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- A piece of german history – "LACH DIAMANT GOes East"
- CNC machining for electromobility
- Precision tools, guide to machining titanium
- Looking ahead EMO Milano 2021

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Eric Schäfer
editor-in-chief

Curtain up!

The brief moment before the curtain rises and the show begins always brings a bit of uncertainty but also excitement. Will everything go as smoothly as planned? This is the point of the event we are currently at. When **EMO Milano** showcases "the magic world of metalworking" in October as a face-to-face event for the first time in two years, the organizers, exhibitors and visitors are hoping that the event will be a success. Because that would be another step towards normality for all of us.

There are some great performances planned for **EMO Milano.** We are eagerly awaiting a world premiere by *United Grinding*. Some exhibitors have already lifted the curtain a little in advance for the readers of *"hp tooling"*–the articles marked with the EMO logo provide a first premiere glimpse.

This *"hp tooling"* also gives manufacturers of precision tools a stage to present their latest creations. Tools are constantly being further developed, and new experience from daily use is always being incorporated. One example: *LEUCO* developed a PCD milling cutter for special requirements of FRP machining in the automotive industry, which can show its advantages over carbide and CVD coatings.

It has been known for a long time that the automotive industry will need fewer tools if electromobility becomes widespread. But on the machine side, it is also important to adapt to this. Our technical report from *MAG,* a leading provider of customized manufacturing and technology solutions, shows how CNC machining for electromobility may look in the future, for example for the production lines of electric powertrain components.

Eric Schäfer
editor-in-chief

…and do have a look at
www.harnisch.com

table of contents

cover story

materials & tools

processes

machining center

components

departments

fairs in alphabetical order				current status
AMB	**AMB**	Stuttgart, (September 13-17, **2022**)	Germany	**2022**
CCMT × MTS	**CCMT**	Shanghai, (April 11-15, **2022**)	China	**2022**
DEBURRING EXPO	**DeburringEXPO**	Karlsruhe, (October 12-14, 2021)	Germany	2021
EMO MILANO 2021	**EMO**	Milano, (October 4-9, 2021)	Italy	2021
EPHJ	**EPHJ**	Geneva, (September 14-17, 2021)	Switzerland	2021
FABTECH CANADA	**FABTECH**	Toronto, (June 14-16, **2022**)	Canada	**2022**
FEIMEC Feira Internacional de Máquinas e Equipamentos	**FEIMEC**	São Paulo, (May 3-7, **2022**)	Brazil	**2022**
FILTECH	**FILTECH**	Cologne, (March 8-10, **2022**)	Germany	**2022**
GRINDING HUB	**GrindingHub**	Stuttgart, (May 17-20, **2022**)	Germany	**2022**
GrindTec 2022	**GrindTec**	Augsburg, (March 15-18, **2022**)	Germany	**2022**
HANNOVER MESSE	**Hannover fair**	Hanover, (April 25-29, **2022**)	Germany	**2022** real & digital exibition
	IMT	Brno, (September 13-17, 2021)	Czech Republic	2021
IMTS2022	**IMTS**	Chicago, (September 12-17, **2022**)	USA	**2022**
intertool	**intertool**	Wels, (May 10-13, **2022**)	Austria	**2022**
JIMTOF 2022	**JIMTOF**	Tokyo, (November 8-13, **2022**)	Japan	**2022**
METALEX	**METALEX**	Bangkok, (November 17-20, 2021)	Thailand	2021
METAV 2022	**METAV**	Düsseldorf, (March 8-11, 2022)	Germany	**2022** real & digital exibition
sps smart production solutions	**sps** **sps on air digital**	Nuremberg, (November 23-25, 2021)	Germany	2021 physical & digital exibition
Stone+tec Nürnberg	**Stone+tec**	Nuremberg, (June 22-25, **2022**)	Germany	**2022**
Surface Technology GERMANY	**Surface Technology**	Stuttgart, (June 21-23, **2022**)	Germany	**2022**
TIMTOS	**TIMTOS**	Taipeh, (March 4-9, **2023**)	Taiwan	**2023**
TMTS	**TMTS**	Taichung, (November, **2022**)	Taiwan	**2022**

trade fair dates as by middle of August 2021; we are not responsible for reliability of these dates

LACH DIAMANT looks back on 99 years – 9th part

Poly – poly – or what?

"LACH DIAMANT GOes East …" – a piece of german history

Horst Lach, **managing director and CEO of LACH DIAMANT, agreed to write an ongoing series of articles about the development of diamond and CBN tools and grinding wheels in modern industries.**

Horst Lach is known as a true industry veteran, and we are excited to have this pioneer of technology share some insights from his 60 years of professional experience in the diamond tool business. In this episode, you can accompany him to the East, to the very beginning of a German-German success story.

No, this story does not begin with "once upon a time", since it is far too serious, vivid and full of unique facts for a fairy tale.

The German partition created different living conditions in both parts of Germany. Moreover, since August 13th 1961, when the dividing wall was built, the citizens in the Eastern part were deprived of any possibility to move to the West. Thus living conditions and priorities could develop in a contrary direction under totalitarian control.

The West successfully celebrated free market economy, the East fought more and more for foreign currencies in order to survive. *Alexander Schalck-Golodkowski,* the master of currency procurement, gave industrial plants, or rather the heavy industries, which were selected for obtaining foreign currencies, highest priority.

There was practically no brand competition in East Germany – compared to the neighbouring West – and thus the citizens experienced long, cumbersome delivery times for everyday necessities.

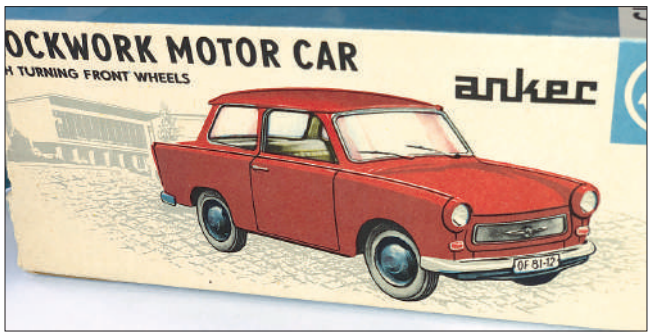
For example, the wait time for a new washing machine was three years, and up to 14 years for a car. In the latter case only the so-called "Trabi" *(Trabant)* and *Wartburg* were available choices, both featuring only minor enhancements over decades. It was certainly not the fault of East Germany's (desperate) engineers. There were enough ideas within the automobile industry of the East: starting with a modern hatchback body to common rail Diesel technology.

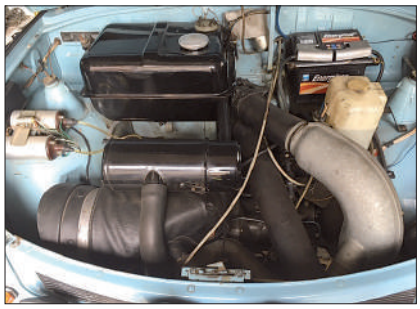
Just a few years ago, there was a discussion whether East Germany (GDR) had invented the VW Golf – which however is not true *(Focus 10/2014).* At the end of the 1980's there were only approximately 200 cars per 1,000 residents; in the West were twice as many. It is not surprising that in 1977 the SED *(Socialist Union Party* of Germany) regime decided to buy 10,000 VW Golfs. VW CEO, *Tony Schmücker,* hoped for on-going business and follow-up orders. Not the case.

The 3-millionth Trabant with a four-cylinder engine
(August 1990, Horch Museum Zwickau)

Technical information for Trabant:

- engine 26 hp
- fuel consumption up to 10 liters gasoline/oil mixture for 62 miles
- top speed 62 mph





A view into the interior of a Trabi
(Bernd Straube, 2019)

Sintered composite material (Elbor)

VW engines for the East

The VW plants in Hanover and Salzgitter had two assembly lines for smaller engines. Both were insufficiently utilised. Simply put, one too many–and the GDR needed one.

According to the magazine *Spiegel 7/1984*, CDU politician and VW board member *Walther Leisler-Kiep*, initiated the deal with the GDR. Details of this plan, not requiring payment in foreign currencies by GDR, came from the former VW manager *Hahn*. The initial offer and project were presented in June 1982 in East Berlin. When subsequent experiments showed that the VW engines could easily be built into Wartburg and Trabi automobiles, this was a breakthrough and the deal was on. According to the plan, VW should assemble a complete production line for the GDR by 1988, with an annual output of 290,000 engines. In return Wolfsburg would deliver a total of 15,000 VW transporters by 1993. All in all it was only a 600 million *Deutsche Mark* business, but Hahn predicted "this will be a long-running deal".

Everyone was convinced that the Volkswagen group would now become the most important facilitator of the planned modernization of the East German automobile industry. Up to this point both Wartburg, produced in Eisenach, and Trabi, produced in Zwickau–still featuring two-stroke engines–were completely out-of-date: low performance, excessive fuel consumption in addition to a negative environmental impact.

Farewell to the tuk-tuk of two-stroke engines?

From 1988 onwards only modern, water-cooled four-cylinder four-stroke engines were to be installed in GDR cars in the production line supplied by VW. A newly built plant in Chemnitz should build the engines, previously propelling the VW Golf, with 40 or 55 hp (1,100 or 1,300 cm^3 cubic capacity); the same applied for a diesel version.

190,000 engines were meant to be built for domestic demand, another 100,000 for VW. Finally in October 1988–after the end of the autumn trade show in Leipzig–the beginning of a new era for the GDR automobile industry could take its course, as planned in 1984.

In addition to delivery problems, noticeable not only during plan realization for accessory components, the industry was also behind schedule for the delivery of the old-style models. On top of that GDR citizens soon were disillusioned and disappointed after the first cars with four-cylinder engines were delivered–a new engine simply does not make a new car.

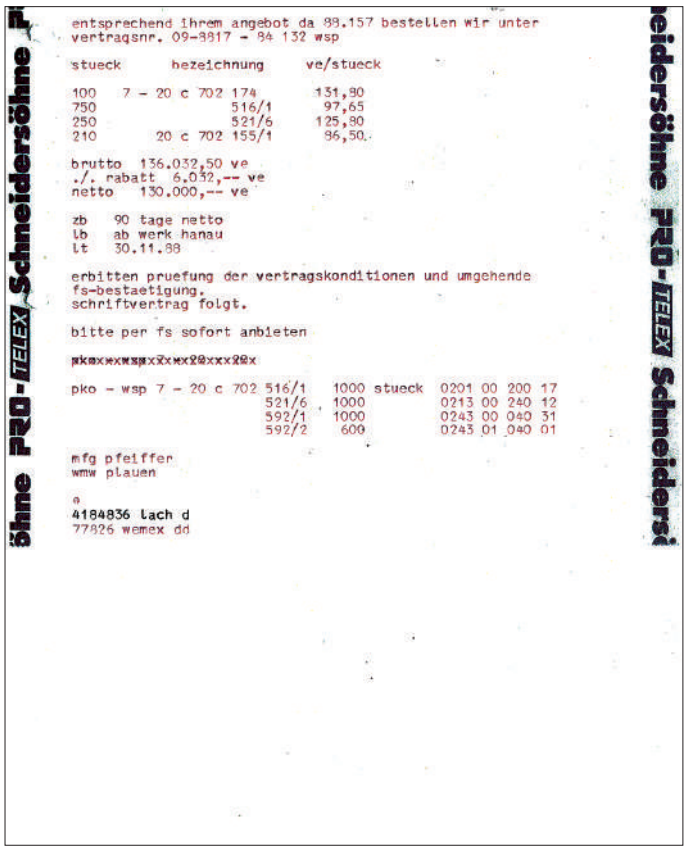
The unproportionally high price of over 30,000 East Mark for e.g. a Wartburg also discouraged many potential buyers, most of them could not afford this. Only the privileged upper class, high officials or a few craftsmen, could purchase at this price.

New technological insights

Delivery and initial start-up of the VW-provided assembly line for the four-stroke engines gave both engineers and workers for the first time broad-based technological insights which, up to this point, had not been accessible.

Above all, for example, the machining and cutting of aluminium in engine and accessory production–which finally brings us to the topics of "diamonds" and *"Poly–poly–or what?"*.

Polycrystalline cutting inserts, available in the Western industry since 1973 *(see "Poly–poly–or what?" series, part 1)*, were either unknown or, due to lack of foreign currencies, unavailable to GDR tool manufacturers. Machining of non-ferrous metals such as aluminium, copper and composites relied on available carbide tools or pressed



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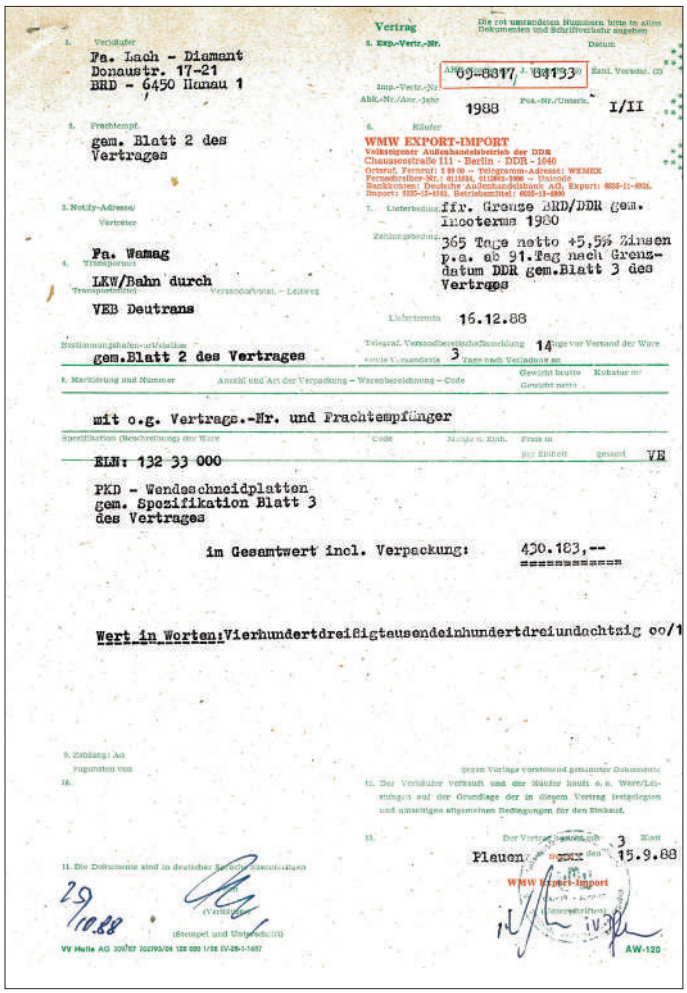

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The beginning, order and contract: polycrystalline diamonds for the production of the first «Polo engines» in GDR

diamond or CBN composite round blanks from the former USSR.

However, these "cutting heads" had one fundamental disadvantage: compared to the successful product "compax™" (at this time offered by the diamond manufacturer *General Electric)* they could not be soldered – the necessary "carbide base" for successful soldering was missing *(see "Poly– poly–or what?" series, part 2, composite material Elbor).*

As apparent from the attached research report, drawings and the case histories, the blade, (tediously) ground from the composite part, had to be either clamped into a holder or even glued! (example: fine drilling of gearboxes).

Therefore, it is not surprising that many natural diamond tools were still used in addition to the USSR cutting material "SKM" as it was known in the GDR, even for engine production.

In the late 1970's, when the Volkswagen group built the assembly lines for the four-stroke Polo engines in Salzgitter and Braunschweig, and increasingly favoured polycrystalline diamonds (PCD), LACH DIAMANT was in great demand as pioneer for the development and production of PCD tools; and according to documents available to me, the sole supplier.

Rush order for LACH DIAMANT

Up to the time of the Leipzig spring trade show in 1988, LACH DIAMANT had no business connection at all with the former GDR or any state-owned export-import collectives of the GDR – briefly called WMW Export-Import – a network of companies directly controlled by Schalck-Golodkowski.

How high the pressure on the state leadership – *"We are the people"* – must have been in mid 1988's, that they tried to present a special treat for the people, a true highlight, at the autumn trade show in Leipzig. Four-cylinder engines for Trabant and Wartburg made in Karl-Marx-Stadt (today Chemnitz) and Eisenach.

It is quite comprehensible that simultaneously the procurement companies became agitated in order to secure production processes. On August 5th, 1988, LACH DIAMANT received a rush order via telegram for 1,310 PCD inserts, with delivery no later than November 30th. This advance order also included an inquiry for approximately 4,000 additional PCD inserts with the urgent request to provide an immediate quote via telegram. It is easy to imagine that this caused quite a bustle at LACH DIAMANT as well.

The ordered and the additionally requested PCD inserts could easily be associated with the currently used and implemented inserts for turning and milling tasks in VW's engine production.

VW had requested LACH DIAMANT as sole supplier within the framework of their functional warranty to the

Visit of GDR companies during the «after-the-wall» transition period, e.g. Schleifmittel Reick *plant (abrasives) in Dresden*

GDR. At LACH DIAMANT *Dipl. Ing. Günter Hobohm* and *Konrad Stibitz* were immediately put in charge of the technical management of this order, which at that time was considered a major project. *Gerd Gottschalk (†),* export manager, had the equally difficult task to finalize the contract negotiations with WMW Plauen and Berlin; this finally happened in my presence October 25th, 1988 in Plauen, with two contracts in result. In the end the total supply contracts ended up covering 560,000 DM. As agreed the first part of the order was delivered on time on October 31st, 1988, and the rest on December 13th, 1988.

"Poly" could now finally be also used in GDR state enterprises – not only as PCD tools for machining non-ferrous metals, but also for furniture manufacturing which was represented by no fewer than five furniture collectives in the GDR.

This was another area where carbide tools had been the dominating tool used for wood and composites – with very few exceptions such as diamond trial tools, delivered by tool manufacturer *Ledermann & Co.*

A time of change

The change came with the fall of the Berlin wall on November 9th, 1989. Up to the time of the German-German reunification we lived in a so-called "Time of change". It was a time of new beginnings on both sides.

Together with Gerd Gottschalk (†) I visited many facilities within the GDR, many with illustrious names, like *Heckert-Werke* and research center in Chemnitz, *Robotron,* a manufacturer of electronics and accounting machines, *Wismut,* VEB combinat *"Getriebe und Kupplungen"* (gears and clutches) in Magdeburg, tool manufacturer *Geringswalde* and abrasive producer *Reick* in Dresden, as well as the diamond grinding shop in Quedlinburg and many others.

After receiving requests for the finally available "poly" tools from various industries – by the way together with inquiries about diamond dressing rolls and grinding wheels, I decided that LACH DIAMANT had to establish itself as service provider and consultant in an "idle" landscape. Especially after I noticed that only two grinding machines for re-grinding/sharpening of PCD tools were available for the entire GDR: an old, SWU grinding machine, modified for SKM (composite) in Jena and a second machine in the research facility of Heckert-Werke in Chemnitz. *Dr. Ing. Stefan Becker,* who joined us in 1990 as representative for East Germany, affirmed this approach. Within only a few months five new sales representatives delivered knowhow and service to the "capable" companies in the East.

Unfortunately, these "capable companies" became less and less. Either the sudden performance pressure was too high, or the necessary capital and equipment was not available, or the necessary knowhow – in other words, work power – was no longer sufficiently available, due to the now actively starting migration towards the West.

Due to a lack of generated revenue our engagement became less and less. However the diamonds delivered to the GDR via the VW project were still there and would need grinding service during ongoing engine production.

The fall of the wall – November 9th, 1989
(photo action press/R. Succo)

Honoring the pioneers of the founding team during the key handover in 2012; finalization of the 3rd stage of construction
(left to right: Reiner Weiss, Dieter Miton, Horst Lach, Jörg Hänel, Bernd Straube)

Ceremonial key handover 2012
(left to right: Robert Lach, Horst Lach, Bernd Straube)

New Production Site in Saxony

For this purpose, we had started the project "LACH DIAMANT GOes East" on February 4th, 1991. We had been looking for a manager for this project and found him in *Dipl. Ing. Bernd Staube* in December 1990. However, it must be stated, that it was difficult to arrange an interview in Hanau, since at the most only 100 telephone lines were enabled between East and West. While he had already waited several hours for a line for his call to Hanau, he then only got the response "Mr. Lach currently unavailable" after finally getting through to my secretary and was told to "try again in five minutes…".

