a higher frequency, the energy peaks at the workpiece are reduced, and this in turn prevents microcracking.

Roughness of only

0.05 μRa
with the oil bath machine



Falk Lange shows the surface finish of a cutting punch produced on an oil-bath wire EDM compared to one produced on a water-bath machine.

Significantly better quality

"We tested the original material from the RWTH project on an MX600 demonstration machine in Mitsubishi Electric's showroom – the result was so much better than anything we had been able to produce until then," says a still enthusiastic Lange. In fact, he had already been impressed by the results of the fine-blanking machines in use at the time. "We were able to achieve a surface finish of approximately 0.25 Ra in the water bath – with the oil bath machine we now achieve a roughness of only 0.05 Ra." As an example he shows us two cutting punches made of standard steel – one wire-eroded in a water bath with a roughness of 0.3 Ra, and one in an oil bath with a roughness of 0.1 Ra – and asks us to scrape a fingernail over it. The difference is indeed remarkable. The surface of the punch wire-eroded in an oil bath is tangibly smoother and looks almost varnished. "Another important advantage of wire eroding is that much less stressing occurs in the material," Lange continues. "The whole structure of the machined metal is of higher quality – that's a massive difference." In concrete terms, this meant that the problematical edge layers of the component required for the RWTH project could be reduced to almost zero.

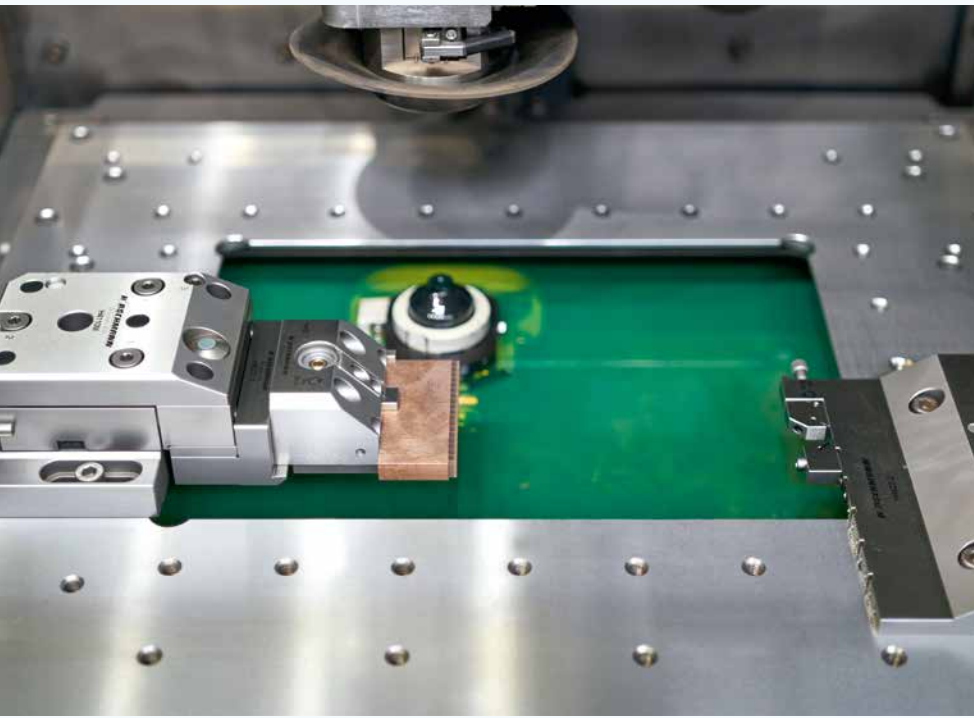
The second machine quickly follows

In the light of this result Lange did not have to think long – he bought his first MX600 in the summer of 2016. The decision was made easier by the fact that he was able to purchase a cheaper demonstration machine. And because he also managed to persuade the RWTH researchers, so he was finally awarded him the series production of the component. "This meant that the MX600 was well utilised right from the start – so well that there were even problems with delivery deadlines," Lange recalls. There would be enough work for a second MX600 – but two of these high-tech machines in a 10-man operation? Lange took his time in thinking

this over –



Winding mandrel for lamp filaments



Production of a follower electrode made of tungsten copper with a web width of 0.1 mm

and then, true to his motto, took the next step and the risk of buying another MX600.

