

When turbine manufacturing is fun ...

Turbine Technology Days 2016

**Process reliability in line with
purity requirements**

Dörries VCE 1600/140 SM So vertical
turning lathe from the Starrag Group

Modern, more modern – production cell 3

Machining solution for Mercedes Benz

Market conquered with flexibility

Modern crankshaft manufacturing takes
place on Starrag Group machining centres

**Innovative products through
innovative production**

Milling/turning centre enables complete
machining of complex pump parts

A large background image showing industrial machinery in operation, with a large cylindrical part being machined and a lot of metal chips flying off. The scene is brightly lit, highlighting the metallic surfaces and the dynamic nature of the manufacturing process.

**Focus and Solid Rock as
the icing on the cake of
a well-rounded program**

Starrag Group: Transportation &
Industrial Components Technology
Days 2016

Content

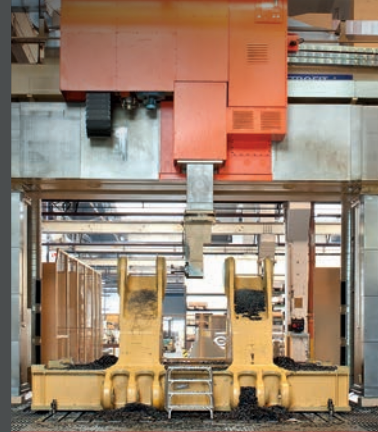
06

Turbine
Technology
Days 2016



09

Focus and Solid Rock as the icing on
the cake of a well-rounded program



12

Burly giant undergoes
rejuvenation cure

05 Editorial

By Walter Börsch

CURRENT NEWS

06 When turbine manufacturing is fun ...

Turbine Technology Days 2016

09 Focus and Solid Rock as the icing on the cake of a well-rounded program

Starrag Group: Transportation & Industrial
Components Technology Days 2016

CUSTOMER SERVICE

12 Burly giant undergoes rejuvenation cure

Retrofit of a 30-year veteran Schiess portal milling
and drilling machine assures sustainable future

AEROSPACE & ENERGY

16 Adaptive manufacturing of turbine blades

Starrag develops a flexible manufacturing system
for the individual series machining of turbine blades

LEGAL NOTICE

**Star – The Starrag Group
magazine**

Publisher:

Starrag Group Holding AG
Seebleichstrasse 61
9404 Rorschacherberg
Switzerland

Tel.: +41 71 858 81 11
Fax: +41 71 858 81 22
Mail: info@starrag.com

Managing Directors:

Walter Börsch (CEO)
Gerold Brüttsch (CFO)

Editorial staff:

Eva Hülser, Sabine Kerstan,
Angela Richter, Michael Schedler,
Saskia Schmitz, Ralf Schneider,
Isabelle Sieber, Stéphane Violante

Picture credits:

© Photographs and illustrations:
Starrag Group 2016
© Page 19–21, Ralf Baumgarten

Design:

Gastdesign.de

Printing:

Druckhaus Süd, Cologne

Reprinting:

All rights reserved. Contents
may not be copied without
written confirmation.

Star – the Starrag Group
magazine appears in German,
(official Swiss spelling rules),
English and French. Despite
careful editing, no guarantee can
be made. Star appears biannually.

www.starrag.com

19

Process reliability in line with purity requirements



22

Machining solution for Mercedes Benz in Sindelfingen

AEROSPACE & ENERGY

19 Process reliability in line with purity requirements

In customers' hands: Dörries VCE 1600/140 SM So vertical turning lathe from the Starrag Group

22 Modern, more modern – production cell 3

Machining solution for Mercedes Benz in Sindelfingen

TRANSPORTATION & INDUSTRIAL COMPONENTS

26 Market conquered with flexibility

Modern crankshaft manufacturing takes place on Starrag Group machining centres

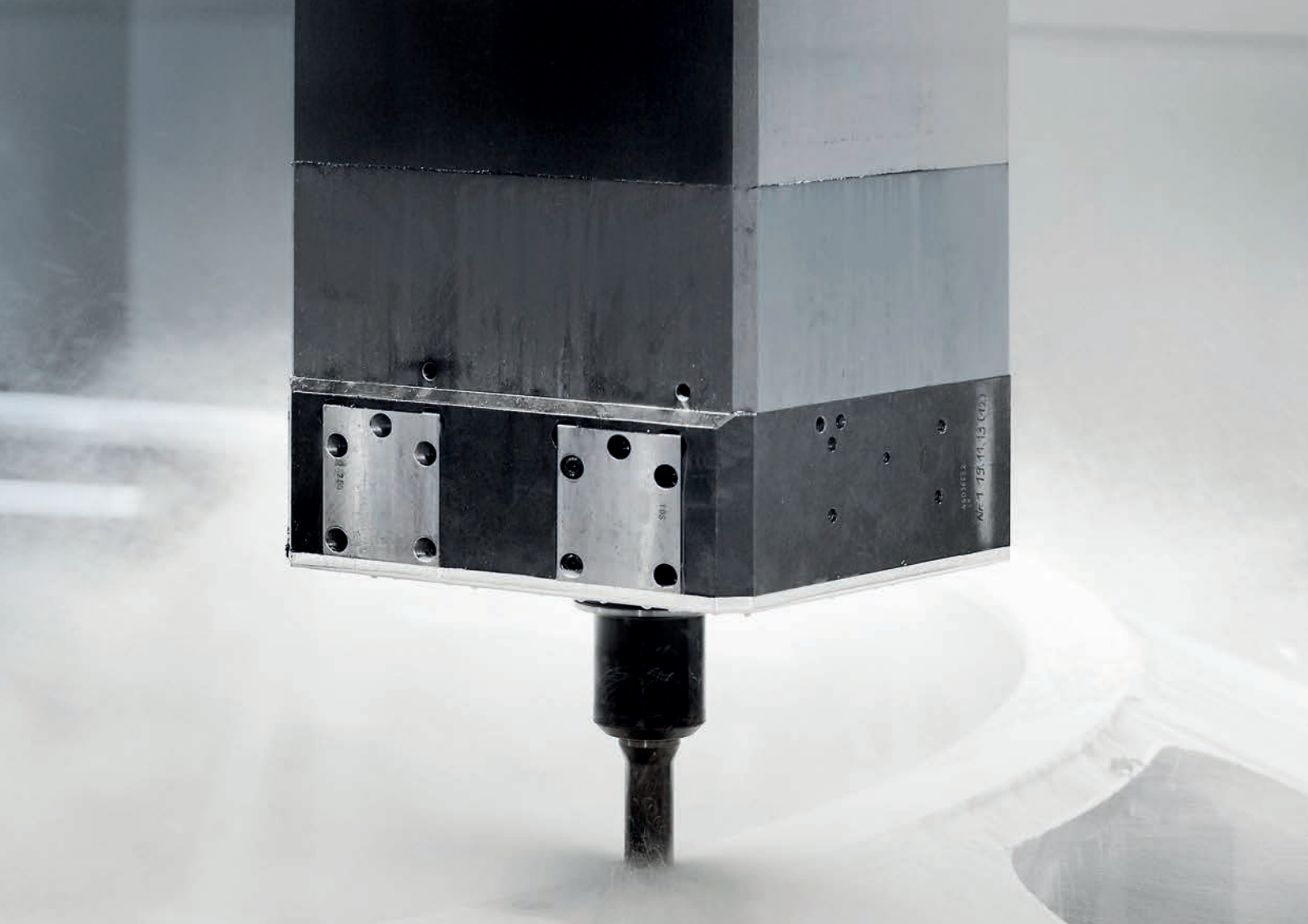
30 Innovative products through innovative production

Milling/turning centre enables complete machining of complex pump parts

PRECISION ENGINEERING

34 UCH & BUMOTEC: a relationship built on trust

Interview with Ahmed EL YAMANI, CEO of the UCH SA



Starrag Group at trade shows

20.–25.01.2017

T-Gold Vicenzaoro
Vicenza (Italy)

26.01.–01.02.2017

IMTEX
Bangalore (India)

03.–06.02.2017

IJS
Mumbai (India)

07.–10.03.2017

INTEC
Leipzig (Germany)

04.–07.04.2017

Industrie Lyon
Lyon (France)

17.–22.04.2017

CIMT
Beijing (China)

15.–19.05.2017

Metalloobrabotka
Moscow (Russia)

23.–26.05.2017

AMB
Teheran (Iran)

06.–09.06.2017

MACH-TOOL
Poznan (Poland)

19.–25.06.2017

Paris Airshow
Le Bourget (France)

20.–23.06.2017

EPHJ
Geneva (Switzerland)

15.–20.08.2017

Maks Airshow
Zhukovskiy (Russia)

18.–23.09.2017

EMO
Hanover (Germany)

09.–13.10.2017

MSV
Brno (Czech)

08.–09.11.2017

MDM
Minneapolis (USA)

13.–16.11.2017

Compamed
Düsseldorf (Germany)

www.starrag.com



Walter Börsch
CEO of the Starrag Group

Dear reader,

Although I have now been working for the Starrag Group for nine years, I am still surprised by the enormous variety of products and services that we develop on a daily basis for customers from the Aerospace & Energy, Transport & Industrial Components and Precision Engineering target markets.

Despite the differences between the ten brands, there is one message that unites them all: Our promise – “Engineering precisely what you value.” We always provide the customer with precisely what they need and what is important to them – nothing more, nothing less. The way in which we achieve this is continually improving.

What is our recipe for success? Customer proximity: To better understand customers and their requirements, we listen carefully to all that they have to say – during initial customer contact, during the implementation of projects, when providing customer service, at conferences and at international events, such as the Farnborough International Airshow or the International Manufacturing Technology Show (IMTS) in Chicago.

Our three tailored customer event days, to which we invite visitors from the three target markets of the Starrag Group, have proven to be particularly successful. Nearly 500 experts from across the globe came to watch, listen and exchange information at the Aero Structures Technology Days 2016 in Mönchengladbach, the Technology Days Transportation & Industrial Components 2016 in Chemnitz and the Turbine Technology Days at the Starrag Group headquarters in Rorschacherberg. The guests were fascinated by demonstrations of the 100th ECOSPEED model and astonished at the increase in productivity of up to 87 %. Guest were also impressed by the presentation of the new and extensive concept for flexible manufacturing systems (FMS) with cell controllers developed by the Starrag Group.

Two innovations were met with particular interest in Chemnitz: While the new Solid Rock high-precision kit for the Heckert machining centre eliminates the need for air-conditioning in halls, the new Focus horizontal machining centre is optimized for the maximum benefit of customers. By concentrating on the essentials, investment costs have decreased by 20 % and delivery times by 60 %. After they were presented for the first time, the new Focus machines generated so much interest and positive feedback from users that they quickly bought all twelve available machining centres.

You can read more about these and other “Star” stories in the fourth edition of our customer magazine. You can find out more about us at one of our various Starrag Group events in 2017, to which you are warmly invited. These events will, amongst other things, focus on our highly specialist solutions for Industry 4.0, which – like all of our services – are based on our promise. I look forward to receiving your personal feedback, whether indirectly or by discussing this in person.

Sincerely, Walter Börsch

When turbine manufacturing is fun ...

Turbine Technology Days 2016





AT THIS YEAR'S Turbine Technology Days (TTD) event, which was being held for the fourth time in 2016, Starrag and the German company HAIMER GmbH promised to deliver a show with numerous partners and demonstrations. The main focus at the Starrag site in Rorschacherberg was on one important finding: The manufacturing of turbine components is fun. "Together with numerous interesting event partners, we will be presenting the best products and services relating to the manufacture of turbines," said Dr Bernhard Bringmann, Managing Director of Starrag, as he welcomed around 150 guests to the event.

"I'm here because it's important for me to keep my finger on the pulse of the manufacturing processes", pointed out Dr Gregor Kappmeyer, Engineering Associate Fellow Machining at Rolls-Royce Deutschland Ltd & Co KG in Oberursel. A holistic approach is very important for him with regard to the manufacture of aircraft components, explained Dr Kappmeyer in his lecture "Modern Aero Engine Components – Efficient Machining, the Key for Success".

Dr Kappmeyer declared what is referred to as the marketplace, where the partners of the Starrag Group showed how different products and services can be combined with those of the machine tool manufacturer to produce tailor-made solutions, a complete success. An important partner for Starrag in this field is HAIMER GmbH in Igenhausen: "The customers were able to gain a clear picture of why the tool clamping device plays a key role in the overall process as an interface between the machine spindle and the cutting edge of the tool. Why balancing the entire tool is so important for the machine spindle, workpiece precision and tool life was covered in detail."