Well we did get together after all–and he brought two new employees with him: *Jörg Hänel* and *Dieter Miton*. We had established an "autonomous" grinding service for these three in Hanau. They were trained for the establishment of a grinding and sharpening service as envisioned in "LACH DIAMANT GOes East", and were prepared for opening a new production site in Saxony.

On November 15, the time had come: Dipl. Ing. Bernd Straube had found a suitable location for the diamond service in Oberlichtenau near Chemnitz. *Mr. Weiß,* previously employed by Heckert-Werke, completed the initial team.

"All was well–but was it really well?" No, unfortunately not. The anticipated grinding orders from the new *Barkas* plant Chemnitz were missing–they could not come!

What had happened? Following reports which were available to me decades ago, my text and explanation should have continued as follows: "The new line had been disassembled, by the Trust Agency (Treuhand) or VW (?) and transported to China–including all poly cutting inserts."

While writing this sentence I was beginning to doubt whether such a statement could stand up to close scrutiny today–hence the question mark. During the following, extensive research, amongst other things, I came across a report by *professor Dr. Peter Kirchberg* "The implantation of the VW engine into the automobile industry of GDR". When I talked to him in person, he vehemently excluded the possibility that these four-stroke engine lines, though not up to the latest technology, would have been sold to China by VW, and certainly not by the Trust Agency, as had been assumed at the time.

The site manager of the facility in Saxony, Dipl. Ing. Bernd Straube, finally brought me onto the right track: *Wikipedia* key word "VEB Barkas-Werke". It says there, among other things, after commissioning of the line for the production of the VW engines 1.1 and 1.3, respectively: "[…] 200,000 short engines were built until the year 1991, which were installed in the Wartburg automobiles from 1988 on […]."

According to the above source, VW-licensed engines were built at Barkas up to 1991 for use in Wartburg and Trabant automobiles. After the fall of the Berlin wall there was a high demand for Western cars–and the former GDR automobile production came to a standstill.

Dieter Miton during training for the start in Saxony on a LACH EDG machine

In my assessment it took two to three years until production was resumed under the name of *Volkswagen Sachsen GmbH,* a full subsidiary of Volkswagen.

For LACH DIAMANT trying to succeed in Saxony the result was the same. Whether China or "Motorenwerk Barkas"–there were no orders in sight at the end of 1991.

Great grinding service facility, but what to do now? *Ing. Günter Hobohm,* at that time sales manager at LACH DIAMANT knew what to do. In negotiations with VW Salzgitter, he received assurance that we might receive contingent of PCD cutting inserts for regrinding. We only had to pick them up and bring them back. And so it happened, that initially Mr. Straube drove in his two-stroke Wartburg to Salzgitter twice a week and kept "LACH DIAMANT GOes East" going.

Even the last sceptics in Hanau, if there should have been any, slowly realized what the industrious Saxonians could accomplish–at some point, with increasing personnel, they were no longer satisfied with their role as "mere service facility" and they started to manufacture new tools also. Successfully, of course.

Almost at the drop of a hat, mayor *Eberhard Meyner* from Lichtenau contacted us. He was very persistent and "worked" the LACH DIAMANT management until they finally "gave in" and purchased a nice piece of land in his newly developed industrial area for a new plant for LACH DIAMANT Saxony. The move into the first hall was scheduled for Juli 1997, two subsequent building sections were planned. Thus a German-German success story revealed thirty years after the reunification that "it was about time that the wall came down!"

Over the last thirty years, the LACH DIAMANT plant in Saxony contributed to our image as pioneers and innovators in our implementation of ideas for the global automobile, wind and aircraft industries–only to name a few examples.

The chapter "LACH DIAMANT GOes East" may serve as another example within the "German-German automobile industry".

Horst Lach

LACH DIAMANT factory in Saxony, after the 3rd stage of construction

further information: ***www.lach-diamant.de***

New high performers for trochoidal milling

Short machining times and long tool life

Ideal for deep cavities: the new CARBLoop trochoidal milling cutter from LMT Tools guarantees maximum cutting performance

With the CARBLoop, LMT Tools is expanding its extensive tool portfolio to include solid carbide milling cutters that have been specially developed for trochoidal milling. Thanks to its maximum depth of cut (3 x Ø and 5 x Ø) and ideally matched geometry, the new trochoidal milling cutter guarantees outstanding cutting performance, the shortest machining times and long tool life. Production costs can thus be drastically reduced.

Trochoidal milling is an extremely dynamic machining process that is increasingly gaining ground due to its noteworthy advantages. Thanks to high speeds, machining times can be reduced by up to 70 % compared to the conventional milling strategy, and productivity is significantly increased. At the same time, tool life is more than tripled because less cutting heat is generated thanks to the smaller wrap angle. The tool cutting edge is therefore exposed to lower stresses. The lower cutting forces due to smaller and consistent chip cross sections also have a positive effect on wear.

A new benchmark for trochoidal milling

With the CARBLoop, LMT Tools now provides the perfect tool solution. The new trochoidal milling cutter has been specially designed for innovative milling and adapted to the process-specific requirements. One characteristic feature is the completely newly developed chip breakers, which are arranged offset to each other. The chip breakers reduce the chip volume by half and ensure smooth chip evacuation even at high cutting values. Depending on the diameter, the tools have up to 14 chip breakers. This high number not only ensures optimum chip removal, but also significantly reduces vibration, which has a positive effect on tool life. A special cutting edge geometry with defined edge preparation and the latest coating enables high cutting speeds and guarantees maximum metal removal rates as well as tooth feeds. Another advantage is the 2 mm longer cutting edge. This means that the CARBLoop can be reground several times without sacrificing the maximum insert depth.

More efficiency for deep cavity machining

The CARBLoop is available in two variants: as CARBLoop STEEL for the application range ISO-P and ISO-K as well as CARBLoop INOX for the machining of ISO-S and ISO-M materials. Cutting geometry, coating and cutting edge treatment have been specially developed for the materials to be machined and are optimally matched to each other. This enables the best milling results to be achieved. In particular, components with deep cavities benefit from switching to trochoidal milling, because the high metal removal rate means enormous time savings. But thin-walled or unstable components can also be machined excellently thanks to the low cutting forces.

The perfect solution for trochoidal milling

Whether in die and mold making, aerospace or general mechanical engineering: trochoidal milling opens up unimagined performance and efficiency potential in roughing and semi-finishing. With the new CARBLoop, LMT Tools makes this accessible and offers a powerful tool solution that sets standards in terms of productivity, machining time, tool life and economy.

By the way: The CARBLoop is not only suitable for trochoidal milling, but its advantages – high infeed depth, high cutting speeds, low cutting forces, efficient chip removal and long tool life – are just as effective in conventional corner milling or slicing.

further information: ***www.lmt-tools.com***

Opportunities through use of diamond-tipped cutters

Machining FRP with special PCD cutters

In the automotive industry, polycrystalline diamond (PCD) is still a rarely used cutting material when machining fiber-reinforced plastics. However, for those who need long edge life and the best surface quality, LEUCO offers the right solution with its PCD cutters.

When milling fiber-reinforced plastics (FRP), most cutting materials quickly reach their limits. The cutting edges of carbide cutters can be so worn after only a few running meters of material that they no longer cut cleanly or the dimensional accuracy of the component can no longer be maintained. Even the most modern CVD diamond coatings offer only a limited remedy here.

In the automotive industry in particular, very thin-walled and geometrically complex components, which are produced in medium to large series using the RTM process, usually have to be processed. The classic PCD cutters, which are otherwise used on a large scale in engine block production, for example, are unsuitable for this purpose because they do not meet the requirements for smooth running. Negative consequences include vibrations, tool failure as well as poor cutting quality and, at the same time, insufficient edge life.

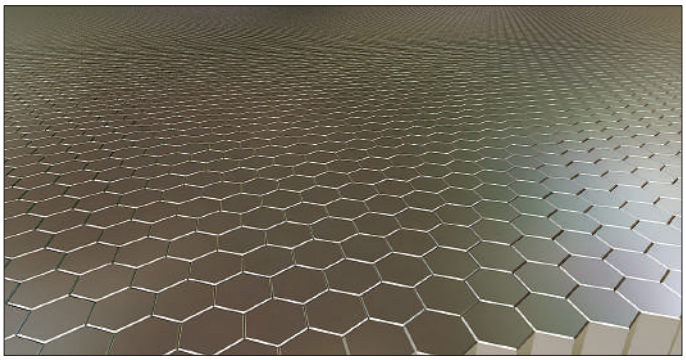
In contrast, LEUCO offers PCD cutters that are adapted to the special requirements of machining FRP in the automotive industry. Through use of cutters with many teeth and sophisticated tool geometries, it is also possible to cut unstable and thin components without vibration and with minimal cutting forces. Only this way the advantages of the extremely wear-resistant PCD cutting edges can be fully used.

In other fields of application as well, PCD cutters from LEUCO are always adapted to the individual requirements so that the diamond-tipped blades can be utilized to their full potential. As a result LEUCO has an economical solution for companies that require long edge lives in conjunction with high quality when processing FRP.

further information: ***www.leuco.com***

New technology provides high speed plus durability

New CVD coated turning grade



CRYSTAL ORIENTATION

There is an increasing demand from the market for an improvement in machining efficiency and for higher cutting speeds. Additionally, the use of high strength materials in components that requires cutting tools with high wear resistance is also increasing. However, cutting tools with a high wear resistance are generally prone to chipping and instability. To meet the demand, *Mitsubishi Materials* has released MC6115, a new CVD coated turning grade for steel machining, which is capable of both high speed machining and providing excellent cutting edge stability.

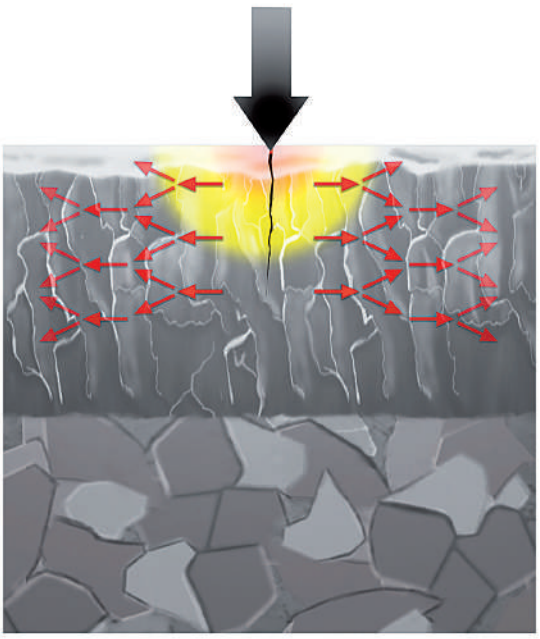
MC6115 has the combination of a high hardness base material and new thick Al_2O_3 outer coating with improved wear resistance at high temperatures. It also has higher peeling resistance and cutting edge stability achieved by super TOUGH-GRIP technology. This provides the ultimate enhancement of the adhesion between the Al_2O_3 and TiCN coating layers.

Super nano texture technology

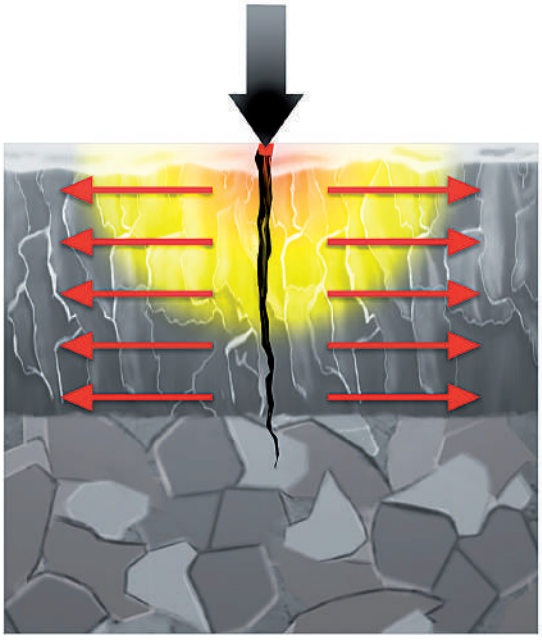
The outstanding crystal orientation of the Al_2O_3 coating has been developed by improving the conventional Nano Texture Technology. These technological improvements increase both wear resistance and tool life.

Preventing wear and sudden fracturing

Cracks that occur due to the impacts during unstable cutting are prevented by the relaxation of the tensile stress of the coating. The MC6115 grade decreases the tensile stress by 80% compared to conventional CVD inserts. When cracks are generated in the surface of coatings during machining, they propagate through into the substrate due to



Lower tensile stress in MC6115 stops cracks penetrating



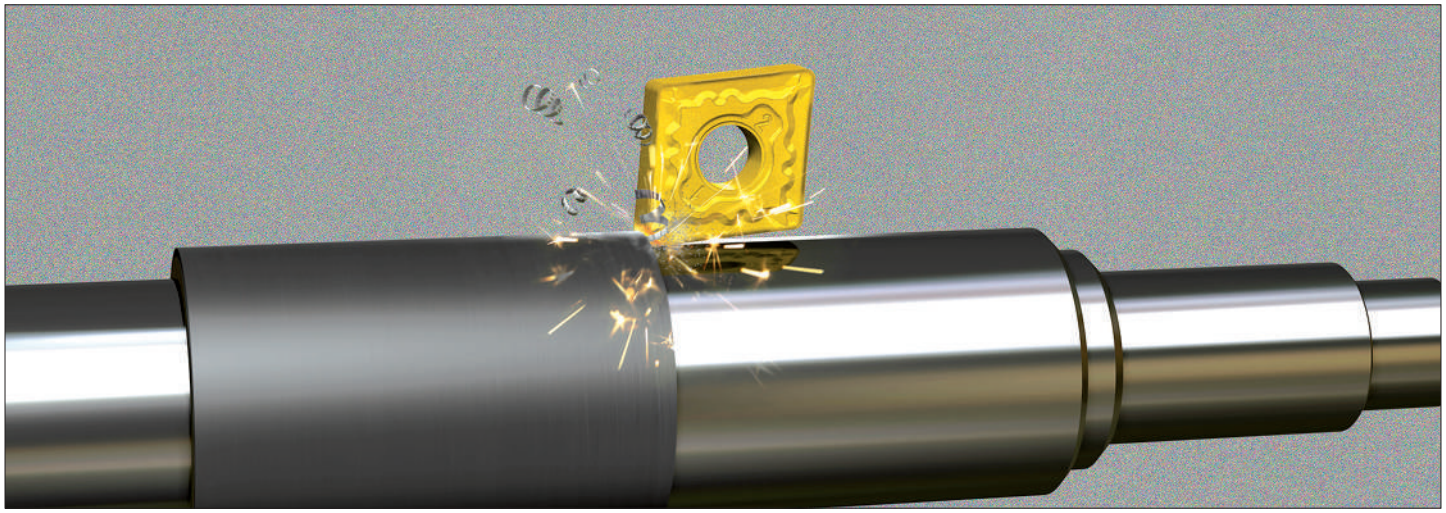
Higher tensile stress in conventional coatings allows cracks to penetrate

the large tensile stress in the coating structure. This creates one of the main causes of sudden insert breakage. MC6115 has a much lower level of stress than conventional CVD coatings due to the surface treatment that spreads the force of impacts during machining and protects it from sudden fracturing.

A new range of possibilities

The combination of the tough substrate and wear resistant coating enables high performance during both high speed continuous and interrupted cutting, thereby permitting a wider range of steel turning applications up to a cutting speed of 480 m/min (v_c).

The inserts are finished in a gold color for easy identification of used edges and are available in six negative geometries, CNMG, DNMG, SNMG, TNMG, VNMG and WNMG, with eleven different chipbreakers.



further information: ***www.mmc-hardmetal.com***

EMO MILANO 2021
fieramilano 4-9 October

Dynamic HPC milling

New high-performance geometry

Paul Horn GmbH **is expanding its portfolio of DS-type solid carbide end mills with a new high-performance geometry. This system has been specially designed for use in HPC (high-performance cutting) milling of high-strength steels at high material removal rates. It particularly excels in dynamic roughing applications as well as in standard roughing cycles.**

The different helix angles create an irregular tooth pitch, making operation exceptionally smooth. The tools' optimised face geometry reduces the cutting pressure when linear or circular ramping. Improved chip spaces ensure optimal process reliability during chip formation and removal. The system also demonstrates its strengths during finishing. Extremely smooth operation means that high surface quality can be achieved during side milling, for example.

Horn's DS system for dynamic HPC milling excels at dynamic roughing applications as well as standard roughing cycles

HPC milling of high-strength steels at high material removal rates places significant demands on the tools. New carbide substrates and new tool coating technologies make this process feasible. Horn relies on the ES3P grade with a HiPIMS coating for its milling cutters. High power impulse magnetron sputtering technology offers several advantages and new possibilities when it comes to coating precision tools: it enables the formation of coatings that are very dense and compact, as well as extremely hard and tough. The coatings have a very homogeneous structure and exhibit an even coating thickness, even with complex tool geometries. The coating demonstrates very high layer adhesion, thus ensuring good cutting edge stability. Thanks to its high temperature resistance, the coating serves as a heat shield and reduces the amount of heat transferred to the carbide.

EMO Milano 2021, hall 4, booth D15

further information: ***www.phorn.de***

New steel turning generation

High performance, optimal cost-benefit ratio

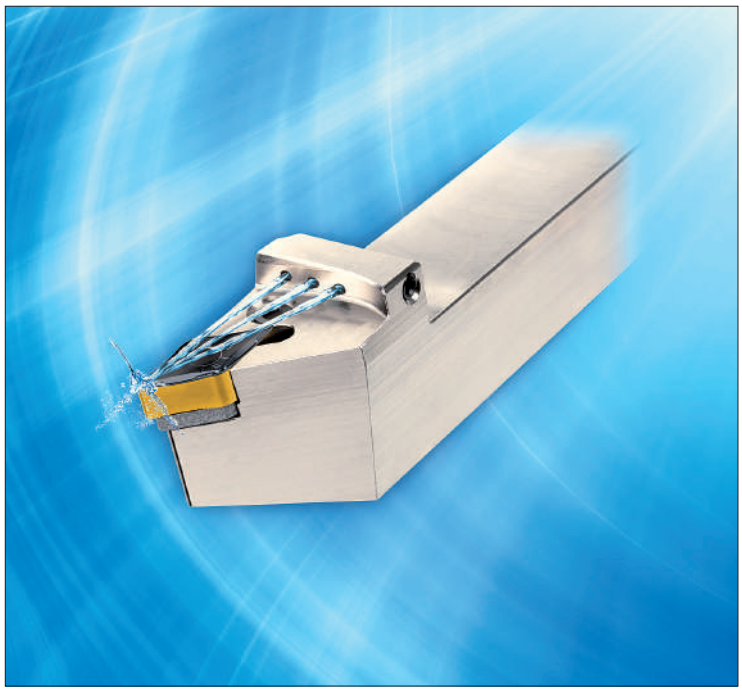
Innovations regarding carbide, coating, and chip flow have given rise to a completely new generation of grades for steel turning. The perfect alignment of all these parameters has created the new, cost-effective steel turning grades BCP10T, BCP15T, BCP20T, and BCP25T.

These new *Boehlerit* turning grades offer excellent performance and process reliability throughout the entire turning process. A newly developed chip breaker with a modified chamfer provides optimised vibration cancelling for the machine and guarantees excellent chip flow and break.

