

**WTB, blade line retrofit (China)**

Interview: Mr. Decheng Wei,  
Vice Minister of Equipment Department

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single clamping operation**

Starrag rounds off its blisk machining line  
with the Starrag NB 151

**An XXL machine for all eventualities**

Starrag meets Metalex's big machining  
plans with large scale six-axis Droop+Rein  
portal machining centre

**The spark of FMS is ignited in Korea**

There is no other machine tool in the  
world that can compete with the  
performance of the Ecospeed range



Success story in Geneva:  
Luxury products workshop  
uses Bumotec technology

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## Starrag Group at trade shows 2019

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18.–23.01.2019  
**T-Gold Vicenzaoro**  
Vicenza (Italy)

24.–30.01.2019  
**IMTEX**  
Bangalore (India)

05.–08.02.2019  
**Intec**  
Leipzig (Germany)

05.–08.03.2019  
**Industrie Lyon**  
Lyon (France)

28.–30.03.2019  
**MECSPE**  
Parma (Italy)

02.–04.04.2019  
**PMTS**  
Cleveland (USA)

15.–20.04.2019  
**CIMT**  
Beijing (China)

30.04.–01.05.2019  
**Ceramics Expo**  
Cleveland (USA)

27.–31.05.2019  
**Metalloobrabotka**  
Moscow (Russia)

04.–07.06.2019  
**MACH-TOOL**  
Poznań (Poland)

17.–23.06.2019  
**Paris Airshow**  
Le Bourget (France)

18.–21.06.2019  
**EPHJ**  
Geneva (Switzerland)

27.08.–01.09.2019  
**Maks**  
Moscow (Russia)

16.–21.09.2019  
**EMO**  
Hanover (Germany)

07.–11.10.2019  
**MSV**  
Brno (Czech Republic)

08.–10.10.2019  
**Pacific**  
Sydney (Australia)

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Dr Christian Walti  
CEO of the Starrag Group

### Dear reader,

In this issue of our customer magazine, we will cover the various machines and services that our group offers – with examples ranging from manufacturing a luxury mechanical watch in Switzerland to an unusual service call-out to a Chinese turbine manufacturer.

For all of these activities, the Starrag Group always considers one thing as central: our customers. Our claim is that they will receive measurable added value from Starrag solutions. The article regarding our retrofitting task for Chinese turbine manufacturer Hangzhou provides solid proof that this is no frivolous, meaningless promise. At the Hangzhou site, the entire production line of Starrag LX machines for blade machining has been modernised.

While improving the precision of turbine blades in China, Starrag has also been supporting a Swiss watch manufacturer during the production of an exclusive mechanical watch that sets new standards in the industry with an

entirely new concept. The machine the manufacturer chose for this purpose – the Bumotec s191V vertical high-performance CNC machining centre – achieved a similar level of innovation in its own field. I personally recommend the interview between Felix Baumgartner, founder of chronometer brand Urwerk, and Stéphane Violante, Marketing Project Manager at Starrag Vuadens – it's a great read. They were amazed to discover that both companies are among the avant-garde of their respective industries, producing surprising and astounding innovations.

Starrag has seen particular success in the aviation industry. The new Starrag NB 151 has been specially developed for this sector, machining blisks for turbines more effectively than ever before. Increasing productivity is also a hot topic for Alfred Lilla, Sales Director Aero Structures at the Starrag Group, whose interview focuses on how Ecospeed machining centres can be interlinked into highly productive flexible manufacturing systems (FMS). Currently, these solutions are particularly in demand in Korean and Chinese aircraft production.

A portal milling machine from the Droop+Rein T line received by our regular North American customer Metalex embodies XXL at its finest. Thanks to the huge amount of space offered (for example a maximum of seven metres' clearance underneath the spindle), the contract machining company is now able to turn and mill even large workpieces easily in a single clamping operation – if necessary, the machine is capable of six-axis operation to improve flexibility.

Starrag has successfully transferred the output and quality characteristics of much larger machines into the new compact Heckert machining centres for pallets of 400 and 500 mm. One example of this is the high degree of rigidity, which is a consistent feature of all framework assemblies. The machines perform impressively on the test stand, and this performance is reproduced in practice with increased productivity and a broader component range for end users.

All of these examples show how seriously we take our claim to our customers – but we can only make our demanding projects a reality thanks to our incredibly motivated expert employees.

I hope you enjoy reading this issue of Star 1/2019. If you would like to know more about the Starrag Group and our products and services, I recommend coming to visit us in person at one of our sites or at one of the numerous international trade fairs we attend.

Christian Walti

# Behind the jewel, meet the technology



**After 6 years of participating to T-Gold exhibition, the International show for discovering the most innovative technologies and machinery applied to gold and jewelry applications, Starrag Vuadens SA and its Bumotec production equipment become a key player there.**

**On a tiny booth**, as fairground is pretty small and request from exhibitors to participate are not totally covered by the fair organization due to the lack of space available, Starrag's experts had the opportunity to meet potential customers from mainly Europe, Asia and Middle east.

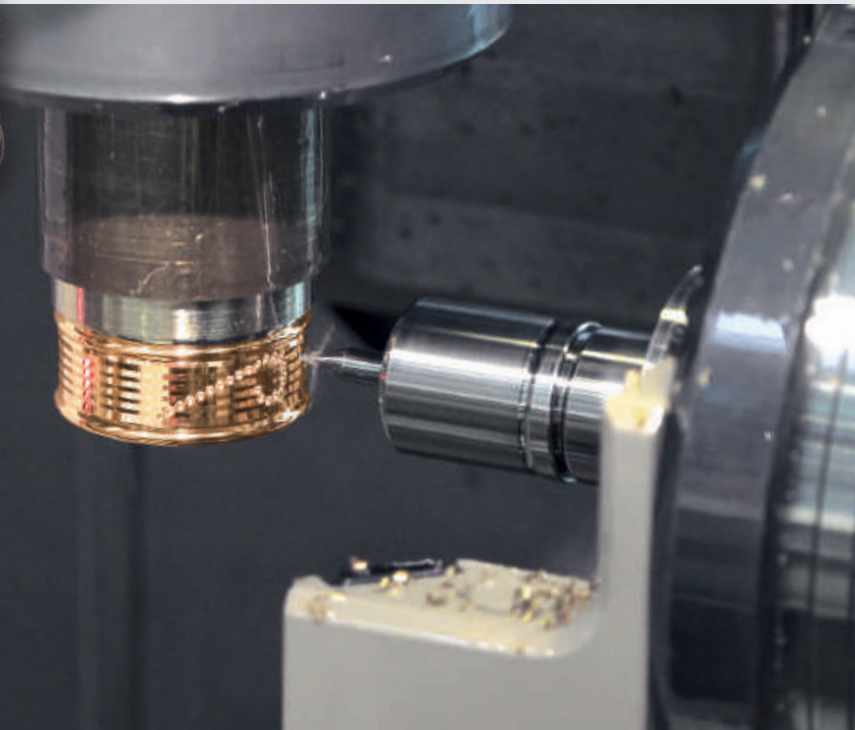
**Pretty well known** by jewels producers and specialists, T-Gold show is integrated to Vicenzaoro event, which globally

welcomes 36,000 visitors from 160 countries, and is declined in different editions around the world, such as Las Vegas, Dubai, Hong Kong. The quality of the contacts established there is really focused on dedicated solutions to produce efficiently perfect masterpieces.

**This year Starrag** demonstrated the ability to respond to market demands through four different rings produced



Diamond setting operation performed with accuracy and efficiency



Rings, bangles,  
diamond-rings,  
medals, cuff-links,  
signet-rings, and  
similar parts



during the show. The Bumotec s128 machine producing from bar, gave visitors an overview of flexibility and accuracy in manufacturing flawless rings, using turning, milling, engraving, diamond setting and diamond finishing processes. In a single setup, the Bumotec s128 is able to switch from one recipe to another, changing models according to fashion trends. Using the ability to work with 5-axis simultaneously, the compact

machining centre produces and engraves a wedding ring in a little bit less than 4 minutes, whatever the raw material used.

**As a successful exhibition,** Starrag will be part of the game next year with latest technological developments and new showcases of our "savoir-faire" in the luxury goods segment, made in Switzerland. ▀



5-axis simultaneous  
to produce this wed-  
ding ring including  
engraving operation



# WTB, blade line retrofit

INTERVIEW: MR. DECHENG WEI, VICE MINISTER OF EQUIPMENT DEPARTMENT



**Wuxi Turbine Blade Co., Ltd. (WTB)** was founded in 1979 and is the core state-owned holding company under the Shanghai Electric (Group) Corporation. The company's main business is the development and manufacture of power plant blades and aviation forgings. It is a leading domestic and world-renowned supplier of high-end power components in the energy and aviation fields. The company is located in Wuxi Huishan Economic Development Zone, covering an area of 230,000 square metres and total assets of 2.5 billion yuan.

After more than 30 years of industrial practice, with advanced technology and professional management, the company has a comprehensive market share of over 80% in the domestic market of large turbine blades for power stations. It has blade process development and manufacturing capabilities in million-class ultra-supercritical steam turbine. In the energy field, the company has become a strategic supplier of electric power to the three major electric companies in China. It has a good reputation for many well-known electric companies in the world such as GE, Toshiba, Mitsubishi, Siemens, Alstom and BHEL.

Since 2008, the company has established and expanded its main business. It has used the four advantages of "technology, equipment, efficiency and brand" established in the energy field, and has opened overseas aviation business through cooperation with GE and R-R.

**From 2005, WTB continuously bought 27 LX machines from Starrag. What is the main reason for WTB to be Starrag's long-term customer?**

**Decheng Wei:** Advanced processing technology, advanced functions, stability and high precision of equipment and good after-sales service of Starrag are the main factors.

**What did Starrag machines bring to your company in the past 13 years?**

**Decheng Wei:** 1. The innovation of blade processing technology has greatly improved the quality of the blade;  
2. Advanced technology and equipment have promoted the improvement of the skill of the company's technicians and improved the safety awareness of employees;  
3. Advanced technology and equipment have led to higher production efficiency, and as a result, the company's turnover.





**What is the main reason for blade manufacturing line retrofit in 2018?**

**Decheng Wei:** Mainly, WTB and the world-renowned aero engine manufacturer Rolls-Royce have signed a “long-term strategic cooperation agreement.” The blade technology aspect is led by the Swiss company Starrag. WTB therefore decided to carry out an overhaul and reconstruction of its’ existing equipment to meet the new requirements.

**What was the main content of retrofit? What was the most difficult in it?**

**Decheng Wei:** It is mainly the overhaul and reconstruction of the Starrag LX line machines, of which six are LX 151 which were overhauled, and four LX 051 machines reconstructed to include double-drive technology. The main difficulty is due to the ultra-high precision of the Rolls-Royce blades, whose high

requirements and standards determined the improvement of the hardware aspects of equipment overhaul, and the reconstruction or the optimisation of the electrical parameters of the machines.

**Were there any hard problems during the retrofit and how Starrag act on it?**

**Decheng Wei:** Rolls-Royce blades have high processing requirements, “Not only the blade size must be qualified, but also the surface quality of the blade must meet the standard.” Under the premise of ensuring the precision of the equipment, Starrag has also conducted the relevant optimisation of the electrical parameters for the surface quality of Rolls-Royce blades to achieve the new requirements.

**How about the retrofit now?**

**Decheng Wei:** Presently, the overhauled equipment has been put into the production of Rolls-Royce blades, and the

**“Advanced technology and equipment have led to higher production efficiency, and as a result, the company’s turnover”.**

qualification rate and stability of Rolls-Royce blades are also high.