Other equally important engineering partners represented at the marketplace were TDM Systems, CGTech Deutschland (Vericut), Boeing (production research), Benz (tools for the machining of housings), Blaser Swisslube (coolants and lubricants), Flexmill (polishing and grinding of turbine blades), Heule (tools



for double-sided deburring, chamfering, countersinking in a single working step), Moldtech (CAD/CAM), Oerlikon Surface Solutions (tool coatings), Thomson (linear friction welding) and Wenzel (coordinate measuring technology).

Starrag Group has gone one step further than in its partnerships with other companies with flexible manufacturing systems (FMS), including cell controllers, with which the company covers 90 to 95 % of requirements. The Swiss specialists are responsible for the complete system, which is very flexible according to individual customer needs. As a current example, Project Manager Marcel Leuch presented a new FMS with four linked machining centres, a grinding machine and two robots (parts handling), which can fully machine seven different components (forged guide vanes and engine housings) – including component cleaning and measuring – in three clamping positions. The really clever thing about it is the automation, which reduces unproductive times and downtimes, thus considerably increasing productivity. Marcel Leuch: "If one robot should fail, the other automatically takes over." A good example of how the important customer requirement of reliability can be met with clever automation.

The fine art of complete machining of hybrid components – in this case an outlet guide vane (OGV) made from aluminium, composite and titanium – was demonstrated by a Starrag expert on a Starrag LX 151, a machining centre specially designed for the 5-axis machining of turbine blades. A 2.65 kg OGV with two pockets was created from 72 kg of aluminium alloy forgings (AMS 4147) in nine machining steps (including 3D roughing, face milling and even finishing). One pocket is filled with composite and sealed with a titanium component. This complete solution is

"Our speciality is tailor-made tools, including for very thin-walled workpieces."

supported by the very low-vibration machining for unstable and sometimes thin components despite the very high speed (up to 18,000 rpm), which is due to a high-quality chatter-free surface ($Ra < 1.6$). For special solutions such as these, Starrag has developed its own tools. Application Engineer Michael Straub: "Our speciality is tailor-made tools, including for very thin-walled workpieces." Thanks not least to special developments such as these, Starrag does not have to miss out on contracts, even where they involve highly unique challenges – in this case the complete machining of a guide vane from aluminium, composite and titanium.



But how did these sorts of demonstrations and their messages go down with the TTD guests? Dr Gregor Kappmeyer from Rolls-Royce Deutschland echoes the positive feedback of many of the participants: "I thought it was good that Starrag put together all the individual elements of machining in one go, as that's the only way to build up a complete picture. The Technology Days have conveyed the holistic approach of the complete process very well." And as the satisfied look on his face at the end of the event showed: "The manufacturing of turbine components is fun." ▀



Focus and Solid Rock as the icing on the cake of a well-rounded program

Starrag Group: Transportation & Industrial Components Technology Days 2016

At the beginning of June, the Starrag Group's Transportation & Industrial Components Technology Days 2016 took place in the industrial city of Chemnitz in Saxony, Germany. The Starrag Group was delighted to have attracted more than 200 visitors to its production halls over three days with two innovations, demonstrations at 13 stations and eight specialist lectures.

A successful event starts with a highlight: True to this rule of successful event management, Dr Marcus Otto, the new head of the Transportation & Industrial Components business unit, opened the T&I Technology Days with not one, but two innovations. First, he unveiled a new Focus horizontal machining centre, optimised for maximum customer benefit. The new horizontal, four-axis machining centres HEC 400F, HEC 500F and HEC 630F are all machines "Made in Germany". During their development, particular emphasis was placed on increasing productivity and reducing unit costs. As a result, investment costs have decreased by 20 % and delivery times have got 60 %

shorter. This means lower hourly rates and a faster start to production for the user. Furthermore, the Focus machines require around 10 % less space. "These new machining centres allow us to implement precisely what many customers need for their typical applications. In all of these new products, the focus is placed on total cost of ownership (TCO)," emphasised Dr Otto in Chemnitz.

The second innovation, Solid Rock, consists of machine beds made of granite. At comparable static rigidity, the thermal transfer is halved when compared to conventional steel, cast or mineral cast constructions.

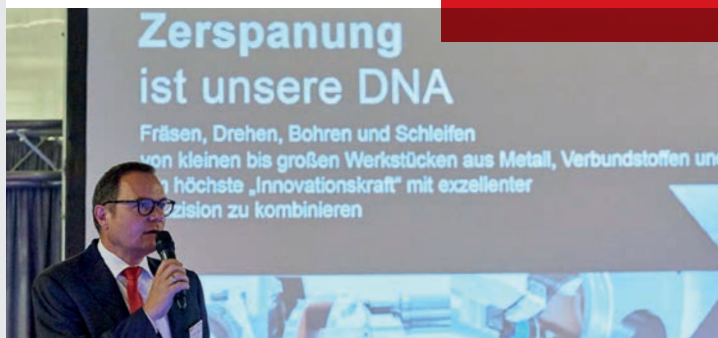
The material-related high heat capacity makes the machine beds particularly resistant to short term temperature fluctuations without additional control measures. These characteristics lead to a thermal stability of the machine beds that has not previously been achieved.

But the solution was not just any old granite. Heckert found a supplier that uses granite with a very homogeneous structure, good damping characteristics and a very low tendency to absorb water. This natural stone is also used by leading manufacturers of measuring machinery. Dr Otto: "What's more, these Solid Rock machines boast unrivalled temperature and vibration stability."

In combination with the new high-precision kit, the customer can use the unique position accuracy of the Starrag Group machining centres



"Delivery times have been reduced by 60%."



Zerspanung ist unsere DNA

Fräsen, Drehen, Bohren und Schleifen von kleinen bis großen Werkstücken aus Metall, Verbundstoffen und... höchste „Innovationskraft“ mit exzellenter Präzision zu kombinieren



without complex air conditioning in its production halls. One component of the high-precision kit is the temperature stabilization of the machine stand, which keeps all structural components at a constant temperature level. This prevents temperature-related displacement. The efficiency of this temperature stabilisation was doubled by the patented insulation. This shields the machine stands from ambient temperatures and internal heat sources. Development Manager Matthias Brand: "Because neither the bed nor the stand move, the accuracy is increased enormously."

The visitors to the Technology Days were not only interested in the two world firsts, but also in the many demonstrations (complete machining, process integration, turn-key solutions) and the service and training ranges. The opening of the new precision measurement room, which is fitted

with two large measuring machines in the high-precision range up to 0.7 μm , also attracted particular attention. This facility will allow optimal implementation of the Starrag Group quality standards for its customers.

The great success of this three-day event was not only due to these demonstrations, but also clever cooperation with the other event organisers in Chemnitz. For instance, there was a collaboration with the concurrent "Sächsischen Industrie- und Technologiemesse SIT" trade fair, whereby its visitors were able to commute between the exhibition centre and the Starrag Group company using a shuttle service.

Links with the concurrent "4th International Chemnitz Manufacturing Colloquium ICMC 2016" were ensured by Professor Matthias Putz, a director at the Fraunhofer Institute for Machine

Tools and Forming Technology (IWU) in Chemnitz. He reported on current machining trends (including deep-hole drilling with the support of ultrasound technology, cryogenic cooling, hybrid machines), which the Starrag Group is also working on. The well-known scientist from Chemnitz also appealed – in particular with respect to Industry 4.0 – for a change in thinking on the part of the users and manufacturers of machine tools. "Because production knowledge is the fuel of the future, we should use the machine tools to generate data."

Condition monitoring with the aid of vibration sensors, a precondition for predictive maintenance, has been used as standard in the Starrag Group since 2011, as the participants at a presentation by Frank Weirauch, Test Field Team Leader, found out. Therefore, the company's experts have already gained many years of experience.



“Thanks to the new Focus Horizontal machining centre investment costs have been reduced by 20 %.”

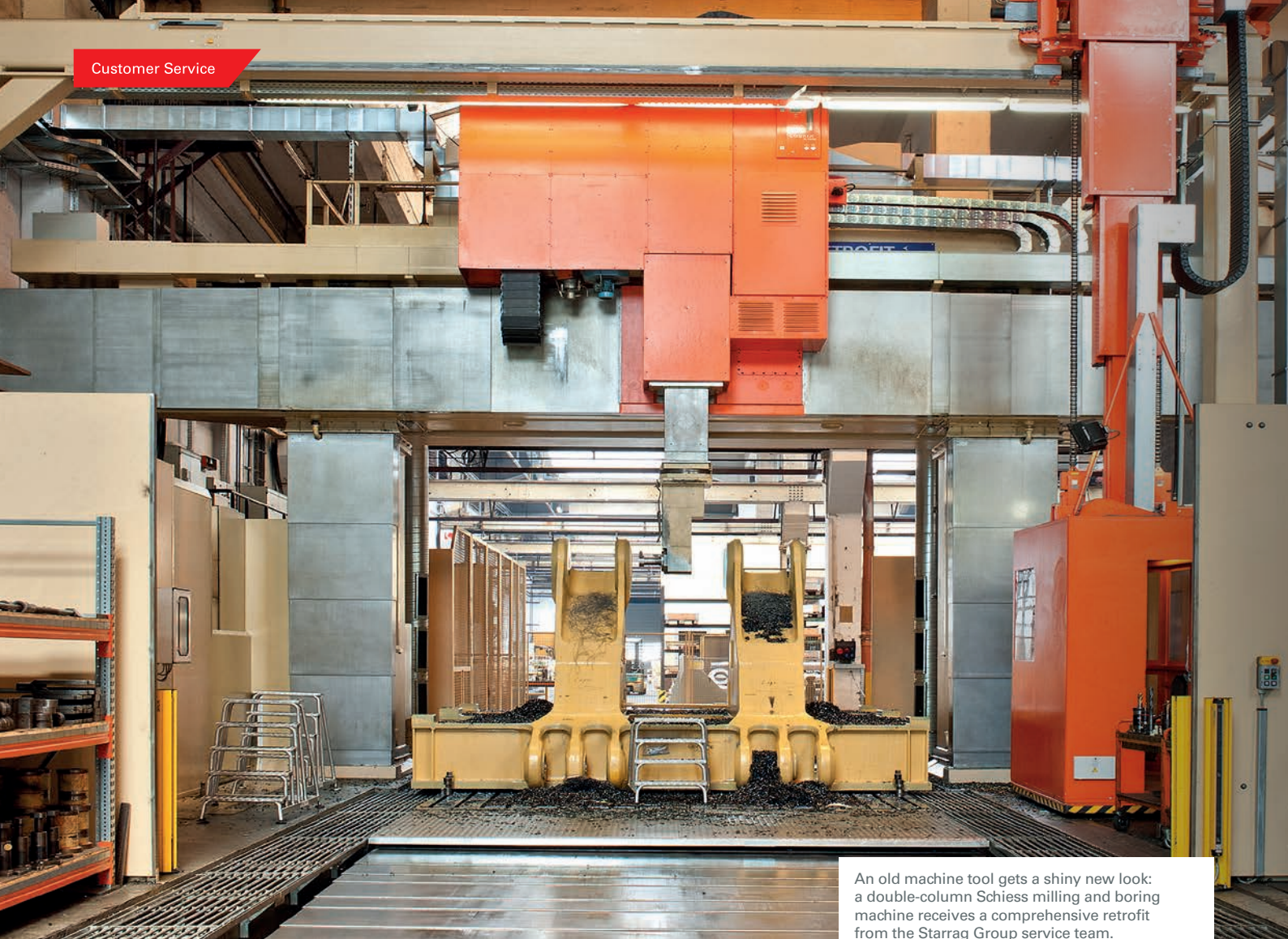
They have an almost unique ability to transform a machining centre into a transparent machine tool, through the interaction of sensors with an evaluating microprocessor. Users can access the data via Ethernet and can even do so remotely. “They can immediately check the status of a machine connected to the company network without leaving their desks”, the presentation explained to the listeners. Interesting opportunities are opening up for the technologist, who can now assess the smooth running of a tool not just by listening to it, but based on measurements. The precisely recorded vibration loads enable him to adjust the processes and parameters.

Thanks to condition monitoring, a component can be specifically replaced long before damage occurs, based on a trend analysis. Such measurements with subsequent analysis are part of a fingerprint that can be collected by

the Starrag Group service department during maintenance of production systems. This enables the production systems to be operated in a more productive and reliable way.