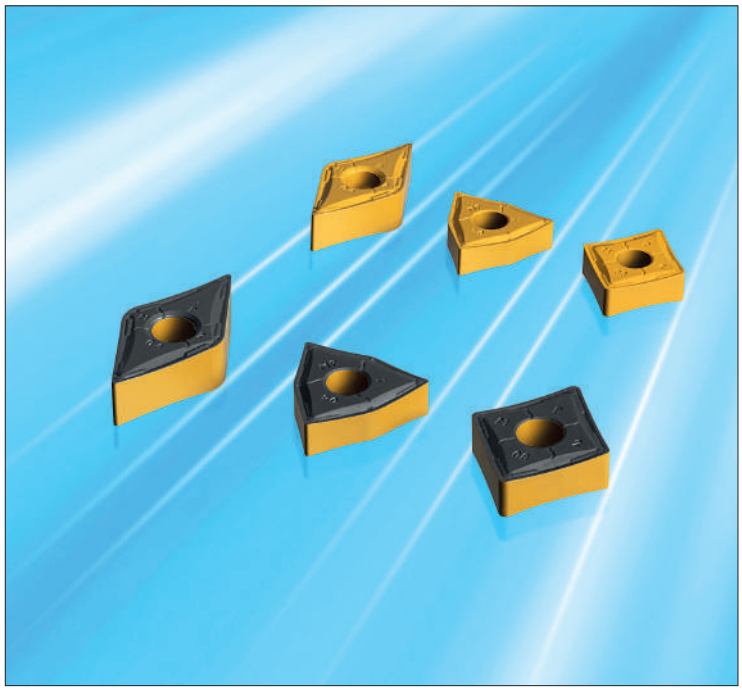
The new BCP15T and BCP25T grades are particularly suitable for turning applications with interrupted cutting. The newly developed AlTiN-PVD coating is able to deal with high temperature and toughness requirements, while its golden colour ensures ideal wear recognition. The process-reliable PVD coating comes into its own with small components, low cutting speeds, and frequent material entry.

The new BCP10T and BCP20T grades, on the other hand, were developed with an eye to a new, two-colour CVD coating concept. The CVD coating is based both on the tried-and-tested MT-TiCN coating system to prevent flank wear and on an α-Al2O3 coating to protect the indexable insert against excessively high temperatures and to reduce crater wear. Again, wear recognition is made easy by the yellow TiN surface layer of the flanks. Both turning grades are particularly well suited for continuous cutting. The new BCP10T and BCP15T grades are recommended for medium applications with high cutting speeds, long operation times, and stable roughing. In contrast, BCP20T and BCP25T deliver excellent results at medium cutting speeds.

The new turning grades are the ideal solution for the entire steel turning process, which is becoming increasingly challenging.



Up to 30 % longer tool life with coolant directly on the cutting edge



The new steel turning generation of Boehlerit

further information: **www.boehlerit.com**

From lettering milled hair to micro-slitting cutter

Unique solution for a special application

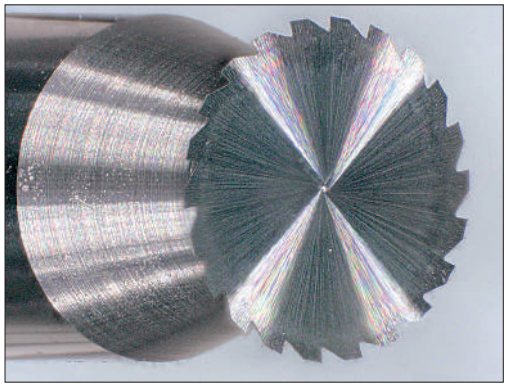
Tool manufacturer *ZECHA Hartmetall-Werkzeugfabrikation GmbH* has shown just how far precision can be taken with lettering milled into a human hair. ZECHA's sensational ten micron milling cutter caught the attention of *Rohde & Schwarz GmbH & Co. KG* in their search to find a unique solution for a special application. In any case, precision is getting to be a substantive issue in the future of communication, information and security.

Rohde & Schwarz has made a name for itself with electronic capital goods for industry, infrastructure operators, and government customers.

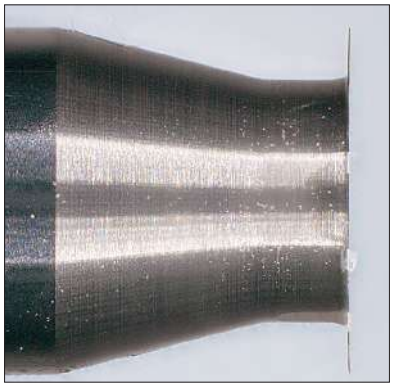
With development, production and marketing of a vast range of products, the technology and market leader is active in the fields of wireless communications and RF test and measurement, broadcast and media technology, air traffic control, and military radio communications, as well as cybersecurity and network technology. As a pioneer and trendsetter in the field of micro-cutting, stamping and forming tools, ZECHA produces the ideal tool solution for every application, every material, and every dimension, however small. With origins in the chronograph industry, the expert for micro tools recognizes the importance of precision in various industries. It is not just recently that Rohde & Schwarz has relied on precision tools from ZECHA. Diverse machining solutions have been used here for some time, including high-end multi-cutters in the small diameter range with diamond-coated, laser-sharpened cutting edges in the IGUANA line.

Rohde & Schwarz is one of the world's largest manufacturers of electronic measurement technology. As a key partner for industry and network operators, they offer a wide range of market-leading solutions for the latest

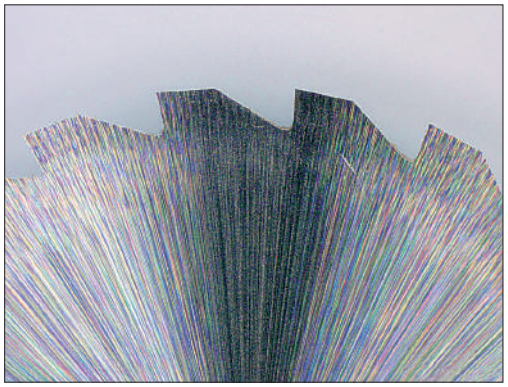
Rohde & Schwarz hub in Teisnach: Stefan Filgertshofer, ZECHA, and Christian Wühr, Rohde & Schwarz



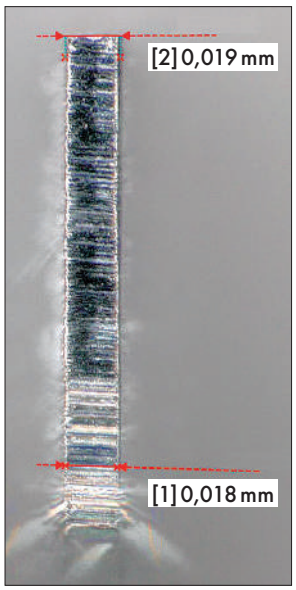
Slitting cutter under 50-x magnification (oblique)



Slitting cutter under 50-x magnification (lateral)



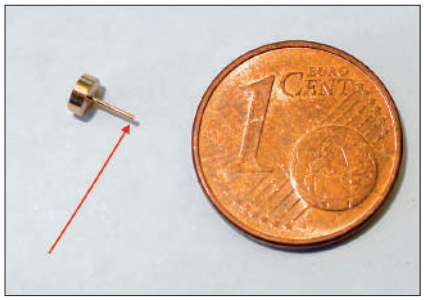
Teeth of the slitting cutter under 150-x magnification (frontal)



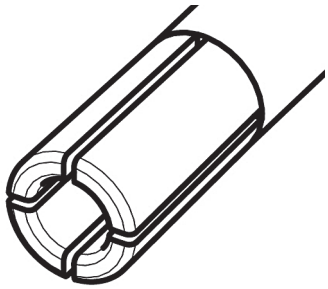
Tool with hollow grinding under 1000-x magnification

wireless technologies, as well as for RF and microwave applications up to 500 GHz. These complex applications demand special solutions. For the creation of a 0.5 mm deep and 0.02 mm wide slit in a brass component, Rohde & Schwarz in Teisnach relied on the expertise of ZECHA. The tool manufacturer designed as special solution a micro-slitting cutter with a diameter of 4 mm and a width of 0.02 mm. To achieve the required even base and optimized cutting performance, a few of the slitting cutter parameters were subsequently improved. Incredible, right?

Together the two technology experts have made the impossible possible. Through mutual expertise and years of experience in their fields the problem was handled with an excellent solution. ZECHA and Rohde & Schwarz have been growing with new challenges for decades and are thus constantly offering their customers innovative and unique product solutions.



Comparison of brass component versus cent piece (milling is performed on red marking)



Drawing of the brass component

Rohde & Schwarz GmbH & Co. KG

Thanks to its industry-leading technological expertise, the independent group is a reliable partner for shaping the future of communications, information, and security.

Rohde & Schwarz develops, produces, and markets a wide range of electronic capital goods for industry, infrastructure operators, and government customers. The independent group is among the technology and market leaders in all of its business fields, including wireless communications and RF test and measurement, broadcast and media, air traffic control and military radio communications, cybersecurity and network technology.

In fiscal year 2019/2020, Rohde & Schwarz generated EUR 2.58 billion in revenue. The company owes this tremendous success to its 12,300 highly qualified employees in over seventy countries.

further information: ***www.zecha.de***

Young generation bears responsibility

The old and new management of KAPP NILES
from left to right: Helmut Nüssle, Martin Kapp, Michael Kapp, Michael Bär, Matthias Kapp

After many years of success at machine tool manufacturer KAPP NILES, *Martin Kapp* is retiring from the joint management of the company with *Helmut Nüssle*.

His sons *Michael* and *Matthias Kapp* will continue the family tradition as of 2021, 1.7. and strengthen the new management together with *Michael Bär.*

The motivation for strengthening the management, combined with a reorganisation of the areas of responsibility, was not only the retirement of Martin Kapp but also the increasing importance of global markets. "We have decided to broaden and strengthen the management team. This will allow us to focus more on operational topics and intensify our global orientation, especially towards China," says Martin Kapp.

In the future Helmut Nüssle will be responsible for China, the most important single market in the group, the coordination and development of the international offices, and strategic issues. Michael Kapp will cover the value-creating areas, Matthias Kapp the development and sales and Michael Bär the commercial part. Martin Kapp will join the advisory board at this time and take over as chairman. After studying mechanical engineering, the two brothers Michael and Matthias Kapp first worked for other companies and have now been with KAPP NILES for several years. Michael Kapp was previously responsible for production, Matthias Kapp was previously in charge of marketing. The grandsons of company founder Bernhard Kapp would like to maintain and expand the current business areas and increasingly focus on new business areas such as digitalisation and e-mobility.

Michael Bär brings his years of experience in the commercial sector to the management team. The graduate in business administration has been with the group since 2012, January, most recently as division manager for controlling, finance and human resources.

Even with the new management, KAPP NILES remains true to itself: the family-run company has always maintained open communication with its employees and attaches highest importance to stability, independence, and security for the future.

further information: ***www.kapp-niles.com***

CERATIZIT acquires remaining shares of former *Best Carbide*

***CERATIZIT S.A.* has acquired the remaining shares in *CERATIZIT Los Angeles* with effect from June 1. The company, which is part of the Austrian *Plansee Group,* now holds 100% of the *Rancho Domingo,* California-based subsidiary.**

The CERATIZIT Group had acquired the majority of the shares in the company, which at that time was still called *Best Carbide Cutting Tools,* in early 2017. Today CERATIZIT Los Angeles, together with the sites in Warren/MI, Schaumburg/IL, and Rancho Cordova/CA, forms the Group's North American production network. As part of this, the site functions as a specialist for solid carbide tools and in particular high-end micro tools and serves customers throughout the Americas.

Mirko Merlo, President CERATIZIT Group Americas, states, "The CERATIZIT Group acquisition of the remaining shares allows us to further expand our footprint and accelerate our growth strategy in the cutting tools market, specifically in high-end micro tools. As a reliable partner and industry leader, we will continue to deliver engineering knowledge and technical proficiency to assist our customers in driving productivity." Both parties have agreed not to disclose any financial details of the transaction.

further information: ***www.ceratizit.com***

ISEM XXI

21st CIRP conference on electro physical and chemical machining

It is a great honor and pleasure for the *Swiss Federal Institute of Technology* to host the ISEM conference for electrical, physical and chemical manufacturing processes in Switzerland and Zurich for the second time.

The organizer hopes very much that this conference can be held as a real face-to-face conference in 2022, in order to re-establish a forum for personal exchange, which is so important in this field of technology.

Call for papers

The CIRP ISEM XXI organizing committee cordially invites you to participate in the 21th CIRP conference on electro physical and chemical machining, held in Zurich, Switzerland. The conference will be a place for researchers, users and providers of machining technology with the scope to show the cutting edge of technologies, innovations and visions in the area of non-conventional machining technologies.

Conference topics

- electrical discharge machining (EDM)
- electro chemical machining (ECM), (ECDM)
- laser material processing
- chemical processes
- additive manufacturing
- hybrid processes
- plasma processes
- electrodeposition
- ultrasonic machining (USM)
- abrasive/water jet machining (AJM), (WJM)

The 21st CIRP conference on electro physical and chemical machining will take place June 14th - 16th, 2022. The conference place will be at the ETH Zürich and is located in the Zürich city center.

further information: ***www.isemxxi.ethz.ch***

EMO MILANO 2021

"The magic world of metalworking"

Promoted by CECIMO, the *European Association of Machine Tool Industries,* and organised by the operational structures of UCIMU-SISTEMI PER PRODURRE, the Italian machine tools, robots and automation systems manufacturers' association, EMO MILANO 2021, the leading world exhibition for metalworking industry, will take place at *fieramilano Rho* October 4 to 9, when the recovery of investment should already have started.

Metal forming and metal cutting machine tools, production systems, enabling technologies, robots and automation, solutions for interconnected and digital factories and additive manufacturing will be among the products and solutions spotlighted at EMO MILANO 2021.

The halls of fieramilano Rho will host the best international technology of the sector, which are more and more closely linked to the issue of interconnection, capable of enabling all those high value functions that the manufacturing industry cannot longer do without. For this reason, fieramilano Rho will transform to the biggest digital factory ever set up within an exhibition fairground.

The large and varied products offered on show, the clear link between production technologies and IoT systems will be of great appeal to the operators of the world manufacturing industry, representing all major user sectors: machine tools, automotive, aeronautics, aerospace, railway industry, metallurgic sector and materials.

In this sense, EMO is an exhibition event capable, like no other, of interpreting the industrial "spirit of the age" and, at the same time, of presenting the most futuristic technologies for the development and wellbeing of society, to such an extent that it can be considered the place that showcases "the magic world of metalworking"–as highlighted in the slogan chosen for EMO MILANO 2021.

With these peculiarities, once again EMO MILANO will be able to attract qualified visitors according to its tradition confirming to be the world exhibition for decision makers of purchases in production technology as 81% of total visitors are decision makers (56% take part in the purchasing decision; 25% decides autonomously).

Italy, Germany, Taiwan, Spain, Japan, Switzerland, China and Korea are among the most represented countries in the list of the exhibitors that will participate in the world travelling trade show. Germany is the first country after Italy in number of exhibitors, more than one hundred, and in exhibition area.

According to the forecasts processed by Oxford Economics, after the big fall registered in 2020, the year 2021 should bring about a recovery in machine tool consumption worldwide, expected to grow to 62.7 billion euro (Asia 35 billion euro, +16.2%; Europe 16 billion euro, +13.3%; Americas 11 billion euro, +14.5%). If we observe the single countries, all of them should experience a demand recovery, likely to continue also in 2022 and in 2023. Focusing on Europe, in 2021 both Italy (3.1 billion euro, +10.1%) and Germany (4.9 billion euro, +8.7%) should again see a plus sign with regard to investment in production technologies. The growth trend is confirmed for both countries also in the two-year period 2022-2023.

further information: ***www.emo-milan.com***

DeburringEXPO

Hands-on presentation of solutions for burr-free, clean, high-precision surfaces

Preparations are running at full bore for DeburringEXPO as a live event at the Karlsruhe Exhibition Center October 12th-14th, 2021.

The booking status also promises a successful 4th leading trade fair for deburring technology and precision surface finishing, where exhibitors and visitors will once again be able to exchange ideas at face-to-face meetings. Emphasis will be focused on solutions and information which enable companies to effectively and efficiently fulfill stricter as well as changing requirements for deburring and surface finishing quality.

Collaboration with GrindTec

Thanks to the new collaboration between *fairXperts* and *AFAG*–promoters of *GrindTec*–the exhibition portfolio at DeburringEXPO 2021 will be extended for the first time to cover the issue of "grinding technology" at a collective booth. This expansion of the spectrum will make it possible to gather more information covering the entire process sequence for surface treatment. DeburringEXPO will also be represented at the next GrindTec, which will take place in Augsburg, March 15th-18th, 2022.

further information: ***www.deburring-expo.de***

Bearing Application World

International digital trade fair for rolling bearing technology

From practice for practice: exhibitors and visitors can look forward to current and future-oriented topics and solutions on the subject of rolling bearing technology.

The *Steinbeis-Transferzentrum Wälzlagertechnik* will be hosting the first ever *Bearing Application World* (BAW) from October 26th-28th, 2021–a digital trade fair for rolling bearing technology. The programme includes both professional lectures by experts and virtual trade booths from a large number of exhibitors. With its practical orientation „Application–Operation–Solution", BAW primarily addresses companies in the international rolling bearing market as well as employees and researchers. Students, graduates and interested persons are also welcome. For visitors the fair is free of charge.

Due to the current trade fair situation, Bearing Application World is designed as a purely digital event. Thanks to the latest technical possibilities this combines the advantages of a physical trade fair with those of digitalisation: The live days from October 26th to 28th will be accessible from anywhere. The trade fair platform will also remain open "on demand" until November 9th, 2021. It offers space for entrepreneurs, exhibitors and speakers to present their products, solutions and services to reach an international audience. In addition to the virtual trade fair platform, the exhibition booths and the conference rooms, there will be an online networking lounge. In various areas participants can spontaneously exchange information on a variety of topics via audio, video and chat functions. Exhibitors will also have access to the BAW community, which offers networking opportunities before the fair even begins.

Capital city of rolling bearings–Schweinfurt

The future of the BAW is connected to the city of Schweinfurt: this is where we would like to establish a leading trade fair on the subject of rolling bearing technology and build up a permanent community. On the one hand this is intended to support small and medium-sized companies in the region, which have grown close to the rolling bearing industry based there. On the other hand the community offers the opportunity to connect the market internationally.

The university of *Applied Sciences Würzburg-Schweinfurt* (FHWS) is also located there. The FHWS is one of the largest universities of applied sciences in Bavaria and educates the engineers of tomorrow. In addition, the university offers a master's degree course called *Product and system development* with a focus on rolling bearing technology, which is unique in Germany.

further information: ***www.bearing-application.com***

2021 Motion + Power Technology Expo

Power Transmission Industry will gather in St. Louis, Missouri, USA

The 2021 Motion + Power Technology Expo *(MPT Expo)* will take place September 14 - 16 in St. Louis, Missouri.

This will be the second MPT Expo (formerly *Gear Expo)* and the first time the show has been in St. Louis. With a large manufacturing base in Missouri, *AGMA* and its partners are looking forward to hosting all parts of the power transmission supply chain in the mechanical, electric and fluid power industries.

"Our industry had a challenging year navigating the pandemic, travel restrictions, sales leads and shifting supply chain bottle necks," said *Jenny Blackford,* VP, AGMA business division and MPT expo director. "Research shows that there is an incredible demand for our industry's products and technology and so we knew that we had to have to offer the tradeshow in person. Our members need and want to meet with their customers face to face and AGMA and its board of directors are 'all in' to provide the industry a great place to do business."

MPT Expo will be one of the first tradeshows to go back to being in person and safety is going to be the top priority. Not only will the show follow all federal, state, and local guidelines regarding COVID-19 restrictions, but all staff will be working closely with the city of St. Louis to ensure attendees to feel comfortable.

"We are very excited to welcome AGMA and the Motion + Power Technology Expo exhibitors and attendees to St. Louis. Manufacturing has a very important role in our city and we are proud to host this tradeshow that will offer an incredible opportunity to do business face-to-face," said *Kitty Ratcliffe,* president, explore St. Louis. "We are diligently working to make sure all safety measures are followed so that the in-person MPT Expo experience is successful."

further information: ***www.motionpowerexpo.com***

Oxygen-free production:

Potential of grinding under oxygen-free atmosphere

written by **Prof. Dr.-Ing. Berend Denkena, Dr.-Ing. Alexander Krödel** and **M.Sc. Nils Hansen**
authors from the *Institute of Production Engineering and Machine Tools IFW*

Prof. Dr.-Ing. Berend Denkena

Dr.-Ing. Alexander Krödel

M. Sc. Nils Hansen

With regard to economically efficient manufacturing processes, production engineering is constantly driven by increasing demands. In combination with increasing requirements on the quality of machined workpieces, manufacturing processes are evolving continuously. When it comes to precision machining, the surface quality is of the utmost importance and therefore plays a key role in evaluating machined surfaces. In this respect, grinding is the most commonly used finishing process due to its ability to produce high surface qualities [1-3].