**Please talk about your wish and suggestion to Starrag after sales service.**

**Decheng Wei:** At present, we are very satisfied with Starrag’s after-sales service for this project. In particular, the team of Starrag engineers and site managers cooperated very well with WTB. For this project, during the entire warranty period, it is hoped that Starrag’s resident service personnel will provide fast and quality service on the WTB site. After the warranty period for the overhaul and reconstruction project expires, a “value-added service” contract has been proposed by Starrag. ▀

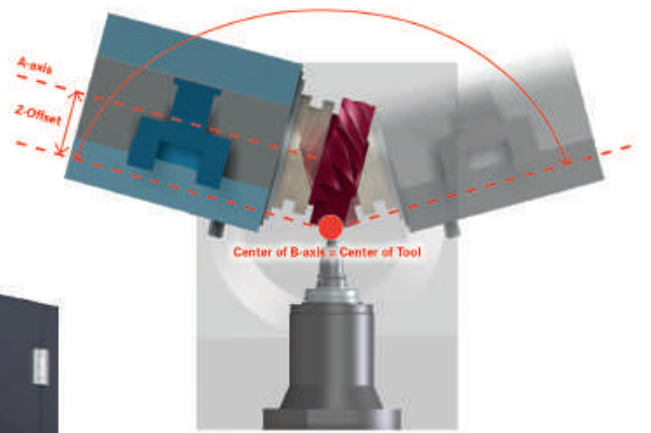
# Manufacturing blisk rotors in a single clamping operation

Starrag rounds off its blisk machining line with the Starrag NB 151

Machining blisks and impellers rapidly and reliably in a single step saves both time and money. Thanks to the five-axis Starrag NB 151, which has been specially designed for such machining processes, users from the aviation, aerospace and energy sectors can benefit from these advantages.



**With its NB line,** Starrag is developing five-axis machining centres designed especially for manufacturing titanium, nickel-based alloy and blade-steel blisks and impellers for stationary gas turbines. At the beginning of 2019, the machine tool manufacturer released the NB 151 as a smaller version of the Starrag NB 351 and NB 251. The NB 151 is



The two circular axes are certainly among the highlights of the Starrag NB 151. Specially developed for blisk machining at the Starrag site in Rorschacherberg, they are 100 % made in Switzerland.

designed to manufacture workpieces up to 600 mm in diameter, up to 290 mm in length and up to 300 kg in weight.

**Starrag NB 151** users can expect to benefit from short cycle times, reduced tool costs and a low amount of wastage. As with the larger models in this line

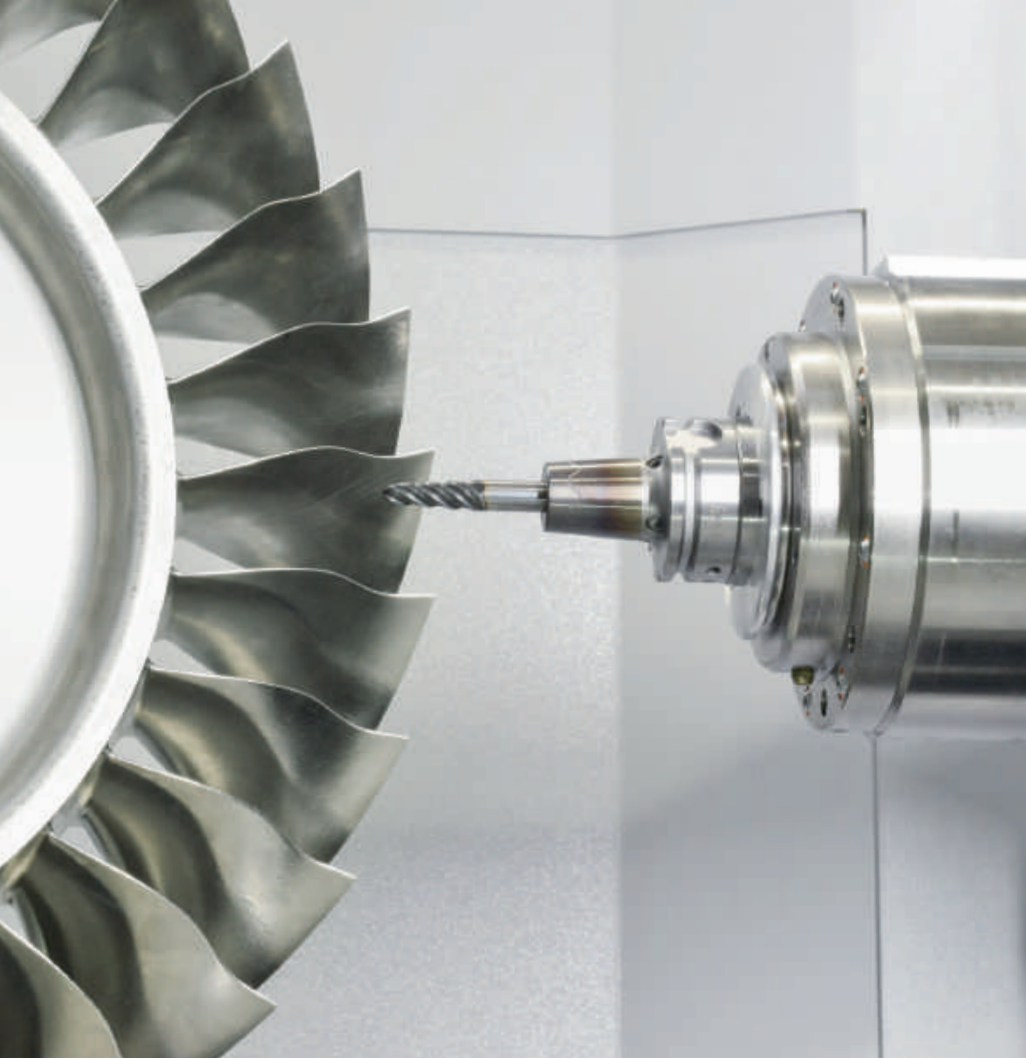
of five-axis machining centres, the NB 151 can perform all relevant production steps for manufacturing blisks and impellers – from the efficient roughing of components from a single piece of material to the adaptive machining of friction-welded blisks, right through to the highly dynamic smoothing of flow surfaces in point contact.

Such efficiency is possible thanks to a basic design that has already been tried and tested in small horizontal Heckert machining centres and the Starrag LX 051 blade machining centre. The mineral cast machine bed has excellent damping properties and a high degree of rigidity, while the compact design still provides easy accessibility to the workpiece thanks to



“With the NB 151, we can provide a service package tailored to blisk and impeller machining that will impress customers with its unrivalled overall performance.”

Head of Development Dr Markus Ess



Its rigidity and excellent damping properties allow higher cutting values while also reducing tool wear.

clever positioning of the spindle and fixtures. The high-quality Starrag spindle also ensures high removal rates.

#### **Special circular axes — developed by Starrag and produced in Switzerland**

**The two circular axes** are certainly among the highlights of the Starrag NB 151; specially developed for blisk machining at the Starrag site in Rorschacherberg, they are 100% made in Switzerland. Without compromise, the axes have been optimised for performance in multi-blade applications, as their layout has been carefully designed to reduce compensating movements of the linear axes to a minimum.

**One key factor** for successful blisk machining is being able to easily access the component; in the NB 151, this is ensured by the wide 280-degree angle of the B-axis, as well as the incredibly compact A-axis. The machine's optimised

obstacle contour both prevents collisions with the spindle and allows the use of shorter tools. The resulting cutting stability ensures the shortest possible roughing times and perfect surfaces after smoothing.

#### **Processing solutions from Starrag**

**Along with supplying** high-quality machinery, Starrag has also become synonymous with providing customers with end-to-end machining solutions for their components. The NB 151 is no exception. This blisk machining centre fits seamlessly into the overall package offered by Starrag, which covers the entire process chain from programming and technology to software, tools and machinery. Head of Development Dr Markus Ess explains: "With the NB 151, we can provide a service package tailored to blisk and impeller machining that will impress customers with its unrivalled overall performance."

**The NB 151** offers customers the chance to improve several aspects of their manufacturing processes, such as productivity. Its rigidity and excellent damping properties allow higher cutting values while also reducing tool wear. The high dynamics of the machine, resulting from features including a low number of moving masses, also contribute to minimised processing times, while integrated sensors and systems improve process reliability. Markus Ess explains: "Various elements of the machine, for example the spindle, are continuously monitored for vibration, deformation and temperature fluctuations. Corresponding automated compensation processes then ensure machine accuracy."

**As standard**, each Starrag NB 151 is also equipped with a measurement fixture which, in conjunction with special Starrag software, allows the blisks to be machined adaptively. This feature automatically measures every single turbine blade on the unmachined part and creates a tailored blade geometry before generating the relevant NC program and executing it on the machine. This ensures perfect transfers between friction-welded blades and the rotor. ▀

# An **XXL machine** for all eventualities

In a significant investment for the future, Metalex Manufacturing located in Cincinnati, Ohio, selected Starrag to supply a large-capacity, multi-axis Droop+Rein portal-type machining centre for their new Centre for Advanced Large Manufacturing.

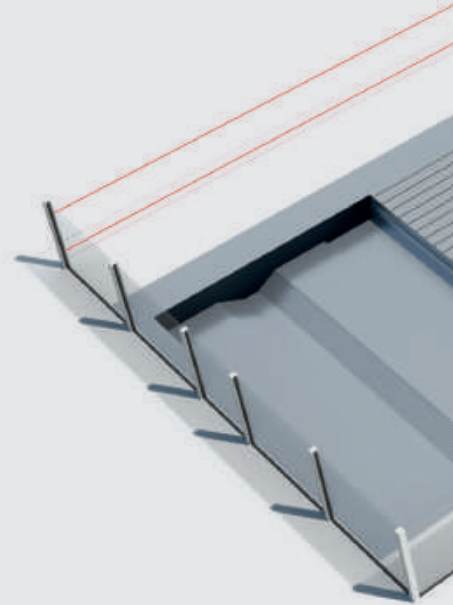
**Starrag meets Metalex's big machining plans with large scale six-axis Droop+Rein portal machining centre.**