However, this requires the storage of a lot of information over a prolonged period of time, which is known as “big data”. One person who is not afraid of the supposed “cold rule of data” associated with this is Karl-Heinz Welz, Director of Production at the international agricultural machinery manufacturer AGCO GmbH in Marktobendorf, a regular customer of the Starrag Group, which already has numerous machines successfully in operation. In view of Industry 4.0, Mr Welz posed a number of questions in his fascinating lecture: “But who actually feeds artificial intelligence, should it really be the task of humans in future? Can everything be predicted with algorithms? What role will people

play in the factory of tomorrow, will they all be replaced by robots?” In Chemnitz he advocated developing respect for the employees and trusting them. Another important recommendation that he made on the subject of communication was quite surprising: “Be meaningful! Say something interesting! Allow mistakes, because it’s only by making mistakes that we learn something from them!” And that points to the other important success factor of the Technology Days: It is not only machine manufacturers and scientists who get a chance to speak, but also the users of machine tools themselves. Therefore, every visitor was satisfied that the Starrag Group claim “Engineering precisely what you value” is more than just empty words. ▀



An old machine tool gets a shiny new look: a double-column Schiess milling and boring machine receives a comprehensive retrofit from the Starrag Group service team.

Burly giant undergoes **rejuvenation cure**

Retrofit of a 30-year veteran Schiess portal milling and drilling machine assures sustainable future

“Our largest excavator boasts a bucket volume of 42 m³”, thus Ralf Petzold, Works Manager of the Komatsu Mining Company GmbH. This corresponds to a handling capacity of approximately 75 tonnes of bulk material, a volume that becomes all the more impressive when one thinks of two lorries capable of being loaded almost completely by a single bucket. In the colossal factory building one is flabbergasted at the huge components manufactured at the Düsseldorf-based plant and assembled to form enormous hydraulic excavators. A Schiess portal milling and drilling machine type 40 FZT has been responsible for machining these outsized components, among others, for the past thirty years. Other imposing features of this gigantic facility include its overall height totalling 7.80 metres and a traverse range extending to 14 metres. The machine has aged over the years so that the management of Komatsu Mining joined forces with Starrag Group Service department located in Mönchengladbach to seek means and ways of rendering it fit for future service.



GROWTH:
 “It was a **successful collaboration** and we **are well prepared for the future.**”

A look at the new gantry lift platform: from here, even high workpieces can be ascended – with a drop guard for increased safety.

Decision in favour of unusual retrofit package

Several factors spoke in favour of a retrofit package, which was tantamount to subjecting the 40 FZT to a thorough overhaul. The outdated machine still revealed excellent and substantial engineering qualities. As far as Komatsu was concerned, the production technology integrated into the 40 FZT was worth preserving. Both the machining accuracy and stock removal rate were highly efficient. Nevertheless down times, wear and outmoded control and safety technology had led to increasing problems occurring. “This having an impact on the arterial lifeline of our enterprise” as Ralf Petzold emphasised. Material flow and production layout had undergone various processes of optimisation over the years so that the company was reluctant to make any changes in that respect. The machine bed was also capable of being reused. The alternative would have been to purchase a new machine. What spoke against this option was the high

replacement value. The essence of the old machine was worth preserving so that a fundamental decision was made to opt for a retrofit. Provided one has found the right partner to work with, a retrofit project can be economically attractive. After carrying out an intensive market search and competitive analysis, the company decided to call on the service organization of Starrag Group to tackle the job. “Rating of the evaluation matrix and personal impressions finally tipped the scales in favour of Starrag Group”, admitted Ralf Petzold. In Starrag Group the company had identified its own philosophy: A solid enterprise that would vouch for what it promised.

Starrag Group Service implements modernisation project with Schiess know-how

“We chose the right partner at the right time.” In the event of unexpected problems cropping up, Starrag Group is well equipped to deal with the situation. Owning all former Schiess documents

– software and hardware diagrams together with all hydraulic plans and construction documents including all component drawings – Starrag Group is in a position to rebuild individual parts of any machine applying tested quality standards. The complete store of know-how relating not only to Schiess facilities, but also to those of other system specialists – Frieriep, Wotan and Köllmann – has passed to Dörries Scharmann along with former personnel. That’s not all: the Starrag Group Service Unit has access to the full range of components traded in by the new machine business enterprise. This comprehensive retrofit range adapted to meet customers’ individual needs accounts for a vast share of the aggregate turnover generated by the company. Ralf Petzold concludes: “This pooled cooperation alliance was successful all along and we are now well equipped for the future.” The results speak for themselves: Proceeding from an ultra steep start-up ramp, the retrofitted machine attains a 98 % level of availability.



Availability of 98 %

After the retrofit, components with a total weight of up to 120 tonnes can be machined with the precision of a new machine.

Performance even exceeds that when the machine was first delivered to the works and accuracy values are fully compatible with those of a new machine.

Complex operations to ensure speed and safety


The immediate impression gained when approaching the machine in its new enclosure is that a major aspect of the upgrading process lay in updating technical safety standards. Achieving a high level of safety was vital in order to protect the operating personnel from hazardous situations without imposing restrictions on work. This included a new mobile portal lifting platform. A special feature of this concept is a fall arrester designed to facilitate safe access to even higher work pieces from the cockpit. Illumination of the work area is another distinct improvement from the angle of visual control and thus too, overall safety. A further important issue relating to the retrofit lay in modernising the system technology. The previous tool manipulator had become prone to failure and was

replaced by a high-tech industrial robot integrating a whole number of advantages: Apart from essentially more straightforward features of design, the new robot system is capable of reacting more quickly, responding as it does with all necessary degrees of freedom not hampered by set axes and traversing limitations. This results in shorter toolchanging times. One of the fundamental aspects in overhauling the outdated machine lay in testing and replacing essential components. Starrag Group is ideally equipped in that respect, having access to in-plant production and design components, including all original drawings, and thus capable of exemplifying more or less every in-house task needed to be accomplished. This ensures high standards of quality combined with reduced turnaround times. The principal components, including drive units such as the motor, gear mechanism and milling head, were overhauled and subjected to a fatigue testing process using Starrag Group in-house test rigs. Whenever new components are required,

Starrag Group can help itself, so to speak, within the Starrag Group and come up with complete solutions derived from other machine-tool segments. The meanwhile obsolete electronic system was likewise replaced by modern units of equipment. All these measures contribute essentially to enhancing operational reliability, thus ensuring process sustainability on this industrial system.

Rejuvenation cure to meet future demands

Also brand new is the air suction system which has brought about a distinct improvement to the quality of air circulating in the work area. This installation is conducive to the health of the machine operators and an item of equipment from which the entire factory building benefits owing to its reducing the concentration of cooling lubricant present in the breathing air. Indeed, the quality of the air during the heavy-duty machining process applying coolant feed is better inside the work area than outside the machine. Optimisation has also extended to feeding of



RESULT:
“The machine now has shorter tool change time intervals.”

A retrofit instead of a new machine – the preservation of the original layout ensures both improved occupational safety and a higher acceptance rate among machine operators.

the coolant. The old cooling lubricant system revealed shortcomings and operational failure caused delays to occur in the machining times. Starrag Group developed a modified design to control waste-water treatment and the cooling lubricant mix. In replacing the hydraulic, pneumatic and electrical components Starrag Group transformed the redundant system into a state-of-the-art solution in compliance with current environmental stipulations. The control technology system has skipped an entire generation. The old control system was replaced by a modern Siemens Sinumerik 840D sl. It was of importance to Komatsu to be able to reutilize all existing programs and for the interface to undergo simplification for convenient tool management.

A partner to share expertise with

“You never can tell what you’re going to find when opening a machine,” remarks the Works Manager, Ralf Petzold, and adds: “Then you have a list of contingencies to sort out of what needs to be done first.” This is critical issue since the customer and service provider sometimes tend to set different priorities.

At this point, the Works Manager pays tribute to the extremely constructive cooperation with the Starrag Group Service Unit. The know-how possessed by Starrag Group and the staff of the Komatsu maintenance group with its vast store of experience accumulated over a period of many years has always succeeded in bringing about amicable solutions. Demands imposed on quality and precision were particularly fastidious. This led to highly complicated repairs being carried out by the Starrag Group Service Unit such as thermal metallization of bearing seats followed by spindling and restoration of the hydrostatic system on the Y- and Z axes. Despite extensive project planning measures and a detailed catalogue of specifications elaborated by Starrag Group with highly committed project managers in accordance with the specific needs of the customer, wear at certain points is unexpected. In the project planning phase it goes without saying that Starrag Group conforms to customer requirements while also drawing attention to the potential offered when retrofitting a machine in the effort to achieve optimum performance

The Starrag Group is the sole owner of all construction documents from the companies Schiess, Wotan, Wanderer, Froriep, Jungenthal, Köllmann and, of course, the current new products of the entire group.

This means that the Starrag Group possesses all documents for all machines built. There are tens of thousands of drawings in the archives, which allows us to service your tool machines and grinding machines with the experience of the manufacturer. This is a crucial advantage for you.

Our expertise with regards to your machine means that we are always the right contact for you!

“The machine is now even better than it was when it was delivered.”

characteristics. Hand-in-hand with the customer, the scope of performance is then defined and the duration of the project assessed. After all, the transitional phase needs to be bridged over by outside enterprises. As far as Komatsu was concerned, the logistic challenge was certainly worth the effort.

Results productive of maximum reliability

Enthusiasm was palpable on the part of all involved in retrofitting and updating the old machine. Works Manager, Ralf Petzold, summed up by saying “We are absolutely satisfied with the results.” Starrag Group Project Manager added “The machine is even better than it was when it was first delivered.” ▀

Adaptive manufacturing of turbine blades



Starrag develops a flexible manufacturing system for the individual series machining of turbine blades

A state-of-the-art flexible manufacturing system from Starrag performs the finishing of precision-forged titanium turbine blades. The Swiss machine and plant manufacturer applied the expertise it has gained over its many years of experience in design and in key details to reliably produce up to 40,000 blades per year. For example, an individual milling program is generated for each blade due to small component differences arising from the process.

Starrag AG, which is based in Rorschacherberg, has been handling turn-key projects for the manufacture of turbine blades and structural components for over 20 years. Around 60 automated multi-machine systems have been created during this time, providing a wealth of technological experience. A large number of customers currently benefit from this wealth of experience, as there is a clear trend towards flexible manufacturing systems (FMS) worldwide. Head of Sales Rainer Hungerbühler explains: "While in the past we had a maximum of two such projects in progress at any time, we currently have four projects that will be delivered to Asia and America. The aerospace and energy industry is increasingly taking advantage of the benefits offered by

this type of automated series production, in terms of both quality and efficiency, in the manufacture of key components such as turbine blades."

The finishing of compressor blades for use in aircraft engines is a particularly impressive project. The titanium blanks for machining are precision forged. While the accuracy of the two blade surfaces (suction and pressure side) mean that no post-machining is required, the edges still need a specific radius. The transitions to each turbine blade must also take place without any noticeable offsets or milling marks.

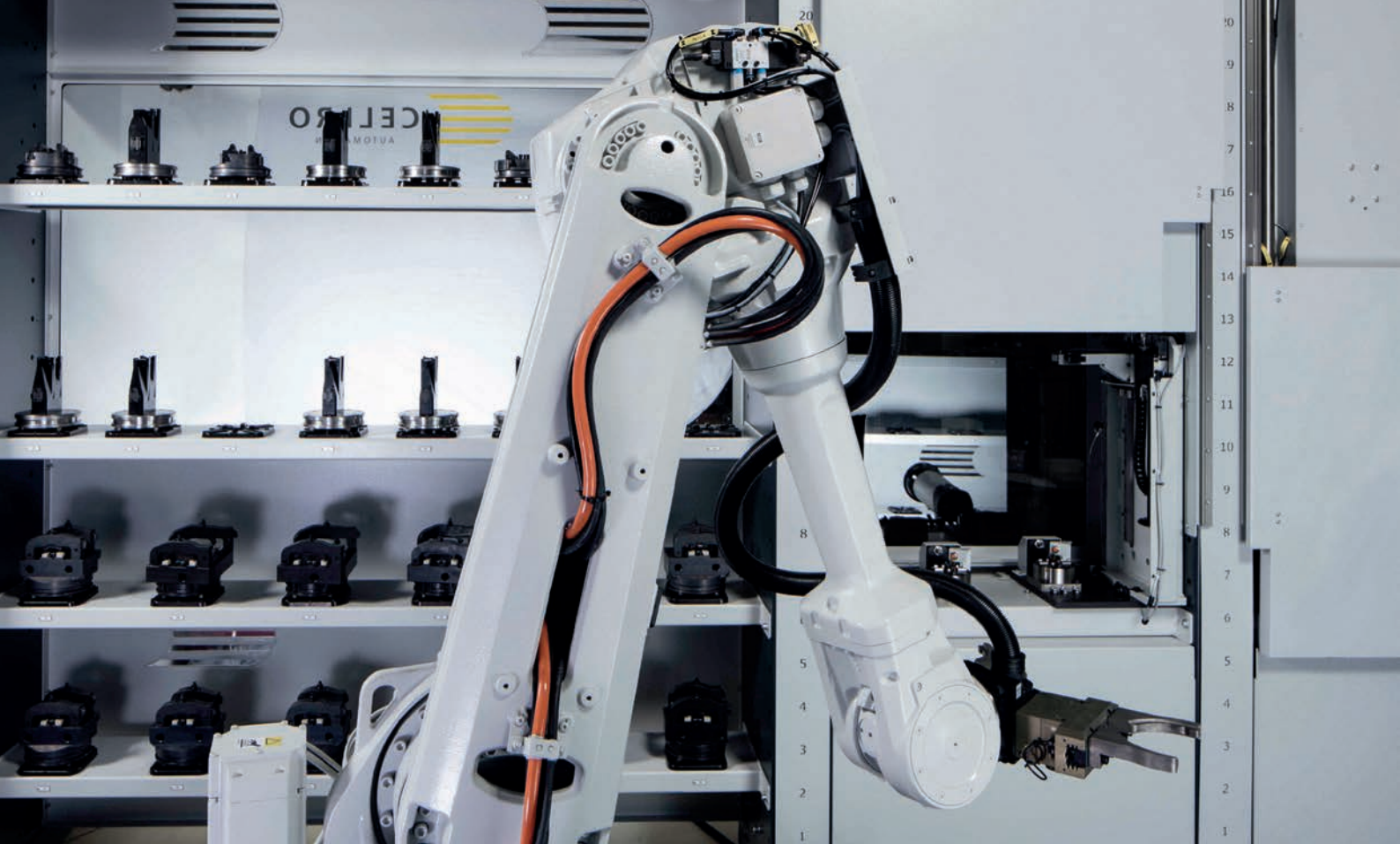
Forging – even when performed with this high level of precision – is a process in which variations between components

A state-of-the-art flexible manufacturing system from Starrag performs the finishing of precision-forged titanium turbine blades.

occur. While minimal deviations within the blade surface have a negligible effect on the end application, contour differences pose considerable challenges with regard to the milling of the edges and transitions.