However, tool wear is limiting the economic efficiency of grinding processes and can occur to a great extent when grinding difficult to machine materials, like titanium (Ti). This can result in high process costs [4]. It is expected that chemical wear and oxidation plays a major role in this degradation processes. Those mechanisms could be controlled by reducing the oxygen content in the machining atmosphere. This oxygen-free atmosphere could reduce oxidation effects during the machining process, which could also have positive impact on the process forces and the subsurface microstructure of Ti-workpieces. This paper presents first results in oxygen-free grinding of Ti alloy.

Metal workpiece surfaces tend to oxidize, especially at higher temperatures due to the presence of oxygen in usual machining processes. This can result in increased hardening and embrittlement of the subsurface microstructure of workpieces. When machining titanium its high chemical affinity to oxygen leads to pronounced oxidation effects [5], which can lead to higher tool wear and poor surface qualities of the workpiece [4]. Based on this assumption a new approach will be investigated within the "Collaborative Research Center: oxygen-free production". By creating an oxygen-free atmosphere during grinding, oxidation effects are reduced, aiming for a longer grinding tool life and better surface qualities of workpieces.

Another aspect that needs to be considered is the cooling lubricant, which is of particular importance for grinding processes. Due to higher contact areas between grinding wheel and workpiece, compared to turning and milling processes, the friction percentage is higher while the chip thickness is lower [6]. In grinding, oil is predominantly used, which enables better lubrication than water-based cooling lubricants, resulting in better process conditions. For the present investigations water (H_2O) would also prevent the process from being entirely oxygen-free due to the chemically bound oxygen. Although grinding oils are not supposed to contain any water, a residual amount of water can still be dissolved in it [7]. In addition a certain amount of air is also dissolved in oil, which means that gaseous oxygen is also present within the cooling lubricant [8]. Both water and oxygen within the coolant are expected to have an influence on the grinding process and therefore have to be taken into account in terms of an oxygen-free grinding process. In order to generate a true oxygen-free grinding process, oxygen has to be eliminated from the atmosphere as well as water and oxygen residues have to be removed from the grinding oil. In a first step this article will present the experimental setup for oxygen-free grinding and the evaluation of the system. In a second step grinding experiments are performed to show the potential of oxygen-free grinding.

Creating oxygen-free process conditions by using silane-doped inert gas

A common method to eliminate oxygen from the atmosphere is to remove the molecules from an enclosed space by creating a technical vacuum. Another approach is to replace oxygen by a second gaseous medium or using a gas that causes a chemical reaction with oxygen. In order to investigate the influence of an oxygen-free atmosphere on the grinding process a combination of these two methods has been chosen. In the first step oxygen will be

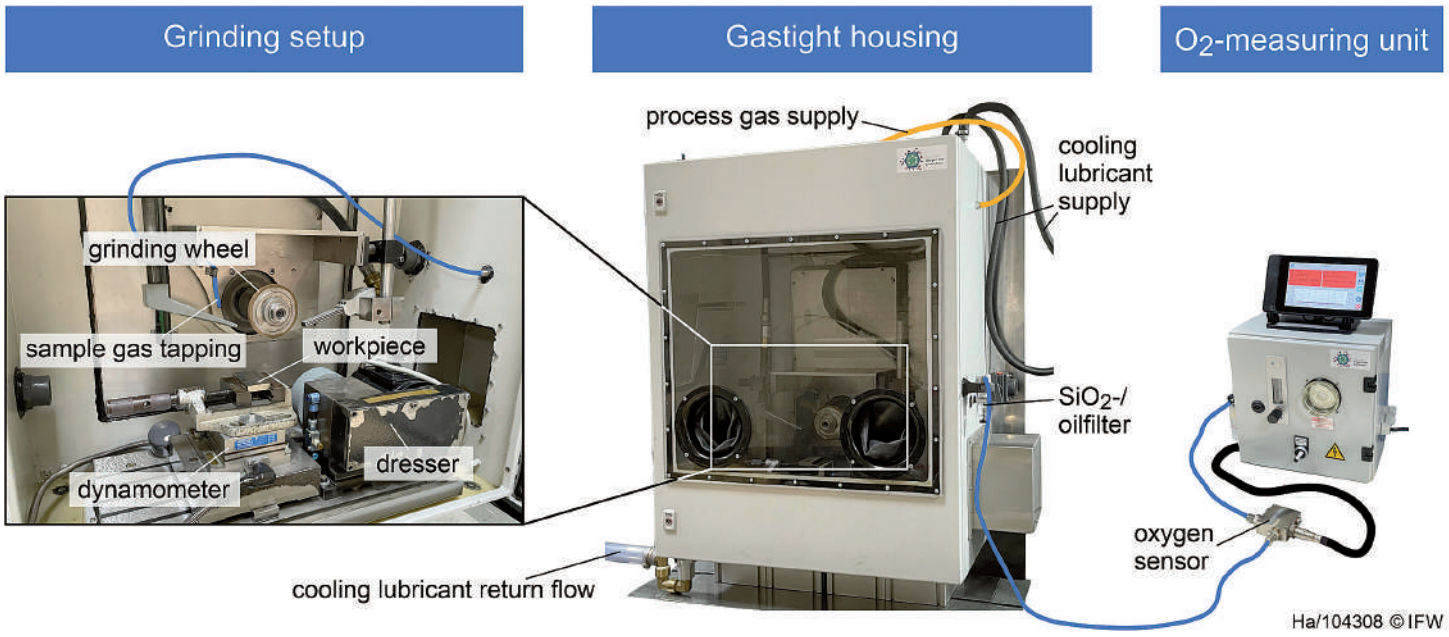


figure 1: experimental setup for grinding under oxygen-free atmosphere

displaced by the heavier and chemically inert gas argon (Ar). Since argon is not able to displace oxygen entirely, low contents of the gas mixture argon/monosilane (Ar/SiH_4) are used in the second step, which leads to the elimination of all oxygen and water residues according to the following chemical reactions [9].

$$SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O \quad (1)$$
$$SiH_4 + 2H_2O \rightarrow SiO_2 + 4H_2 \quad (2)$$

The reaction of silane with oxygen results in the formation of water and a silicon dioxide powder (SiO_2) and water itself also reacts with silane, which leads to the formation hydrogen and silicon dioxide [10]. These reactions are able to generate an atmosphere with very low oxygen partial pressure ($\leq 10^{-20}$ mbar) at ambient air pressure. With respect to the oxygen content, the resulting atmosphere is adequate to an extremely high vacuum (XHV). By definition the XHV range starts at 10^{-12} mbar and has no subjacent limit [11]. Just generating a conventional technical ultrahigh vacuum (UHV) that enables oxygen partial pressures down to 10^{-12} mbar, is much more expensive and complex compared to this approach. Both chemical reactions apply to the gaseous atmosphere within the grinding process as well as the cooling lubricant. The gas mixture that is used to eliminate these elements consists of 98.5 vol. % argon and 1.5 vol. % silane.

Experimental setup for grinding investigations

The experimental setup shown in *figure 1* comprises the grinding setup that is located within a gastight housing, an oxygen measurement unit and a supply unit for deoxidized cooling lubricant, which will be discussed in the next paragraph. The gastight housing provides an environment that enables an oxygen-free atmosphere, in which the grinding process takes place *(figure 1, center)*. In order to achieve an oxygen-free atmosphere the housing is purged with argon that displaces a large percentage of oxygen (>95 vol. %). By adding the gas mixture of argon/silane (Ar/SiH_4) the residual oxygen is then removed. Both gases (Ar and Ar/SiH_4) are injected via the yellow process gas supply hose.

To measure the oxygen partial pressure during grinding an oxygen measurement unit is used. This unit uses an oxygen sensor to measure the oxygen partial pressure close to the grinding process through sample gas tapping via the blue gas hose, which can be considered as close to in-situ measuring. The sample gas flow is caused by a diaphragm pump within the O_2-measuring unit that generates a small vacuum. Since the atmosphere within the housing can contain particles of cooling lubricant and silicon dioxide (SiO_2) the setup also features a filter that removes these particles before the sample gas reaches the oxygen sensor and potentially damaging it. The oxygen partial pressure is recorded at a frequency of around 0.5 - 1 Hz during the entire experimental period. This enables the correlation of the present oxygen partial pressure with resulting parameters like grinding forces.

For the grinding experiments a bronze-bonded grinding wheel with diamond grains is used. To ensure equal grinding tool conditions before every grinding process, a dresser with profile roll generates the profile of the tool and a sharpening block ensures the sufficient grain protrusion *(figure 1, left)*. During sharpening the sharpening block replaces the workpiece within the clamping unit. To measure the forces during grinding a *Kistler* multicomponent dynamometer is used.

The last component of the experimental setup is the unit that provides deoxidized cooling lubricant that will be induced via the black supply hose on top of the housing and leaves it on the bottom before returning to a tank. This system, as well as the principles behind the deoxidation, will be described in the following.

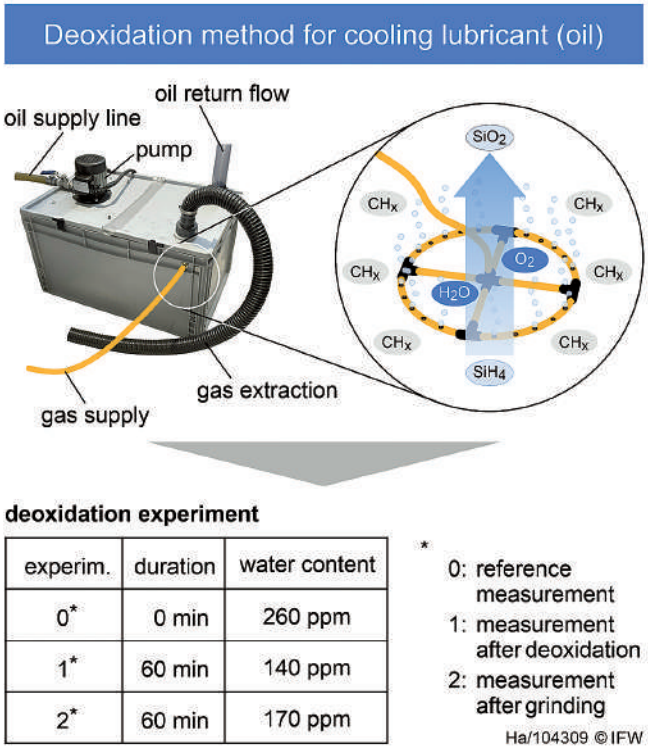


figure 2: deoxidation setup; method (left) and deoxidation results of experiment (right)

Deoxidation of cooling lubricant

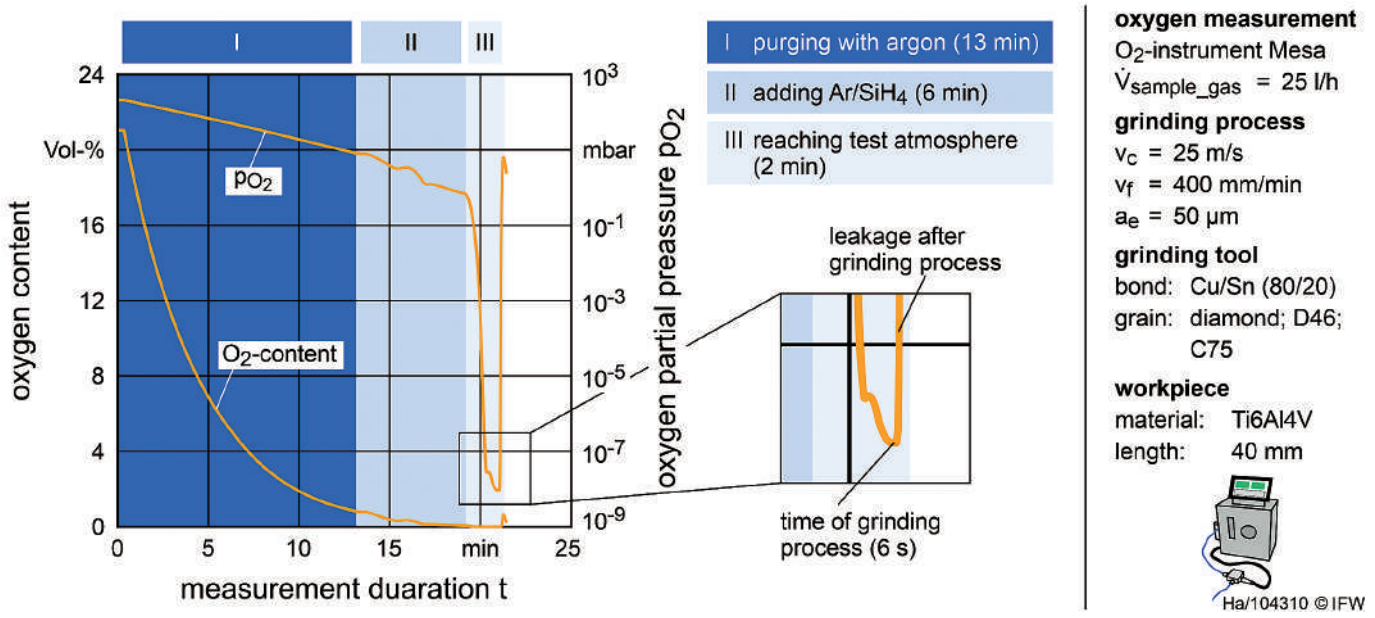
After a gastight housing for grinding investigations under oxygen-free atmosphere is available, a deoxidation method for cooling lubricant is developed, which will further reduce the total oxygen content in the grinding process. The purpose of cooling lubricant deoxidation is to eliminate residues of water and oxygen. Although the used mineral oil has no water solubility, minor contents of water (up to 300 ppmv) were still observed. Since even minor water contents can affect the grinding process, the oil has to be pretreated. In order to deoxidize the oil a similar approach to the elimination of oxygen within the gastight housing has been chosen. The procedure behind this approach is shown in *figure 2*. The oil is represented by hydrocarbons (CH_x) that contain water (H_2O) and oxygen (O_2) residues. To eliminate water and oxygen the process gas mixture of argon/silane (Ar/SiH_4) is injected into the oil at the bottom of the tank. The chemical reaction of equation 1 and 2 then leads to the formation of silicon dioxide (SiO_2) and the gradual reduction of water and oxygen within the oil.

The functionality of the deoxidation concept has been proven during a real grinding process within the gastight housing *(figure 2, bottom)*. Injecting Ar/SiH_4 (yellow gas supply hose) into the oil tank (~ 40 l oil) for one hour leads to the reduction of water from 260 ppmv to 140 ppmv (-46 %). Then conducting a grinding process while deoxidation is turned off, the water content increased by 30 ppmv due to contaminations in the hoses and the housing. The water contents have been determined in a *Karl Fischer titration*, which shows the general feasibility of the oil deoxidation. Another component of the oil tank is the gas extraction hose that functions as exhaust for SiO_2-particles, argon and excess SiH_4-gas. Furthermore the gas tank is directly connected to the gastight housing via the oil supply line, through which the oil is pumped into the housing and the return flow hose, through which the oil gets back into the tank.

Grinding under oxygen-free atmosphere

For the present investigations an atmosphere can be considered oxygen-free when the oxygen partial pressure passes the transition between an ultra high vacuum UHV (10^{-7} - 10^{-12} mbar) and an extreme high vacuum XHV (< 10^{-12} mbar) [11]. Consequently an oxygen partial pressure in the range of XHV is considered oxygen-free. An example of an oxygen measurement during grinding is shown in *figure 3*. The measurement can be divided into three phases. In the first phase the majority of oxygen can be

figure 3: O_2-measurement during injection of process gas ($Ar + Ar/SiH_4$) and grinding process



eliminated through purging with argon, which takes about 13 minutes and reduces the oxygen partial pressure down to 100 mbar (equals 1 vol. %). After this the gas mixture of Ar/SiH_4 is added for six minutes until the reaction of silane and oxygen can be detected. The reason for this detection delay is the long distance between the location where the gas is injected into the housing and the location where the sample gas is tapped. Although the chemical reaction starts immediately when Ar/SiH_4 is injected at the top of the housing, it can only be detected after six minutes since the sample gas is tapped near the bottom. This means that the chemical reaction takes place from top to bottom. However, when the chemical reaction reaches the tapping location, the oxygen partial pressure drops very fast and reaches 10^{-8} mbar in just a few seconds. Due to difficulties with gas leakages, XHV was not achievable and therefore all experiments were conducted in the UHV range at around 10^{-9} mbar oxygen partial pressure. However, an oxygen partial pressure in the UHV range is already on a high technical level that is not available in any other known grinding process. The grinding process itself only lasts a few seconds due to small workpiece lengths and high feed rates.

With the available deoxidation unit and the experimental setup, grinding experiments can be carried out in a nearwise oxygen-free housing and with deoxidized oil. Additionally implemented measuring devices like the dynamometer and the oxygen measuring unit allow for process conditions to be recorded, which can then be correlated with the process parameters and results.

In order to evaluate the mechanical load during grinding under air and Ar/SiH_4 atmosphere with low oxygen partial pressure (~ 10^{-9} mbar) the process forces in tangential (F_t) and normal direction (F_n) were measured. In the grinding experiment, the cutting speed v_c and the feed rate v_f were varied, while the depth of cut was constant at a_e = 50 µm. These three process parameters can be combined within the single grain chip thickness h_{cu}, which can be interpreted as a physical quantity of the load on the abrasive grains of the grinding tool during machining [12]. The single grain chip thickness can then be correlated with the grinding forces, which is illustrated in *figure 4*.

A linear and increasing correlation between both grinding force directions and the chip thickness can be observed. With increasing single grain chip thickness the mechanical load also increases. The main reasons are decreasing cutting speeds and increasing feed rates that cause a rise of the chip thickness according to *FRIEMUTH* [12]. The performed experiments show a significant difference in grinding forces between grinding under air and Ar/SiH_4 *(figure 4, top and center)*. The absolute force values during grinding under Ar/SiH_4 are up to 46 % (F_t) and 48 % (F_n) lower, however, the linear increase is slightly higher in both cases. These results supports the hypothesis of reduced oxidation effects on the workpiece surfaces. This is due to a very low residual oxygen partial pressure within the atmosphere, which leads to reduced reactions of titanium and oxygen. Lower oxide layer formation, in turn,

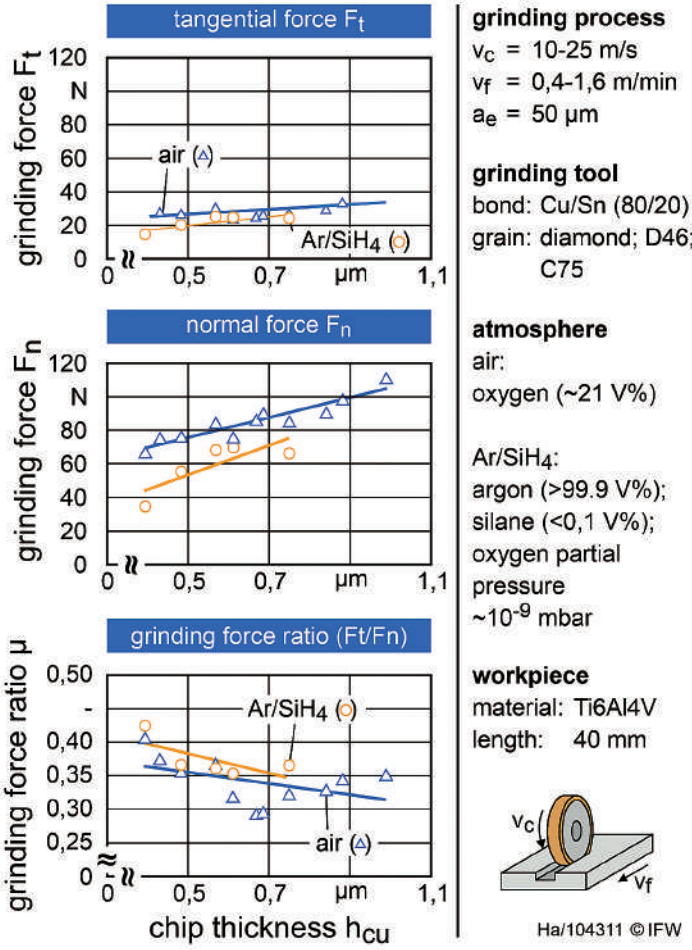


figure 4: process forces during surface grinding under air and Ar/SiH_4 atmosphere

means that the surface hardness and thus the process forces, mainly in normal direction, decrease. Another aspect is the lubricating through SiO_2-particles that are present in the cooling lubricant and can lead to the reduction of tangential forces due to lower friction [13]. These particles are a result from the deoxidation process, that cannot be entirely filtered out of the grinding oil. Due to the high hardness of those SiO_2-particles they act as a combination of rolling and sliding bearings in the contact zone between tool and workpiece, thus reducing the coefficient of friction and tangential force.