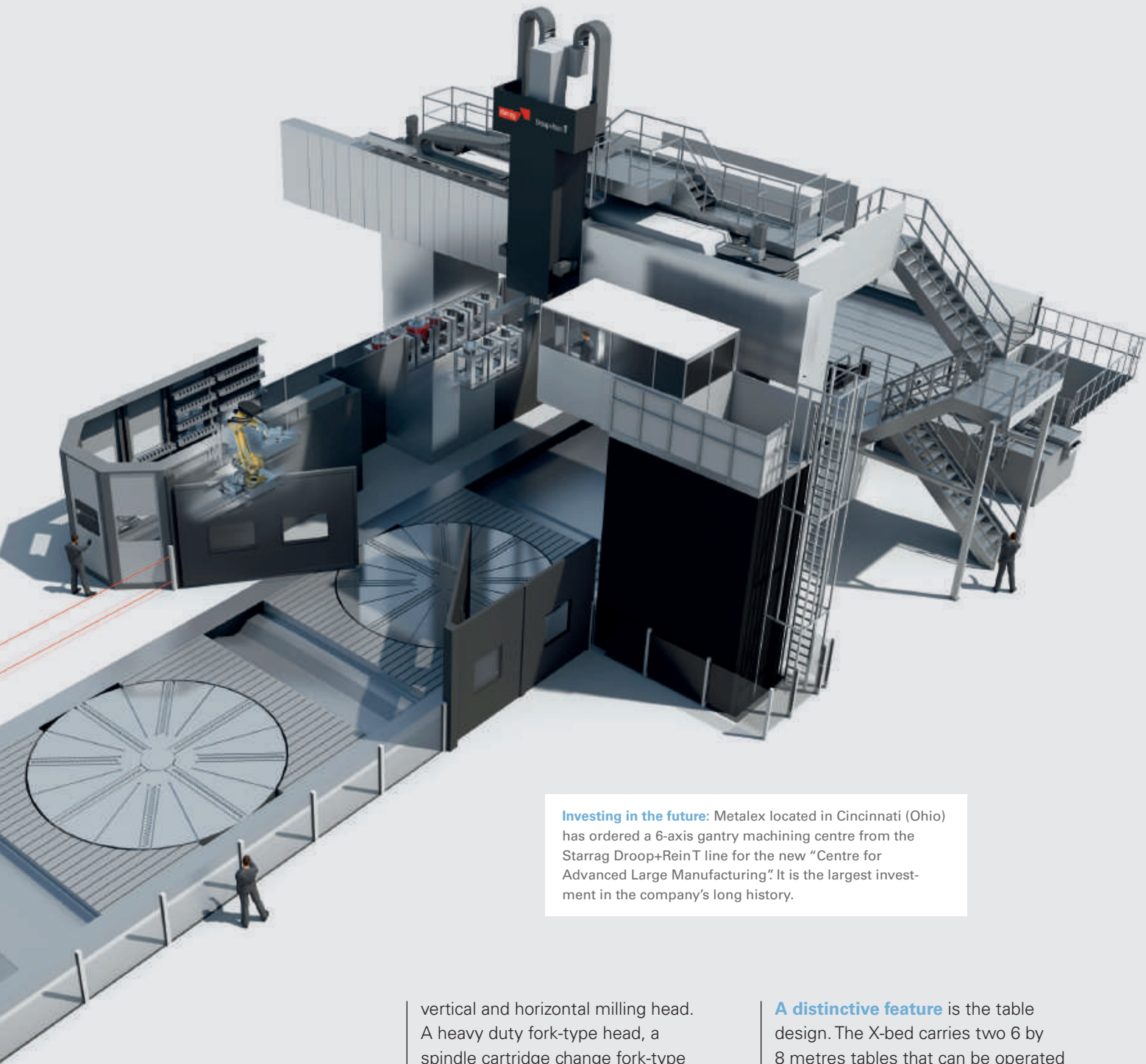
**The machine** – the largest ever installed by the Cincinnati-based contract manufacturer – will provide it with the ultimate in flexible production capacity to meet all Metalex's foreseeable demands in terms of producing highly-accurate milled and turned workpieces in a single set-up.

**Indeed**, the six-axis Droop+Rein T line machine is projected to not only satisfy existing projects but its extraordinary machining envelope of up to 18 metres table length, 9.5 metres between the columns and 7 metres under the spindle will certainly also attract new work

– thus further ensuring Metalex's success in the market of high quality manufacturing.

**The portal-type** milling and turning machine – which is being especially configured to meet Metalex's current and future needs – offers an expansive 19 metres in X- and 9 metres in Y-axis. The 7 metres vertical clearance is





**Investing in the future:** Metalex located in Cincinnati (Ohio) has ordered a 6-axis gantry machining centre from the Starrag Droop+ReinT line for the new “Centre for Advanced Large Manufacturing”. It is the largest investment in the company’s long history.

covered by the 3 metres of ram stroke (Z-axis) and a continuously moveable crossrail of 5.5 metres (W-axis). The C-axis integrated in the ram with infinite rotation and the +/- 95 degrees swiveling B-axis of the universal fork-type milling head complete the 6-axis.

**The impressive** 100 kW main spindle transfers up to 7,500 Nm to the heavy

vertical and horizontal milling head. A heavy duty fork-type head, a spindle cartridge change fork-type head – both to enable 5-axis operation – and a slim spindle extension round up the initial milling head configuration. All heads will be designed, built and tested by Droop+Rein in Bielefeld. Furthermore, the machine will be prepared for more heads to be fitted in the future as new jobs arrive. The versatile 400 pockets Robot Tool Magazine ensures automatic loading of 3 different tooling systems into the selected milling and turning heads.

**A distinctive feature** is the table design. The X-bed carries two 6 by 8 metres tables that can be operated separately under the spindle while the other one is (un-)loaded outside the machining area. Coupled ‘in tandem’ the tables can be extended to an enormous length of 18 metres for machining extra-long workpieces. In addition, each table holds an integrated 6 metres rotary table that utilize the 2 x 111 kW main drives to turn components of up to 200 t weight (using one of the turning tool holders provided in addition to the milling heads) or to



“The impressive 100 kW main spindle transfers up to 7,500 Nm to the heavy vertical and horizontal milling head.”

position as a C-axis for high accuracy milling and drilling operations. The result will be the ultimate one-stop precision machining source for extra-large components with complex geometry that require precision tolerances.

**Established in 1971**, Metalex is a performance-driven contract manufacturing company, specialising in producing high-quality complex workpieces for a wide range of market leaders in the aerospace, energy, marine and consumer goods industries.

**Metalex desire** to source a machine that would not only satisfy current production needs but also meet all projected demands in the years ahead saw it contact with a number of machine builders, including Starrag which in the past has supplied it with a number of machines (a Dörries vertical turning lathe and two Starrag STC horizontal five-axis machining centres).

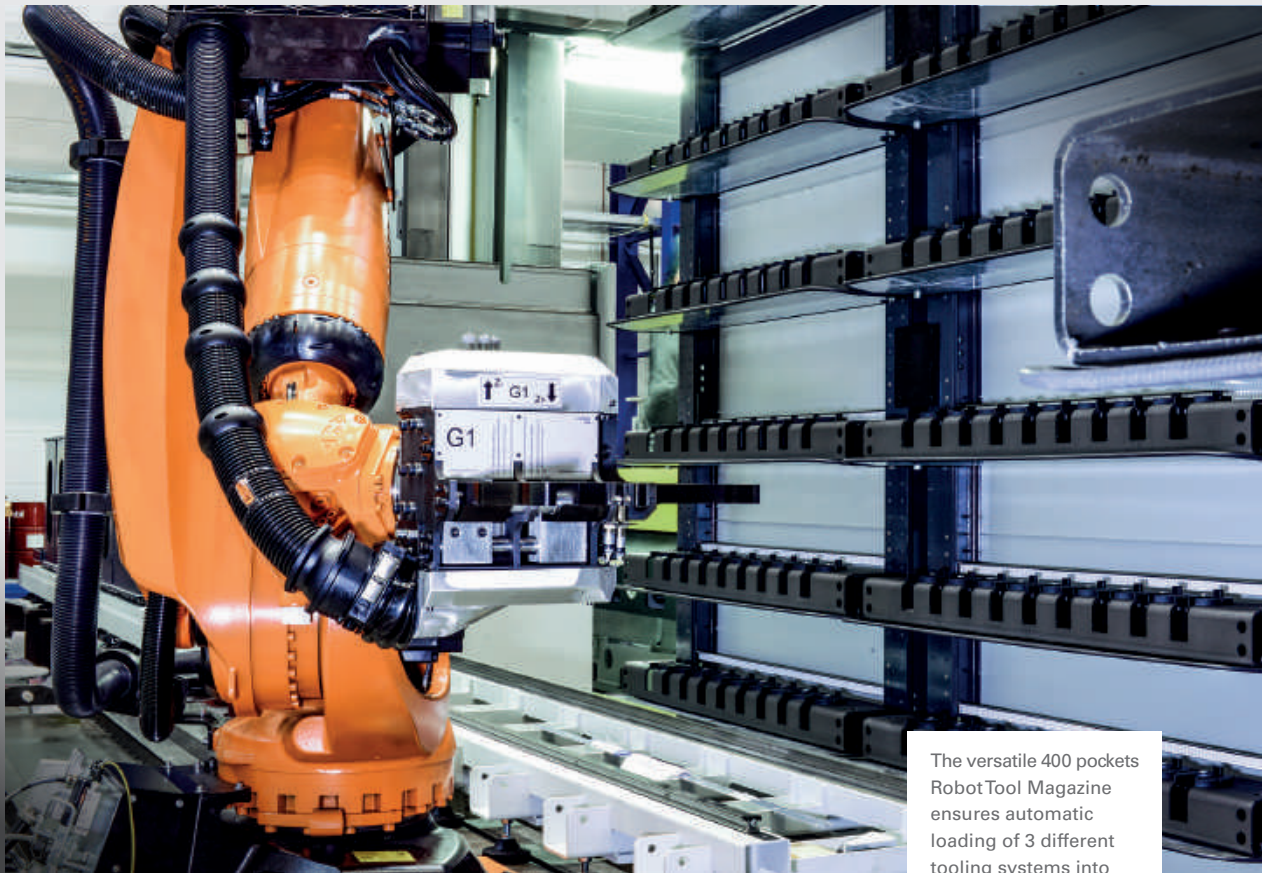
**According to Droop+Rein** Product Sales Manager, Heiko Quack: “We sat down with Metalex to discuss what

was needed – in short: a very flexible, large-capacity and high-accuracy machine with 5-axis capability that would efficiently accommodate a variety of parts in a range of materials and produced to tight tolerances.” “Applying our proven ‘Engineering precisely what you value’ philosophy, our relation with Metalex evolved looking at various solutions and machine types available under the Starrag portfolio and together we arrived at the Droop+Rein T line, a portal milling machine that offers superb rigidity, essential for highly-accurate machin-





Universal fork-type milling head with swiveling B-axis



The versatile 400 pockets Robot Tool Magazine ensures automatic loading of 3 different tooling systems into the selected milling and turning heads.

“Starrag’s solution for the needs of ‘Industrie 4.0’, the Starrag Integrated Production System (IPS), lets the machine be integrated into existing production and tool management systems.”

ing. We added the two rotary tables and the turning tool holders for in-cycle turning operations and expanded the horizontal and vertical clearance to suit.”

**Heiko Quack confirms:** “With no comparative workpieces, from the outset we knew that Metalex wanted a machine that would meet all eventualities and, as always in such cases, Starrag applied the best world-class technology solutions including Balluff tool identification, Renishaw probing, BLUM laser tool measuring, video

monitoring of the work area using four cameras, ARTIS tool and process monitoring and Brankamp collision monitoring all integrated via the machine’s Siemens 840 D SL CNC system.”

**The machine** is due for delivery in 2020 and production is scheduled to commence in 2021. Kevin Kummerle, CEO of Metalex, summarises the pre-order project phase: “For Metalex to continuously evolve and be a company of the future, a combination of

our capabilities, technology and people must work to-gether to create innovation that sets us apart from others. Our customers need to know that their key suppliers are committed to be at the leading edge of their industry offering the best total value in terms of quality, technology, cost and service for today and for the long run.

**Metalex applied** these same considerations in our evaluation process, looking for a partner that could provide a complete technology solution for our application; a highly flexible and accurate machine configuration integrated with the latest in technology supported by a service organisation capable of rapidly solving challenges that arise. All of these factors are why Metalex selected Starrag as our partner on this critical project.”

# The spark of FMS is ignited in Korea

A “never-ending success story”: That is how the Ecospeed machining centre is best summed up. Its quality has been proven in the highly dynamic five-axis milling of large, extremely demanding aluminium components for aeroplanes, due in no small part to its parallel kinematic Sprint Z3 machining head. But, according to Starrag, the machines work even better together: The Ecospeed machining centres can be interlinked to form a highly productive flexible manufacturing system (FMS), with no compromises in performance. Alfred Lilla, Sales Director Aero Structures, explains how Starrag has been able to write the “never-ending success story” under the FMS banner.