This freed up capacity on the first MX600, which he used for existing orders from other customers. "We have some problematical tungsten carbide parts that have repeatedly caused problems on normal water-bath machines, particularly due to microscopic hairline cracking," says Lange. He then machined these parts on the MX600 – and the problems vanished. Lange has had good experience with the dielectric recommended by Mitsubishi Electric. Neuendorf adds: "The two MX600s at K-L Präzision are also equipped with the optional digital anti-electrolysis generator from Mitsubishi Electric. In combination with the oil-based dielectric, the subsurface structure is kept in a healthy state – a beneficial feature particularly for customers in the aerospace and medical technology industries."

Advantages in production and for the customer

The higher quality of the parts produced on the MX600 offers real advantages for the customer – the service life of the cutting punches shown as an example is extended by an estimated 20 to 30 per cent thanks to the higher quality. Lange also machines complex geometries using rotating spindles on the MX600 and also shows us a component as an example: the winding mandrel made

entirely of tungsten carbide used to wind the filament of incandescent lamps. In the past it had to be ground completely round, with a fit smaller than h6. "Today we machine the contour complete with a bore on the MX600 with a rotating spindle, without having to unclamp the component even once. A huge advantage," says Lange, explaining that the intricate contour of the winding mandrels wire-eroded in the water bath used to break off due to microcracking and tensions. Thanks to the MX600, that does not happen any longer. Lange: "We used to be able to machine these parts as well – but only in a much more elaborate process."

Lange is also very satisfied with the handling of the machine:

"The machine runs reliably day and night, even without supervision, and even threading a seven-hundredth wire on its own. However, it must also be clearly stated that to obtain maximum



Precision mould inserts for an injection mould

Designed for surface finish and accuracy.

quality, the necessary inspections and maintenance must be carried out on a regular basis". But the machines are so maintenance-friendly that the Lange team can perform all the necessary maintenance work itself. In addition, the dielectric is very easy to clean. Since buying the machines, Lange hasn't had to change the oil once – regular cleaning of the filter is sufficient.

Problem solver for special cases

"Wire EDM in an oil bath is intended for surface quality and accuracy, not for speed," Lange points out, however. "You should only cut special parts and materials that suit the machine." But then the advantages of the process are impressive. Word has got around in the industry, and Lange has acquired a reputation as an expert in special applications: "Customers come to us when they run out of ideas".



The machine runs reliably day and night, even without supervision, and even threading a seven-hundredth wire on its own.

*Falk Lange, Managing Director at
K-L Präzision Falk Lange GmbH*



Precision and quality in oil

Wire-cutting in an oil bath permits the machining of even challenging materials with extreme precision and superlative surface finishes:



Positional accuracy
< $\pm 1 \mu\text{m}$



Surface finish on
tungsten carbide
 $R_a 0.04 \mu\text{m}$



Geometrical accuracy
< $\pm 1 \mu\text{m}$



Roundness
< $1 \mu\text{m}$



Active into old age.



In the land of the centenarians.

Japan's secret of longevity.

Over 50,000 people living in Japan today are 100 years old or older – and the number is rising. On average, Japanese women today can expect to live to be at least 87. If one adds the men, the life expectancy is just under 84 – the highest value worldwide. But how do the Japanese manage to live so long? Is it their diet of fresh food, based heavily on fish and gently cooked vegetables? Or are the reasons to be found in high-quality oriental medicine, technological progress and the high safety standards in the Far East?