The grinding force ratio µ is described by the quotient of tangential and normal force, which represents the ratio of cutting and friction processes. A higher grinding force ratio means that the cutting process is more efficient, while a lower ratio represents higher friction in the contact zone, resulting in a less efficient grinding process. Sharper cutting edges lead to a larger grinding force ratio while progressing tool wear causes a decrease of the grinding force ratio [1]. The ratio is expected to increase with increasing chip thickness due to a more pronounced cutting of the material. However, the opposite effect can be observed in the present investigations *(figure 4, bottom)*. This can be explained by chips that adhere to the grinding wheel surface

during grinding. These chips cause a clogging of the chip space of the wheel and thus the increase of normal forces. Grinding under Ar/SiH_4 atmosphere shows better mechanical behavior regarding the grinding force ratios compared to grinding under air. This can also mainly be attributed to the described reasons oxide layer formation, reduction of the friction coefficient and welded clogging on the grinding tool surface.

Conclusion and outlook

Grinding under ambient air and ambient pressure conditions as well as using normal grinding oil is the conventional approach in grinding of metal workpieces. However, oxygen has a significant influence on the grinding process as the experiments could show. Grinding under Ar/SiH_4 atmosphere results in lower grinding forces compared to grinding under normal air. Reduced oxidation effects on the workpiece and cooling lubricant deoxidation play a key role in that regard. While low oxygen partial pressures within the gastight housing can lead to reduced workpiece oxidation and thus to reduced normal forces, deoxidized grinding oil and decreased welded clogging is assumed to cause a decrease of the friction coefficient, which leads to a reduction of tangential forces. In general lower process forces result in reduced tool wear, which will be investigated in the ongoing experiments. Further investigations will also include the influence of the described atmospheres on the material removal mechanisms by means of a quick stop device. This enables to create a snapshot of the current chip formation mechanism by interrupting the cut very quickly during grinding.

For future investigations the experimental setup will be improved to further reduce the oxygen partial pressure within the housing. The deoxidation concept will also be improved by implementing a sensor that allows the simultaneous measurement of water residues in the cooling lubricant during grinding.

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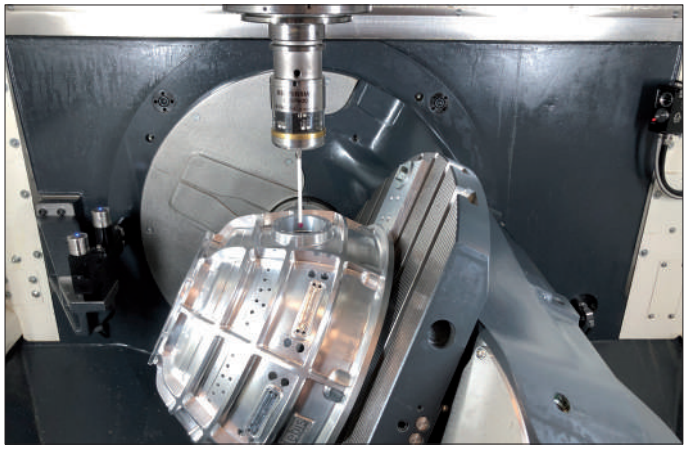
Safety in manufacturing processes and quality in automation

Integrated quality control with "measurement in the manufacturing process"

Tebis–a specialist in CAD/CAM and MES process solutions in production machining and die and mold manufacturing–is partnering with _Renishaw_ to combine CAM and CAQ technologies for integrated quality control. Thanks to "measurement in the manufacturing process," machines can now be used more efficiently and manual intervention can be largely prevented.



If the dimensional accuracy of the part is automatically checked during manufacturing, complete machining is verified before the workpiece is unclamped

Modern, highly automated machining centers are the backbone of productivity in production machining and mold and die manufacturing. However, the large investments that these machines entail result in high hourly rates and require that they be used with maximum efficiency. This can even mean working night and weekend shifts, for which few personnel are available, as shown in the following examples:

Using the handwheel to acquire the reference point on these machining centers takes too long. In addition, errors that require the remanufacturing of a workpiece can't be tolerated: for example, the wrong blank, an incorrect setup, or the wrong reference point. Machining operations that are overlooked or areas with a machining allowance–for example, because the tool was pressed away–also mean a significant amount of extra work. In this case, the part must be reclamped for remachining and the reference point must be reacquired. Surveys show that over 70% of companies have experienced these errors.

Tebis is now working with Renishaw, a global leading company specialized in precision instrumentation to provide an innovative solution with which users can quickly and easily generate NC programs for measurement tasks. It can run before, during or after machining. The intelligent Tebis Job Manager can now generate complete programs for milling, drilling and turning with integrated measurement routines at the required points.

Because Tebis uses digital twins of machines, tools, clamping and measurement devices, all movements are completely collision-checked. This enables manufacturing companies to verify their processes–with no additional manual intervention in the machine. The technology from Renishaw can also be used to support controls that don't have their own measuring cycles.

Measurement in the manufacturing process increases the degree of automation. The results are greater safety in the process, improved efficiency and higher accuracy in manufacturing. Overall machining time is also reduced. The following useful functions are available for the user to implement:

Checking for the right blank

The size and orientation of the blank are automatically checked before the machining starts. The machining operation can be interrupted if the blank is outside the desired tolerance. This establishes the requisite safety for unattended machine operation.

Determining correct part orientation

The orientation of the part can be automatically corrected using reference points and part rotation at the beginning of machining. This expedites setup and ensures the best possible manufacturing quality.

Ensuring tested quality

The dimensional accuracy of the part is automatically checked during machining. This allows any necessary reworking to be done before the part is unclamped. It also reduces effort while simultaneously increasing quality and enabling quality documentation.

Quickly generate documentation

At the end of manufacturing, a measurement record can be prepared that presents the measurement results referenced to the part right in the 3D CAD/CAM data. This documents the manufacturing quality both graphically and in tabular form.

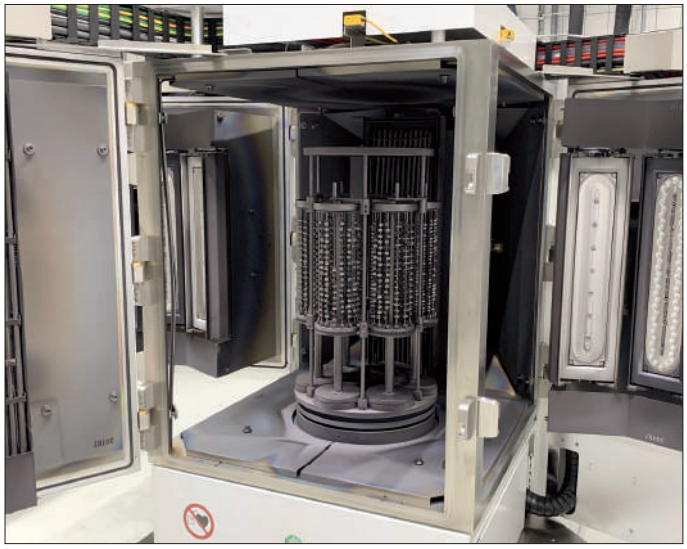
further information: ***www.tebis.com***

Opening for enormous potential in turning

Boehlerit uses the development possibilities of the CC800® HiPIMS

Short distances and the complete tool development process from a single source – this strategy has put Boehlerit from Kapfenberg, Austria, on course for growth. *Gerhard Melcher*, sales manager at Boehlerit, gets confirmation of this every day. A key component in the development of new, high-performance coatings is the CC800® HiPIMS from CemeCon – giving the cutting material and tool specialists from Styria an absolute technological edge.

Gerhard Melcher, sales manager at Boehlerit
(photo: Boehlerit)



With the CC800® HiPIMS, Boehlerit can open up enormous potential in turning
(photo: Boehlerit)

Broad innovation and investment offensive at Boehlerit: the new cleaning system optimally prepares the inserts for coating
(photo: Boehlerit)

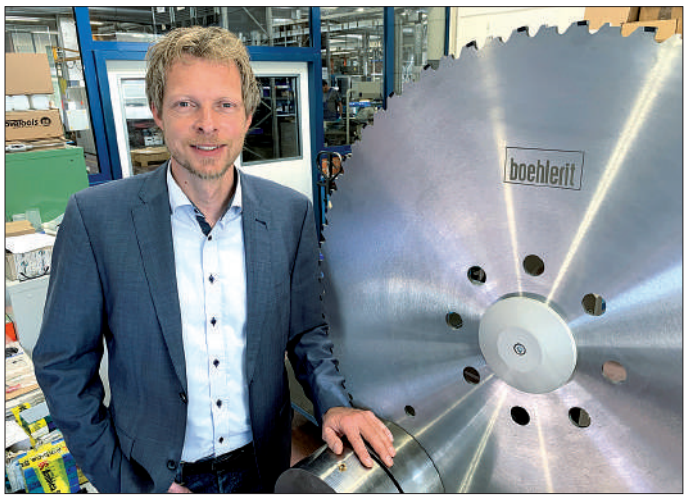
Boehlerit, headquartered in Kapfenberg, Austria – part of the *Brucklacher family group* of companies (*Bilz, Boehlerit* and *Leitz*) since 1991 – develops and produces cutting materials, semi-finished products and precision tools as well as tool systems for milling, turning, drilling and forming for a wide range of materials with 800 employees at twelve locations worldwide. These include highly specialized tools for crankshaft machining as well as for metallurgical technology for rotary peeling, tube and sheet metal machining and heavy-duty cutting. Hard metals for structural parts and wear protection are also among the company's strengths. The cutting and wear protection materials are continuously developed using modern analysis methods and in close cooperation with universities and research institutes.

Boehlerit carbides and precision tools solve the world's most demanding machining tasks and set standards in the machining of metal, wood, plastics and composite materials. The Austrian experts' recipe for success undoubtedly includes a high level of vertical integration and extensive know-how in all facets of tool manufacturing – from design to coating technology.

To meet ever-increasing demands and ensure continuous growth, Boehlerit relies on the latest technologies and is pursuing a broad innovation and investment offensive. "Over the past two years we have invested tens of millions in equipment, automation and digitalization in manufacturing at various locations," says Gerhard Melcher. "We are securing an absolute technological advantage with the CC800® HiPIMS from CemeCon."

Paradigm shift with HiPMS

"In the past, the undisputed dogma in specialist circles was: PVD coatings for milling and CVD coatings for turning. It was unthinkable to use PVD coatings in turning operations, as the required coating thicknesses could not be achieved with this technology," explains *Dr. Arno Köpf*, head of development for PVD coatings at Boehlerit.



Thomas Waltenberger: "Thanks to HiPIMS coating, the new SawTec 2.0 saw blades are perfect for machining steel and stainless materials"
(photo: Boehlerit)

HiPIMS enables coating thicknesses of up to 12 µm and also significantly increases the quality and performance of the coatings
(photo: CemeCon)

"HiPIMS technology changed that abruptly. Today it is possible to achieve coating thicknesses of up to 12 µm in a reproducible manner. This enables successful use even in demanding turning processes."

What does HiPIMS technology have that others don't? Thanks to the synchronization of the HiPIMS cathode pulses with the substrate table – a unique CemeCon feature – the residual stresses of the coating can be actively managed. This enables high coating thicknesses of up to 12 µm. In addition, HiPIMS again significantly increases the quality and performance of the coatings: HiPIMS coatings are very smooth as well as hard and tough at the same time. They have excellent adhesion and, thanks to the uniform distribution of coating thicknesses, provide optimum wear protection for the tool.

HiPIMS coatings already successfully in use

Boehlerit is already using HiPIMS coatings on tools for milling, in crankshaft and tube machining, and in the turning of stainless materials. New cutting material grades with HiPIMS coatings for draw peeling and turning of steel are in the test phase. SawTec 2.0 circular saw blades are an innovative highlight in Boehlerit's product range. Their special feature: unlike other solutions on the market the cutting edges are not soldered on, but can be replaced. This saves users an enormous amount of time and money. Another plus is the new HiPIMS coatings on the replaceable cutting edges. "This makes our new saw blades perfect for steel and stainless materials, especially in robust applications. Initial projections have shown that an average of four SawTec 2.0 saw blades can replace around 100 brazed saw blades," adds *Thomas Waltenberger,* segment manager at Boehlerit.

New possibilities and enormous potential

"HiPIMS technology opens up enormous optimization potential for us: it allows us not only to further improve coating variants that have been tried and tested for years, but also to develop innovative coating compositions that open up new markets for us. The possibilities are enormous," says a delighted Gerhard Melcher.

Dr Arno Köpf next to the CC800® HiPIMS from Boehlerit: "In the past, PVD was considered for milling, CVD for turning. The HiPIMS technology changes this abruptly. Today coating thicknesses of up to 12 µm can be realized. This enables successful use in demanding turning processes."
(photo: Boehlerit)

further information: ***www.cemecon.de***

Titanium – the finicky superalloy

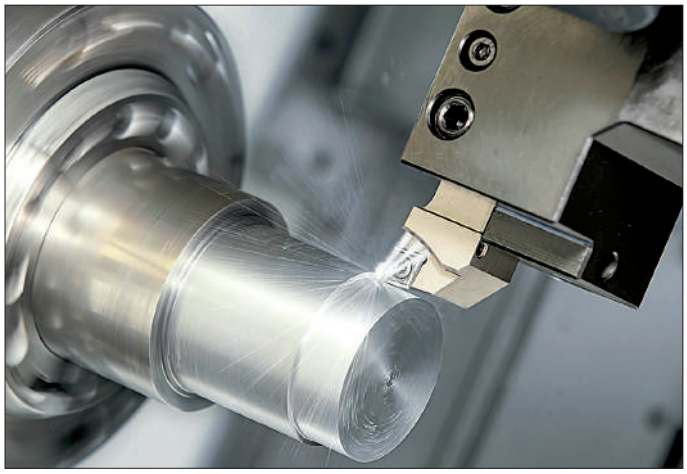
Precision tools, guide to machining titanium

Machining titanium cost-effectively requires special attention to the distinctive features of this material – particularly for choosing the right tools

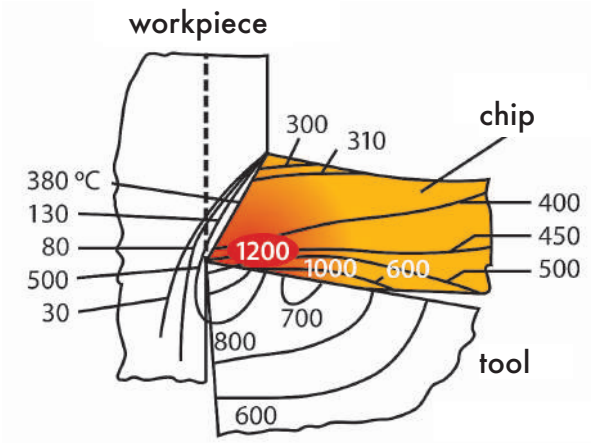
Anyone who has ever machined the superalloy titanium knows that it can be a real diva, requiring special care and attention. Chips that won't break, heat that won't dissipate, and built-up edges are some of the common ways in which titanium puts up a fight during machining. However, titanium's remarkable properties make it a favorite in aviation, motorsport, and medical technology, so it is worth learning how to machine it properly. You never know when a renowned sports car manufacturer will need to place an order for titanium screws.

Manufacturing precision turned parts made of titanium requires tools that are suited to machining this particular material

Whether or not the chemist *Martin Heinrich Klaproth* named the titanium element after the deities from Greek mythology because of its god-like properties is unclear. But the fact is that its properties make it a superalloy. Extremely tension-proof, very light, and outstandingly resistant to corrosion, titanium offers something other materials and alloys don't. Titanium is antimagnetic, biocompatible and resistant to even the most aggressive media. This expensive material is becoming popular in more fields and applications. It's no secret to the engineers at Bugatti, who use many titanium parts in their work.



The superalloy titanium is extremely tension-proof, very light and outstandingly resistant to corrosion



Titanium being a poor thermal conductor, the heat cannot be evacuated from the cutting zone via the chips; at temperatures of 1200°C the cutting tool can quickly sustain heat-related damage

Titanium is expensive – avoid waste

Machining titanium is an investment, as it costs about three to five times more than tool steel. So logically, you want to avoid waste. The careful selection of a suitable cutting tool is only the first step. Manufacturing precision turned parts made of titanium, which are frequently needed in aviation and spaceflight, the chemical industry, vehicle construction and medical technology, requires tools that are suited to machining this particular material, allowing for the most stubborn titanium alloys to be machined as needed.

But this diva of the materials world can do a number on your cutting tools due to:

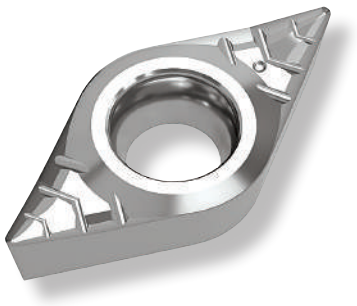
- ➔ high heat resistance (see diagram)
- ➔ chips not breaking
- ➔ titanium's distinct tendency to stick to cutting tools
- ➔ a low elastic modulus (Ti6Al4V = 110 kN/mm², steel Ck45 = 210 kN/mm²)

Since only a privileged few manufacture titanium screws for the 1500-HP Bugatti Chiron super sports car, let's instead take a look at the manufacture of a threaded and grooved shaft made of the standard titanium alloy Ti6Al4V Grade 5/23, as is frequently used in medical technology. With a tensile strength of Rm = 990 N/mm², yield strength of Re = 880 N/mm², a hardness of between 330 and 380 on the Vickers hardness scale, and elongation at fracture A5d of approximately 18 %, this titanium alloy is typically used for medical implants as well as aviation applications (3.7164) and industrial applications (3.7165). With 6 % aluminum and 4 % vanadium, and extra-low interstitial elements (ELIs), this alloy is highly biocompatible, inducing virtually no known allergic reactions.

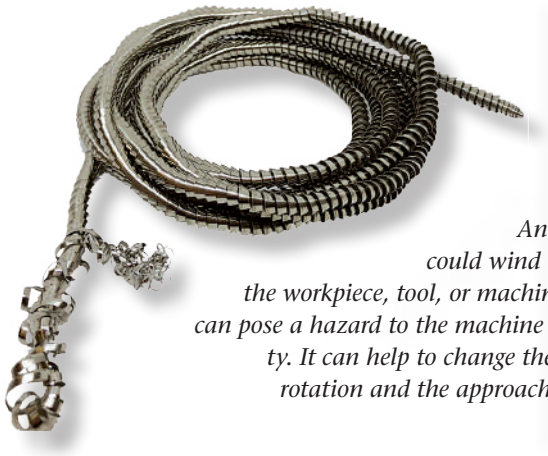
Evacuate heat from the cutting zone

This requires a high-quality surface finish, reliable process safety and controlled chip removal, all while keeping pro-

ARNO Werkzeuge offers one of the largest selections of high-positive indexable inserts. The company's experienced application consultants are happy to share their manufacturing process knowledge



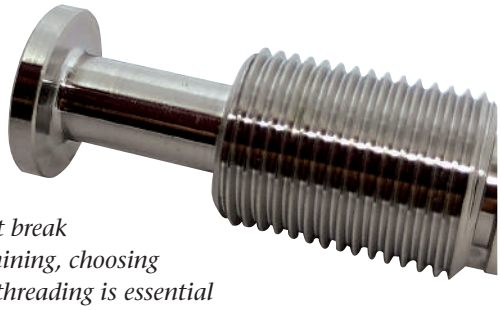
cess times short despite potentially high rates of chip removal. You might assume that most of the heat generated in the turning process is evacuated via the chips, but this isn't so. Since titanium is a poor thermal conductor, the heat cannot be alleviated from the cutting zone via the chips. And at temperatures of 1200°C and higher in the cutting zone, the cutting tool can quickly sustain heat-related damage. The easiest things you can do to prevent too much heat from building up are to feed coolant directly to the cutting zone, reduce the cutting force by using a sharp cutting edge, and adjust the cutting speed to suit the process at hand.