**Alfred Lilla, you are known as “Mr Ecospeed”, because you were there for the birth of the parallel kinematic machining head nearly 20 years ago – which was revolutionary at the time – and because of your significant contribution to the development of the Ecospeed machining centres. How does an airframe mechanic from the now-defunct Augsburg-based aerospace company DaimlerChrysler Aerospace AG (DASA) come to develop a completely new machine concept?**

**Alfred Lilla:** In 2000, as head of NC programming at DASA, which later became EADS, I was researching a completely new machine technology with production engineer Helmut Färber. This technology would need to be suitable for the highly productive machining of the incredibly complex structural components for the central section of the Eurofighter fuselage. As there were no suitable or effective machines on the market, we developed

an HSC system with horizontal parallel kinematics in collaboration with DS Technologie Werkzeugmaschinenbau GmbH, based in Mönchengladbach – and now a Starrag subsidiary. This invention proved to be a very good machine concept, which has developed into a highly successful Starrag product range under the Ecospeed name. Its success is down to the fact that there is no other machine tool in the world that can match its performance level.

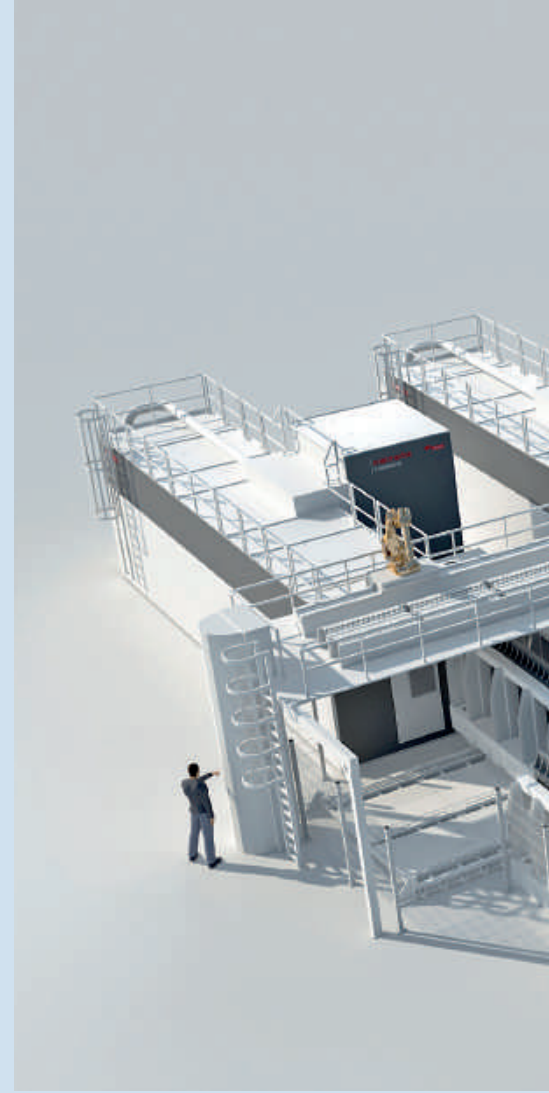
**Currently, out of more than 130 Ecospeed machines installed worldwide, 60 work in combination as an FMS. How did the 19 FMS systems – now in use around the world in the aerospace industry – come about?**

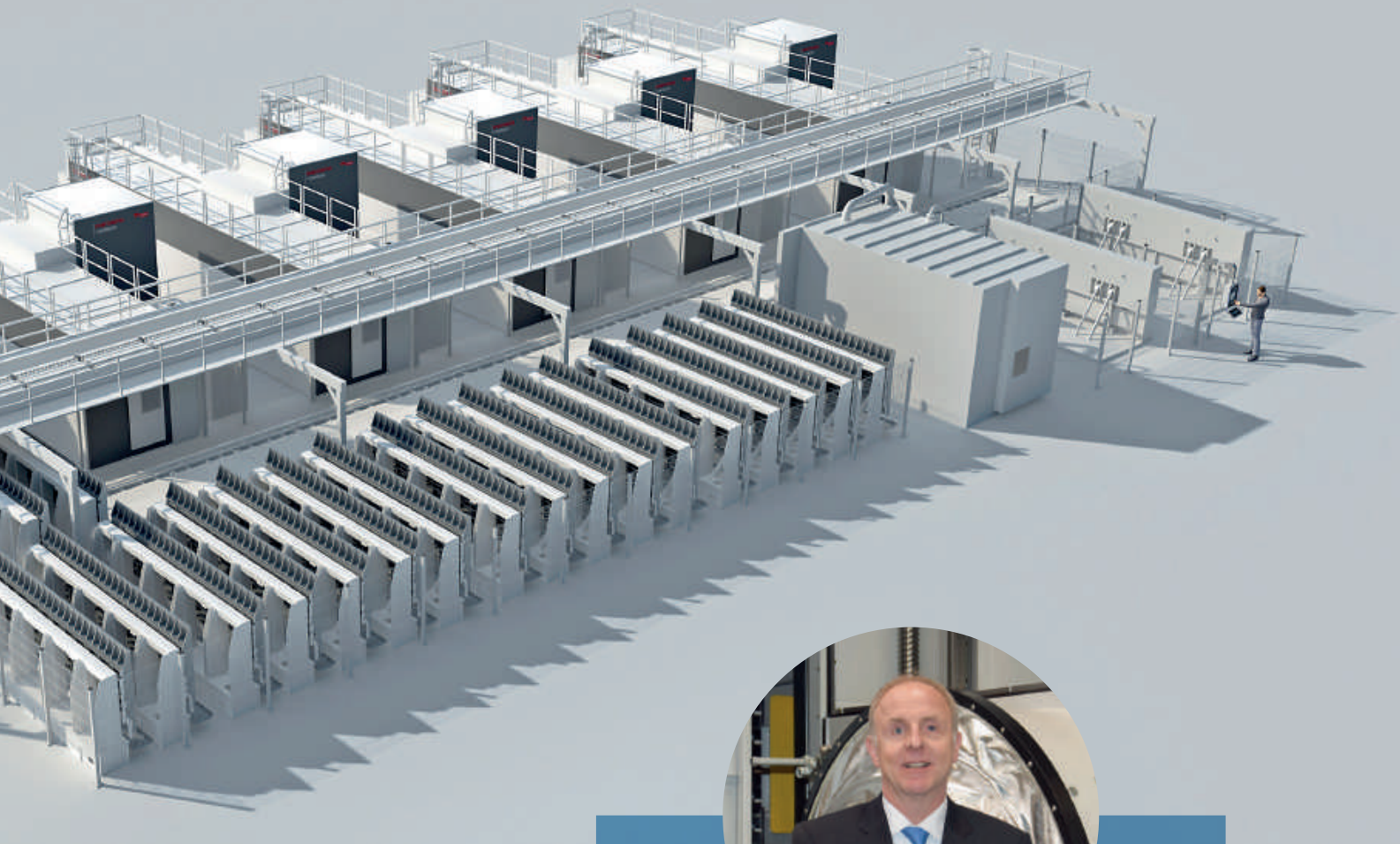
**Alfred Lilla:** Since 2009, one of our key customers, Korea Aerospace Industries (KAI), has ordered a total of 12 Ecospeed machine tools for high-speed machining of large aluminium structural components. KAI ordered an FMS made up of nine

ECOSPEED F 2060 machines for machining wing ribs, following an analysis that revealed that they are 30 % more productive than the linked machines of any other competitor. Since 2016, KAI has been the home of one of the world’s largest Ecospeed FMS systems, with 9 machines, 4 set-up stations, 2 transfer wagons and a total of 90 pallets.

**How does KAI rate the performance of this line now?**

**Alfred Lilla:** Very highly, because the South Koreans have said themselves that they now process the wing ribs of the Airbus A350 five times faster than they could on their previous conventional machining centres. As a result, KAI – together with local suppliers – now uses Ecospeed to manufacture all Airbus A350 wing ribs. Overall, several hundred wing ribs are now produced each month for this aircraft type. It is not only the performance that is impressive, but also the high availability of the FMS, at 97 %. According to our





**Alfred Lilla, Sales Director Aero Structures at Starrag:**

“There is no other machine tool in the world that can compete with the performance of the Ecospeed range. It is particularly powerful as part of an FMS in combination with additional units such as purifiers – digitally supported and monitored by the Starrag Integrated Production System (IPS).”

customers, the Ecospeed technology is significantly less error-prone than machines with circular axes (AC or AB kinematics). But it was ultimately the performance and reliability that finally convinced customers across Europe, the USA and China to invest in Ecospeed FMS. In addition to Chinese companies CAC, Chengdu Aviation and AVIC Shengyang Aircraft, which have ordered 4 FMS with 20 ECOSPEED F machining centres in total, an American aerospace supplier showed interest in our product range for the first time, in particular in our linked solutions.

#### **Did you win the customer?**

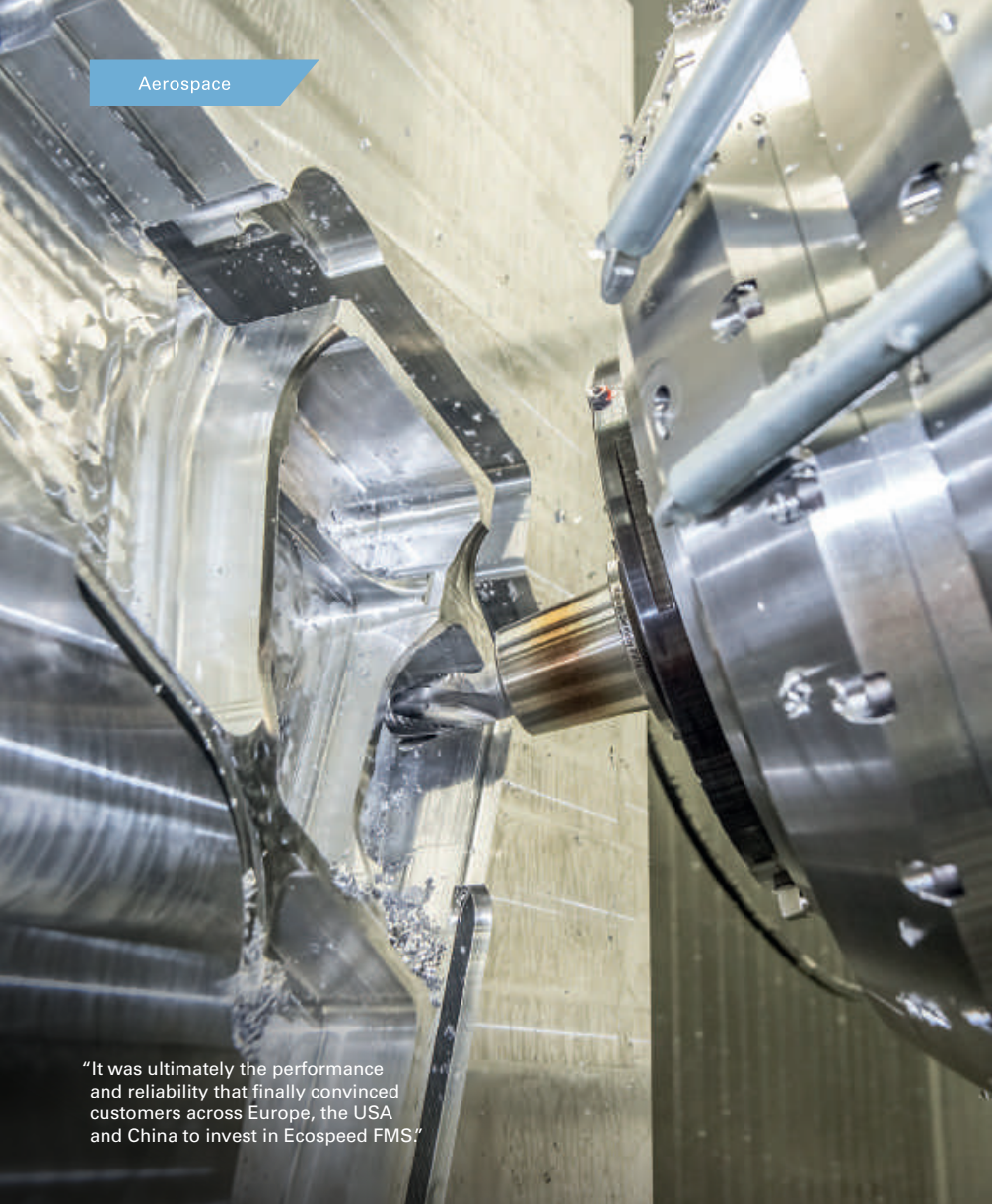
**Alfred Lilla:** Yes, it is the aerospace supplier Orizon Aerostructures, which first saw an ECOSPEED F 2060 in use when in the process of acquiring another company. Impressed by the performance, the aerospace supplier closely examined the FMS solution adopted by KAI, before deciding spontaneously to build a