Highlight: adaptive milling

The Swiss plant developers opted to use LX 051 machines for this purpose. This series of machines has been developed by Starrag for the highly precise, simultaneous five-axis machining of turbine blades. To achieve an optimum transition for each blade, Starrag opted for adaptive milling. This means that the milling process is individually adjusted for each blank. First, a measurement process is performed in the machine, during which the shape of each blank is scanned.



Production safety as a top priority

A six-axis robot transports the components and also supplies the machines of the second line if needed.

Based on this data, an individual NC milling program is calculated for each blank and is then immediately executed. The result is a tailored transition between edge the radius and blade surface.

Günter Leitold, who is responsible for the automation of flexible manufacturing systems at Starrag, explains: "This adaptive milling is one of the system's highlights. It is important that the measurement process is performed very quickly to ensure high productivity levels are maintained. This is achieved by using the latest scanning technology available on the market." The engineer points out that Starrag acts as a general contractor for this type of manufacturing system, and therefore has overall responsibility: "Our core competence lies in the field of machine tools, tools, equipment and CAM systems. We also have extensive knowledge of the configuration of such systems. What's more, it is important that, for other components, we only

work with leading companies that can achieve the high level of performance and availability that is required."

Redundant design ensures high availability

The reliability of the system was a key consideration during the planning stage. Ultimately, in the final configuration, up to 40,000 turbine blades will be produced per year. The designers therefore opted for a fully redundant set-up. The FMS consists of two lines with identical configurations, each comprising two loading stations, two LX 051 machining centres with a scanning device, one washing system, a marking needle and a measuring cell. A six-axis robot transports the components and also supplies the machines of the second line if needed.

The entire system is controlled by a cell controller with a PPC system, and this controller also enables various emergency strategies. This ensures that the

system can operate continuously for six days a week in three-shift operation. Günter Leitold adds: "Even maintenance can be carried out during operation by stopping individual cell parts and using the redundancy. The unit in question is removed from cell controller operation with the click of a mouse and is then available for maintenance work or program tests."

Adaptive set-up ensures a consistently high blade quality

To ensure a high level of availability, the set-up of the system was also carefully planned. The minimal contour differences arising from the forging of blanks mean that Starrag still needs to rely on human assistance. "Given that the entire process is otherwise virtually fully automated, this was not an easy decision," explains Patrik Rutishauser, Head of Application Technology. "But the calculations showed that our operator-assisted set-up is the



The Swiss plant developers opted to use LX 051 machines for this purpose. This series of machines has been developed by Starrag for the highly precise, simultaneous five-axis machining of turbine blades.

Fully automatic production with cell controllers as a basis for growth targets

most efficient solution for this system.” The reason for this is that a productive milling process requires secure clamping with specified forces. Although the deviations from blade to blade are only small, if the device is configured automatically, some blanks may not rest exactly on the support points. During fixing, stresses may arise in the component, leading to deformation upon release after milling and making the blade unusable.

Therefore, Starrag developed an adaptive device that adapts to the specific blade blank. Restrictions on the permitted component tolerances were also considered as an alternative. All blade blanks that do not comply with these tolerances would have to be removed in advance. Automation with a fixed device would then be feasible. However, with forged titanium blanks, the discarded quantity would be too great to ultimately achieve an acceptable result.

Fully automated: Milled twice, deburred, washed, marked and checked

The system has a total of four set-up points. Each point is equipped with a control PC that communicates with the cell controller. The blanks are already marked with a unique 2D code upon delivery. This code is recorded by the reading device upon set-up and is then transmitted to the cell controller. Head of Sales Rainer Hungerbühler highlights the versatility of the FMS: “The system is designed for seven different turbine blade variants. The blade production sequence is specified by the cell controller using different priorities.”

The basic procedure is the same for all blades. Each blade is machined in two clamping positions, meaning that two different fixtures are required. In the first fixture, the blank is clamped using a clamping principle developed by Starrag.

This leaves the edges and transitional areas on both sides free for machining. The second fixture includes a blade clamping system that allows the base and head of the blade to be milled. The necessary deburring takes place after the milling process in the machine. After the original marking is removed during the second milling process, a new 2D code is added to each blade with a marking needle.

A further fixture is needed for the final optical measurement process during which over 50 features of each individual blade are checked.

To ensure set-up is as efficient as possible, during full operation of the system all three fixtures for a blade type are available concurrently at the set-up point. Once machining is complete, the operator removes the blade from the measurement fixture, changes over the other two, and places a new blank in fixture one.

Machining expertise

Application engineer Patrik Rutishauser highlights other valuable features of the system: “Starrag’s expertise lies not only in the machines, but also in the machining process. Our CAM software is used to generate the adaptive milling programs and our solid carbide milling tools ensure optimum cutting performance.”

In order to handle the high demand for tools in the four machining centres, which operate around the clock, Starrag also provides the linked manufacturing system with two tool grinding machines plus auxiliary equipment, the capacity of which is planned from the cell controller. They ensure that the final grinding of specific tools can take place on site. As with all required tools, these tools are measured, shrunk in the holder and made available to the machines as required. ▀

Process reliability in line with purity requirements



Project manager Antonius Mußhoff and specialist Christian Spiegel: Planning a complete machining project on the Dörries CONTUMAT.

In customers' hands: Dörries VCE 1600/140 SM So vertical turning lathe from the Starrag Group

What important factor do a cruise ship in the Mediterranean, a brewery in Asia and a dairy in Bavaria have in common? They are all equipped with GEA centrifugal technology, produced in Oelde. Centrifuges are used to process and clean all types of liquid or to separate liquids and solids. Example applications of this technology include in the treatment of drinking water and waste water, the production of beer and milk, the cleaning of ballast water and the treatment of diesel fuels. GEA, a company based in EastWestphalia in Germany, meets the extremely high demands of its customers in the food and process industries using reliable production technology from the Starrag Group.

"If you open your fridge at home, you will definitely find at least three food products that were produced using technology from GEA," says Lilian Schmalenstroer, who is responsible for Corporate Media & Press at GEA Group AG based in Düsseldorf and is Public Relations Manager for the EastWestphalian subsidiary. GEA has evolved from a manufacturer of individual components, such as separators and decanters, into a supplier of systems that operate at a high level of vertical integration, including complete dairies, breweries or special facilities for ships (preparation and cleaning of fluids).

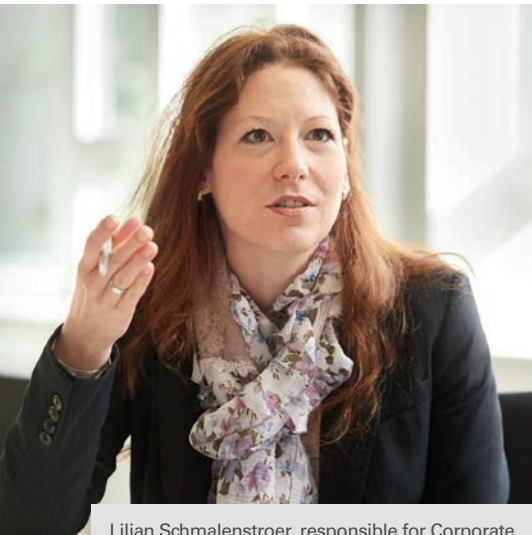
"With its innovative system solutions for the constantly growing global population, GEA is making its contribution to the field of food processing and the use of scarce energy resources," says Antonius Mußhoff, Project Manager at

GEA at the site in Oelde. The production facility in Oelde is equally complex. Among the products manufactured at this site are some of the company's key components (e.g. around 800 separators a year, generally in batch sizes of 1 to 3). "We fulfil all manner of unique customer requirements at this site," the expert mechanical engineer notes. "Nothing comes ready-made: We go to the customer with a view to creating an individual system following intense discussions"

In this respect, the Swiss Starrag Group is a perfect fit with GEA, as Starrag also primarily focuses on creating customer-specific production solutions. "We have been manufacturing separators that can process ever-increasing throughput quantities for over 120 years now," says the project manager. "Requirements in terms

of accuracy have also increased; we currently offer accuracy of at least 20 µm at certain points." For these exact points on the component, the production process must be designed so that it is extremely reliable and machining can take place with a high level of repeating accuracy. This requirement stems from the typical operating conditions in which separators work, namely with a speed of up to 12,000 rpm. Despite this high speed, smooth running is nevertheless required and can only be achieved using drive technology that delivers low unbalance and precise running properties. Antonius Mußhoff: "We have reduced the unbalance of a 1.5-tonne drum to 300 – 400 grams. Once all components have been mounted and fine-balancing has taken place, the residual unbalance is only five grams"

“This important finish achieved on the CONTUMAT significantly increases productivity.”



Lilian Schmalenstroer, responsible for Corporate Media & Press at the GEA Group AG in Düsseldorf: “We are able to supply all our customers around the world with separators that meet the requirements set out in the strict hygiene regulations from the European Hygienic Equipment Design Group (EHEDG) and the 3-A Sanitary Standards that apply in the USA.”

To meet these requirements, as well as the extremely strict regulations that apply in the food industry for example, the typical main components of products must be precisely coordinated with one another and offer a precision fit. All components are made exclusively from modified duplex steel. As production technology for processing food must be cleaned with water and chemicals due to the strict hygiene regulations, non-rusting stainless steel and a highly effective sealant are used. Lilian Schmalenstroer: “We are able to supply all our customers around the world with centrifuges that meet the requirements set out in the strict hygiene regulations from the European Hygienic Equipment Design Group (EHEDG) and/or the 3-A Sanitary Standards that apply in the USA.”

To achieve this, once fully machined, the most important components are now finished on a Dörries CONTUMAT (VCE 1600/140 SM So) vertical turning lathe supplied by Dörries Scharmann, a company based in Mönchengladbach,



High level of quality awareness: Hall 5 with the machines for material processing shows that solid process reliability is not just achieved here, but actively ensured (the image shows a Dörries CONTUMAT machine).

“For us, the **added value** is in the high level of **process reliability**. With this level of reliability, we can produce all components on the Dörries CONTUMAT to a consistently high level of quality.”

Germany, and a subsidiary of the Swiss Starrag Group. Antonius Mußhoff: “This important finish achieved on the CONTUMAT significantly increases productivity. At this point in the production process, accuracy is tremendously important.”

However, it is not only a high level of precision that is required; products must also demonstrate a good surface quality. Regulation 3-A from the USA stipulates that surfaces in contact with food must have an arithmetic mean roughness value of $Ra \leq 0.8$. All in all, the success of products ultimately hinges on a high level of process reliability being achieved – a factor that is monitored on an ongoing basis. When looking at the production process, specialist visitors will immediately see that process reliability is not just achieved here, but actively ensured. This reliability is checked and safeguarded by the use of 3D coordinate measuring technology.