An endless chip could wind itself around the workpiece, tool, or machine chuck and can pose a hazard to the machine or your safety. It can help to change the direction of rotation and the approach angle of cut

Choose the right tools to increase service life

Real improvements are made by selecting the correct cutting tool. Since the heat must be evacuated via the cutting edge and the coolant, not via the chips, as is the case with steel, a small portion of the cutting edge must withstand extremely high thermal and mechanical stress. The cutting pressure is reduced by using ground, high-positive indexable inserts with polished flutes, if necessary, with the appropriate coating, minimizing friction in the chip removal process. These three parameters help prevent heat from being produced in machining. If only a little bit of the heat is reduced further through optimal coolant flow, the cutting edge will have a longer service life. Or the cutting speed (V_c) can be increased again to improve productivity.



Since chips do not break in titanium machining, choosing the right tool for threading is essential

So far, so good. But since this diva's chips don't like to break, you may face other difficulties. An endless chip could wind itself around the workpiece, your tool, or the machine chuck and pose a hazard to the machine or your safety. It could help to change the direction of rotation and turn the cutting edge around if the machine's design allows it. If the cutting edge is pointing downward, chips will fall freely to the ground and no longer pose a danger. However, when working with demanding roughing applications and less-than-stable machinery, you will have to check whether the cutting action allows the chips to be directed towards the machine bed. Once the chips have left the work zone, they can no longer disrupt the process.

Find a tool manufacturer that offers advice and process support

If you want to make sure that you choose the right tool for titanium machining, turn to a manufacturer. Some go above and beyond, offering advice based on specific application experience in addition to supplying the cutting tool itself. For instance, ARNO Werkzeuge is a tool manufacturer that has been around since 1941. In addition to manufacturing one of the largest selections of high-positive indexable inserts, it employs many experienced application consultants who would be happy to share their knowledge to ensure that customers' manufacturing processes run smoothly.

Its high-positive indexable inserts are sharp enough to keep cutting force to a minimum, and their optional rounded edges ensure excellent stability. Expedient high-tech coatings make them well-equipped against the poor thermal conductivity of this tricky material. Negative indexable inserts with EX, NFT, NMT and NMT1 geometries provide an affordable, reliable solution for more basic machining and roughing. Arno's positive indexable inserts with geometries PSF and PMT1 are ideal for machining superalloys. All of these inserts are highly resistant to notch wear and heat when machining tough material. Unique geometries ensure exceptional chip control and process safety. Dedicated titanium machining experts and ARNO customers are well prepared. After all, you never know when you're going to get that call from a Bugatti engineer.

further information: ***www.arno.de***

CNC machining for electromobility

written by **Dr. Manfred Berger**

The challenge of production planning for the vehicle market has never been more difficult due to the unclear parameters from the market and politics. The majority of car manufacturers will not be able to commit to one technology and the end of the combustion engine is still a long way off.

The production volume of vehicles with combustion engines (singular or integrated in hybrid drive systems) is still such that in the coming years a complete phase-out of the technology seems impossible for most manufacturers.

On the other hand, electric drive volumes are increasing quite slowly and in this scenario the risks and manufacturing are usually left with the suppliers. There are also strategic considerations as to whether the electric drive will remain a core competence of the vehicle manufacturer in the future. Is it not already possible to find an answer to this question in TESLA's development lead? The considerable development expenditure of vehicle manufacturers for attractive product offerings in each vehicle segment influences the objectives in production planning. Reuse or reconfiguration are often the current tasks.

More honing instead of grinding

According to an analysis by the *German Engineering Federation* (VDMA), the production of the powertrain in an electric vehicle contributes about two-thirds less to the value added than in a vehicle with an internal combustion engine. Due to the trend of integrating the electric motor and the inverter as well as the transmission into a common housing, designs are available that require >1,000 s of total machining compared to a cylinder crankcase (approx. 900 s of total machining; *see figure 1)*. The classic electric drive as shown in *figure 2* consists of the stator housing with cast-on front bearing plate, a separate gear housing and an equally separate inverter housing. The end shield is fitted and screwed onto the gear housing via a fitting diameter on the outside of the end shield. With this design, the bearing seat and the outside diameter must be machined in a single clamping operation and from one side in order to maintain the required tolerances. Ideally the bearing bore, outside diameter and stator plate seat are machined in sequence in this setup. The aim is to achieve the smallest possible air gap between the stator and rotor. The gap width between the components determines the magnetic resistance, the level of induced current (asynchronous machines) and thus the efficiency of the motor. For many reasons, including the tolerance chain of the components, the air gap is only 0.5 to 0.6 mm. Another significant difference to the classic combustion engines is the motor speed of >10,000 1/min. Both characteristics: plugged drive shaft and high speed are responsible for the noise behavior of the drive train. In addition to the high requirement of the position tolerances of the gearbox bearing points, the surface qualities of the gearwheel teeth (honing instead of grinding) are also important for optimum smoothness of the drivetrain.

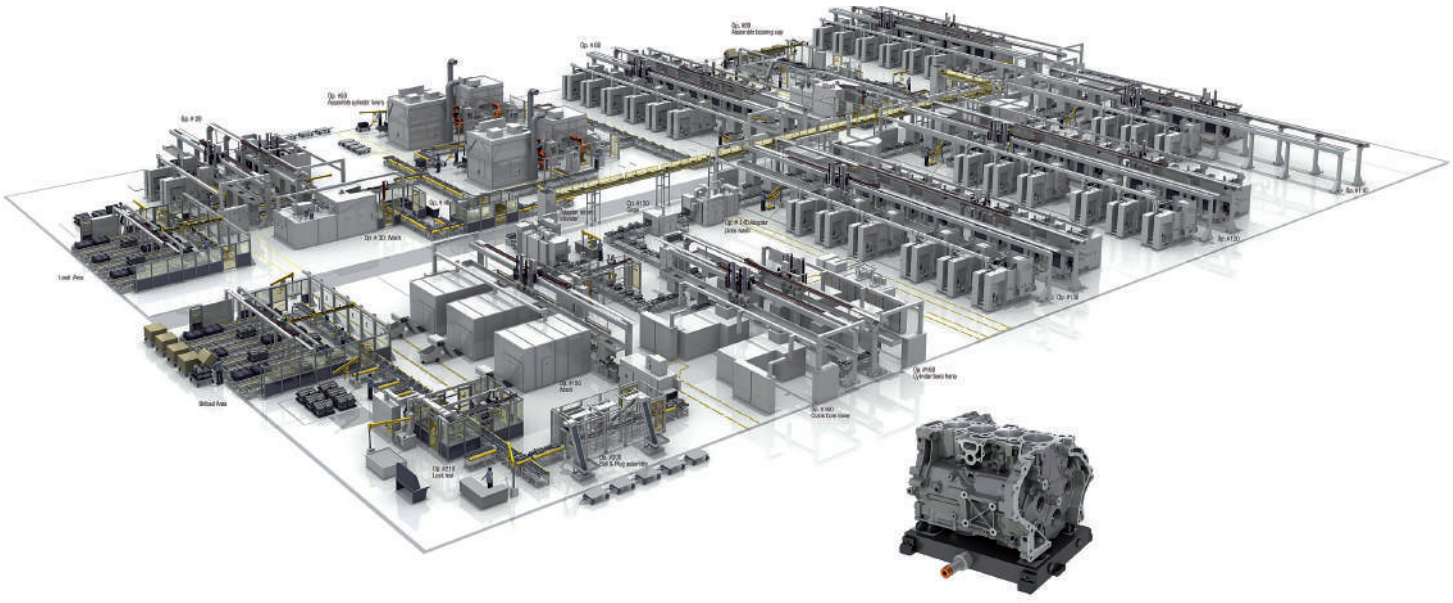


figure 1: agile manufacturing system for cylinder crankcases (turnkey)

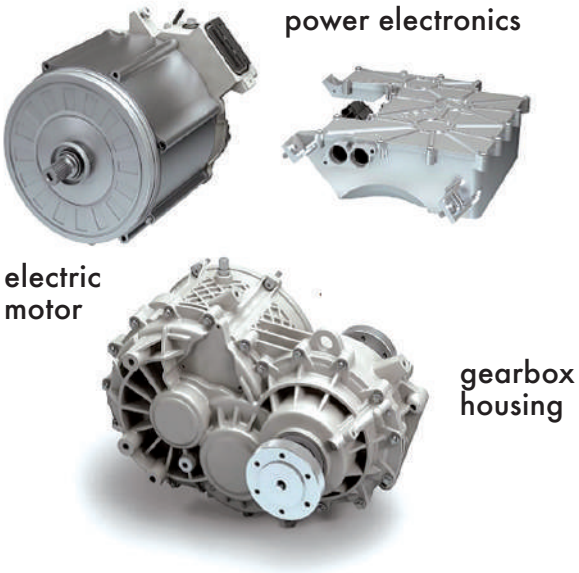


figure 2: e-axis from BOSCH
(photo: Robert Bosch GmbH)

figure 3: MAG as a system partner for the powertrain of electromobility with more than 25 years of manufacturing experience of integrated high-performance electric motors

Many years of experience with electric motors

Within the *FFG Group, MAG,* as the system supplier of small manufacturing cells up to complete turn-key systems for high production volumes, can take on the role of general contractor at the customer's request with its know-how in planning and processing. The FFG Group's range of technologies covers almost the entire spectrum of components to be machined for electromobility.

Whether new or reconstructed machines, the Eislingen-based machine builder has many years of experience. For example, MAG has been manufacturing its own motor spindles *(figure 3)* and rotary tables for over 25 years, in which electric motors–analogous to the drive of the electric vehicle–are installed. With this experience in manufacturing, assembly and test engineering, as well as the partner company's broad know-how in insulation, winding technology and impregnation for stator and rotor, planning for a turnkey system and its execution are implemented with professional project management. Although a vehicle drive is dynamically less stressed during operation than the direct drive of machine tools and the running times (duty cycle) are also shorter, the knowledge gained from assembly must be incorporated into the production process in order to control the sensitive side of the electric drive (running noise in the gearbox; housing expansion with frictional installation of the stator).

For machining the sensitive thin-walled components *(figure 4)*, direct clamping in the fixture (alternative adapter plate) and multiple clamping (rough and finish machining) are recommended. During roughing, machining should always be performed in the direction of the workpiece support. The extensive chip removal on the inner diameter of the stator housing releases stresses which affect the geometry and therefore reclamping is necessary before finish machining. A fine machining of the inner diameter (butterfly tool) without slide bars to avoid burn marks would also be optimal.

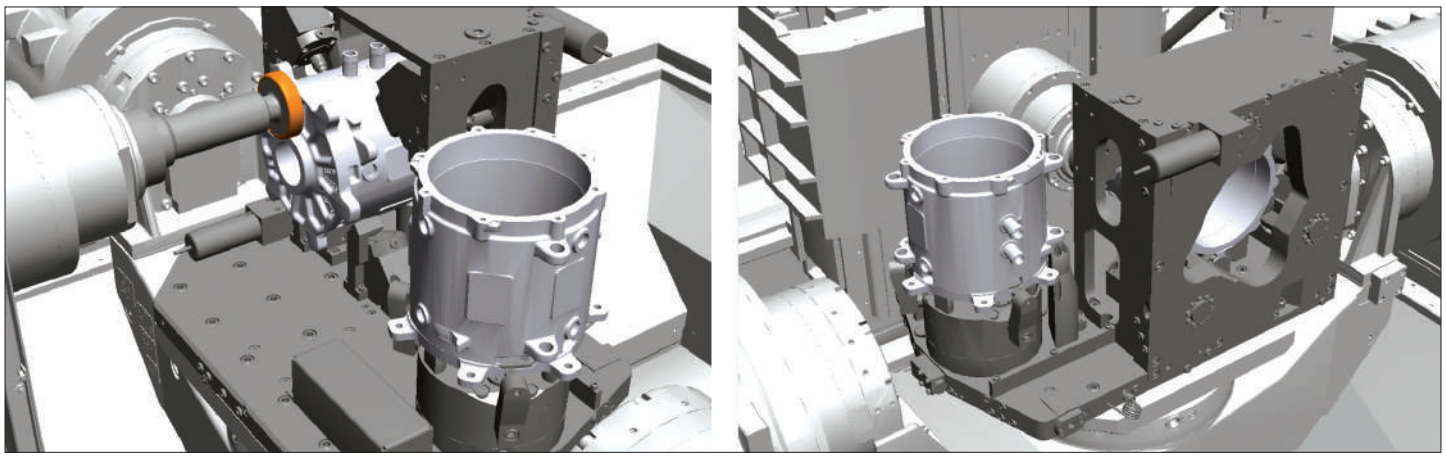


figure 4: machining of a stator housing on the SPECHT 600 A/B machining center in three process steps with emulsion and HSK 100 tool interface

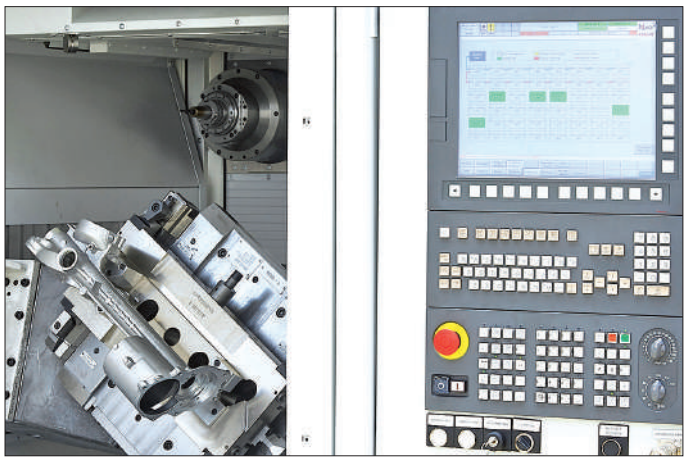


figure 5

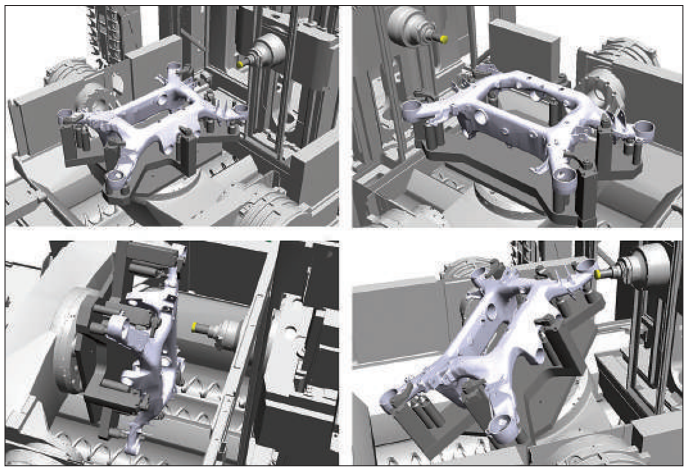


figure 6

figure 7

From SPECHT to HESSAP equipped for electric drive

The range of single- and double-spindle CNC high-performance machines in the SPECHT series offers the exact machine for every cubic component of the electric drive, energy storage and chassis. Compared to the classic ball-screw axis drives, linear drives can improve productivity between 8 to 12% (depending on the component). The machines are designed for wet and for dry machining with minimum quantity lubrication (can also be retrofitted). A five-axis CNC machine also provides the prerequisites for process and workpiece flexibility. When using adapter plates *(figure 5)* even very different components can be clamped and machined in one machine without retooling (batch size 1). This is an advantage that should not be underestimated in the phase of the market launch of electric vehicles (variety of types and moderate quantities).

Digital process twins are used for process commissioning and are subsequently available to the operator for his own commissioning *(cf. figure 6)*.

The FFG Group also covers the technology of shaft machining from bar stock or from the forging to the ready-to-install component with running teeth or with a spline profiling with its own products for machining with defined as well as undefined cutting edge and associated automation. For turnkey systems the thermal and/or chemical processes as well as the honing are purchased from partner companies.

The complete soft machining of shafts with splines in a manufacturing cell *(figure 7)*, consisting of the MODUL H 250 C gear hobbing machine and the HESSAPP WDM 250 shaft turning machine, is an example of the integration of several operations. A highlight is the equipment of the gear hobbing machine with a unit for chamfering and deburring of the gear teeth with cutting tools during machining. The combination of machining operations in one production cell eliminates the need for interfaces, and the technology integration of gear hobbing and chamfering/deburring in parallel operation reduces operation sequences and non-productive times. Both contribute not only to lower production costs, but also to an increase in component quality.

Also additive and laser technologies integrated

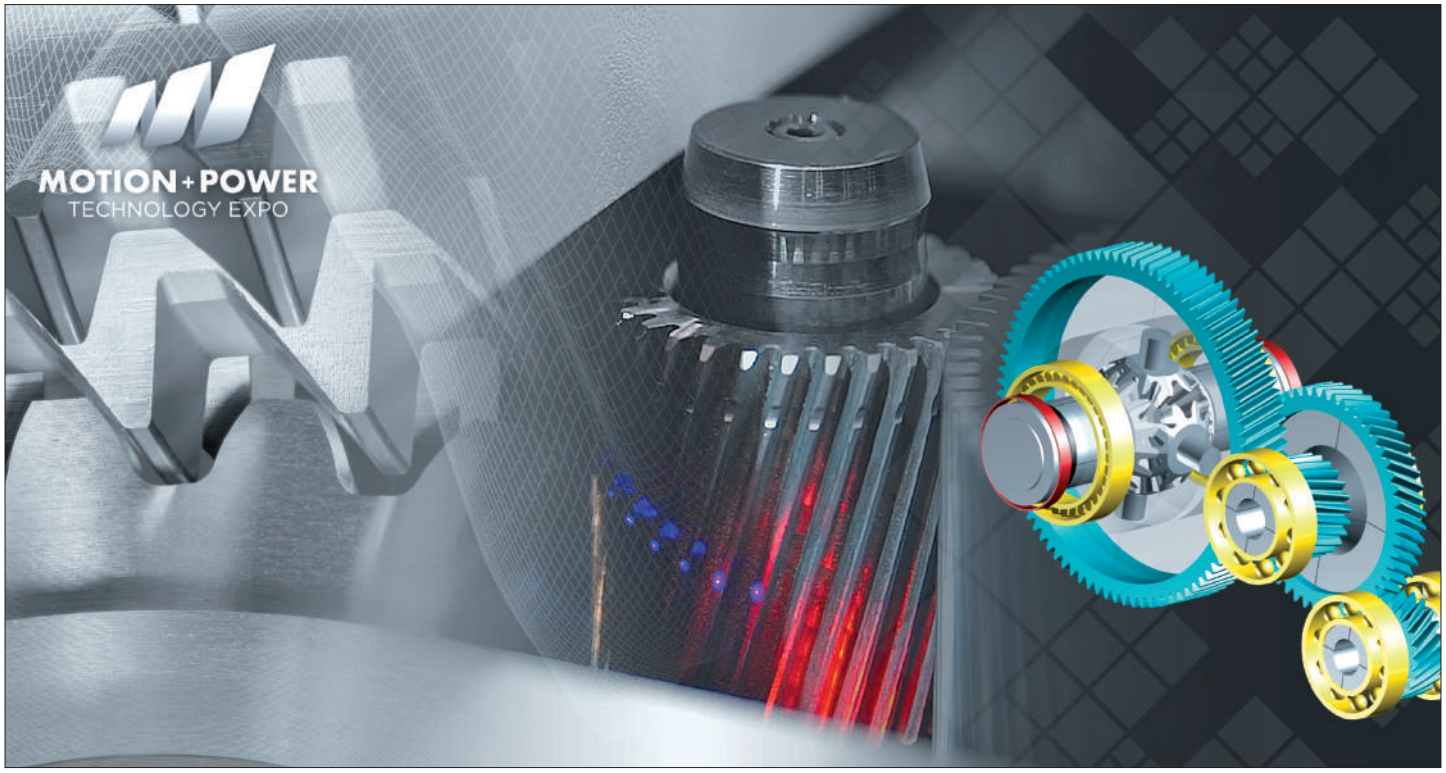
Hard machining of shafts can be performed with horizontal (BOEHRINGER) and vertical (HESSAPP, SMS) lathes. Independently of this turning processes for ultra-fine machining, e.g. twist-free turning with wide finishing wheel (running surfaces of shaft seals), can be carried out on the machines. The integration of additive technologies such as laser or induction hardening, rolling or grinding lends itself. For the classic grinding processes the FFG Group offers external and internal cylindrical and profile grinding machines in vertical or horizontal designs with products from MECCANODORA, MORARA and TACCHELLA.