new production hall with six linked ECOSPEED F 2060 machining centres. We saw success not just with the fast commissioning – which took only eight months – and the performance, but according to Orizon, the new FMS works 40 % faster than comparable existing machines. Orizon therefore decided to order three more ECOSPEED F 2060 machining centres, which will go into operation in 2019. The results for Orizon speak volumes for its investment in an FMS with nine ECOSPEED machining centres. With

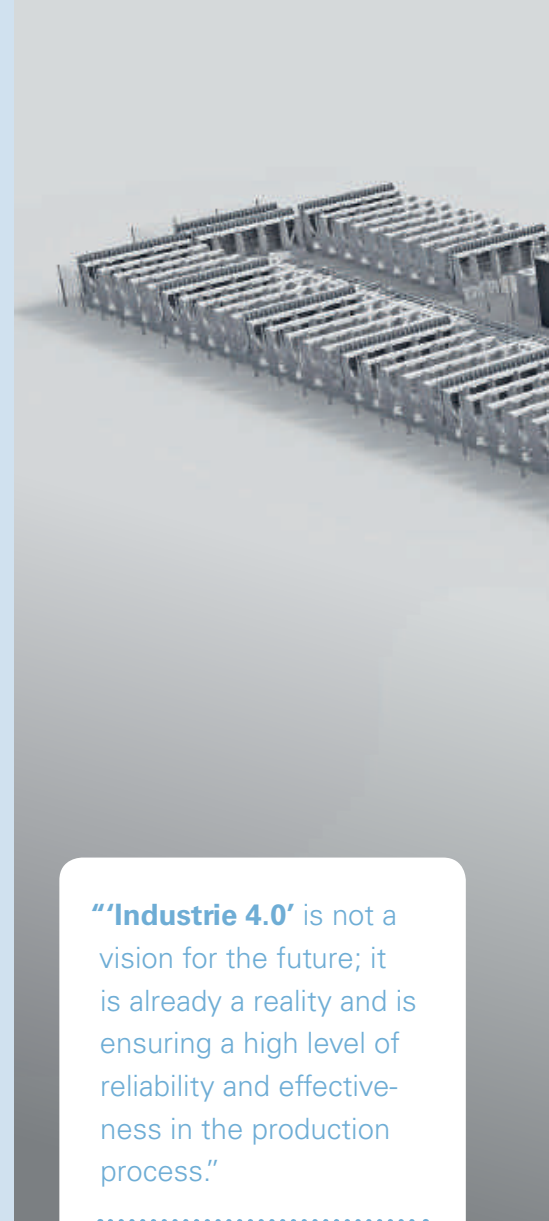
consistently high availability, they are in use all year round – except for a short annual break in production of five days. The owners of the company are thrilled to be able to expand production capacity by at least 50 % thanks to the new machines.

#### **Is this technology only for large companies?**

**Alfred Lilla:** It is true that we can count many large, well-known aerospace companies among our FMS customers.



"It was ultimately the performance and reliability that finally convinced customers across Europe, the USA and China to invest in Ecospeed FMS."



"'Industrie 4.0' is not a vision for the future; it is already a reality and is ensuring a high level of reliability and effectiveness in the production process."

However, our customers range from the supplier Premium Aerotec, our largest and oldest regular customer with a total of 8 FMS and 20 ECOSPEED machines, down to the small but perfectly formed Swiss aircraft manufacturer Pilatus, which ordered an FMS with 2 ECOSPEED F 2040. So it is clear that FMS are also suitable for small and medium-sized companies.

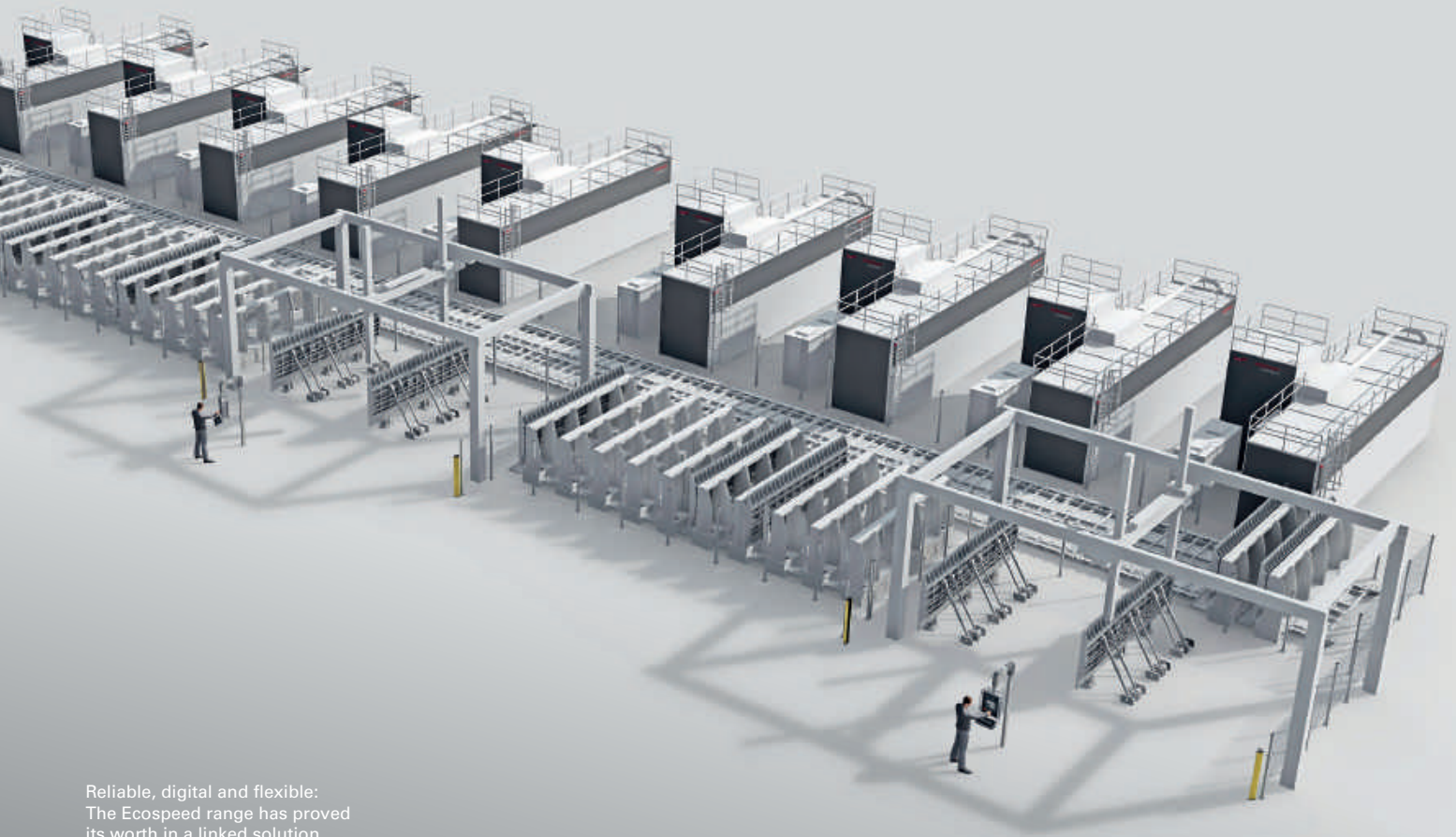
**When you look back at the successes of FMS, what is the common denominator of all buyers of FMS – also with regard to the Starrag claim "Engineering precisely what you value"? What do FMS buyers really value and appreciate?**

**Alfred Lilla:** The customers rely primarily on growth and safety. We meet these

two wishes with significantly increased productivity, which we substantiate with average performance increases of 300 % to 500 % when compared with old conventional machines, and from 30 % to 40 % compared to new machines from competitors. Additionally, thanks to the robust technology, we can provide an extremely high system availability of > 96 %. For the majority of buyers, however, it all comes down to a rapid return on investment. We fulfil this requirement by ensuring fast, productive utilisation of the FMS with fast delivery and commissioning. For example, Orizon expected its new FMS solution to be operational within just eight months, in accordance with its "letter of intent" – and we achieved just that. This also contributed to increased growth and safety.

**Does digital transformation play a role in the specifications of customers? How do you meet their requirements?**

**Alfred Lilla:** The best example of this can be seen in Korea with KAI. As its core element, the FMS features a cell controller, which automatically monitors all processes. This ensures that everything runs automatically. The user only needs to clamp the parts to be machined onto the pallets – everything else is done automatically. The cell controller controls the entire process – from the automatic loading and storage of the raw material to the unloading of the finished components. All information and resources are managed via the cell controller, which receives orders from the primary ERP system of the end



Reliable, digital and flexible:  
The Ecospeed range has proved its worth in a linked solution (FMS), which is reliably monitored by a cell controller that is developed in-house by Starrag.

customer. The cell controller ensures there is digital transparency in the factory because it centrally manages all the FMS information, which it forwards on to primary computer systems as required via standard interfaces. For us, 'Industrie 4.0' is not a vision for the future; it is already a reality and is ensuring a high level of reliability and effectiveness in the production process.