GEA manufactures with coolants that flow out of the round, closed components during machining in order to

ensure a reliable production process. “In the final phase of the machining process, we change to a vertical finishing process that runs without tension to ensure quality,” the project manager explains. “We centre the components so that all the diameters have the same tolerance as each other.” GEA already has considerable experience with this kind of machinery that it has gained operating two Dörries CONTUMAT vertical turning lathes since 1970. When replacing these machines, the company ultimately switched to a competitor for cost reasons. However, as Antonius Mußhoff notes, because GEA could not manufacture all of the components using that system, they soon learned that cheaper does not necessarily mean better.

For this reason, GEA purchased a new Dörries CONTUMAT machine for handling important components weighing up to a tonne. Thanks to its solid cast construction (designed for a maximum workpiece weight of 9 tonnes), significant drive power (feed force of 35,000 N)



Specialist Christian Spiegel starts a program on the Dörries CONTUMAT that was created in a central programming department.

Production safety:

“What’s more, we are on our way to achieving 0 % wastage with a great deal of success.”



Low unbalance: Separators from GEA are characterised by an extremely low residual unbalance of just a few grams (the picture shows a CSI 500 separator with an integrated direct drive).



Antonius Mußhoff, Project Manager at GEA in Oelde: “Thanks to the highly reliable, production-level turning process employed on the Dörries CONTUMAT, there are practically no instances where rework is required.”

and hydrostatic guide, the CONTUMAT is able to machine heavy duty components with a high level of repeating accuracy, in a quiet and reliable process with very little vibration. For the application at GEA, it is particularly important that no vibrations occur: With the CONTUMAT, the hydrostatic guides and solid cast machine bed ensure quiet processing. “Flexibility is another key strength offered by the Starrag Group”, Antonius Mußhoff goes on to say. “This flexibility enabled us to seamlessly integrate an additional measuring axis that we worked together to develop in several stages. This sort of collaboration only works if there are specialists on both sides who can exchange ideas. We are therefore very satisfied with the machines built as a result of this process.”

The vertical turning lathe has particularly proven its worth in handling drum

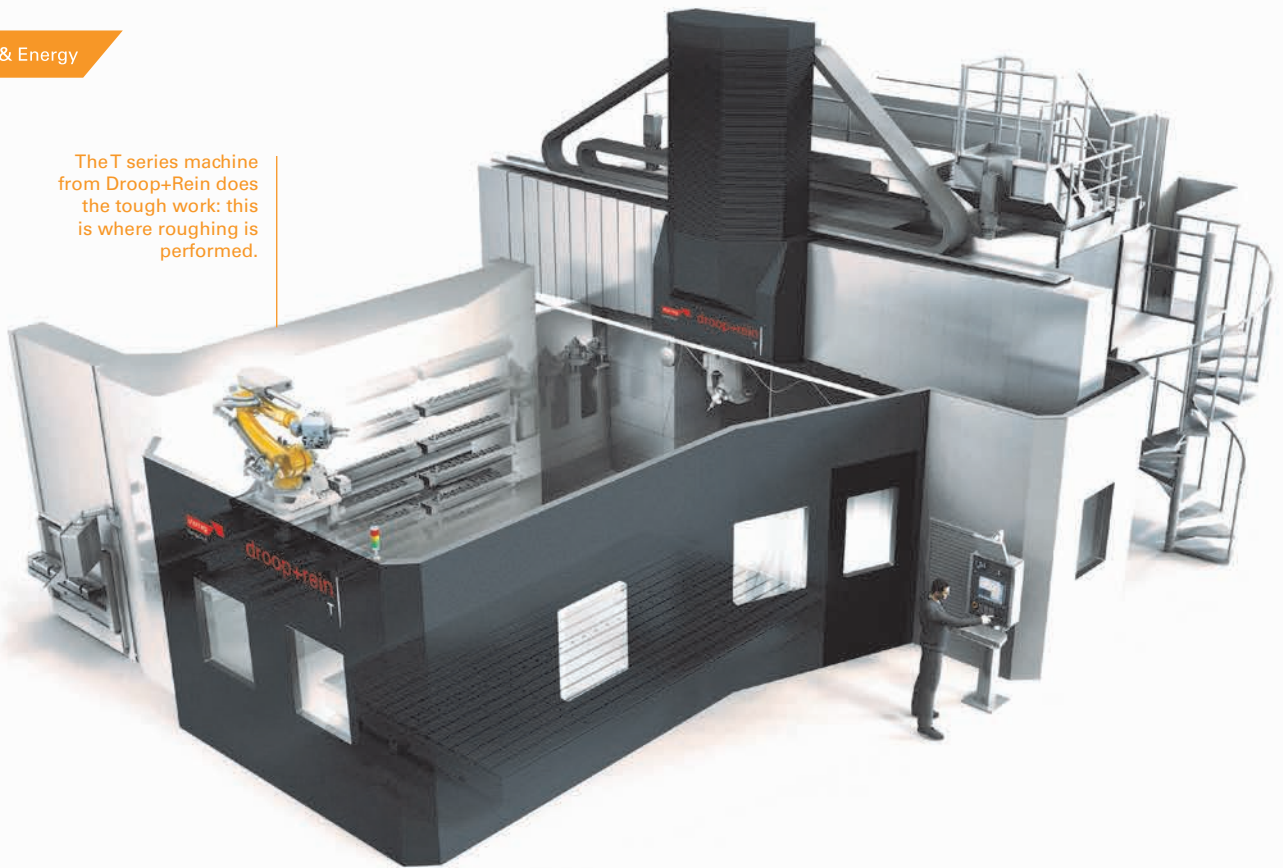
bases, one of the most complex components seen to date: As this component is used as a supporting element for all the other components of a separator, a great deal hinges on the level of quality and precision it offers. “The drum base offers the highest level of quality with the IT6 tolerance grade, which requires parts to demonstrate a position and form tolerance of 20 µm in relation to one another,” explains Mußhoff. “This quality can only be achieved with a reliable process.”

However, it was not only process reliability that played an important role in the decision to purchase: As a great deal hinges on the machining process using the CONTUMAT, GEA places considerable value on receiving a reliable service. “We do have our own maintenance team that covers a lot of the work”, says the project manager. “However, for special operations, an expert from the Starrag Group

can be on hand within three hours. This is important in a process flow where there is no room for breakdowns. We also expect our machine suppliers to work over the weekend in emergency circumstances thanks to a 24/7 round-the-clock service.”

The products and services of the Starrag Group are developed in line with the slogan “Engineering precisely what you value”, meaning that customers only get precisely what they need and what is important to them. But what is important for GEA as a customer? According to Antonius Mußhoff: “For us, the added value is in the high level of process reliability. With this level of reliability, we can produce all components on the Dörries CONTUMAT to a consistently high level of quality. Thanks to the highly reliable, production level turning process employed on the CONTUMAT, there are practically no instances where rework is required. What’s more, we are on our way to achieving 0 % wastage with a great deal of success.” ▀

The T series machine from Droop+Rein does the tough work: this is where roughing is performed.



Modern, more modern – production cell 3

Mercedes Benz, Sindelfingen:

Developing a toolmaking system that is expressly intended to be a model for others, is a demanding task. Only the most modern machines with intelligent control technology can be considered. At such a high level, a significant amount of engineering is required.

In order to secure the Mercedes-Benz plant in Sindelfingen as a site for development, technology and expertise, Daimler AG is also investing in this equipment centre with an additional building on Tübinger Allee, which is known internally by the abbreviation "TübA". It was here that in 2015 the new "production cell 3" was created – as a try-out centre, where sheet metal forming tools for the outer shell of vehicles can not only be manufactured but also tested straight away.

In addition to the fundamental requirements of Daimler for maximum accuracy, reliable processes, environmental protection and energy efficiency, Centre Manager Günter Sprecher set clear objectives for the project: "The new technology factory is intended to

serve as a model for other toolmakers. And the equipment centre will in turn play a key role in the technology factory, because toolmaking and systems engineering skills can be bundled here." To implement all the requirements, all the project participants had to break new ground, as many new functions relating to the machine and control technology had to be developed in the process.

A strong team

With its brand Droop+Rein, Dörries Scharmann, part of the Starrag Group, is well known for large, special-purpose toolmaking machines with interchangeable milling heads. It was awarded the contract to fit the system with the appropriate protection machinery including accessories. To be able to fully simulate the machining process, it was

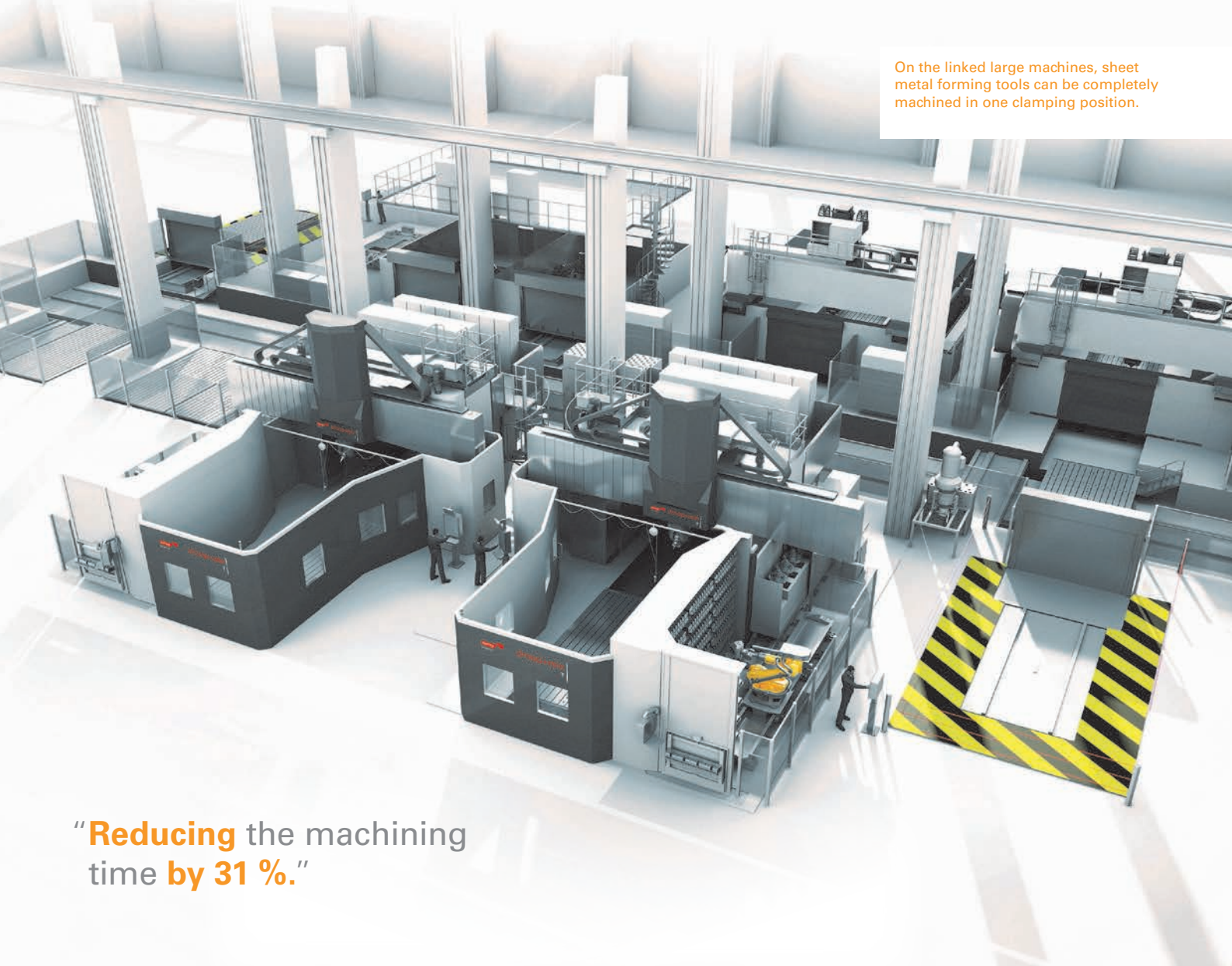
established in advance that the machines would have to be fitted with Sinumerik 840D sl CNCs from Siemens AG.

"Because this control system fits seamlessly into the Siemens NX process chain that is planned for the future and is therefore one of the factors that contribute to process reliability", explains Ali Fidankök, Project Manager for Large Machines at Daimler. To ensure that the details in the technical specifications could also be fulfilled, the machine engineers required full access to the control technology. Consequently, this job marked the start of a close project partnership between Droop+Rein and Siemens.

The equipment

The system, which became operational in mid-July 2015 as planned, comprises two T 30 55 PT R75 C portal machining

On the linked large machines, sheet metal forming tools can be completely machined in one clamping position.