Ultimately, the production lines for electric drive train components do not represent a quantum leap compared to modern agile manufacturing systems. What is new is the way in which they are planned and implemented, using the available digitization methods for the specific technology knowledge. The disruptive process must be mastered by both sides: the vehicle manufacturer must accept that another core component may come from the supplier, and the system manufacturer must cope with the disappearance of many engine and transmission components and increasingly adapt to customers from the supplier industry.

further information: **www.mag-ias.com**

Closed loop manufacturing

100 %-in-process quality control with gear noise analysis



At *Motion+Power Technology Expo* (MPT) which will take place Sept 14-16th in St. Louis/MO, USA, *Gleason Corporation* will showcase the latest technologies in design, manufacturing and inspection of cylindrical and bevel gears. Special focus will be given to the new KISSsoft® gear and transmission design capabilities, 100 %-in-process control, gear noise analysis and live manufacturing demonstrations from Gleason operations around the globe.

KISSsoft®: intuitive gear and transmission design at system level

The market leader will demonstrate its KISSsoft® 2021 release with numerous new features, including: KISSsys®, the intuitive concept design software at system level; the new interface with SKF bearing technology to simplify transmission development; the interface with Gleason's GEMS® to exchange gear and system information for bevel gear manufacture; the closed loop system to exchange data with metrology and production machines, and much more.

Up to 100 %-in-process quality control with integrated gear noise analysis tool

The new GRSL gear rolling system with laser technology revolutionizes in-process gear inspection and sets a new standard for high-speed, high-volume quality control. This compact gear inspection unit combines double flank roll testing with index and involute measurement as well as lead measurement on all teeth for full analytical and functional in-process gear inspection. Measurement data and process trend analysis are displayed in real time throughout the production run, with automatic closed loop corrections. In addition, Gleason's advanced waviness analysis allows the detection of potentially conspicuous gears in real time regarding noise problems.

Live product demos and complementary virtual show

Gleason will present several new products with live webcasts directly from its global operations, including a world premiere, the 280HCD Genesis® gear hobbing machine with integrated chamfer hobbing, threaded wheel gear grinding, power skiving, and the new Phoenix® 500C bevel gear cutting machine with Pentac® ecoblade cutter system for mid-size bevel gears. Experts will be available to answer questions and demonstrate specific features of products. For customers not able to participate in MPT2021, Gleason's "emotions" virtual showrooms will be available to experience all exhibits remotely. For more details, please refer to Gleason's website and social media channels.

further information: ***www.gleason.com/mpt2021***

Gripping, clamping, stocking and machining – and this around the clock

Compact-variable-individual

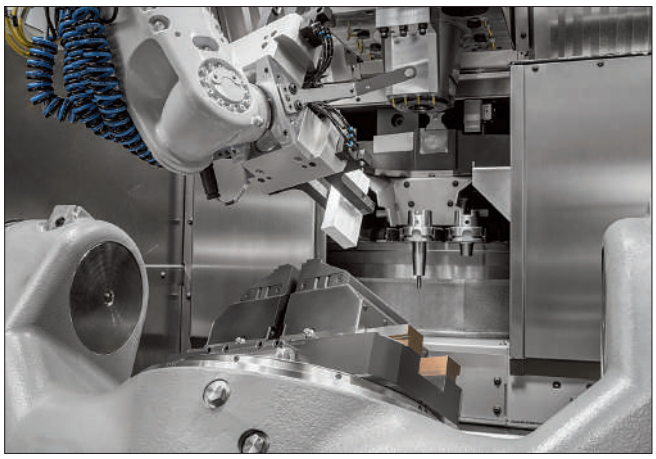
The *Hermle* RS 05-2 robot system can be used in all areas where fully automated production of workpieces, weighing up to 5 kg, is required. Particularly in precision engineering and medical technology the RS05-2 shows all its advantages, such as compactness, high variability both in the rack storage and in the clamping device and gripper insert. A newly developed finger change on the gripper allows truly flexible production for the first time in small robotics – can also be used as a double gripper for even faster workpiece changes.

Automatically produce more

The combination of NC-controlled long-stroke clamp and the new automatic finger change allows workpieces to be changed fully automatically. In combination with the individual parts supply using infinitely adjustable Hermle universal matrices, the innovative RS05-2 robot system increases productivity in an unprecedented way. And here is one of its greatest advantages: grippers and clamping devices adjust themselves fully automatically to the workpiece blanks – in a very large and coordinated gripping and clamping range – so that manual intervention is virtually eliminated.

Three individually selectable rack storage variants ensure optimum provision of parts.

- **single storage**
  The single storage with two universal dies is already a highly efficient solution for numerous applications, making flexible and profitable automation possible.

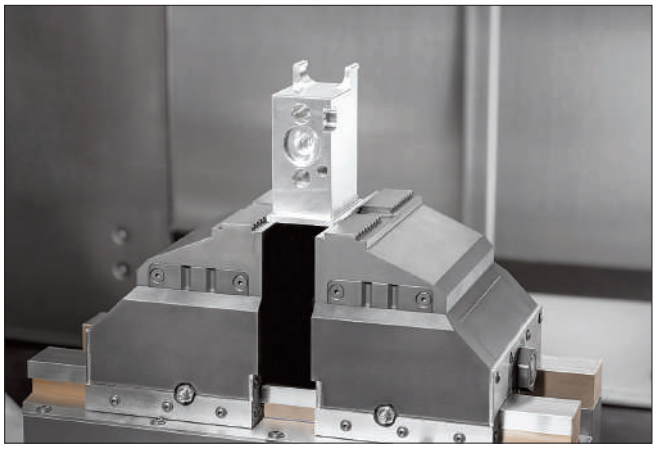


RS05-2 robot system – double gripper with a wide variety of finger grippers for increased productivity

- **drawer storage**
  The perfectly docked drawer storage for maximum storage in the smallest of spaces. Storage solutions with 4, 5 or 6 individual drawers available. A number of standard and easily adjustable universal dies quickly adapt to any workpiece shape. Even oversized workpieces can be changed and machined without any problems.
- **pallet storage**
  Perfectly integrated: the rack storage solution for up to 67 small pallets depending on the type of pallet. It offers maximum capacity and allows ergonomically perfect setup during the primary processing time.

RS05-2 robot system – 5-fold drawer storage with universal dies for individual and large workpiece storage

RS05-2 robot system – change of finger grippers – high clamping range for a wide range of workpiece dimensions



NC-controlled long-stroke clamp – high clamping range for a wide range of workpiece dimensions

Variable machine selection

The RS05-2 robot system can be adapted to various Hermle machining centers: C12, C22, C32, C250 or C400. With an installation area of only 2 m², the RS05-2 robot system always provides free access to the working areas of the machines, regardless of whether the system has been adapted at the front (C32, C250 and C400) or at the side (C12 and C22).

Easy handling

The RS05-2 is fully integrated into the Hermle software environment and is correspondingly easy to operate via the touch screen – just like a stand-alone machine. There is hardly any need for manual intervention.

HACS

The Hermle "Automation-Control-System» (HACS) is the proven control software from Hermle. Intuitive operation and a clear structure help to prevent errors. The operator has a clear view of all relevant data including system overview, work plans, sequence plans and tool overview. Forecast of runtime and tool usage. All workpieces are automatically ranked in the sequence plan as soon as they are set up. The priority of machining can be adjusted at any time. And all of that with drag and drop plus optimum visualisation.

RS05-2 robot system with 5-fold drawer storage – adapted to a Hermle C 12 U machining center

further information: **www.hermle.de**

EMO MILANO 2021 fieramilano 4-9 October

World premiere at EMO 2021

The UNITED GRINDING Group, a manufacturer of precision machines for grinding, eroding, lasering, measuring, and combination machining, is presenting a revolutionary innovation at EMO 2021 in Milan: UNITED GRINDING C.O.R.E. – *Customer Oriented REvolution*. Each of the Group's brands – MÄGERLE, BLOHM, JUNG, STUDER, SCHAUDT, MIKROSA, WALTER, EWAG and IRPD – will be on hand to see the innovation presented to the public on the first day of the trade fair (October 4, 2021 at noon local time).

A milestone in development

No details about C.O.R.E. are being divulged ahead of the official market launch. *Stephan Nell,* CEO of the UNITED GRINDING Group, is willing to reveal only this much: "We have invested unwaveringly in research and development both before and during the coronavirus pandemic, to secure the future – not just for us, but above all for our customers. And when we talk about the future, it is inseparably linked to digitalization today and with an increasing work simplification in production." In this connection, C.O.R.E. is intended to put the focus back on people – and in a truly revolutionary way. The brand name says it all: C.O.R.E. – Customer Oriented REvolution.

Inter-group project

Experts from each of the Group's three technology areas – surface and profile grinding, cylindrical grinding, and tool machining – worked within a joint team on this groundbreaking development. "This project reflects our bundled development expertise," explains *Christoph Plüss,* CTO of the UNITED GRINDING Group. "Through C.O.R.E. we are laying the foundations for a new generation of machine tools to pave the way into the digital age." The result is a world-first that encompasses all of the Group's brands and machine types.

EMO Milano 2021, hall 3, booth D16 E31

further information: **www.grinding.ch**

TSCHUDIN presents the CUBE 350 with collaborative robot

In combination with a collaborative robot, the TSCHUDIN CUBE 350 provides users with a productivity boost

Swiss technology company TSCHUDIN AG will present the innovative CUBE 350 centerless grinding machine with a collaborative robot at EMO Milano, which takes place October 4 - 9 (hall 3, booth E30).

This year, the world's leading trade fair for machine tools and metalworking is themed "The magic world of metalworking". "It is therefore suitable that visitors to the TSCHUDIN booth will also be able to admire some magic – we will be demonstrating impressive automation solutions that make the CUBE 350 even more efficient," says *Iwan von Rotz*, CEO of TSCHUDIN AG.

Productivity boost through automation

The use of robotics can ensure autonomous operation around the clock. Flexible loading and unloading solutions and faster setup times mean optimized efficiency.

The compact, centerless CUBE 350 external cylindrical grinding machine, which won the *Red Dot Design Award* in 2020, impresses with its elegant appearance. The concept puts the user at the center and impresses with its ergonomics, efficiency and wide range of process options. The three-axis CNC grinding machine has a small footprint. It was specially developed for processing small workpieces with a diameter of up to 20 mm.

Wide range

Versatility is the trump card for the Swiss grinding specialist. That is why TSCHUDIN will be presenting not only the CUBE 350 mentioned above at EMO Milano, but also information on the 400 ecoLine / proLine and 600 ecoLine / proLine centerless grinding machines. The TSCHUDIN machines can machine workpieces in a wide range of sizes: from the smallest wires for medical technology, whose shape can only be seen under a magnifying glass, to truck axles.

EMO Milano 2021, hall 3, booth E30

The centerless grinding machines of the TSCHUDIN 400 ecoLine / proLine series are optimally suited for machining medium-sized workpieces with diameters up to 150 mm

For large workpieces up to 250 mm in diameter and 500 mm in length, the TSCHUDIN 600 ecoLine / proLine is ideal

further information: **www.tschudin.swiss**

EMO MILANO 2021
fieramilano 4-9 October

New machines in Milan

When the EMO 2021 in Milan throws open its doors, Biberach-based sharpening specialist VOLLMER will take its place on a trade fair for the first time in Europe since the coronavirus pandemic began. October 4th to 9th, 2021, visitors to stand E18/F13 in hall 2 can gain insights into the latest VOLLMER portfolio of sharpening machines and services.

VGrind 360S – the latest addition to the machinery range

The newest model of VOLLMER grinding machines is the VGrind 360S, which can be used productively to machine carbide tools with a diameter of up to 25.4 mm. Depending on the machine kinematics and the tipping of the grinding wheel packages, it can even be used for tools up to Ø 150 mm. Wear-free linear induction motors on all three axes mean lower maintenance costs for the machine and higher surface quality for the tool. The tried-and-tested double-spindle concept features an oriented spindle stop for the first time, which always stops the spindle at a specific position – this function is also known as spindle indexing. This reduces the axial run-out errors and concentricity errors even further and offsets wear in the HSK holding system. Another new feature is a plate heat exchanger to efficiently cool motors and spindles, which in turn leads to increased thermal stability. The VGrind 360S incorporates VOLLMER's trusted operating concept and can be operated unmanned around the clock thanks to automation features such as pallet magazine, free-arm robot and chain magazine.

Premiere of the VLaser 370 at the EMO

The VOLLMER VLaser 370 machine will, restrictions permitting, have its premiere in Milan – its first live appearance will be at the trade fair. The VLaser 370 uses the power of laser to contactlessly sharpen the cutting edges of cutting tools made of PCD or other ultra-hard materials. At the core of the machine is its fixed laser beam guidance with precision machine kinematics. The way in which the five axes are arranged means that the tool is always machined at the pivot point of the C-axis. This makes it possible to sharpen tools with minimal axis movement and to ensure stable process control.

Precision grinding and eroding with the VHybrid 260

Also on show at the EMO will be the VHybrid 260 grinding and erosion machine, which tool manufacturers can use to grind and erode a wide range of carbide and PCD tools in one combined set-up. The VHybrid 260 combines technologies and experience that VOLLMER has gained in the fields of grinding and eroding over many decades. The key component for the eroding process is the VPulse EDM erosion generator, which optimises efficiency and surface quality. For grinding operations, the VHybrid 260 features the tried-and-tested machine concept of the VGrind series.

Comprehensive service package from VOLLMER

The trade fair will also be attended by the services division, presenting offers for maintenance, servicing, training, financing and digitalisation. These include digital solutions from VOLLMER's V@dison initiative, such as the "Performance pack for VHybrid 260" V@ boost solution or the "Visual Support" V@ guide solution, which enables customers to connect with VOLLMER technicians in real time.

EMO Milano 2021, hall 2, booth E18 F13

further information: ***www.vollmer-group.com***

Portal milling machine with thermosymmetrical design

Reinventing yourself in change

Daniel Demlang: "With our new FZP line, we want above all to support customers in being able to compete successfully on the market in the long term"

Model, tool and die makers must deliver perfect quality at competitive prices under increasing deadline pressure in order to prevail against strong global competition. *Zimmermann* is responding to this with the completely newly developed FZP machine line. The 5-axis portal milling machines are customizable, space-saving–and extremely thermostable.

This is ensured by the new thermosymmetrical design with a center-guided Z-slide. *Daniel Demlang,* technical director at F. Zimmermann, knows the advantages for the user.

An evolution is a progressive process, a revolution, on the other hand, is a fundamental and lasting structural change of a system–"this is exactly what we have done with the development of our new FZP machine line," reports technical director Daniel Demlang. The demands that model, tool and die makers have to meet today have grown steadily: their customers demand workpieces with near-perfect surfaces and consistently high dimensional accuracy. The key to this is manufacturing equipment that minimizes rework to ensure fast delivery times. "Our customers are burdened by increasing cost pressure and the demand for ever higher quality with simultaneously increasing deadline pressure for components. Reducing throughput times for workpieces was one of our main goals with the newly developed FZP series in terms of design," describes Demlang. "Stable process control and high machining quality are decisive factors for the cost-effectiveness of our systems." However, the customizability of the milling machines was not allowed to suffer. Machines of the FZP series are therefore even more flexible in terms of set-up and designed with a comprehensive range of additional options.

It can be equipped with automation–here with changeover slides on both sides

Customizable–not only in length and width

"With our new FZP line, we primarily want to empower customers in being able to compete successfully on the market in the long term," says Zimmermann expert Demlang. The developers have placed particular emphasis on the customizability of the machines. Their structure can be varied in length and width with different vertical slides and gantries, thus adapting to a wide range of workpiece sizes. The "lightest" machine from the FZP line is the new FZP32 with a working range of up to X=10, Y=4 and Z=2.5 meters. The user can use it to machine block materials, plastics, as well as CFRP, GFRP and aluminum, among other materials. Due to the large working area, it is also possible to mill components completely without reclamping. "The modular design of the machine offers the possibility to consider different options: automation solutions, such as a pallet changing system, a positionable rotary table, dust extraction bells or an individualized tool clamping system are possible," explains the technical director.

Thermosymmetrically constructed

It was important to the developers to develop the FZP line for maximum dimensional accuracy during workpiece machining. This is because changing temperatures in the hall as well as long machine running times inevitably influence the machining quality. For this reason, the Zimmermann developers designed the portal milling machine thermosymmetrically–a concept that was used highly successfully for the first time at Zimmermann in 2017 in the compact FZU portal milling machine line and was enthusiastically received by our customers.

"The idea of the thermosymmetrical design is based on the fact that inevitable thermal influences can be absorbed to a considerable extent by the design of the machine structure," explains Demlang. In the portal milling machines of the FZP line, Zimmermann has arranged the milling spindle, guides and other accuracy-determining components in such a way that their heating is either absorbed or can expand in non-critical directions. The gantry's center-guided Z-slide in double-bridge design has an octagonal cross-section that makes it particularly stable. "With this design we achieve very high thermosymmetric stability," says Demlang. Comparable systems usually use complex cooling or software-based compensation for this purpose.

"Our concept is future-proof, especially when the demands on quality and surface continue to rise," promises the Zimmermann expert. Among others, companies that do not have an air-conditioned machine hall and are therefore particularly exposed to temperature fluctuations in their production will also benefit from this. And this is where this new design scores points, according to Demlang. The design of the structure alone reduces the effects of the influencing variables to a minimum.

VH10: milling head with extraction

The VH10 milling head is used. The fork head is designed in monoblock versions made of cast iron. It is compactly built, has only minimal interference contours, achieves high clamping forces and thus enables stable component machining. Zimmermann optionally equips the VH10 with process cooling with cooling lubricants or even minimum quantity lubrication. To reduce throughput times, a powerful spindle with 34 kilowatts at a maximum speed of 24,000 rpm is used as standard in the milling head. "We have now also equipped the VH10 with a dust extraction bell around the milling tool," Demlang tells us. This makes it suitable for abrasive and harmful materials such as GRP or CFRP, which are used in aircraft construction. The dust extraction system captures the dust directly at the point of origin, which greatly reduces contamination of the interior.

Great flexibility by design

Hall situations are often a challenge for the installation of milling machines. Free installation space is usually scarce and machine concepts must offer a high degree of flexibility in installation. The Zimmermann developers have applied symmetry not only to the basic structure of the gantry, but also to the complete machine concept. This allows the customer to individually determine where exactly he wants the connections or peripherals. "We can then simply position the peripherals as required by the hall situation without making any major design changes to the new FZP32," says Demlang. Overall, the ratio of floor space to work space has been optimized with the new development.

Zimmermann equips the new machine line with larger tool magazines or even pallet changers on request. This allows users to reduce non-productive time and make their production more automated. Another feature: "Milling-turning applications are increasing, especially in aircraft construction, for example for turbine production," reports Demlang. "For this purpose, we also equip our milling machines with carousel rotary tables on request." No matter what task the customer needs to solve, Zimmermann's experts can execute the machines in a customer-specific, optimized way with their modular plant construction kit (MAB).

The developers have applied symmetry not only to the basic structure, but also to the complete machine concept

The completely newly developed FZP32 machine: the 5-axis portal milling machine is compact, very flexible – and highly accurate

What's next?