**Are we talking about tailored solutions that only large, solvent customers can afford?**

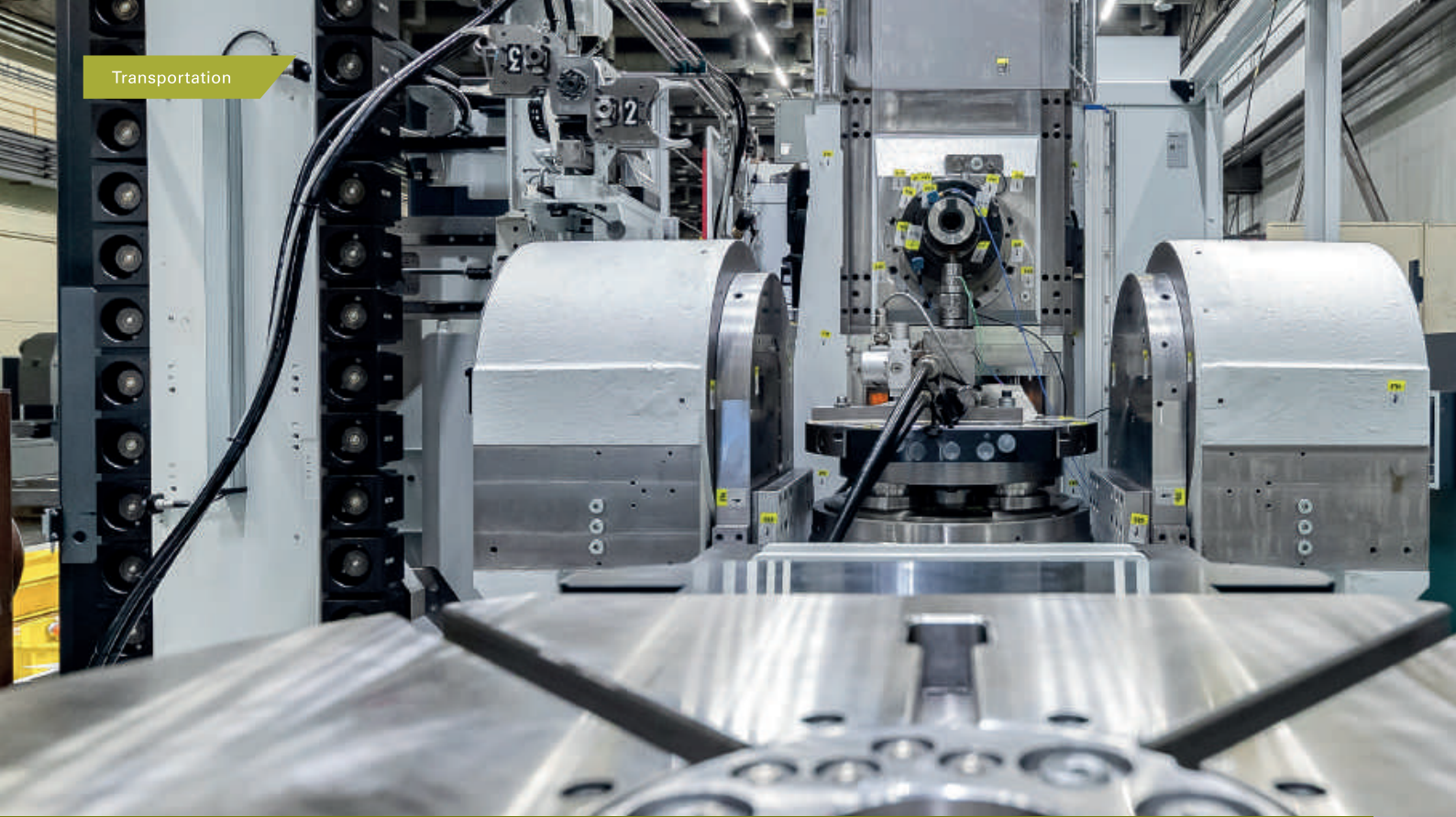
**Alfred Lilla:** Yes, they are tailored. We rely on the foundation of our Integrated Production System (IPS), from which the customer can select their individual 'Industrie 4.0' solution "à la carte". But they are also available to medium-sized

50%

“The owners of the company are thrilled to be able to expand production capacity by **at least 50% thanks to the new machines.**”

suppliers: The Starrag IPS is used as a platform for automating and digitising production – step by step if desired. IPS ranges from individual machines, to FMS and right up to complete production lines. In contrast to other providers, we also use products developed in-house for all important components: The core element is the cell controller, developed by Starrag, which monitors FMS and production lines to ensure

reliable processes. This digital icing on the cake shows not only that it can guide and control the entire production process – in conjunction with a higher-level ERP system where applicable – the cell controller also ensures digital transparency in the factory by visualising the system status, for example. And thanks to our in-house development, we also ensure high availability when it comes to digitalisation. ▀



# No compromise on quality

With the new compact Heckert machining centres for pallets of 400 and 500 mm, Starrag has successfully set new standards in terms of output and quality characteristics. A key factor of these machining centres is their high degree of rigidity, which is a consistent feature of the framework assemblies and one that is being continuously optimised in the test field. The end users benefit from increased productivity and high-quality machining results.

Almost two years have passed since Starrag presented its horizontal machining centres, which were newly developed from scratch – the Heckert L40 (line module for 400 mm pallets) and Heckert H50 (four-axis for 500 mm pallets). Thanks to the modular concept, further variants followed within a short period of time, such as the five-axis X40/45 and the five-axis, multi-functional T45.

During the development of this line, the Chemnitz-based company concentrated first and foremost on high productivity per unit area. This approach was clearly a success, as demonstrated by a reduction of as much as 30% in the space requirement of the machines and a 15% increase in productivity. Secondly, the developers paid close attention to

achieving a consistently high quality of mechanical engineering – an asset that users of Heckert machines have appreciated for many years.

## Quality characteristic: “Rigidity”

The new compact machining centres boast a high level of performance, process reliability and long-term precision. As the basic requirement for achieving these characteristics, a high degree of rigidity constitutes an integral component of the design concept. Rigidity is a crucial quality characteristic, particularly in framework assemblies – i.e. in machine beds, columns, tables and rotary swivelling units – and is necessary not only for heavy-duty cutting, but also for the processing of demanding materials and

high-performance excavation of light-weight materials, such as those commonly used in aircraft construction.

Designers and technologists at the Chemnitz site worked together closely during the development of the new framework assemblies, capitalising on their many years of experience as well as modern analytical methods. Numerous calculations and experiments played a role in finding the perfect composition of rigidity, weight and cost.

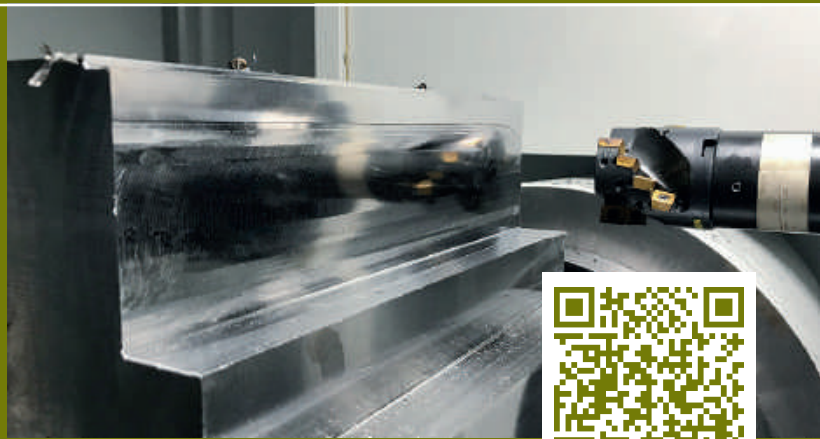
## A focus on framework assemblies

Throughout these experiments, the primary focus was on rigidity. However, rigidity was never looked at in isolation, but always in connection with damping



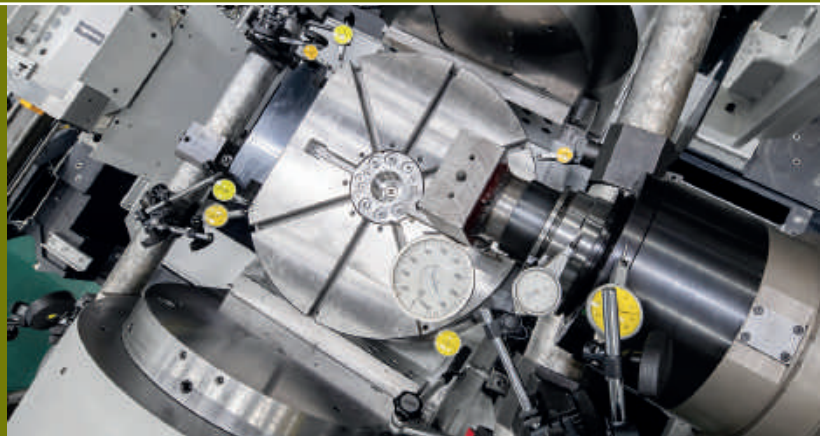
# The stages of Heckert property analysis

1



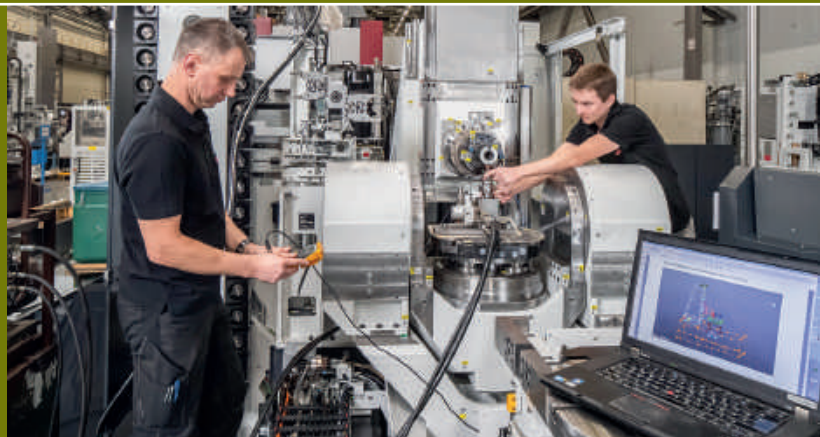
**Performance cutting:** Here, the cutting performance of the main drive was tested right up to the shut-down limit.

2



**Static measurement:** These measurements determine the elasticity of the machine under a wide variety of conditions.

3

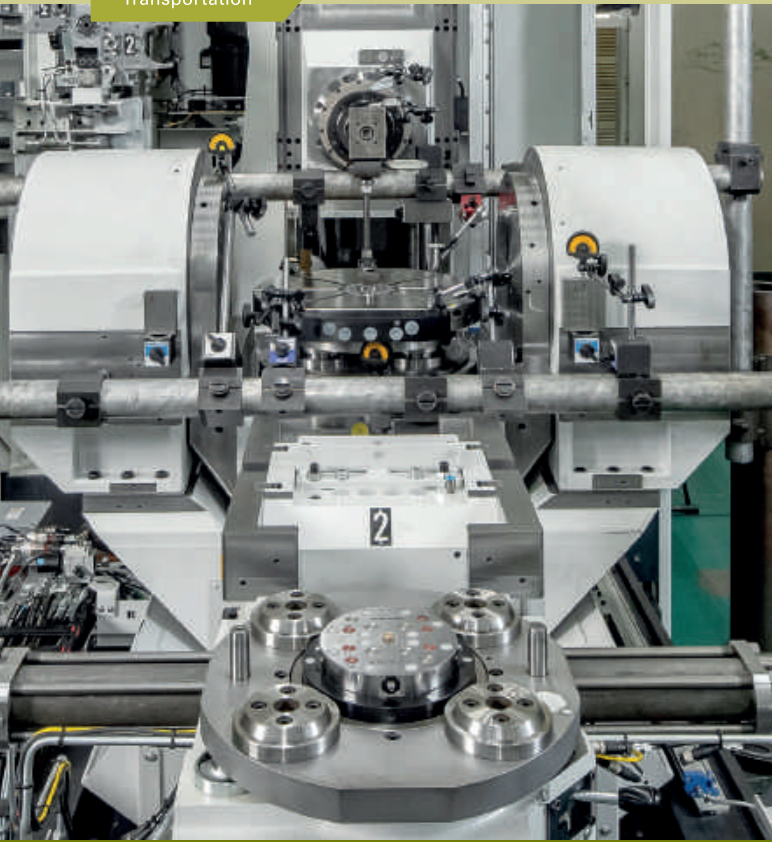


**Modal analysis:** This process allows the natural frequency both of assemblies and of the entire machine to be determined.