“Reducing the machining time by 31 %.”

centres and two FOGS 50 68 PT M40 C multi-functional, high-speed centres with high gantry design. Supplemented with a pallet transport system for a workpiece weight of up to 40 tonnes and robotic workstations etc., these linked large machines can completely machine the sheet metal forming tools in one clamping position.

The machining process of the cast unmachined parts starts at the portal machining centre. This machine delivers drive power of up to 75 kW and a torque of up to 5,500 Nm for the heavy duty cutting. It has six milling heads with an automatic milling head changer, plus a tool magazine based on a seven-axis robot. This machine does the tough work – this is where roughing is performed. The fine machining and finishing, such

as of the active surfaces that are in direct contact with the sheet metal when pressing, then takes place on the FOGS series high gantry machines. They are each fitted with four automatically interchangeable milling heads, including a fork head for various motor milling spindles.

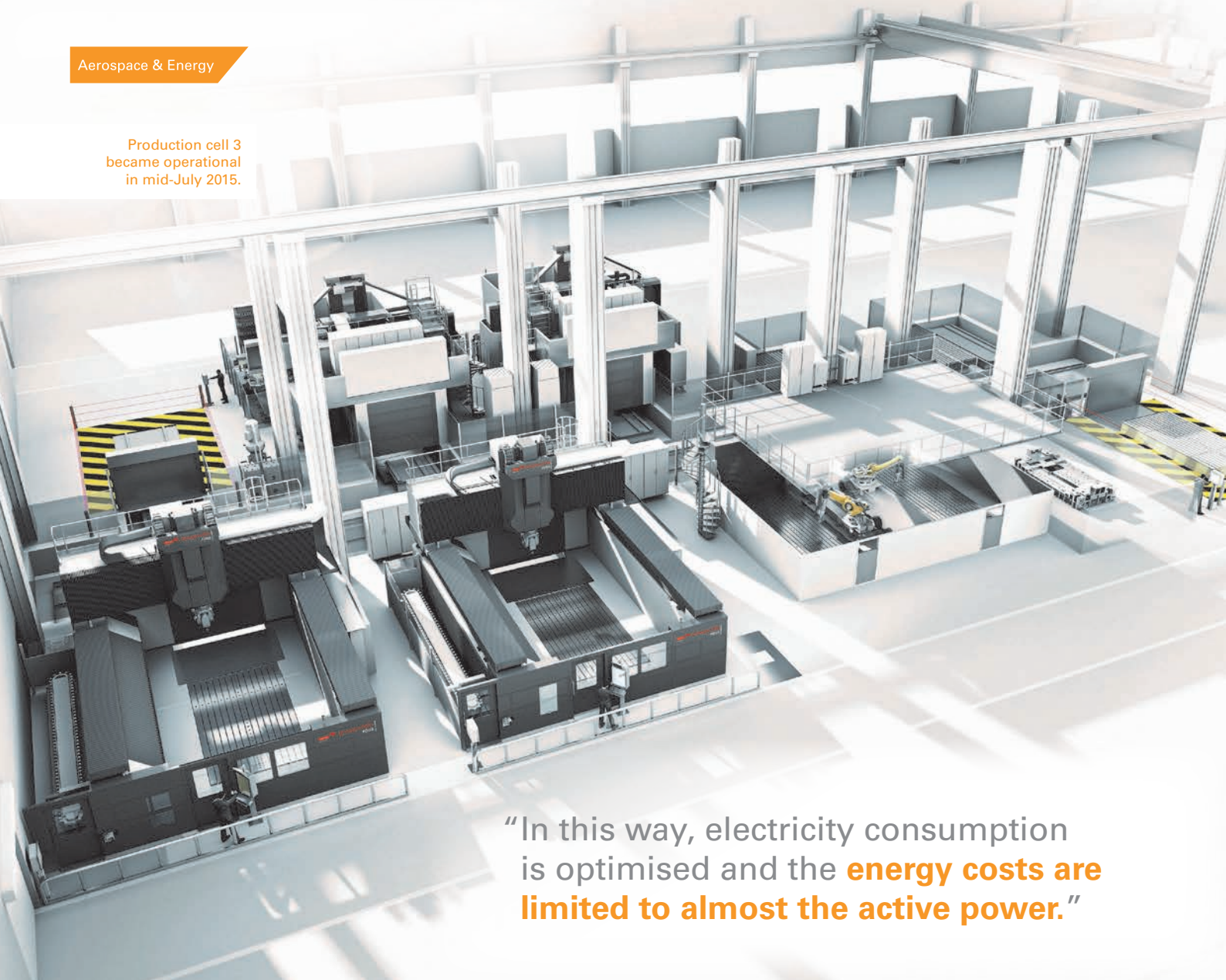
The process and technology used are designed to ensure that the parts can move to the next step on the try-out press with the least possible or even no rework at all. “We implemented this and at the same time reduced the machining time of the defined acceptance part from 36 to 25 minutes,” says Ulrich Wiehagen, Head of Sales and Plant Manager at Droop+Rein. “The surface features of the CNC make an important contribution to this.” Use is made of the Sinumerik MDynamics milling technology package,

which enables high machining speeds with excellent and visually attractive milling performance by means of improved web run. Support is also provided by the latest mechatronic motion control highlights, such as the model-based feedforward control Engineered Motion Control (EMC).

Kinematic measurement increases process reliability

Machines with interchangeable milling heads have complex kinematics. If, due to a temperature difference for example, there is uncertainty regarding the machine accuracy, or if particularly delicate or high-precision machining is planned, the automatic kinematic measurement of the milling heads provides the necessary process reliability. Based on the new C9960 measuring

Production cell 3 became operational in mid-July 2015.



“In this way, electricity consumption is optimised and the **energy costs are limited to almost the active power.**”

cycle made by Siemens, Droop+Rein developed a measuring and checking cycle for all milling heads available on the machine, which is easy and safe for the machine operator to use. The measurement of the machine kinematics is performed quickly, precisely and without a service call-out or special equipment. With the machine's standard measuring probe and a high-precision ceramic calibration ball, the machine operator is able to reproducibly qualify a milling head in less than an hour. Change the measuring probe, put on the calibration ball, call up the program, execute the automated process, check the results, adopt the correction values if necessary – and it's finished! For new system applications, such as the

implementation of this extended kinematic measurement, what are called kinematic chains are required in the control system. These are a standardised declaration of the kinematic structure. Although they sound abstract and remain in the background for the user, they facilitate the realisation of other future functionalities, therefore making the machines future-proof.

Easy handling: moving in tool orientation

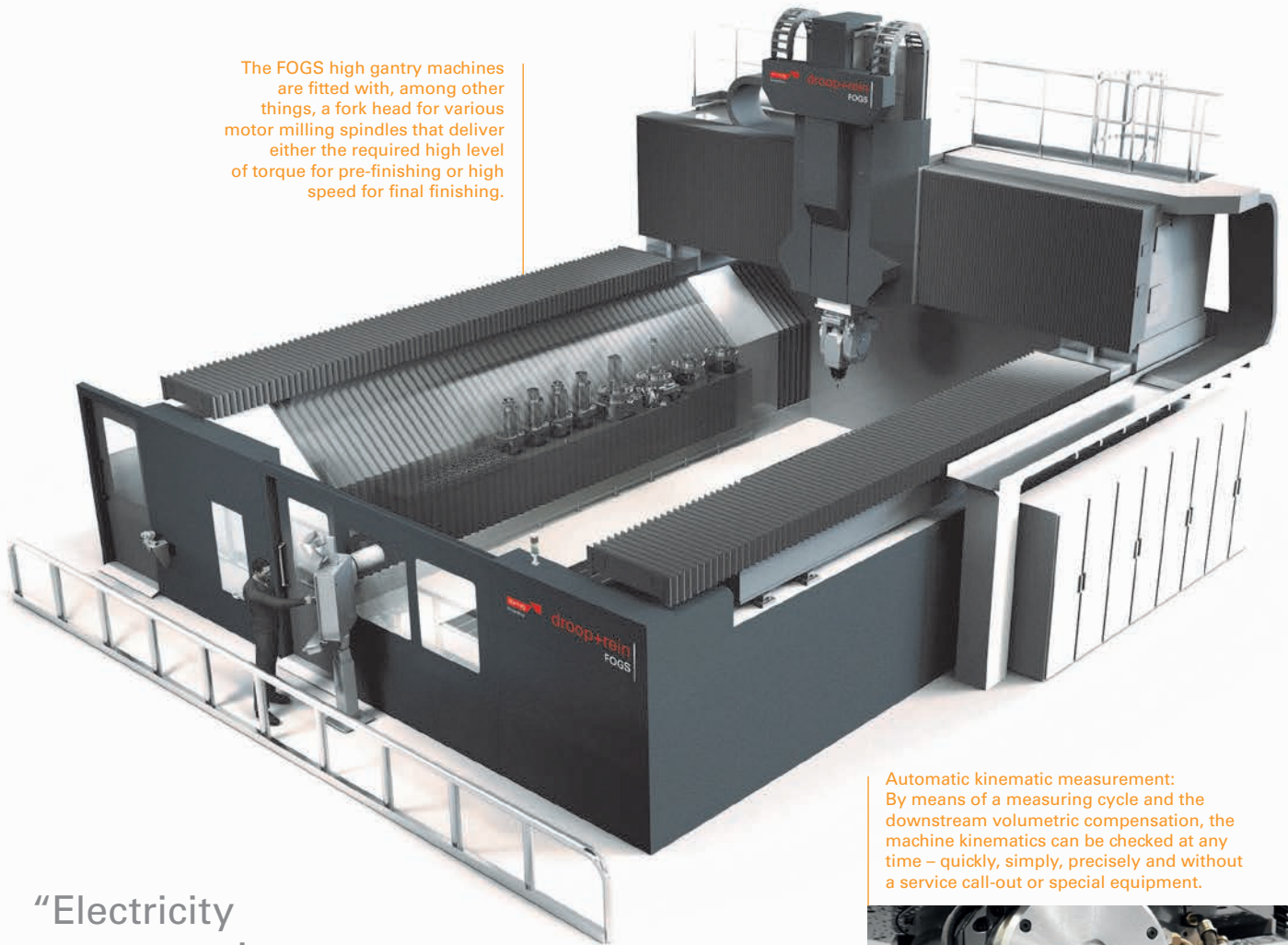
The ability to move the milling cutter together with the milling head into a wide variety of operating situations in tool orientation makes life much easier for machine operators. For the implementation of this virtual Z-axis in the tool direction, the newly available Tool

Coordinate System (TCS) within the control system was used for the first time. According to the orientation of the tool and the milling head in the working area, when they are moved, the respective portions of the displacement are then distributed across the linear geometry axes.

Environmental protection and energy efficiency

The equipment of the new production cell 3 should not only ensure faultless and highly productive performance of the actual machining tasks; environmental protection and energy efficiency were other important issues in project implementation. The high requirement of the Daimler overall project management led by Ulrich Funk that energy consumption should be reduced by 40 % was successfully

The FOGS high gantry machines are fitted with, among other things, a fork head for various motor milling spindles that deliver either the required high level of torque for pre-finishing or high speed for final finishing.



“Electricity consumption reduced **by 40 %.**”

achieved through intensive project work on the part of all the participants. Everything had been thought of from the LED lighting on the machine and the fitting of the machines with Siemens high-efficiency asynchronous motors of energy efficiency class IE3, right through to the idle power compensation. The latter is not simply a conventional, one-off, predefined idle power compensation. Instead, it automatically responds to different load statuses of the machine, which are produced with each activation or deactivation of swarf conveyors, units, etc. The idle power is therefore compensated automatically, permanently and almost completely. Ulrich Wiehagen: “In this way, the electricity consumption is optimised and the energy costs are limited to almost the active power.”

Modern service and maintenance concept supports process reliability

Droop+Rein has also implemented a modern and forward-looking service and maintenance concept here. The state and quality of the machine tools are continuously monitored based on Analyze MyCondition from the Sinumerik Integrate software suite, which supports smooth machine operation and keeps unplanned downtime to a minimum. This is another, not insignificant piece of the puzzle, which supports the process reliability of the system.

Up to three in no time at all

After production cell 3 became operational in July, three-shift operation was introduced as early as the beginning of August 2015. All the participants

Automatic kinematic measurement: By means of a measuring cycle and the downstream volumetric compensation, the machine kinematics can be checked at any time – quickly, simply, precisely and without a service call-out or special equipment.



are extremely proud of the result. In accordance with the Starrag Group claim “Engineering precisely what you value”, the exact requirements stipulated were implemented for Daimler AG in the most modern manufacturing system for sheet metal forming tools. The proof of this success can be seen in the technology factory on TübA: as an exemplary toolmaking system. ▀



Market conquered with flexibility

Modern crankshaft manufacturing takes place on Starrag Group machining centres

With delivery times of weeks instead of months, the crankshaft manufacturer Feuer powertrain managed to conquer the European market and become one of the leading players in the world in less than ten years. The key to its success: consistently moving away from the previously conventional

production of crankshafts on special-purpose machines. Instead, the production lines consist of machining centres – such as the horizontal HEC 630 D from Heckert – which makes production fast, flexible, high quality and ultimately profitable.