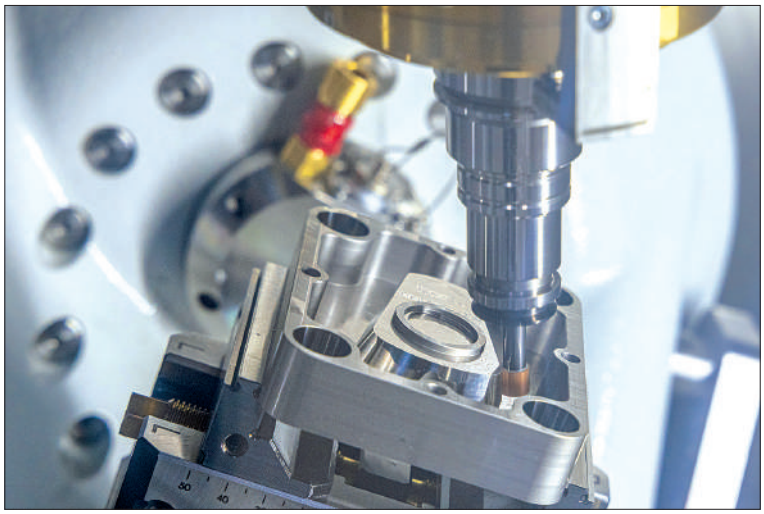
"We already have the first orders for the FZP32, our 'light' entry-level model in the new series," says Demlang. "Based on the new double-bridge gantry, we will soon launch the new FZP37, a machine in the medium segment, and the FZP42, one in the heavy segment for the mold and die industry." The heavy-duty FZP42 machine will be in the 1,000 newton-meter torque range. "We have taken a forward-looking path with this machine line," the Zimmermann expert is convinced.

further information: **www.f-zimmermann.com**

EMO MILANO 2021
fieramilano 4-9 October

Experience the limit of what is feasible

At the EMO 2021 in Milan (hall 1, booth C21), Kern will focus on the five-axis Micro HD high-precision center. The machine roughs and grinds injection molding tools for filter housings in one clamping in polishing quality.



How can parts – e.g. injection molding tools for filter housings – be machined with a precision of less than 1 µm and surfaces in the low single-digit nanometer range? With the Micro HD from *Kern*. At the EMO 2021 in Milan, hall 1, booth C21, Kern will show in live acts how it works.

Superlatives such as "extremely precise" should only rarely be used. But how else could one describe the five-axis series production of components with process-reliable accuracies of less than 1 µm? If you want to see how it works with your own eyes, you can do so at EMO 2021. The machine manufacturer Kern manufactures injection molding tools for filter housings that are used in respiratory masks in a live act.

The parts are first roughed with the Heidenhain OCM option and then brought to the highest quality at critical points with five-axis grinding cycles via jig grinding. After machining, manual polishing is usually the order of the day. Due to the high surface quality in the low single-digit nanometer range that the Micro HD achieves, this production step can be omitted.

Several innovative features are decisive for the performance of this technological miracle from Kern. According to the manufacturer, in addition to the linear direct drives, the unique microgap hydrostatics and the sophisticated temperature management are the main contributors.

Different automation systems can be integrated depending on the particular application. That is why Kern considers targeted, project-related advice as almost indispensable.

EMO MILANO 2021, hall 1, booth C21

further information: ***www.kern-microtechnik.com***

Small but mighty

ZSG mini centric vice from CERATIZIT packs a punch

For those who have tried them, there's no turning back: centric vices are the little helpers that often make day-to-day machining activities much easier. Extending this benefit to particularly small and delicate workpieces, CERATIZIT is adding the ZSG mini vice for small parts to its portfolio.

The demand for small parts remains high: whether in electronics, medical technology or the watchmaking industry, they are what machining businesses do every day of the week – with all the drawbacks and challenges that go with it. Having a solid basis in form of a highly precise and flexible clamping system. Available since July 2021, the ZSG mini centric vice for small parts in the WNT performance series from CERATIZIT does just that while improving process security and quality-critical steps in the process.

A thrilling investment without the risk

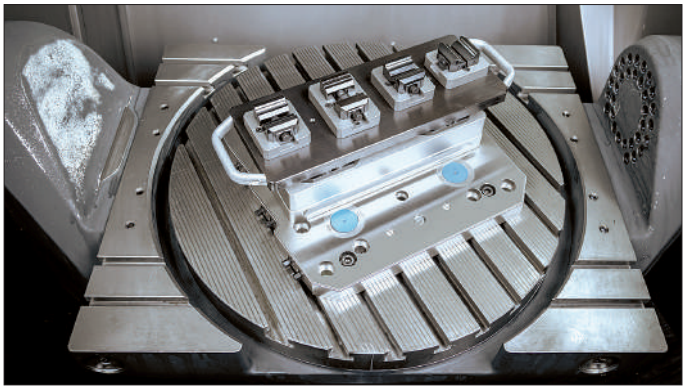
Fixed connections are particularly important for vices when machining small parts, mainly due to extremely tight tolerances that are required. "There are various ways to achieve this. For example, it's possible to pre-stamp the workpiece using a special machine prior to actual clamping and create a positive mechanical connection using the negative embossed profile in the jaw. However, this requires a corresponding investment and an upstream process step that we can eliminate with ease with our new ZSG mini. Thanks to its very high clamping force of 16 kN, our approach is simple: clamp, lock, go!" says *Christoph Retter,* product manager *clamping fixtures* at CERATIZIT.

Change jaws – in seconds!

Quick and easy handling is often the crucial factor in the race to minimise non-productive time. Here, too, the ZSG mini scores highly because it can be accessed easily from all sides, making it ideal for the machining of raw and finished parts, multi-clamping and automated applications. "But what saves an enormous amount of time is the quick change system for the jaws. They can be replaced in a matter of seconds without any tools at all, when in place they are totally secure in the base body thanks to the integrated pull-down action, which is generated via two spring pressure pins, ensuring total machining precision and quality!" explains Christoph Retter.

The ZSG mini centric vices for small parts are available in lengths of 80 mm and 100 mm with quick change jaws in widths of 45 mm and 70 mm – all case-hardened to between 54 and 56 HRC. These again are available in different versions, all hardened, with a smooth step and also in grip variants. "The real highlight here is the fact that all jaws can be used on any ZSG mini. This makes the system extremely flexible," adds Christoph Retter. The stainless base body that is hardened to 45 againHRC also promises a long and reliable service life for the clamping system.

Extremely small but incredibly strong: the ZSG mini from the WNT performance range by CERATIZIT is the ideal partner for clamping small workpieces



Its quick change jaws keep non-productive time conveniently short and its stainless base body ensures long operating times for the user

Small, strong, robust

Christoph Retter is of the opinion that you should never judge things by their size: "Our ZSG minis might look cute and unremarkable but there's a lot going on behind that stainless steel body. With a clamping force of 16 kN, they really pack a punch but soon relent to allow for a jaw change – to keep non-productive time short and machining relaxed!"

further information: ***www.ceratizit.com***

Handheld device for automated surface inspection of CFRP components

written by **Thomas Götz** and **Andreas Gebhardt**
Fraunhofer Institute for Manufacturing Engineering and Automation IPA

Modern composite materials such as carbon-fibre-reinforced plastics (CFRP) are increasingly being used in various manufacturing sectors. Particularly in the aerospace, automotive and mechanical engineering sectors, the lightweight construction potential of this material is stimulating a growing demand. In these industries, complex CFRP components are usually processed in rather small quantities, with the proportion of manual work being comparatively high. However, the use of CFRP in series production requires a significant cost reduction along the entire manufacturing chain in order to secure Germany as a manufacturing location in the long term. Among other things, this also applies to the time-consuming quality control.

Inspection of fibre composite components made of CFRP

In the manufacturing process of CFRP, a near-net component manufacturing is aimed at in order to increase material efficiency and thus reduce the costs of the components [1]. However, a final machining of the components is usually a necessary step in the production chain [2], because in the primary or forming component production, edge zones usually arise that have no strength functions. Both, for the removal of these edge zones and for the insertion of other component-specific elements such as holes, pockets or cut-outs, machining processes such as drilling and milling are predominantly used [3].

Depending on the type of material and machining, specific damage patterns can occur during the machining of CFRP components *(see figure 1)*. These include in particular chipping or breakouts of the brittle and hard matrix material, fraying due to incompletely cut fibres and delamination, especially of the surface layers [4].

So far there are no suitable automated inspection systems on the market for assessing the specific damage patterns, so that at present the inspection is mainly carried out manually by the worker, for example with the aid of limit sample catalogues. However, this subjective assessment is time-consuming and error-prone.

This involves the need for measuring methods and measuring equipment that can be used to ensure better reproducibility and documentation of the measurement results by means of automated recording and evaluation of machining errors on bores and milled edges. In order to close this gap, the company *Math&Tech Engineering GmbH* in collaboration with the *Fraunhofer Institute for Manufacturing*

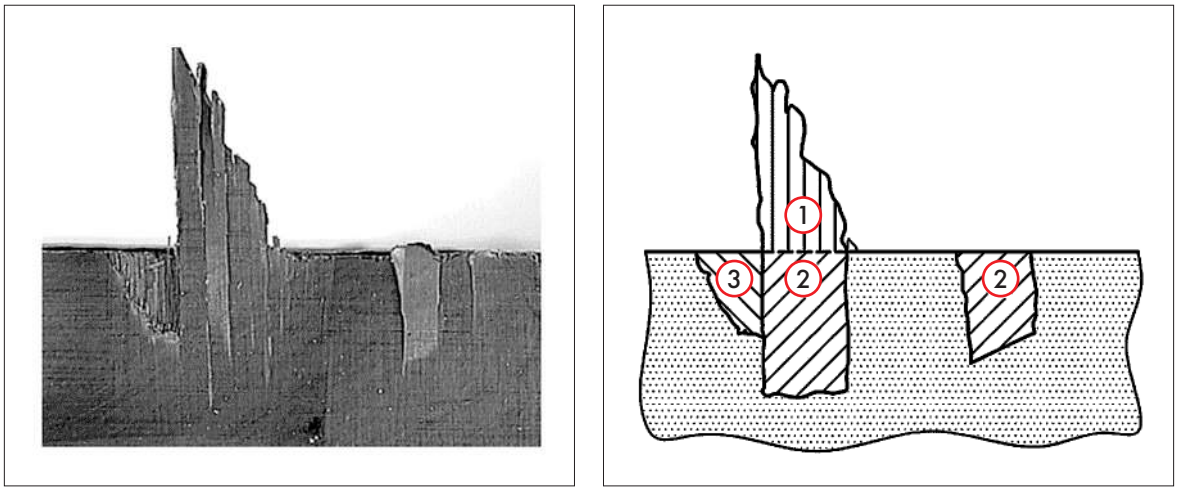


figure 1: representation of the damage patterns fraying (1), delamination (2) and chipping (3) [5]

figure 2
The modular hardware architecture makes it possible to develop different recording units for a wide variety of measuring and inspection tasks.

The handheld unit can thus be adapted to the respective inspection tasks without a great deal of time and technical effort
(Fraunhofer IPA/photo: Rainer Bez)

Engineering and Automation IPA developed the handheld device AICC 2.0 (Automatic Inspection of Cut Carbon).

Modular handheld unit AICC 2.0

The handheld unit AICC 2.0 consists of two components: an exchangeable recording unit and a computer unit *(see figure 2)*. The recording unit has an integrated camera with fixed optics and an illumination device. The computer unit consists of an embedded board, a battery, a touch screen and other electronic components.

Thanks to the modular hardware architecture, it is possible to develop specific recording units for a wide variety of measuring tasks and workpieces and to adapt the handheld unit to the respective required inspection tasks without great effort by quickly changing the recording unit.

figure 3
For component inspection, the recording unit is placed on the test object and an image recording is started. Based on the recording, defect characteristics such as defect size, defect type and quality indicators are determined with the help of implemented evaluation algorithms and the test result is then displayed on the screen.
(Fraunhofer IPA/Photo: Rainer Bez)

For example, particularly small recording heads are conceivable for measuring points in aircraft construction that are difficult to access.

In order to detect and measure a defect image, the recording unit is placed on the test object, an image recording is started and the pixels of the defect region are recorded using segmentation methods. Subsequently, defect characteristics such as defect size, defect type or quality indicators are determined using evaluation algorithms. After evaluation, the results are displayed to the operator in an output window on the touch screen of the inspection device *(see figure 3)*.

Industry 4.0 approaches for quality control

The integration of AICC 2.0 into networked production is achieved by a local and a cloud-based server. Both server solutions are implemented against the background of offering a solution suitable for the different requirements of potential users in terms of data transmission rate, data security and investment budget. The servers not only offer the possibility of expanding the limited computing power of the embedded system with a powerful evaluation in real time, but also realise the integration of several test devices as well as a central administration of statistics and reports.

By creating interfaces to processing machines and developing and implementing self-learning algorithms, process as well as quality control can be designed efficiently. The networking between component and testing device is realised with the help of QR codes. This allows specific measuring programmes to be defined for components and the measuring points to be visualised sequentially on the display. In addition, the measurement protocols can be clearly assigned to a component so that traceability is guaranteed. The interface between the processing machine and the testing device enables the adaptive adjustment of the measuring programme, for example to the wear condition of the cutting tools used. In this way, random sample measurements can be carried out on new cutting tools, while all relevant characteristics are checked towards the end of the cutting tools' service life. Conversely, the machining quality recorded by the testing device can alert the operator to increasing tool wear or incorrect cutting parameters, which allows the processes to be controlled, regulated and optimised even before rejects are produced.

The handheld unit AICC 2.0 thus enables in particular small and medium-sized enterprises in the machining and production industry to enter the digitalisation of quality assurance in manufacturing processes.

Acknowledgements:
The development project "AICC 2.0–Networked Handheld Device for Automated Surface Inspection of CFRP Components" was funded by the *Federal Ministry of Education and Research* (BMBF) as part of the "Industry 4.0 Test Environments" funding programme and supervised by the DLR project management organisation.

The authors would like to thank the BMBF for the funding and the project management organisation for its support.

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Ausgabe 2017-02

Supertec chooses NUM technology for its latest CNC cylindrical grinding machines

Supertec Machinery Inc., one of Taiwan's leading machine tool manufacturers, has chosen to base new versions of its renowned plunge type of CNC cylindrical grinding machines on NUM's Flexium+ CNC platform.

Founded in 1954, Supertec Machinery Inc. has grown to become one of Taiwan's top machine tool manufacturers. The company specialises in precision grinding automation and produces a diverse range of centerless, cylindrical and surface grinding machines. Based in Taichung City, Supertec operates sales and support facilities at strategic locations throughout Asia and Europe, as well as in the USA and South America.

Supertec has traditionally used Fanuc CNC systems for most of its machine tools. However, when NUM added non-circular grinding functionality to its popular NUMgrind cylindrical grinding software back in June 2020, the company realised that this innovative CNC technology provided exactly what many of its customers needed on their cylindrical grinders.

NUMgrind simplifies the creation of G code programs for CNC grinding machines through the use of a highly intuitive graphical human machine interface (HMI), and unlike conventional CAD/CAM workstation tools, it is designed specifically for use by shop floor personnel in a production environment.

Supertec's latest plunge type CNC cylindrical grinding machine is based on NUM's Flexium+ CNC platform; left Mr. Chu, general manager of Supertec; right Adrian Kiener, CSO Asia NUM

After evaluating the software, Supertec immediately raised a purchase contract with NUM. According to *Betty Chu,* Supertec's assistant general manager, "NUM has an excellent reputation in the grinding industry. Much like Supertec, this has been earned over many years. And the latest version of NUMgrind, which accommodates non-circular grinding, is a natural fit for our CNC cylindrical grinding machines. We now also benefit from very responsive local support–NUM's Taiwan facility is less than 15 km away from our factory."

Supertec's latest plunge type CNC cylindrical grinding machine accommodates complex parts requiring non-circular grinding

Supertec's Plunge type of CNC cylindrical grinding machines offer a choice of six capacities, covering distances between centers from 500 mm to 2,000 mm. The machines can also accommodate grinding diameters from 300 up to 430 mm (3 sizes), grinding wheel speeds up to 1,390 rpm and workhead spindle speeds from 30 to 350 rpm.

The new versions of these machines are based on NUM's Flexium+ 8 CNC platform and use NUM's high performance MDLUX drives and brushless servo motors for the X-, Z- and C-axes. In addition to the NUMgrind HMI, the software that is being supplied by NUM includes the Flexium 3D simulator, which can be used offline or online, and an application-specific profile editor which enables users to import DXF files.

Johnny Wu, general manager for NUM Taiwan, points out, "The ability to use the Flexium 3D simulator both offline and online provides Supertecs' customers with a distinct advantage. CNC programs can obviously be prepared offline and checked for potential problems such as collisions before being transferred to the machine. But the simulator can also be used online. This enables operators to gain vital visibility of the grinding process–which is normally obscured by the flow of oil."

further information: **www.num.com //www.supertec.com.tw**

Platinum Tooling named North American distributor for Tecnicrafts

Effective immediately, *Platinum Tooling Technologies, Inc.,* will be selling products from *Tecnicrafts Industries,* a manufacturer of collets and guide bushings for Swiss type CNC lathes.

Tecnicrafts is an *ISO 9001:2015* certified company, with its manufacturing plant in South India with state of the art machine tools and 115 technicians. Tecnicrafts collets and guide bushings are exclusively used for Swiss turning applications on Citizen-Cincom, Tsugami, Star, Tornos, Hanwha, Traub, Hardinge, Manurhin-Kmx, Miyano, Nomura and other popular machine brands and are widely recognized and accepted by customers in Europe and Asia.

Collets

The collets are offered in steel and carbide lined versions with grooved, smooth, serrated bores in standard and long nose types. Tecnicrafts produces special collets such as V-line, U-line, over-grip collets, for positive gripping of delicate parts without marks. The ultra-precision (XP) W-type collets are available for tool grinding applications on machines from Rollomatic, Anca, Ewag and others. Other collets offered include 5C and 16C types.

Guide bushings

Tecnicrafts guide bushings are generally offered in carbide lining having super finish bore with roughness value of less than 0.4 micron. These special guide bushings include U-line, extended nose and long carbide bores (max land) for special turning applications.

Bar feeder collets

The bar feeder collets are available for various bar feeders like Fedek, LNS, Ikura-seiki, Iemca, Citizen, FMB and other popular brands. All collets and guide bushings are offered in standard and ultra-precision grades. The bore profile includes round, square, hexagon, rectangular and profile bores as per customer drawings. Platinum Tooling Technologies, Inc., with its expertise in precision tooling and customer representatives throughout North America, is ready to meet the work holding tool needs for Swiss turning applications with this new Tecnicrafts product line on its roster of quality tooling.

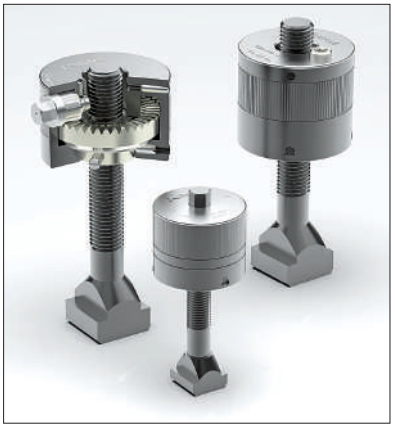
further information: ***www.platinumtooling.com***

Mechanical power clamping nuts

Expensive special tools are often required to clamp large tools or workpieces. To avoid these acquisition costs, ENEMAC has developed various mechanical power clamping nuts. These can generate high clamping forces without a great deal of effort or time.

The mechanical principle of these clamping elements: there is a hidden transmission gear in the housing, which can be driven by a small nut outside the housing without great effort. As a result the internal thread is drawn in slightly, which means that the counterpart is tightened. With this simple principle a force of 6-20 tons can easily be exerted manually.

The power clamping nut only has to be screwed onto the existing bolt, then the operating hexagon at the top can be turned up to the specified torque with a commercially available torque wrench and the clamping nut clamps the workpiece or tool quickly and safely.



Type ESB is intended for workpieces or tools of the same strength, as the screw-in depth is limited by the blind hole. With changing component thicknesses, the ESD series with through hole thread should be used, as this has an unlimited stroke.

The ESG series also has a through hole thread for changing tool and workpiece thicknesses. Their low overall height makes them even more versatile in use. These mechanical types can be used almost everywhere, e.g. for tensioning conveyor belts, tools in presses and punching or workpieces during welding.

further information: ***www.enemac.de***

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