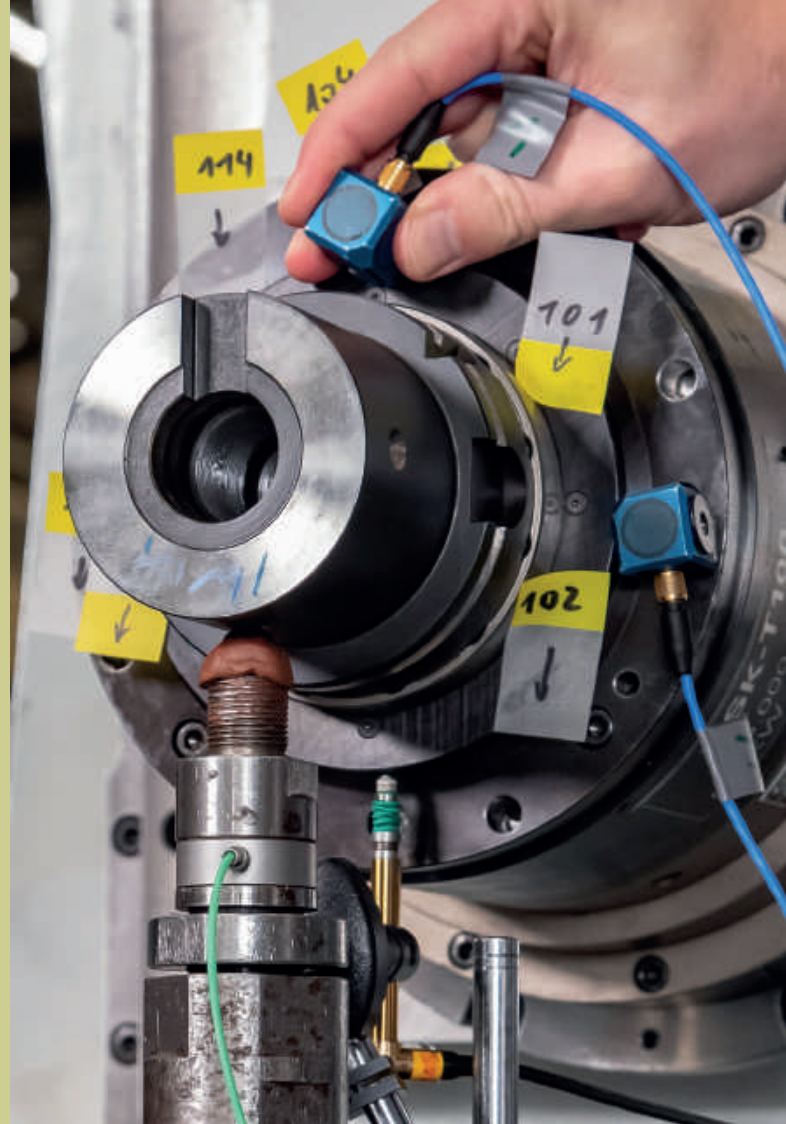
and other parameters. In roughing processes, for instance, proper damping ensures that deflections can be brought to a standstill in no time at all. For this reason, the designers decided that a temperature-stable and vibration-resistant mineral-cast machine bed would be the perfect base for a machine with overall rigidity.

**When it comes** to designing the columns, differentiation is required to achieve perfect results every time. That is why Starrag offers a weight-optimised version for highly dynamic machining, while a stronger column with a composite construction was developed for heavy-duty cutting. The welded steel casing is filled with a special concrete that ensures improved damping.

**The rotary swivelling** unit is another crucial component of the five-axis versions (X and T) of the new Heckert machining centre. Here, the developers



**Rigidity in the framework assemblies is crucial, such as in machine beds, columns, tables and rotary swivelling units.**



During the modal analysis, Starrag collects vibration values at several hundred measuring points.

have successfully transferred the A-axis concept, which has been tried and tested in the HEC centres, into the compact new machines – with impressive results. The double symmetrical mounting lends the cradle optimum stability, supported by precise, high-performance circular axes and high-precision pallets, so that workpieces can be processed dynamically and with a high level of precision.

**Even the tool** and collet chuck were designed with rigidity in mind. If the machining centre is required for a high level of cutting performance, Starrag recommends the Heckert H55, X45 and T45 versions, which are equipped with the HSK-A100 or HSK-T100 tool holder as standard. This is because the large

planar support provides the necessary rigid tool connection.

#### **Optimisation in the test field**

**Especially** with new machines, such as the horizontal Heckert machining centre, it is important that the prototype or pre-line model demonstrates that the combination of all the framework assemblies is able to deliver the expected result. The Starrag plant in Chemnitz has a test field that is perfectly equipped for such optimisations – not only with regards to the necessary measuring equipment, but first and foremost in terms of the specialists required to perform a wide range of test tasks and evaluations of properties.

**From the fields of mechanics, electronics and control technology among others.**

**Klaus Frost**, an expert in experimental quality analysis, describes the procedure as follows: “The first practical proof of efficiency must be demonstrated by the machine during various performance processes. In this example, the cutting performance of the main drive was tested as far as the shut-down limit. In the current example, when cutting tempered heat-treated steel (C45), our new Heckert T45 achieved a cut volume of 1,200 cc/min – 300 mm above the swivel axis and without having to cool down. This represents a considerable cut output of 45 kW.” Frost continues: “This test is only successful



for us, however, if we achieve a perfect surface with a low level of tool wear. A cutting performance that can be achieved with technology is ultimately meaningless if the result does not meet expectations, or if the time saved is offset by tool costs that are so high as to no longer be economical." To achieve a successful overall result, the machine must be able to offer a high level of rigidity, both when moving and when stationary. This means that, after the cutting performance test, more tests take place. Firstly, static measurements are carried out on the pre-line machine. The flexibility of the modules is determined using measuring stands and up to 20 gauges, with static forces measured in every direction. This very quickly indicates whether the simulation carried

out beforehand was accurate. Just as important, but far more complex, is the test performed on the machine while it is moving. Using a hydraulic exciter, the machine is subjected to infinitely variable frequencies of up to 500 Hz. Klaus Frost explains the benefits of this measure: "We get a clear picture of all relevant vibrations that occur when operating the machine and gain an understanding of their significance for the subsequent cutting process. The results obtained from the quasi-static tests are essential. Using dynamic measurement methods, we are able to determine which components are statically deformed down to the level of individual parts". During this process, Frost and his colleagues log the results of several hundred measuring points.

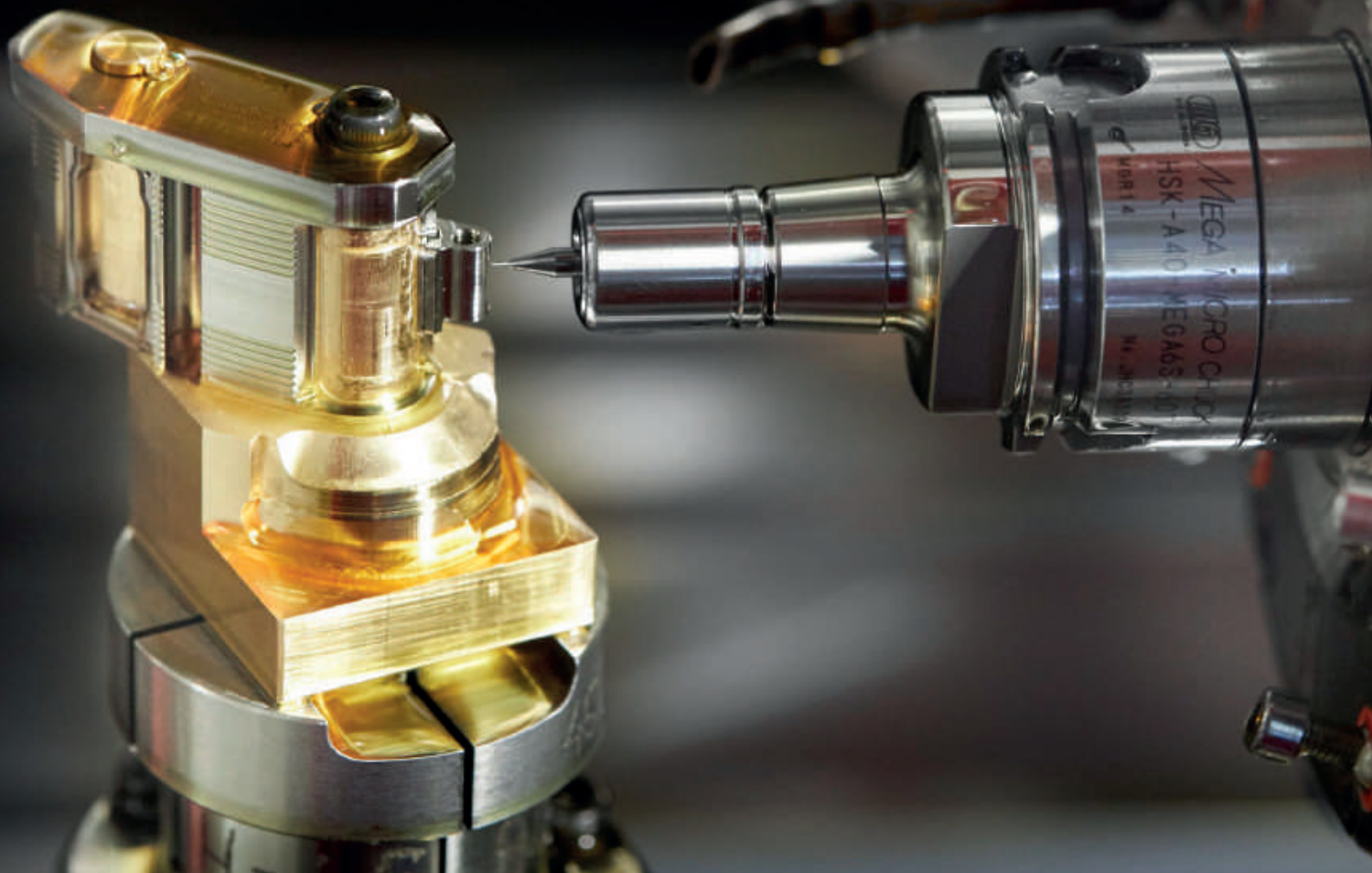
**After this** analysis is performed, the construction is always redesigned to incorporate the findings into the upcoming series production, thereby improving the machine further. The pre-line machine then goes to the customer for industrial testing.

**The optimisation process**, during which the rigidity and thermal symmetry of Heckert machines are improved, extends from the plant in Chemnitz to other product ranges. This process provides a verifiable group-wide value, whether the products in question are assemblies and machine beds from the ECOFORCE centres in Mönchengladbach or STC machines from Rorschacherberg. ▽

**Developers, designers and technologists work together to produce frameworks with the most rigid yet lightest structures (thermo-symmetrical design, ribbing, etc.) using suitable materials.**

Klaus Frost prepares static measurements.





..... SUCCESS STORY IN GENEVA: LUXURY PRODUCTS WORKSHOP USES BUMOTEC TECHNOLOGY .....

## The chips are flying in the “Lamborghini basement”

Premium bodywork upstairs and high-tech production downstairs: There couldn't be a more perfect setting for a workshop producing luxury goods. The Lamborghini Geneve showroom is used to showcase luxury Italian sports cars to wealthy customers, while in the basement Niru Swiss is busy machining highly complex components for the jewellery and watchmaking industry. For a decade now, the starring role in the basement operation has been played by a Bumotec s191V from Starrag.