Crankshaft manufacturing is seen as the supreme discipline in metalworking. After all, the central component of a combustion engine requires 20 to 50 machining processes before it is ready for use – depending on the size and requirements of the respective engine. Feuer powertrain produces cast and forged crankshafts of 300 mm to 1,400 mm length in small and large batches for classic car engines of VW, BMW, Audi, Ferrari, Jaguar, Maserati, GM and others, as well as for the high-end twelve-cylinder engines of Bentley and Rolls-Royce. They are not only popular in the car

industry: they can also be found in trucks, industrial engines, ships and generators.

The workforce of approximately 650 employees at the headquarters in Nordhausen in the Thuringia manufacture up to 1.5 million crankshafts a year and supply customers all over the world.

The new plant in Tunica in the US state of Mississippi, which is due to start production this year to supply the American market, will ensure further growth. This will be followed by a production facility in Asia, and further building work is also planned in Nordhausen.

And so the success story continues. Finally in 2003, the eponymous founder of the company Dieter Feuer, his partner Bernd Gulden and Managing Director Oliver Wönnmann stepped in to revolutionise crankshaft manufacturing with their new company “Feuer powertrain”. They wanted to use great flexibility and speed to conquer the market and become the market leader in Europe by 2010 – which they did. With an annual turnover of around EUR 150 million, Feuer powertrain is now even one of the four leading suppliers in the world.

Machining centres are replacing special-purpose machines

The Feuer powertrain team actually managed to completely redesign the production of crankshafts. For a long time, only special-purpose machines were used to carry out the varied machining operations that a crankshaft requires. These include cutting to length, centring, turning, milling and turn-broaching, deep-hole drilling, surface rolling and roller levelling rolling, rolling, double-headed orbital grinding, fine balancing, polishing and thermal treatments. Various measuring and checking procedures must also be carried out before the product is ready for dispatch.

Special-purpose machines are expensive to buy and inflexible in terms of machining, so using them is only worthwhile in large-scale production. With small and medium-scale production, the unit costs reach an almost unaffordable level. That is why the Feuer powertrain team looked for – and found – alternatives: all production lines in the five plants now established at headquarters in

Profitability:

“Where others need an average of six to eight months, we are **ready to deliver after just eight weeks.**”

Nordhausen consist entirely of linked Heckert machining centres. They differ only in their complexity and number of stations, as some tuning tasks are only required in the high-end category. The degree of automation also varies. While on production lines for smaller batches of 1,000 or 10,000 units, the employees intervene manually at one point or another if necessary, production in plant 2, for example, is fully automated. The usual batch sizes there are in the order of 10,000 to 100,000 units.

A common feature of all production lines is that they can be adapted quickly and with little effort. This allows qualified employees to respond very quickly and flexibly to new orders. An important success factor, as emphasised by

Managing Director of Technology Hubert Singer: “When others need an average of six to eight months, we are ready to deliver after just eight weeks. With our manufacturing concept based on machining centres, we have found the balance between productivity and product variety.”

Standard machines and self-developed processes

There are over 300 machine tools in continuous operation in Nordhausen, 24 hours a day, seven days a week. 42 of them were made by Heckert. This cooperation has existed since 2007. Fikret Ersindigil, Head of Process Optimisation, recalls: “At that time we were starting to shift production to machining centres. To complete a



The tasks of the HEC 630 D cover the following processes: cutting to length/centring, inserting oil channels, bearing relief, stroke relief and end machining.



39 HEC 630 D and three CWK 500 D machining centres are installed in the Feuer powertrain plants in Nordhausen. Feuer powertrain also relies on the partner Heckert at the new plant in Tunica in the US state of Mississippi.

“In a rush order, we urgently needed three machines for drilling and milling work, and Heckert was able to supply us with these immediately.” These machines were the CWK 500 D horizontal centres, which Feuer powertrain incorporated into a semi-automated stand-alone solution for urgent, small-scale production. “We were therefore able to fulfil this order and at the same time gain experience with Heckert machines,” explains Fikret Ersindigil. After all, he and his colleagues were still looking for suitable equipment suppliers for the new concept. “Our first attempt to transfer a production line to a machine tool manufacturer as a turn-key project did not go quite as we had expected,” reports the process specialist. “So we decided to develop and set up the production processes ourselves for the next line. For this we needed powerful, reliable basic machines.”

Safety:

“Conceptually, the machines are built to be so stable **that they last forever with our applications.**”

Powerful and reliable

They found just the partner they were looking for in the Starrag Group, as Hubert Singer explains: “The cooperation regarding the CWK machines demonstrated that we could rely on this supplier and that the machine concept tied in very well with our production philosophy.” Feuer powertrain therefore fitted the next line with the successor to the CWK 500 D, the HEC 630 D, which was brand new to the market at that time. The horizontal, four-axis machining centre is part of the fairly small, dynamic series from Heckert, but due to the “XXL traverse paths” in the different axes, it opens up the way to the medium-sized segment. In the past,

this was also expressed in the name of the machine: HEC 500XXL. Today it is known as the HEC 630 D, and the machine data has been further optimised with regard to customer benefits: The working area offers a clamping surface of 500 × 500 mm and allows a workpiece interference diameter of 1,000 mm. The pallet can be loaded with components weighing up to 1,000 kg. The high level of dynamism in the linear axes is provided by digital AC servo drives in combination with pretensioned ball screws supported on both sides. These allow speeds of 100 m/min combined with speeds of 10 m/s² in all axes. As a work spindle, a motor spindle with speeds of up to

20,000 rpm and – for increased speeds – with a hollow-shaft motor is optionally available. The NC rotary table has a direct drive delivering 100 rpm and therefore guarantees the shortest positioning times, including in the B-axis.

The power data is now only of secondary importance for the usage at Feuer powertrain, explains Fikret Ersindigil: “We only use a fraction of the spindle power. More important to us are the axis acceleration rates and the fast tool change in order to reduce unproductive times. The simple operation of the tool magazine during the machining time also suits us well.” Fikret Ersindigil also considers the high level of process reliability and availability of the Heckert centres to be particularly valuable as a basis for high quality and profitability. He goes on to emphasise: “Conceptually, the machines are built to be so stable that they last forever with

our applications. At any rate, we have machines that have been in operation round the clock for eight years and still do not exhibit any significant wear.”

Versatile

The tasks of the HEC 630 D cover five different processes: cutting to length/centring, inserting oil channels, bearing relief, stroke relief and end machining. One particularly challenging task is inserting oil channels. These are drilled from the main bearing through the crank webs to the pin and conrod bearings so that the crankshafts can be lubricated in operation at the important points. The channels are up to 200 mm long, with a diameter of 5 mm. Fikret Ersindigil is aware of the difficulty of these deep-drilled holes: “Such complex machining would previously have been inconceivable on a standard machining centre. We had to invest a great deal of expertise to get

the process safely onto the machine. But now it runs perfectly thanks to a hydraulic clamping device with integrated NC axes, which puts the component in the right position. The HEC machining centres are fitted with appropriate hydraulic coupling points, and the NC axes can be incorporated into the CNC control technology, so that this task is also automated.”

The fixtures, which can be used for different workpiece sizes, are also used for inserting the bearing relief and stroke relief. The reason for this is the weight saving that is achieved via the drill holes in the shaft (bearing relief) and the crank webs (stroke relief), enabling an increase in performance. However, these machining processes only make sense for high-performance engines.

Service – a cost-saving component

For the five processes mentioned, Feuer powertrain uses the standard version of the HEC 630 D – with one small addition: On the machines for making the oil channel holes, the X-axis has been extended by 50 mm. “Heckert offers this as an option, which has saved us having to buy larger machines,” says process optimiser Fikret Ersindigil with a smile. Overall, he is very satisfied with the service provided by the Chemnitz-based machine tool manufacturer: “It starts with sound advice before purchasing and continues with professional acceptance as well as fast assistance during operation.” Fikret Ersindigil continues: “If I report a fault in the morning, the replacement part is generally delivered in the course of the day, meaning that the machine can resume operation in the evening.” He also praises the support provided via remote maintenance or telephone: “I always get through to specialists and not call centre staff who have no idea about technology.” This ultimately saves stress as well as time and money – and contributes significantly to a satisfying long-term partnership. ▀



Hubert Singer (left), Managing Director of Technology, and Fikret Ersindigil (centre), Head of Process Optimisation at Feuer powertrain, along with Dr Michael Fiedler, Head of Sales for Transportation & Industrial Components at the Starrag Group, are pleased with the successful partnership between the two companies.

Sascha Korupp,
Technical Manager
with full signing
powers at Herborner
Pumpentechnik.



Innovative products through innovative production

Milling/turning centre enables complete machining of complex pump parts

Herborner Pumpentechnik, a company with a long tradition now spanning more than 140 years, is achieving great success with innovative pumps. The basis for this is provided by equally innovative production equipment, including a fully automated manufacturing system with two machining centres. In particular, the newly installed Heckert HEC 800 HV MT milling/turning centre ensures economical manufacturing costs through reliable complete machining of large and small cast components.

Anyone wishing to succeed as a medium-sized pump manufacturer surrounded by large competitors needs to show they have something special. Innovations are the key to success – in terms of a company's own products, but also the equipment that is available for development and production. Sascha Korupp, Authorised Representative and Technical

Manager of Herborner Pumpentechnik is convinced of this. However, he first points out another success factor: "The employees are particularly important. For example, the willingness of our development department to experiment leads again and again to results that are reflected in the longevity, cost effectiveness and high utility value of our

products. Then when the ideas are implemented in production, we are again reliant on employees who know how technically challenging components can be produced economically on modern machines."

The fact that Herborner Pumpentechnik is well positioned on all of these points is demonstrated by its growing market share and the success of its new products, such as the 100 percent coated pumps, which have been on the market since 2012. What is referred to as the HPC (Herborner Pump Coating) is 500 to 1000 µm thick, extremely smooth and can even level out slight bumps

and cavities. "It allowed us to improve the hydraulic efficiency by up to 10 per cent," emphasises Sascha Korupp. "It also offers high corrosion protection and therefore enables the use of grey cast iron components where considerably more expensive stainless steel or bronze elements would otherwise be needed."

Herborner Pumpentechnik worked its way consistently towards this new development, which required a change-over in production among other things, as the Technical Manager explains: "Our pumps are based on a modular design and consist primarily of the four cast parts pump housing, back panel, impeller and cover. These parts had to have a slightly more complex structure for the coating, meaning that we are reliant on the most advanced equipment when it comes to machining. In addition to this, the pumps requested are getting bigger and bigger, which is another important reason for the investment in a new, larger machining centre."

Complete machining of all cast parts

Production Manager Klaus Tollerian explains the requirements in detail:

"Because we now produce pumps in sizes up to nominal diameter 400, we need a large enough working area. These parts – whether it be impellers or housings – require turning as well as drilling and milling operations. So everyone feared we would have to invest in a vertical turning lathe and a machining centre." However, with the Heckert HEC 800 Athletic HV MT milling/turning centre, the team in Herborn found a suitable alternative that combined both capabilities. With its horizontal/vertical milling head and the powerful, directly driven NC rotary table, the horizontal machining centre offers ideal conditions for the complete machining of all cast parts.

Regarding the preliminary benchmark with other machines, Heckert had a prior advantage. Ultimately, Klaus Tollerian and his colleagues already have more than 15 years' experience with the Chemnitz-based company and its machines. Back then, a Heckert CWK 630 replaced a Japanese milling centre and, over the years, it has impressed with its performance and enormous reliability.

Sascha Korupp adds: "Even the cooperation with the Heckert employees was always conducted at a particularly high level. It's a crucial factor for us that we receive competent and reliable support right from sales to service, and that the response times are fast. At the moment, none of our other machine suppliers can keep up with Heckert on these points, so we feel we are in very good hands with this partner."

Process reliability and availability – pillars of successful automation

Part of the success strategy of Herborner Pumpentechnik is to continuously optimise the production processes. From an early stage, linking machines and pallet storage units appeared inevitable to the team in order to achieve unmanned night shifts and therefore remain competitive in Germany. So in 2008, the pump manufacturer put a fully automatic Liebherr manufacturing system into operation, which incorporated the two Heckert centres.

"The system has proven its worth in the last eight years," explains



Profitability:

"As a result of complete machining, machining times can be **reduced by up to a third.**"

Production Manager Klaus Tollerian. This is largely attributable to the high level of process reliability and availability of the Heckert machining centres, without which reliable automated operation is not possible. "Our new HEC 800 Athletic HV MT, which replaces one of the two integrated CWK 630 machines, will also not disappoint in this regard," says the machining expert with conviction.