Not only over 100, but also active into old age

What makes Japan's aged so incomparable is not only their large number, but also their vigour. The Japanese wish to continue working into old age – a sentiment that obviously has a lot to do with the Japanese work ethos. Industriousness and dedicating one's efforts entirely to the success of the (corporate) community have been highly valued for centuries. In the event of illness, the individual can resort to an excellent network of state doctors and clinics, nursing staff and even one's own family. There's plenty of mutual assistance in 3-generation households, enabling parents and grandparents to lend a valuable

hand even in retirement. The feeling of being needed and doing something useful has a lot to do with the secret of longevity in Japan and keeps people mentally fit as well.

Japanese cuisine: Japan's secret

When older people in Japan are asked whether they watch their diet and eat healthily, they usually say they eat what they enjoy eating. One of the secrets can probably be found in healthy food. Even without paying attention to nutrition, most meals are freshly prepared and abounding with vitamins, trace elements and antioxidants. Japanese cuisine avoids fat and too many products from mammals. Beef and pork are cooked for a long time



and are thus free of fat and carcinogens. Fish is prominent on the menu – even raw and in the form of sushi. Mackerel, eel, salmon, squid and tuna are among the country's most important foods. At the famous Tsukiji fish market, you can gain a good impression of the broad diversity of the seafood consumed in Japan. Even the poisonous pufferfish seems to have no ill-effect on life expectancy. Liberated of its toxin glands by a master chef, it is a genuine delicacy and – who

knows? – maybe it even steels gourmets against future illness.

While the steeling effect of pufferfish toxin is only speculation, the antibacterial effects of the bitter melon and shell ginger are well-known. Like other vegetables, these two foods are served either fresh or briefly stir-fried in a wok. This way, the vitamins and antioxidants are preserved and have been shown to enhance immunity to illness and relieve stress. The substance resveratrol in the leaves of shell ginger is said to retard the ageing process considerably, as research at the University of Ryukyu on the Okinawa island chain has suggested.

Natural medicine in Japanese

What in Europe tends to be considered medically dubious if not charlatanism is an integral part of everyday life in Japan. In the daily round, and particularly in the cooking traditions, a lot of attention is devoted to balancing the body and to inner harmony. If such principles are consistently applied, people feel better and age much more slowly. Japan's herbalists therefore often prescribe plant-based products that are intended to balance the energy household and mitigate the effects of possible toxins. Along with shell ginger, extracts of green tea are beneficial to healthy ageing. Most Japanese drink green tea several times a day anyway.

When plant medicines and regular exercise no longer help, Japan's modern medicine comes into play. The Land of the Rising Sun is a technological front-runner and regularly hits the headlines with Nobel prize-winners



Many Japanese hope to continue working into old age – like this owner of a sushi restaurant in Tokyo.



The active ingredients of shell ginger (immediately above) demonstrably retard the ageing process. The bitter melon (top) has antibacterial action.



Okinawa – tropical paradise for the aged

Shell ginger came to the attention of researchers during a visit to Okinawa. The island chain is considered Japan's Hawaii and, with its tropical climate, is a popular destination for the summer. Nowhere else on earth do people live to be as old as on Okinawa. Even compared to the rest of Japan, the rate of cardiovascular disease is exceptionally low here, which, it is supposed, must be attributable to a low-fat diet, plenty of exercise and good genes. In fact, Okinawa's cuisine is somewhat low on calories and is based on regionally available fruit and vegetables. Algae, seafood, squashes, soya and beans are high on the list of ingredients. Salt in the preparation of meals is used only in small quantities. The culture of holding elderly people in high esteem in oriental societies is also beneficial to a long life. On top of this there's the agreeable climate that also helps people to stay healthy for longer.



in medicine, physics and chemistry. These achievements find expression in modern surgical techniques and revolutionary pharmaceuticals. Along with the values and methods of eastern natural medicine applied on a daily basis, a healthy cuisine low on calories and fat, a busy and active life into old age and internationally high safety standards in everyday life, advanced technology is an assurance of Japan's longevity well beyond the age of 100. Incidentally, the oldest currently living person has already been with us for over 115 years: Tanaka Kane was born in Fukuoka Prefecture in 1903. In the list of the oldest people of all time, there are many more Japanese – like the women Nabi Tajima and Choyo Miyako who only died in 2018 having walked the earth for more than 117 years.