**Small, sophisticated and exclusive** – three words that perfectly sum up Niru Swiss, part of the Tel Aviv-based international company Niru Diamonds Israel Ltd. Niru Diamonds Israel Ltd. was founded four decades ago in India by Mr Ranjeet Barmecha and has built a reputation for machining and finishing rough diamonds. In 2009, the company established a state-of-the-art CNC factory in Geneva with a view to extending its expertise into other sectors. In addition to taking on projects for the jewellery industry,

Niru Swiss SA and its four employees now work primarily for premium Swiss watch brands. The work mainly consists of producing cases from all the established materials, such as aluminium, stainless steel, gold and titanium, and jobs generally involve between 10 and 300 units.

“**Competition** in this field is extremely tough here”, explains Managing Director Julien Ducommon. “We make our mark by focusing on producing incredibly

complex components for the jewellery and watchmaking industry; we use our Bumotec to produce these components to impressive standards of quality and precision, guaranteed.” The investment in the Geneva site has allowed Niru not only to gain a foothold in the watchmaking industry, but also to successfully tap into new industries. “I now occasionally even produce prototypes for medical technology,” says Ducommon. “And I machine not just metals, but also plastics such as PEEK. Most of the prototypes



“For me, the most important requirements in this competitive field are the ability to deliver optimum productivity, precision and stability. And that’s why I can say with certainty that my next CNC machine will also be a Bumotec.”

**Julien Ducommun, Niru Managing Director**

are generally turned and cut in a single clamping operation.”

**The team in Geneva** uses a total of four CNC machine tools, three of which were already owned by a company that Niru acquired. When it came to selecting a fourth machine, Niru Swiss consciously opted for the Bumotec s191V vertical high-performance CNC machining centre, which delivers precise, productive machining. The combination of linear motors, direct drives, nano interpolation

and a high measurement resolution of 1/100 µm supports excellent contouring accuracy (e.g. a roundness of 1.4 µm with a radius of 50 mm). The “excellent thermal stability” allows Julien Ducommun and his team to turn and cut components continuously from early in the morning until late at night without any loss of precision. With this technology, the team can work across five axes simultaneously and components are machined using a single clamping operation. “Used in conjunction with an automation unit, the Bumotec

can also be operated without the need for human intervention – a bit like a ghost shift”, adds Stéphane Violante, Marketing Project Manager at Starrag Vuadens SA. “All in all, the costs per part are therefore significantly lower than with other machining centres that purport to be more economical.”

**The investment** also paid off by virtue of the impressive feed speed (50 m/min) and acceleration (1.2 g) as well as the ability to achieve an outstanding spindle



### Precision work:

The case of the new UR-111C wristwatch is just 15 mm high and 46 mm wide and is cut from an stainless steel blank using a Bumotec s191V from Starrag. The case also includes a 20-mm-deep side compartment to accommodate the movement.

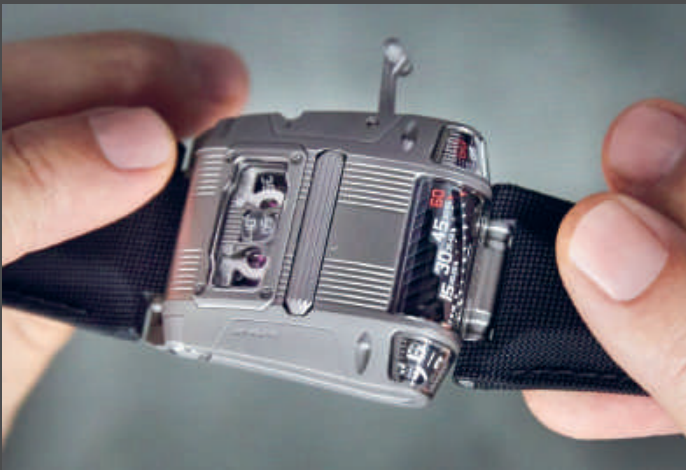
speed of 30,000 rpm within 1.5 seconds. The s191V comes with a Fanuc-31i control unit that makes it easier to operate the Bumotec's special, interactive user interfaces. Julien Ducommon is painfully aware that Bumotec owners are clearly won over by all of the benefits the machine offers: "I would have bought a used Bumotec, but they very rarely become available."

**The sort** of complex components that Niru is dealing with can generally only be manufactured effectively if there is close collaboration with the customer in relation to CAD/CAM considerations. Julien Ducommon generally receives a CAD file.

He uses the GibbsCAM program to simulate the machining process on a computer; this optimises the subsequent process, including the traverse paths. The fine-tuning work is done on the Bumotec itself. Although Niru Swiss uses digital in-line measurement technology, Ducommon also carries out quality assurance on all components after the machining process using high-tech equipment. Julien Ducommon: "Even though we produce simulations and carry out optimisation work beforehand, continuous monitoring is the only way to ensure that we comply with all the applicable parameters for the complex components we are machining. The perfection level of each

component we produce must always be documented. That is simply the reality of producing complex, high-quality components in small production runs."

**When new orders** are received, the team in Geneva completes small test runs that involve producing a small number of test components. If the results are good, larger orders may be received. One of the factors that has helped Niru Swiss to build such a strong reputation is the collaboration with avant-garde brand Urwerk and its founder Felix Baumgartner, who Julien Ducommon knows from his time working in the watchmaking industry earlier in his career. The Bumotec



“We make our mark by focusing on producing incredibly complex components for the jewellery and watchmaking industry; we use our Bumotec to produce these components to impressive standards of quality and precision, guaranteed.”

Julien Ducommun, Niru Managing Director

machining centre is currently proving its worth with a special component for the Urwerk brand (see also the separate interview with Urwerk CEO Baumgartner and Starrag Manager Violante on page 30): The case of the new UR-111C wristwatch is just 15 mm high and 46 mm wide, and there is no screw-mountable bottom plate. Instead, it is cut from an aluminium blank, and includes a 20-mm-deep side compartment to accommodate the movement. The work is completed to


the high quality that is synonymous with the Bumotec, delivering excellent repeating accuracy to the last micrometre from early in the morning until late at night.

**Niru Swiss** is set to gain even more recognition as a result of its work on this component. With this in mind, 35-year-old Julien Ducommun is already turning his attention to a new workshop that will provide much more space for both staff and machines. But how does he view the

importance of the Bumotec brand in this whole process, in particular with reference to the Starrag brand message “Engineering precisely what you value”? Julien Ducommun: “For me, the most important requirements in this competitive field are the ability to deliver optimum productivity, precision and stability. And that’s why I can say with certainty that my next CNC machine will also be a Bumotec.” ▀

## The avant-garde join forces

“We have an awful lot in common” – this is the conclusion reached by Felix Baumgartner, founder of chronometer brand Urwerk, and Stéphane Violante, Marketing Project Manager at Starrag Vuadens. The greatest common denominator is that both companies are among the avant-garde of their respective industries, producing surprising and astounding innovations.



Avant-garde: With its UR-111C, Swiss brand Urwerk once again appears to have achieved the impossible – a mechanical wristwatch with a linear time display.

**Mr Baumgartner, key elements of your new wristwatch – the case and the movement – are produced in Geneva at the Niru workshop using a Bumotec s191V five-axis machining centre from Starrag. Urwerk is considered something of an avant-garde pioneer of the industry – how do you plan to maintain this reputation with the UR-111C? Master watchmaker Felix Baumgartner, CEO of the Urwerk brand, Zurich and Geneva:** The UR-111C marks the next step towards a concept we started working on ten years ago – to create mechanical watches with a linear time display. The focus is on displaying the time not with figures or hands, but as a continuous, straight line. The C in the model name refers to the cobra, a snake.

**Because time twists and winds like a snake?**

**Felix Baumgartner:** Exactly. The minutes meander across the watch in a spiral effect using a roller, while the hour display of the 111C is digital. Instead of a crown at the side there is a roller on the case, giving the wearer a whole new

winding experience. Equally unconventional is the lever design for setting the time in 15-minute increments. The cylinder is only rotated through 300 degrees when wound and it uses the winding force to “jump” the last 60 degrees. This jump moves the hour on.

**And how are the seconds displayed?**

**Felix Baumgartner:** A precision-made fibre-glass component transfers the second display, which is also digital, from inside the movement. This idea came from our chief designer Martin Frei. He took his inspiration from a piece of stone-like art on his desk that acted a bit like a crystal and created realistic three-dimensional impressions of small objects. Our fibre-optic block works like a visual projector rather than a magnifying glass.

**And how does the Bumotec s191V five-axis machining centre come into play?**

**Felix Baumgartner:** It is not possible to create the unusual case design using conventional production technology. Cases are typically encapsulated from

behind using a cover, but we needed a compact case with a deep, spacious compartment into which we could insert the movement at the side. This slot at the side has a depth of more than 20 mm, almost twice the usual dimension. This design resulted in an extremely slim watch that is easy to wear – which was precisely our goal.

**It all sounds very much like what you might expect from an engineer – it's certainly no surprise to hear that the case and movement are precision cut and turned to the last micrometre using a machine tool from a company also renowned for delivering typical Swiss precision. What else do the Urwerk and Bumotec brands have in common?**

**Felix Baumgartner:** Buyers want a watch that sits comfortably on their wrist – a watch that not only looks good but is also ergonomic and easy to wear. And the watch should also be manufactured and assembled with the utmost precision. I firmly believe that a watch is the best type of jewellery a man can wear.



Urwerk founder Felix Baumgartner: "Urwerk chronometers are inspected by us every two to three years. We use a special treatment on the casing that allows us to polish out scratches, even those that are years old."

Mr Violante, this must sound familiar for Starrag and its brand message "Engineering precisely what you value"?

**Stéphane Violante, Marketing Project Manager at Starrag Vuadens SA:**

That's true. When we are developing machines we always start by considering the benefit to the customer, which in this case means considering the most effective way to manufacture a completely new wristwatch.

What do you see as the particular challenges?

**Stéphane Violante:** Just like Urwerk, our focus is on new functions, a new design and a new approach to manufacture high-precision components. It is equally important for us that machine handling is ergonomic. So it's clear that both companies have the same mindset.

The Urwerk homepage tells us that: "There has to be a strong bond with a mechanism that merges into your wrist: a machine becomes part of you and gives you information in return for energy."

"It is not possible to create the unusual case design using conventional production technology."

**This brings us to the next similarity: Urwerk also considers a chronometer to be a machine. But what are the key things to understand about how this machine is manufactured?**

**Felix Baumgartner:** "Form follows function" is another mantra we live by, and we consider the feasibility of actually implementing the ideas to be an extremely important function too.

**Stéphane Violante:** Urwerk's priority is using a precision CNC machining centre to produce parts that will subsequently be finely finished by hand and then fitted in an extremely complex chronometer. We also focus on effectively combining technology and craftsmanship, which is why the guideways on our machine tools are still meticulously scraped by hand.



Felix Baumgartner, founder and CEO of the Urwerk brand, talks with Stéphane Violante, Marketing Project Manager at Starrag Vuadens (right).

**After-sales service is important with machine tools: How does Urwerk set itself apart in this area?**

**Felix Baumgartner:** Urwerk chronometers are inspected by us every two to three years. We use a special treatment on the casing that allows us to polish out scratches, even those that are years old. This is what sets our watches apart from many other brands. Urwerk: Bold horology solutions. ▀

**starrag**

Engineering precisely what you value

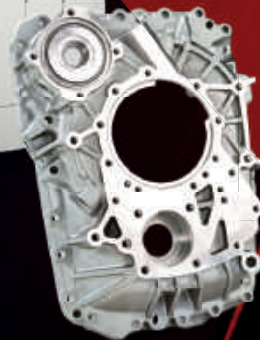
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