With its robust, thermo-symmetrically designed main assemblies, the digital AC feed drives and complex profile rail guides and ball screws in all linear axes, the machine concept lays a solid foundation for the reliable processes required. It also incorporates various control and monitoring devices. As standard, these include a vibration sensor on the spindle, via which the machining process can be monitored and optimised. Holger Quintus, Regional Sales Manager of the Starrag Group, explains: "The sensor includes evaluation software that detects tools with a very high imbalance, just as it detects wear on the spindle bearings. This allows service work to be planned

in advance and sudden failures to be avoided. As it also indicates vibrations during machining, the process can be optimised with regard to higher quality and longer service life of the spindle."

For Klaus Tollerian, there are other important details: "The working area is designed in such a way that the swarf falls freely into the centrally positioned swarf conveyor. This prevents a build-up of swarf in the working area, which in turn would jeopardise process reliability." He also takes a positive view of the use of fixed plates instead of telescopic covers to optimally protect the functional elements against swarf and coolant. This enables higher acceleration and rapid traverses, as the plates do not need to be carried along with the linear axes. While the machines of other suppliers could not combine all the benefits of the Heckert HEC 800 Athletic HV MT (or only by using expensive additional services), the complete package of compatibility with the existing machines, performance and cost advantage was a crucial factor in the decision, argues Klaus Tollerian.

"Also, we can now manufacture a far broader range of parts on the machine, due to the fact that the machining area is around a third larger than on the CWK 630. This is sufficient right through to the large impellers – our pump sizes now range up to nominal diameter 400 – for which our cycle lathes reach their limits."

Fast-rotating table and additional axis in the head extend the range of applications

The chosen machine configuration with horizontal/vertical milling head and NC rotary table played a significant part in the success. The HV head has two working positions, horizontal and vertical, into which it can swivel even while the spindle is running, significantly reducing unproductive times. Once the respective end position is reached, the head is locked with a Hirth coupling. The form fit created as a result contributes to high stability, which is particularly important during turning. The additional decoupling of the drive train in rotary mode absorbs any impacts on the housing in the event of interrupted cuts, thus sustainably



Result:

"It allowed us to **improve the hydraulic efficiency by up to 10 percent.**"

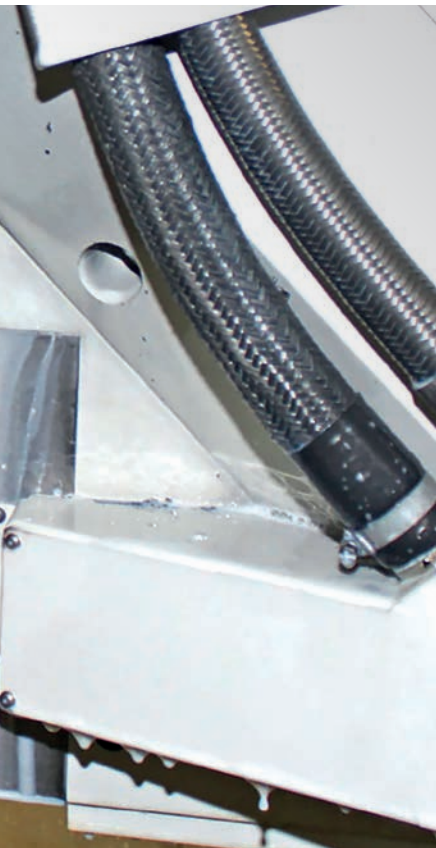
preserving the spindle bearings. In addition, the HSK-T100 tool holder is used for turning work, enabling precise radial positioning. This means that the high level of accuracy that is expected from Heckert is also guaranteed with turning.

The high-precision NC rotary table with a load-bearing capacity of two tonnes provides another condition for internal machining of the large impellers thanks to its output of 57 kW (at 100 % duty cycle), speed of up to 500 rpm and maximum torque of 2,520 Nm. Holger Quintus points out the automatic unbalance detection that the HEC 800 Athletic features as standard: "An integrated program measures the unbalance and indicates the position and size of the balancing weights required, so that the operator can quickly rectify the unbalance."

Due to the entire kinematic system of the Heckert HEC 800 Athletic HV MT, the machining team at Herborner Pumpentechnik can now process numerous parts in a single clamping position instead of



Heckert HEC 800 Athletic HV MT provides the ideal base for boring, milling and turning.



several as previously required. "This allows us to reduce the machining time by up a third," says Klaus Tollerian with delight. He is also happy about the fact that the programs available on both of the machines installed in the Liebherr system can be used without any adjustments, and that all the previous components can be machined on the HEC 800 Athletic HV MT without any problems.

To create the conditions for this, the team did not have the normal machine table installed on the new HEC 800 Athletic HV MT, but a modified table of size 630 x 630 mm. Another special feature is the automatic loading hatch in the roof of the machine, through which oversized workpieces can be loaded easily. The Production Manager also mentions another plus point: the tool magazine with 180 slots that can automatically accommodate tools of up to 340 mm in diameter and up to 800 mm in length. "Despite the extended range

of applications, this capacity is sufficient for all tasks. There is even enough room left for sister tools." In spite of its large capacity, the tool magazine has a small footprint compared to other solutions on the market, which is a key argument in cases where space is confined.

Conclusion

By investing in a Heckert HEC 800 HV MT milling/turning centre, Herborner Pumpentechnik extended the capabilities of its linked manufacturing system, which includes a Heckert CWK 630 as a second machining centre. Thanks to their high process reliability and availability, both machines guarantee reliable automated operation, even during unmanned night shifts. With its large working area, the horizontal/vertical milling head and the fast-rotating machine table, the HEC 800 HV MT creates the ideal conditions for drilling, milling and turning large and small cast parts. As a result of complete machining, machining times can be reduced by up to a third. ▀

UCH & BUMOTEC: a relationship built on trust

At the heart of the French Jura mountains, 60 km from Geneva, Ahmed El Yamani, CEO of the company UCH SA, welcomes us to their premises in Villard Saint-Sauveur to talk to us about their activity, their business strategy and their relationship with the Bumotec brand. Created in 2003 by five partners who were specialists from the machining world, UCH now has 35 employees in France and has recently set up a subsidiary in Morocco.



Ahmed El Yamani, CEO of the UCH SA

INTERVIEW WITH AHMED EL YAMANI, CEO OF THE UCH SA

UCH is a rapidly expanding company. What are the keys to your success?

Ahmed El Yamani: Machining lies at the heart of what we do. We are sub-contractors for small- and medium-sized assembly companies who, in turn, work for large international groups. We owe our successful expansion to the strategic decision to diversify our activities. From the outset, we made a choice not to focus on a single market; for watchmaking, we invested in an inventory of machines which enables us to offer a range of products which can be manufactured whilst remaining profitable. The result is that, today, we have a production output which is balanced, and split across sectors, with 30 % of our activities in watchmaking, 40 % in leatherwork, 20 % in energy and the remaining 10 % split between medical, micro-engineering and eyewear.

More specifically, what type of parts do you create for these market sectors?

Ahmed El Yamani: For the watchmaking sector, we mainly produce large runs of titanium inserts and bracelet links, but we also manufacture clasps, end pieces and cases. The leatherwork sector is a much broader one, and covers all metal items which are assembled with leather, such as buckles, fasteners, clasps, etc.

For the energy sector, we mainly produce accessories and small electrical components for circuit breakers. Some 90 % of our production is delivered to customers in France, Switzerland and Italy.

What equipment enables you to meet the demands of these markets?

Ahmed El Yamani: Our machine inventory comprises 40 production units, including 23 machining centres, 20 of which came from Bumotec, a few mechanical lathes and transfer machines, plus a few hybrid production units, which combine mechanical technology and numerical control to enable us to increase the production options we offer, in terms of complexity. What sets us apart is our ability to offer the right machine solution for the various needs of the market. Without the technical capabilities of our machines, we probably wouldn't still be around today.

Your collaboration with Bumotec started in 2003. What is the current situation?

Ahmed El Yamani: During the year when UCH was being set up, I was lucky enough to meet Damien Chêne, a Bumotec representative, at a trade fair. I already knew the brand, but did not yet have any machining centres. The first order was placed that year for an s192

model. Since then, orders have been placed at regular intervals. On average, one Bumotec machine has been installed every 8 months since UCH was founded. Today, we have 20 Bumotec machines in total. These include two s192 models, two s89, eight s94, one s90, three s92, and, most recently, we purchased four s191 models, with a fifth to be delivered in 2017. All of these machines are currently running 24 hours a day, 7 days a week.

Growth:

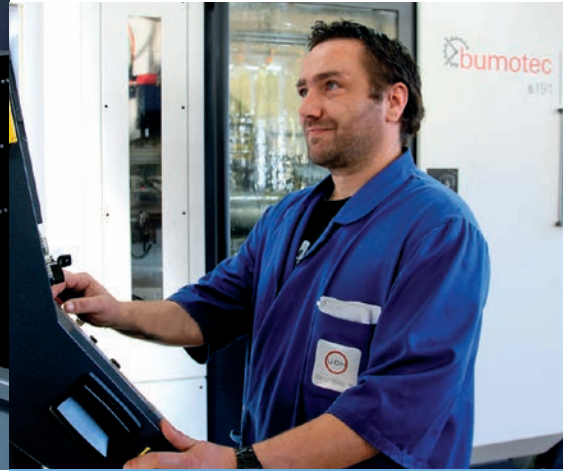
“Bumotec machines have enabled us to successfully pursue our strategy of diversifying our sectors of activity”

Bumotec centres make up half of your machine inventory. What led you to make that choice?

Ahmed El Yamani: Initially, we opted for Bumotec because the company and its products already had a good presence in Switzerland, particularly in the watchmaking sector. Furthermore, to be listed with these large groups, we have to be able to offer them the same level of equipment that they have in-house, with the same level of quality and accuracy. Also, Bumotec machines have



Choosing the s191 gives us a fourfold reduction in production time as compared to a multi-fixture solution



enabled us to successfully pursue our strategy of diversifying our sectors of activity as they offer a wide range of machining possibilities whilst optimising the costs per manufactured part. The second main reason was the after-sales service. We have encountered huge problems with maintenance on some of the competitor machines that we own and, as a result, one of our criteria for selecting suppliers is the quality of their service. Bumotec offers a quick, efficient and high-quality service. The number of machines we have acquired stands as clear evidence of this efficiency. Any time we need an intervention or maintenance, their service team always find the right solution in record time. With production running at the kind of rate we currently have, we can't afford any unscheduled machine downtime. Moreover, their team of »application experts« is easy to contact and always available to actively provide input on any test and set-up projects we may wish to implement. Lastly, I would say that Bumotec manufactures reliable, accurate machines that enable us, as subcontractors, to provide our customers with clean parts, with no burrs or retouching required, even for the highly complex parts we produce.

Can you give us a concrete example of a part manufactured on an s191H?



Cufflink

Ahmed El Yamani: I could cite many examples, but here is one from the world of luxury goods: a cufflink made from titanium. The challenge for this part was that all of the six faces had to be machined in a single production cycle to enable us to remain competitive. We won this contract thanks to the capabilities of the s191 machine which, with its re-taking unit, enabled us to machine the six faces in a cycle time of under 15 minutes, resulting in a part ready to be dispatched to the customer, using milling, contouring, drilling and tapping techniques... in a single clamping position. Without the performance of this machine, we would have needed to split the machining operations across several production

Profitability:

”Bumotec machines enabled optimising the costs per manufactured part”

units, causing the costs to rocket and giving a fourfold increase in the average production time for each part, not to mention the loss of output when setting up the multi-fixture operations. Another factor is that titanium is a highly flammable material during the production process, so this is another reason why we only use s191 models to machine it, as they are equipped with integrated extinguishers.

What are your projects and plans for 2017?

Ahmed El Yamani: Our medium-term strategy consists of continuing, through the expansion of our activities, to update our machine inventory so that we can benefit from the technical possibilities of the latest new developments. As concerns our quality strategy, we have recently renewed our ISO 9001 certification and are now preparing for the 2015 version. In commercial terms, we will be attending the EPHJ 2017 show, as we do every year, from 20 to 23 June, to demonstrate the production options we offer. ▀

starrag

Starrag Group

Engineering precisely what you value

Focus live!

We are looking forward to your visit!



IMTEX, Bangalore
26.01. – 01.02.2017
Hall 4, Stand C101



-20%

lower investment costs

-60%

shorter delivery time

INTEC

INTEC, Leipzig
07. – 10.03.2017
Hall 3, Stand G20/H21



www.starrag.com