Horoscope

for hard-wired EDM experts.

Capricorn



21 December – 20 January

As a top EDM specialist, you are more in demand than ever and your ideas yield improvements for which you are praised to the skies. But from time to time, devote some attention to your most important team member, the MV2400R. This way you produce punches much faster than you ever expected. Even if you don't need one right now, just give it a try!

Aquarius



21 January – 19 February

Venus is currently a source of good company in the sign of Aquarius. As a talented communicator, you always have plenty of friends around you, yet things can now get even better. Inspired by this, your taper angle leaves nothing to be desired – but don't get lost on chaotic travel paths!

Pisces



20 February – 20 March

The career stars are not shining favourably on you right now. But keep your chin up, everything will come good. Now pour all your energy into the relationship with your partner, but don't turn up with a bunch of wire-cut flowers as a gift. Let work be work. Your partner will thank you – you already know how.

Aries



20 March – 20 April

In the sign of Aries, you currently find Saturn about an arm's length below Mars. This brings you strength, energy and also new challenges. Are you in line for promotion – or perhaps for a new EDM system? The second half of the month will be much calmer and you will have more time for your hobby.

Taurus



21 April – 21 May

If you take a bull by the horns, it may well see red. These days, however, it is the seductive red of your laser-cutting machine that completely captivates you – this is where you've really hit the bulls-eye! Any machine without this bewitching colour is now a red rag to you.

Gemini



22 May – 21 June

Wipe the display of your EDM system as clean as you can – this is important because Mars, with its specific density, may make its mark here. Your partner also feels that you're neglecting her at the moment, so show her more attention. Go for a fancy meal or take a trip to the lake – this will work wonders!

It's written in the stars. And you can read it here ...



Cancer

22 June – 22 July

Extreme accuracy is your trademark, as is obvious to everyone. Perhaps you should also consider this for your socks – just because you have dyed them in the dielectric of your MV1200S doesn't mean that they will soon be in fashion as the standard equipment of every eroding machine.



Leo

23 July – 23 August

When roughing and pre-finishing, don't take any short cuts in the next few weeks. Taking extra care with your work pays off in the long run. Venus and the Moon continue to deliver great curves, both at work and at home. But make sure you get enough exercise to slowly burn off that excess energy!



Virgo

24 August – 23 September

Your performance curve has currently hit rock bottom. This is something you should definitely do something about. You cut positive angles and have great ideas, but this is no reason to rest on your laurels. You're sure to hit upon your next wire-cutting idea any time soon.



Libra

24 September – 23 October

Watch out, because Mars and Saturn are in different houses. Everything has to go! Sink all the scrap you no longer need. And you certainly no longer need the drop-outs. At the end of the month, you meet a friend from the past and gain new inspiration in the conversation – much to your surprise.



Scorpio

24 October – 22 November

You don't do things by halves. And certainly not when it comes to your EDM system. Currently under the influence of the warrior planet Mars, your impetuosity gets the better of you. Try a little gentle precision, calmness and composure instead! Your boss will also be much impressed and will show his gratitude for your effort and enthusiasm.



Sagittarius

23 November – 21 December

Believe in miracles! In the coming months you will be setting spectacular trends in the EDM sector, and the inspiration will come from Jupiter. No need to worry about the flashing cameras of your fans afterwards – just put on your sunglasses outside. Keep your feet on the ground, for it's better to let your tubular direct drive do the floating on air.

The Art of *Economy*



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